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Stricture and Nasal Place Assimilation

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## STRICTURE AND NASAL PLACE ASSIMILATION\*

Theories of feature organization typically treat stricture features like [continuant], [consonantal] and [approximant] as independent of place of articulation features. The best argument for this view centers on [continuant] and facts of nasal place assimilation – in particular, instances of nasal place assimilation to fricatives, where the nasal appears to remain a stop. However, a closer look at nasal place assimilation provides a strong argument against this standard view: across languages, place assimilation to fricatives is highly disfavored in comparison to assimilation to stops, and occurring nasal-fricative clusters behave like affricates. I show how a theory in which [continuant] is place-dependent can explain these facts, exploiting the notion of stricture preservation. The treatment of stricture proposed brings feature geometry more in line with models based on facts of phonetics and vocal tract anatomy, e.g., the gestural model of Browman and Goldstein.

## 0. INTRODUCTION

There is broad consensus among those who work on feature geometry that place of articulation features constitute a significant grouping, since they pattern together in phonological processes. The same can be said of laryngeal features; hence, the ubiquitous Place and Laryngeal nodes in proposed feature geometry representations. The role of so-called ‘manner’ features, however, has been less clear. Early tentative attempts to group together all of the features [sonorant], [consonantal], [continuant], [nasal], [lateral], etc., under a Manner or Sonority node (e.g., Clements 1985; Mohanan 1983) were abandoned when it became apparent that these features do not reliably spread or delink together or otherwise behave as a class.

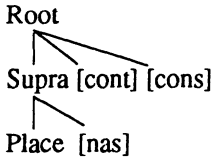
Consider in particular the manner features [sonorant], [consonantal] and [continuant], features which determine the degree of constriction in the vocal tract. Following Steriade (1987), Catford (1988) and others, I call such features stricture features. Uncertainty persists about the treat-

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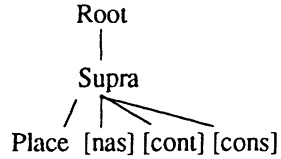
\* This paper has benefited from discussions with many people, including audiences at the University of Massachusetts, Amherst; the University of Pennsylvania; Cornell University; the University of Maryland, College Park; the University of California, Santa Cruz and the NSF Workshop on Properties of Feature Organization at UCSC, July 1991. I am especially grateful to John McCarthy and Lisa Selkirk and to the following people: Abby Cohn, Louis Goldstein, Roger Higgins, Beth Hume, Sharon Inkelas, Junko Itô, Michael Kenstowicz, Armin Mester, Máire Ní Chiosáin and three anonymous *NLLT* reviewers. All mistakes are my own responsibility.

ment of these features, with representations as different as those shown in (1) found in the literature, among others. ('Supra' abbreviates the class node Supralaryngeal).<sup>1</sup>

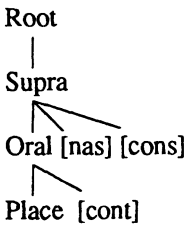
(1)a. Sagey (1986a)



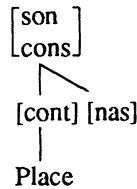
b. Archangeli and Pulleyblank (1986)



c. Clements (1987)

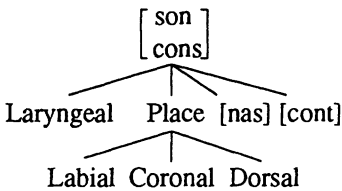


d. Selkirk (1991)



I will take a fifth geometry, due to McCarthy (1988) and shown below as my own point of departure. This geometry lacks a node Supralaryngeal, a point I will take up in Section 2.1.

(2)

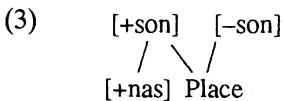


Despite the differences, all of the geometries in (1) and (2) agree in one respect: stricture features are independent of place of articulation features and are located higher up in the feature geometry tree. In fact,

<sup>1</sup> Much irrelevant detail has been omitted, though [nas] is included to give more meaning to the comparisons. In this paper I will abbreviate the names of features in ways that should be clear, e.g., [son] for [sonorant], [cons] for [consonantal], etc.

this view of stricture features is held by virtually all researchers who have considered the question. The best (and most frequently cited) argument for it comes from Sagey (1986a): in some languages, nasal consonants assimilate in place, but not stricture, to a following consonant. Sagey provides an example from Kpelle, which I discuss in more detail later. The possessive prefix *N* combines with a form like *fela* ‘wages’ to give *mvela* ‘my wages’. While the nasal and following consonant share place features and must be place-linked, they do not seem to share [sonorant] and [continuant] values. Therefore, these stricture features cannot be located under Place in feature geometry.<sup>2</sup>

The view that [son] is independent of Place seems unassailable. We must represent the common nasal-obstruent clusters **nd**, **mb**, etc., with something in the spirit of (3).

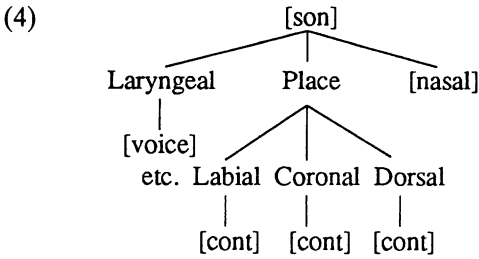


However, in this paper I argue for a reassessment of the relation between place features and the feature [continuant], motivating two closely related points.

First, phonological phenomena systematically reveal an interaction between place features and [cont] that is not captured by the widely-held geometries. Perhaps the best example of this, ironically, comes from facts of nasal place assimilation. This paper will focus largely on a pervasive cross-linguistic asymmetry between nasal place assimilation to stops on the one hand and to fricatives on the other — the latter is extremely disfavored in comparison to the former. Further, in languages where there is nasal place assimilation to fricatives (significantly, typically with hardening of the continuant to a stop or affricate, I will argue), there is assimilation to stops as well, while the reverse is far from true.

Second, in order to capture this place-stricture interaction, I argue for the feature geometry in (4), which differs fundamentally from those shown above:

<sup>2</sup> Explicit arguments concerning place and [consonantal] are virtually non-existent (note that **m** and **v** are both [+cons]), though the conclusion that stricture features are independent of Place has commonly been extended to this feature. See Clements (1985) and Sagey (1986a).



(4) is a modification of the geometry in (2), differing in the location of [cont] under Place and, in particular, under the articulator nodes, a placement first argued for by Sagey (1986b) to deal with complex segments. I will show that the representation in (4) allows the theory to explain the nasal place assimilation facts noted above as well, facts that remain a puzzle in the commonly assumed geometries. Further, I show that the place assimilation data that seem to contradict (4), (*mv*, *nz*, etc.), are in fact arguments for it. The geometry I propose raises many questions that cannot be considered at length here, though I address some briefly. It should be emphasized, however, that the argument for locating stricture independently of Place rests largely on the existence of nasal place assimilation to fricatives like that seen in Kpelle. Hence, if this argument can be shown to be wrong, the entire issue must be reconsidered.

Browman and Goldstein (1986, 1989) posit phonological primes, called 'gestures', that consist of a unitary specification of articulator, place and stricture information. The geometry argued for here is to a great extent consistent with this notion and gives particular answers to some criticisms raised against it, as in Steriade (1990) and Clements (1991). Because the term 'gesture' carries much significance beyond what is at issue here, I simply call an articulator feature, together with [cont] as shown in (4), an *articulator group*. I refer to all geometries that locate [cont] independently of Place and that do not otherwise predict any special interaction between place and this feature by the collective term 'the standard theory'. Though I take (2) as representative of the standard theory in what follows, this term also refers to (1)a–c and all other geometries in this spirit.<sup>3</sup>

The paper is organized as follows. Section 1 examines the stop-fricative asymmetry in nasal place assimilation. We see various means by which assimilation to fricatives is avoided — in particular, default place assign-

<sup>3</sup> Though not (1)d, since Selkirk (1990, 1991) argues for further assumptions that motivate place-stricture interaction.

ment to the nasal, nasal deletion and assimilation with hardening of the fricative. The account proposed here connects these diverse processes and nasal place assimilation, while in the standard theory, this connection is stipulated or not noted at all.

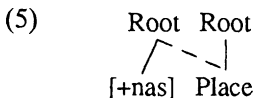
Section 1.5 confronts apparent counterexamples, including cases like **mv**, **nz**, where the nasal does not seem to acquire the fricative's [+cont] specification under place assimilation. Adapting arguments of Steriade (1991), I show that such clusters are generally best seen as *affricates*, differing from overt cases like **mbv** and **ndz** only in implementation. In fact, as Steriade shows, the properties of clusters like **mv**, **nz** can be explained only under such an account. These facts support the articulator group rather than the standard theory.

In Section 2 I briefly consider alternative accounts within the standard theory for the nasal place assimilation facts, rejecting these accounts in favor of the articulator group. Section 3 concludes by considering further implications of the theory.

This paper assumes a basic understanding of feature geometry theory; the reader may refer to Clements (1985), Sagey (1986a) and McCarthy (1988).<sup>4</sup>

## 1. PLACE ASSIMILATION AND [CONT]

Consider the rule of nasal place assimilation shown below.



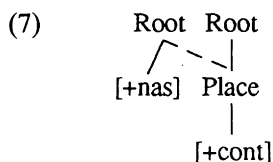
In a language in which nasals occur before both stops and fricatives, we might expect the rule to produce assimilated clusters like **mb**, **nd**, and **mv**, **nz**. In fact, without stipulations to the contrary, we should expect assimilation to fricatives to be as natural as assimilation to stops. Yet in language after language we find that, far from assimilating blindly to both stops and fricatives, nasals typically assimilate to stops, while one of the situations in (6) occurs before fricatives:

<sup>4</sup> This work has been inspired to a great extent by the work of Selkirk (1990, 1991) on nasal place assimilation and the idea of place-structure interaction in general and by the work of Rosenthal (1989, 1992), Herbert (1986) and Steriade (1991). Each of these presents accounts for facts of nasal-obstruent sequences, though under basic assumptions quite different from one another and from those of this paper. (See also Wetzels 1991). Space does not permit a detailed comparison of their accounts of nasal place assimilation and mine, though Section 2 bears on many of the relevant issues. The reader is directed to the original works.

- (6)a. The nasal simply does not assimilate, receiving a default place.  
 b. The nasal deletes.  
 c. The nasal assimilates but simultaneously hardens the fricative to a stop or an affricate.

Examples of each will be examined in this paper. Although (6) does not exhaust the possibilities of what occurs before fricatives in languages, it is representative of the most common patterns<sup>5</sup> that have been discussed by numerous authors, including Herbert (1986), who surveys a great number of languages, and more recently Rosenthal (1992), Selkirk (1990) and Steriade (1991). Though assimilation to fricatives does sometimes occur (typically, I argue, as in (6)c above), there is an entailment to be captured here: in a language where nasals assimilate in place to fricatives, they assimilate to stops also. The reverse does not obtain.

What unifies the different outcomes in (6)a-c is the avoidance of place assimilated nasal-fricative clusters, a behavior pervasive across languages. Since the standard theory of stricture maintains that [cont] is independent of Place, it has no natural account for this pattern. In contrast, the articulator group provides a ready means of explaining it in terms of structure preservation. Place assimilation means [cont] assimilation:<sup>6</sup>

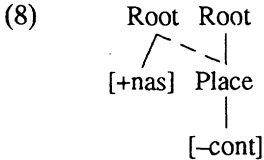


Given the feature geometry, place assimilation derives the feature combination [+nas, +cons, +cont] — that is, nasal place assimilation to a fricative creates a nasalized fricative. Such segments are at best extremely rare in the inventories of languages, arguably nonexistent underlyingly, and so we expect their creation by phonological rule to be highly disfav-

<sup>5</sup> Another candidate pattern involves total assimilation of the nasal to the fricative. The nasal in the Attic Greek prefix *syn-* assimilates to a following *s* in this way, e.g., *syssitia* 'common meal', while assimilating only in place to a following stop. (Sommerstein 1973, p. 20). A similar pattern is found with nasals in some Modern Greek dialects (Newton 1972).

<sup>6</sup> From here on I will sometimes omit the articulator feature from representations where it is not relevant to the point. The reader should keep in mind that [cont] is articulator-dependent, however. See Section 2.

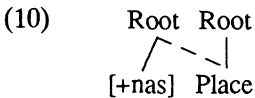
ored, an instance of structure preservation.<sup>7</sup> In contrast, there is no obvious problem in specifying a nasal consonant [–cont] (however, see the discussion of marking conditions below). A nasal may therefore assimilate to stops. (This is all the more true if [–cont] is not specified at all in the triggering consonant within a theory of radical underspecification):



Before laying out the assumptions about structure preservation and the relevant marking conditions, I turn to an example of a stop-fricative asymmetry in English, involving the prefix *in-*. The nasal in this prefix assimilates in place to a following stop. Before fricatives the nasal assumes a default place, although pronunciations like ‘[i[m]fallible’ are heard in casual speech, a point I return to in section 1.5.1. (I rely here largely on Kiparsky 1982 and Borowsky 1986).<sup>8</sup>

(9)a.	impale	*inpale	b.	infallible	*imfallible
	impossible	*impossible		infamous	*imfamous
	impenitent	*impenitent		infinite	*imfinite
	implicit	*implicit		invariable	*imvariable
	imbue	*imbue		involuntary	*imvoluntary.

Let us formulate the rule as follows:



Kiparsky (1982), Borowsky (1986) and others place this assimilation at

<sup>7</sup> Underlying nasalized fricatives have been claimed to exist in a few languages. In a recent discussion of these cases, Cohn (to appear) suggests plausible reanalyses of all of them except Waffa, a language of Papua New Guinea. Waffa is reported to have an underlying nasalized bilabial fricative (Stringer and Hotz 1973), but further investigation is warranted. (See Ladefoged and Maddieson 1986 for discussion).

<sup>8</sup> Since the nasal assumes the alveolar place when assimilation cannot apply (*inappropriate*, etc.), we cannot observe the stop-fricative asymmetry before alveolar consonants. I assume that the facts are as with the labials: the nasal receives its place by assimilation in *indelible* but not in *insensitive*.

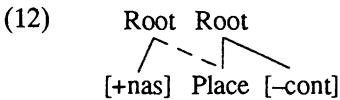


Level 1 in the lexical phonology of English. The rule applies differently to the (Level 1) prefix *in-* than nasal assimilation does at other levels; for example, the nasal assimilates completely to liquids, as in *illegal*, with later degemination.

If English phonology prohibits nasalized fricatives (at least at the level where this rule applies), then the proposed geometry predicts the failure of assimilation in (9)b. Assimilation would create the feature cooccurrence \*[+nas, +cons, +cont]. Therefore, the nasal surfaces as coronal instead. Let us assume that the nasal is placeless underlyingly and receives coronal place by default rule.<sup>9</sup> Compare *impossible* and *infamous*:

(11)		iN + possible	iN + famous
	Assimilation:	impossible	FAILS
	Default Place:	N/A	infamous

We could derive the same result by stipulating a [-cont] trigger in the standard theory, as in (12).



However, Pulleyblank (1989) has pointed out problems with this alternative to a marking condition approach. First, we require the same stipulation for similar rules in many languages, including the cases discussed below, missing the point that there is a more principled reason why nasals avoid assimilating to fricatives. We might just as well stipulate a [+cont] trigger, although such a rule is unattested. Second, given the normal assumption that simpler rules denote more natural processes, this alternative account wrongly predicts that the rule without the stipulation (assimilation to stops and fricatives) should be more common. Our account

<sup>9</sup> I will generally assume a placeless nasal segment and default place assignment in cases like this. However, the question of whether underspecification should be appealed to (see Mohanan 1991 for recent discussion) is independent of the argument being made here. The crucial point is the failure of assimilation to fricatives. Of course, if the nasal has no place underlyingly, it can have no [cont] value either, given the articulator group. Both place and stricture are then supplied by default.

instead preserves the simple formulation in (10) and allows it to express the more natural process: assimilation to stops and not fricatives.<sup>10</sup>

The facts of another Level 1 prefix *con-* parallel those seen above for *in-*:

(13)a.	complacent	*complacent	b.	confess	*comfess
	composit	*conposit		confederacy	*comfederacy
	compassion	*compassion		confirm	*comfirm
	combust	*conburst		convert	*comvert
	combine	*conbine		convoke	*comvoke

In the case of *con-*, however, there are a few cases where we do have apparent assimilation before the fricative, assuming that these cases should be analyzed as containing the prefix at all:

(14) comfort, comfrey, comfit

We treat these as unassimilated clusters underlyingly, separately specified for labial place, since place linking would derive \*[+nas, +cons, +cont]:

(15)	com	fort
	lab	lab
		[+cont]

Under this approach, they are on a par with words like *Camden*, *Canberra*, which also have nasals with a lexically specified place. This move seems justified, since the number of such words is very small in comparison with the many examples like *convivial*, *confide*. A search of the English lexicon does bring up other examples of *mf/mv* clusters, as in the Greek forms *amphi-*, *triumph* and isolated forms like *clamjamfry*. Yet the striking fact

<sup>10</sup> Borowsky (1986, p. 93) observes that there is also no labiodental nasal phoneme in English and therefore suggests another marking condition: \*[+nasal, +labiodental]. This condition is meant to prohibit assimilation to *f* and *v* for reasons having nothing to do with their stricture. Yet we should not appeal to this solution for two reasons. First, the specification of labiodental place is entirely redundant in English, predictable from the value of [cont]. That is, *f* and *v* are underlyingly simply labial, and so a condition based on a feature [labiodental] is not obviously relevant to the facts here. More importantly, an examination of other languages reveals many instances of failed place assimilation involving bilabial fricatives (e.g., Kikuyu, Rosenthal 1992, Padgett 1991) or other places of articulation. The use of [labiodental] could not extend to these cases.

is that examples of the sequence **mf/nv** vastly outnumber them. Since the former require specifying two places underlyingly, this is what we expect.<sup>11</sup>

### 1.1. *Structure Preservation and Marking Conditions*

At this point our assumptions about structure preservation and marking conditions must be made clear. Below is a formulation of the principle of Structure Preservation based on the discussion in Kiparsky (1985) and Myers (1991b).<sup>12</sup>

(16) *Structure Preservation*

Restrictions on the underlying representation hold throughout the lexical phonology.

Kiparsky recognized that this principle may need to be weakened (p. 135, n3). Subsequent research has shown this to be true, since it is sometimes violated in the lexicon (Archangeli and Pulleyblank 1986; Myers 1991b). Further, in some cases Structure Preservation seems to remain in force in the postlexical phonology. Although Kiparsky's intention is unclear, Archangeli and Pulleyblank interpret the principle to rule this out as well. To explain such facts, Myers (1991b) proposes the elimination of Structure Preservation and generalizes Kiparsky's Strong Domain Hypothesis to the relevant restrictions. This hypothesis originated in unpublished work and is explored by Borowsky (1986) in the following formulation, which I adopt as the Strong Domain Condition:

(17) *The Strong Domain Condition (SDC)*

- a. All rules are available at the earliest level of the phonology.
- b. Rules may cease to apply, but may not begin to apply at a later level by stipulation.

Applied to marking conditions as well, the SDC says that a language's conditions are in effect in the lexical representations and into the derivation but may be 'turned off' at any level of the derivation. Conditions do not 'turn on' at any point. This formulation preserves the requirement

<sup>11</sup> These **mf/mv** clusters are then exceptions to Yip's (1991) claim that English clusters are specified for only one place. (Yip argues that Coronal is not specified). Other exceptions include **gm** clusters, as in *stigma*. Note that cases like *circumvent*, *circumference* involve underlying **m**; compare *circuminsular*. In further support of our account of English, Borowsky (1986, p. 189) remarks on the unexplained rarity of nasal-fricative clusters in English codas.

<sup>12</sup> Following the example of Myers (1991b), I will let 'structure preservation' denote the property of respecting some marking condition, while 'Structure Preservation' refers to Kiparsky's hypothesis about the domain of such marking conditions (discussed below).

that structure preserving rule applications precede non-structure preserving ones, although only with respect to any single condition. That is, one condition may cease to apply while another remains in effect. Further, conditions may now cease to apply in the lexical phonology or, on the other hand, continue into the postlexical phonology. Unlike a theory with Structure Preservation, then, this theory claims that each marking condition has its own domain. This is a significant weakening of the original principle, but as Myers notes, it is *more* restrictive than Structure Preservation in requiring that if a condition holds postlexically, it holds lexically and in the underlying representation. (Structure Preservation makes no demands on a condition that holds postlexically).<sup>13</sup>

For purposes of this paper, I adopt Myer's proposal with the following qualifications. The facts suggest that the marking condition prohibiting nasalized fricatives is respected throughout the phonology for the great majority of languages. Though violations of other marking conditions, such as one prohibiting velar nasals, are fairly common even lexically (see the references given above), this is not the case with the marking condition against nasalized fricatives. This difference should probably be correlated with another difference: velar nasals are common in language inventories, while nasalized fricatives are perhaps non-existent. We might attempt to explain these differences within a theory of 'phonetic naturalness' and its relation to phonological constraints. (See Pulleyblank 1989; Cohn to appear and references therein, and cf. the 'phonetic grounding' of Archangeli and Pulleyblank 1992). If nasalized fricatives are phonetically less favored than velar nasals — if they are hard to produce, for instance (see Ohala 1975) — then they should occur less frequently in inventories, and the prohibition on their derivation should be a stronger force, i.e., perhaps persisting longer in the derivation.<sup>14</sup> As Cohn notes, in many respects we are still a long way from such a theory. For the purposes of the following discussion, let us simply assume that the marking condition prohibiting nasalized fricatives is respected throughout the phonology across languages. Although this is only approximately true, it is close enough for present purposes; I will address counterexamples in 1.5.2.

Let us now examine the nature of the marking condition itself. All recent proponents of underspecification, whether radical (Kiparsky 1982;

<sup>13</sup> Compare Archangeli and Pulleyblank's (1986) proposal that configuration constraints (corresponding to marking conditions to a large degree) be assigned either the  $X^0$  or the  $X^{\max}$  domain. This proposal gives similar results, but not identical ones, e.g., it is not possible to restrict a marking condition to only part of the lexical phonology.

<sup>14</sup> Other examples of robust marking conditions in phonologies include conditions preventing voiceless sonorants or nasalized liquids.

Archangeli 1984, 1988) or restricted (Clements 1988; Steriade 1987; Mester and Itô 1989), agree in leaving truly redundant features unspecified in lexical entries and throughout some part of the phonological derivation. Since [cont] does not serve to distinguish among nasal consonants, it is not specified underlyingly. I further assume the universal redundancy rule given in (18).

$$(18) \quad [+nas, +cons] \rightarrow [-cont]$$

Marking conditions are often intended to exclude predictable feature content from lexical entries. (See Kiparsky 1985, for instance). Thus, we might formulate a condition prohibiting the cooccurrence of either value of [cont] with [+nas], as shown below. As long as such a marking condition is in effect, no rule will specify a nasal for [cont]:

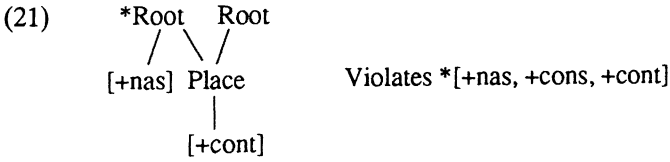
$$(19) \quad * [+nas, +cons, \alpha cont]$$

Marking conditions play an important role in explaining patterns of assimilation in languages, as argued by Kiparsky (1985), Archangeli and Pulleyblank (1986), Pulleyblank (1989) and Cohn (1989, 1990). I am arguing here that a prohibition on nasalized fricatives is crucial to an understanding of nasal place assimilation facts; however, the condition in (19) suggests that [+nas, +cons, -cont] and [+nas, +cons, +cont] are treated equally by the phonology. Yet the basic point of this paper is that only the latter feature cooccurrence is at issue under nasal place assimilation. Ruling out [+nas, +cons, -cont] as well eliminates redundancy in the underlying representation — I know of no evidence suggesting that nasal consonants fail to be specified [-cont] by an assimilatory rule. Consider the separated conditions given below.

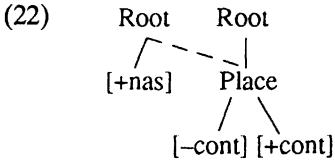
$$(20)a. \quad * [+nas, +cons, -cont]$$

$$b. \quad * [+nas, +cons, +cont]$$

(20)b has been proposed independently by Cohn (1989, 1990) to account for facts of long-distance [nasal] spread in Sundanese, and it seems to play a role in nasal place assimilation, ruling out assimilation to a fricative, assuming the articulator group:

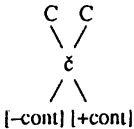


One might suppose that (20)a is not violated when assimilation occurs to stops simply because the stop is not specified for [cont], under some version of radical underspecification. But consider now the case of assimilation to an affricate. The fact to be accounted for is that nasals assimilate to affricates as freely as to stops. (We will see instances of this in later sections.) I assume that affricates are represented with both [-cont] and [+cont] specifications, following Steriade (1982) and Sagey (1986a) (perhaps both privative, Lombardi 1990). I assume further that an affricate is specified underlyingly for both values, since otherwise it is often indistinguishable from a stop or fricative. Therefore, when a nasal assimilates to an affricate, it acquires both [cont] values.<sup>15</sup>



Here both of the proposed conditions fail us: neither would allow this assimilation. The problem is the negative formulation of the conditions.

<sup>15</sup> What is the interpretation of (22)? What does it mean for the nasal to be both [-cont] and [+cont]? By analogy to the implementation of a geminate affricate, it would mean that the nasal is implemented as a stop. Compare the representation of /čč/, which is identical in the relevant respects:



Geminate affricates typically translate into stop-affricate sequences at the phonetic level, not into affricate-affricate sequences. I assume that in the usual case homorganic nasal-affricate sequences are interpreted in the same way; that is, (22) represents [mbv], [ndz], etc. However, see §1.5.3 for a crucial qualification.

Consider instead the positively stated condition given below, which can be compared to the positively stated 'c-constraints' of Archangeli and Pulleyblank (1986) or the positive conditions 'discussed in Pulleyblank (1989) and Mohanan (1991).

- (23) *Nasal/Continuant Marking Condition:*  
If [+nas, +cons], then [-cont]

This condition, which will be assumed here, intriguingly resembles our redundancy rule [+nas, +cons] → [-cont]. It allows assimilation to the affricate; the extra [+cont] value is irrelevant. What the condition prohibits is the assignment of *only* a [+cont] value. The difference between saying in effect that nasals may not be fricatives, on the one hand, and nasals must be stops, on the other, is in most cases untestable. Affricates provide a test case, however, if they are both stops and fricatives. The positive interpretation accounts for the facts by crucially allowing a rule to specify a nasal for redundant [-cont].<sup>16</sup>

At first sight, the nasal/continuant marking condition (23) may seem to have unwanted consequences in comparison to (19). First, it allows a nasal to be specified [-cont] underlyingly.<sup>17</sup> However, to prevent this redundant underlying specification, we should not invoke a marking condition in any case. Rather, the absence of [-cont] in underlying nasals should follow, directly and by principle, from the existence of the redundancy rule [+nas, +cons] → [-cont] itself. Such a connection between redundancy rules and underlying representations has always been assumed in work on underspecification but is missed if we posit marking conditions beside the related redundancy rules to ensure underspecification.<sup>18</sup> (On this issue, see Padgett 1991 and Itô, Mester and Padgett 1993). Second, (23) allows a nasal to be specified [-cont] in the course of the derivation. This is in fact a desirable consequence, given the account of affricates and the assimilation of nasals to stops in general by which they acquire this feature (if it is

<sup>16</sup> A clear alternative to this approach to the affricate facts maintains that affricates are only [-cont], following Steriade (1989). This move would allow the use of a negative condition like (20)b.

<sup>17</sup> Actually, the condition *requires* [-cont] specification. For the purposes of this paper we could instead write "If [+nas, +cons] is specified for [cont], it is specified [-cont]," a statement more consistent with the following discussion. However, Itô, Mester and Padgett (1993) argue that an approach to underspecification within the framework of Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993), in which constraints are not surface true, makes the simpler (23) a possible formulation, and in fact the necessary one.

<sup>18</sup> Kiparsky (1982), for instance, states "... we revert to the natural assumption of early generative phonology that phonological features are unspecified in underlying representations if their value can be assigned by a rule."

specified). Of course, some further principle must prevent the redundancy rule itself from filling in the relevant feature immediately, if underspecification may persist into the derivation. Proposals to this effect are found in Kiparsky (1985) and Archangeli and Pulleyblank (1986).<sup>19</sup>

This account of nasal place assimilation explains the entailment we saw earlier: when nasals assimilate to fricatives (typically hardening them, I argue), they assimilate to stops. The reason for this entailment is that nasals may always assimilate in place to stops, while the marking condition in (23) means that assimilation to fricatives must either fail or lead to hardening. (See the following sections). Why assimilation fails in some cases but applies with hardening in others is a question that will be addressed only briefly later, when we see instances of hardening that seem to require some notion of ‘repair operation’ or ‘fix-up rule’. For the time being, I assume that the condition in (23) serves to block rule application.

Let us now turn to more cases illustrating what happens when nasals occur before fricatives. We will see that, though the nasal/continuant marking condition and the articulator group predict the stop-fricative asymmetry in nasal place assimilation, other factors, sometimes language-specific, can determine the precise fate of the nasal fricative cluster.

### 1.2. *No Assimilation; Default Place Assignment: Polish*

I first consider cases where assimilation to fricatives is blocked, leading to default place assignment to the nasal. This option is available only to languages that allow the relevant nasal consonant to bear its own place specification. We have already seen the first such case in English. Here we turn to the second case.

A well-known instance of failed place assimilation before fricatives occurs in Polish. Though the facts are complicated, they clearly demonstrate the stop-fricative asymmetry. Two rules of Polish, nasal place assimilation and nasal gliding, are in ‘complementary distribution’, as many have noted (Gussmann 1980; Steele 1973; Bethin 1984; Czaykowska-Higgins 1988, 1992 and references therein). Place assimilation occurs before stops

<sup>19</sup> Itô, Mester and Padgett (1993) argue on independent grounds for an understanding of redundant feature specification in terms of *licensing*, analogous to that proposed by Goldsmith (1990), extending Itô (1986, 1989). Applied to these facts, while \*[+nas, +cons, +cont] represents a truly antagonistic cooccurrence, [-cont] is absent in nasals merely because nasals do not license this redundant feature, hence the typical underspecification. However, in place-assimilated nt, for example, if [-cont] is also assimilated, licensing of this feature is still fulfilled by the obstruent itself, assuming [cont] is contrastive among the obstruents. For motivation of this view of underspecification, see Itô, Mester and Padgett (1993).



and affricates, while gliding of the nasal occurs elsewhere — before fricatives and word-finally. This pattern of assimilation occurs both lexically and postlexically and affects various nasal segments: the ‘nasal vowels’, the coronal **n** and the labial **m**. Our main concern here is this stop-fricative asymmetry. For other aspects of the analysis of Polish, I rely on Czaykowska-Higgins (1988, 1992) and Bethin (1984).

I begin by examining the behavior of the ‘nasal vowels’ **ɶ** and **ɷ**. Though there is debate about the precise underlying representation of these two entities (the only so-called nasal vowels of Polish), generative analyses at least agree in treating them as a sequence of mid vowel (**ɶ** is actually [ɔ]) and nasal consonant (e.g., Gussman 1980; Rubach 1984; Bethin 1984; Czaykowska-Higgins 1988). They are not fully nasalized as are the nasalized vowels of French; rather, they are realized as a sequence of oral vowel (perhaps slightly nasalized) and nasal segment. In addition, they are longer than ordinary vowels. (On these facts, see Brooks 1968; Dukiewicz 1967; *inter alia*). The nasal portion of **ɶ** and **ɷ** is realized as a place-assimilated nasal stop before stops and affricates. Data here and below are taken from Bethin (1984) and Czaykowska-Higgins (1988, 1992). The first column is given in Polish orthography.<sup>20</sup>

(24)a.	ząb	[zomp]	‘tooth’
b.	zęby	[zembɨ]	‘teeth’
c.	rząd	[ʒondu]	‘government’
d.	zajęty	[zajenti]	‘busy (masc. sg.)’
e.	ręce	[rence]	‘hands’
f.	tęcza	[tenča]	‘rainbow’
g.	bądź	[bońć]	‘be (imperative)’
h.	zajęci	[zajeńci]	‘busy (masc. pers. pl.)’
i.	węgiel	[vɛŋg’el]	‘coal’

Below I give the underlying consonantal inventory of Polish, from Czaykowska-Higgins (1992). **C'** is palatalized. **c** and **ʒ** are dental affricates.<sup>21</sup>

(24)a.	<i>Polish Underlying Consonantal Inventory</i>	
	labial	p, p', b, b', f, f', v', m, m'
	dental	t, d, s, z, c, ʒ, n, ɲ, r
	alveopalatal	ʃ, ʒ, ʧ, ʤ

<sup>20</sup> I do not indicate partial nasalization of the vowel in the phonetic transcriptions, nor the alveopalatal pronunciation of **n** before **č**.

<sup>21</sup> /h/ (underlying [+back]) is realized as [w], a fact we return to shortly. **ć**, **ʃ**, **ś**, and **ź** are underlying **t'**, **d'**, **s'** and **z'**, respectively.

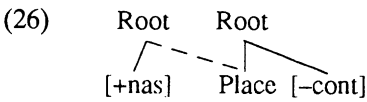
prepalatal	ć, j, ś, ź, l', ń
velar	k, g, x, w

In contrast, before fricatives the nasal segment surfaces as the nasalized glide  $\tilde{w}$ .<sup>22</sup>

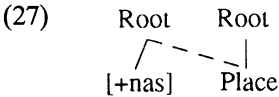
(25)a.	mąż	[moŃš]	'husband'
b.	wąski	[voŃski]	'narrow (masc. sg.)'
c.	męski	[meŃski]	'man's (masc. sg.)'
d.	książka	[kšoŃška]	'book'
e.	gęsi	[g'eŃši]	'geese'
f.	węch	[veŃx]	'smell'
g.	dążyć	[doŃźić]	'aspire'
h.	rzęsa	[žeŃsa]	'eyelash'

Affricates group with stops: the nasal does not delete before them but assimilates to them, as predicted by the account developed. As we saw above, the positive marking condition requiring that nasal consonants be specified [-cont] can explain the patterning of affricates with stops in this way, a patterning typical of nasal place assimilation rules.

Observing the assimilation behavior of the nasal consonant portion of  $\text{ɶ}$  and  $\text{ɷ}$  (and the consequent predictability of its place of articulation), both Bethin and Czaykowska-Higgins propose that it is underlyingly placeless. Assimilation is a fill-in process in these cases, applying according to the rule in (26), which is adapted from Czaykowska-Higgins (1992).



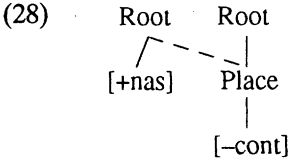
Under my account, the rule is simplified to (27).



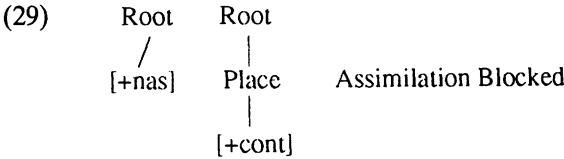
This account relies on the location of [cont] under Place, giving the stop-fricative asymmetry a principled rather than stipulative account, which is desirable for reasons already discussed. Place assimilation entails [cont] assimilation. Assimilation to stops and affricates causes no problem, since

<sup>22</sup> Gliding of the nasal sometimes results in  $\text{j}$  rather than  $\tilde{w}$  due to the presence of surrounding [-back] segments. See the sources cited for details.

the nasal/continuant marking condition states that if a nasal is specified for [cont], it must be specified [-cont]. Again, if [-cont] is unspecified, assimilation will likewise obtain.



The marking condition prevents assimilation to fricatives, given the geometry proposed:



In the environments where assimilation does not occur (before fricatives and word-finally), the nasal portion of **ɶ** and **ɷ** is realized as the nasalized glide, as shown above in (25).<sup>23</sup> Though some researchers (e.g., Bethin 1984) rely on a rule of gliding, I follow Czaykowska-Higgins (1988) in assuming that gliding is default place assignment (at least in the syllable coda), hence, I group Polish with English. Independent support for this assumption is found in the behavior of the underlying [+back] lateral [l], which surfaces as [w] (unless followed by a [-back] segment, in which case it is [l'] or [l]). There is, then, a general process of default labiovelar place assignment that affects sonorants. (See Czaykowska-Higgins 1988, p. 254–5 for details of the argument).

This account makes the necessary connection between place assimilation and nasal gliding: the latter occurs just where the former cannot. Previous accounts fail to make this connection. In some, for example, gliding is stipulated to occur before homorganic fricatives, where it is assumed that the preceding rule of place assimilation applies before *all* obstruents, fricatives as well as stops (e.g., Bethin 1984). In others, gliding applies where place assimilation does not, and yet the failure of place assimilation

<sup>23</sup> That is, the nasal becomes [-cons]. Note that since the marking condition in (23) refers to nasal consonants, it is indifferent to the [cont] status of a glide.

itself is stipulated — a [-cont] trigger is written into the rule (e.g., Czaykowska-Higgins 1992). The articulator group theory not only explains the ‘complementary distribution’ of assimilation and gliding, it makes the necessary connection between the facts of Polish and those of English, as well as Zoque and the other languages examined in this paper. What these languages have in common, I claim, is an aversion to the creation of nasalized fricatives.

As I mentioned at the outset, the nasal segments **n** and **m** undergo a pattern of place assimilation similar to that of the ‘nasal vowels’, though under different conditions. In casual speech, the coronal nasal **n** assimilates both within and across words. (In careful speech, assimilation may be confined to within words and may fail to apply before velars):

- |        |                   |                     |                      |
|--------|-------------------|---------------------|----------------------|
| (30)a. | blond             | [blond]             | ‘blond’              |
| b.     | bank              | [baŋk]              | ‘bank’               |
| c.     | pan bog           | [pam buk]           | ‘lord god’           |
| d.     | huragan kolosalny | [huragaŋ kolosalni] | ‘colossal hurricane’ |

Except for a difference in domain of application (‘nasal vowels’ do not assimilate across words), the behavior of **n** is parallel to that of the ‘nasal vowels’: under the conditions that induce assimilation to stops and affricates, there is gliding before fricatives:

- |        |          |            |            |
|--------|----------|------------|------------|
| (31)a. | szansa   | [šaŋsa]    | ‘chance’   |
| b.     | kunszt   | [kuŋšt]    | ‘art’      |
| c.     | konflikt | [koŋflikt] | ‘conflict’ |
| d.     | konwent  | [koŋvent]  | ‘convent’  |

Czaykowska-Higgins (1988, 1992) argues that **n** is underlyingly specified for Coronal. (Recall that the default rules for sonorants in Polish fill in labiovelar features, not coronal.) She further assumes a rule that delinks this specification and makes the nasal a target for the rule of assimilation given in (27). I adopt these aspects of the analysis. At this point, we can explain the behavior of **n** just as we did the behavior of the ‘nasal vowels’: assimilation to a [+cont] segment cannot occur due to the familiar marking condition; default rules then fill in labiovelar features. Czaykowska-Higgins shows that the rules of place assimilation and nasal gliding must target the nasal vowels in the lexical phonology and **n** postlexically. Hence, the marking condition is in effect throughout the phonology of Polish, a possibility noted in 1.1.

One other type of nasal gliding, the gliding of **m**, occurs in Polish, providing striking additional support for the crucial role of place features

in the gliding process. Gliding of **m** occurs only in casual speech and, more important, only before a labial fricative. Compare (32)a-c and (32)d.

(32)a.	triumf	[triuw̃f]	'triumph'
b.	tramwaj	[traw̃vaj]	'tram'
c.	tam walą	[taw̃ valoŵ]	'they are banging there'
d.	chamski	[xamski]	'boorish'
		cf. *[xaw̃ski]	

Unlike **n**, **m** does not assimilate to other places of articulation (i.e., *klamka* 'doorknob' is never \*[klaŋka]). There is apparently an OCP-related rule at work postlexically, as Czaykowska-Higgins argues. The rule deletes the first of two adjacent labial specifications, affecting the sequence in *triumf*, for example:

(33)	m	f
	⊕	
	Labial	Labial

The nasal cannot assimilate to a following labial fricative, and so it receives a place specification by default, giving *w̃*. This systematic connection between place assimilation and stricture finds no explanation within the standard theory.

### 1.3. No Assimilation; Deletion of the Nasal

In some languages where assimilation to fricatives is blocked, the outcome is not a nasal with default place but rather deletion of the nasal. Most analyses of such cases have postulated independent rules of nasal place assimilation and nasal deletion. In the account argued for here, the two rules are necessarily connected: deletion results from the (language-specific) failure of the nasal to receive a place specification. Thus, our analysis requires little more than we have said so far.

#### 1.3.1. Zoque

The first example comes from Zoque, a language of southern Mexico. I rely on the work of Wonderly (1946, 1951). In Zoque, the pronominal prefix **N** assimilates in place to the following stop or affricate (Wonderly

1951, p. 120). *c* and *ʒ* denote voiceless and voiced alveolar affricates, respectively.<sup>24</sup>

(34)a.	/N + pama/	[mbama]	'my clothing'
b.	/N + burru/	[mburru]	'my burro'
c.	/N + tatah/	[ndatah]	'my father'
d.	/N + disko/	[ndisko]	'my phonograph record'
e.	/N + cima/	[nʒima]	'my calabash'
f.	/N + čoʔngoya/	[nʒoʔngoya]	'my rabbit'
g.	/N + kayu/	[ŋgayu]	'my horse'
h.	/N + gayu/	[ŋgayu]	'my rooster'

Before continuants, we get not assimilation, but deletion of the nasal. I treat *l* as [+cont] here.

(35)a.	/N + faha/	[faha]	'my belt'
b.	/N + s^k/	[s^k]	'my beans'
c.	/N + šapun/	[šapun]	'my soap'
d.	/N + lawus/	[lawus]	'my nail'
e.	/N + rrančo/	[rrančo]	'my ranch'

Nasals within stems do not undergo place assimilation:<sup>25</sup>

(36)a.	camd^hkaʔopya	'he mediates'
b.	minba	'he comes'
c.	kendʔoʔpya	'he wants to look'
d.	maŋba	'he goes'
	etc.	

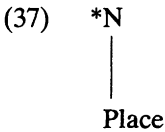
None of the non-assimilated nasals in (36) are word-initial. Dell (1973) therefore formulates the rule to apply only word-initially. As he notes, there are forms that appear to belie this formulation, cases where the pronominal prefix is itself preceded by another prefix *hay-* (neg. completive) in verbs, as in *hangyenaʔs* 'I did not see it' (= *hay-* + *N* + *ken-* 'see' + *-a-* (neg. comp.) + *Prn*), though this interpretation assumes that *hay-* constitutes part of the word. We must either restrict assimilation to the morphological entity *N* (and the other deleting nasal *Ny*), or else

<sup>24</sup> The rule voicing the post-nasal consonant is independent; it applies to non-homorganic nasal-stop sequences as well. The account of Zoque here ignores Spanish loans, which behave differently. See §1.5.

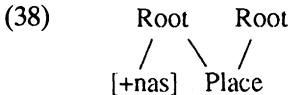
<sup>25</sup> Three other morphemes besides *N* evince assimilation: one is a different pronominal prefix *Ny*. (*y* metathesizes with the following consonant by another rule before assimilation). The others are the suffixes *-taM-* (1st/2nd pers. pl.) and *-aʔM-* (perf.). *M* is realized as *m* before vowels and *w*, but does not occur (in distribution) before fricatives.

assume that *hay-* does *not* form part of the (relevant) word; i.e., we have *ha[ŋgyenaʔs]<sub>wd</sub>*. There is reason to prefer the latter view, as we will see below.<sup>26</sup>

The failure of assimilation to fricatives in Zoque is just what we expect, for reasons now familiar. However, why does the nasal delete, rather than assume a default place, as it does in English? Lombardi (1990) suggests that the morphophoneme N may not receive its own place specification, pursuing a strategy developed by Itô (1986, 1989) in discussing other languages, presumably intending a constraint as in (37):



Under this view, the assimilated nasal is exempt from (37) by the Linking Constraint (Hayes 1986; cf. Schein and Steriade 1986), which requires that association lines be interpreted exhaustively. Given the Linking Constraint, the nasal does not meet the structural description of (37), since the Place node is doubly-linked:



In contrast, when the nasal appears before a fricative and so fails to assimilate, it is subject to the language-specific constraint in (37). The constraint prevents default place assignment, a state of affairs that in Zoque leads to loss of all feature content, i.e., segment deletion.

(37) predicts that the nasal would delete even if it were the sole onset consonant (assuming the nasal could not receive place from the vowel nucleus, as seems likely). Since there are no vowel-initial stems, it is impossible to test this prediction; however, it may seem dubious. An appealing variation on Ito's constraint-plus-inalterability approach recasts it in terms of positive licensing conditions, following Goldsmith (1990) and Itô and Mester (to appear): in Zoque, the syllable can license exactly

<sup>26</sup> The reader might wish to invoke the Strict Cycle Condition (Kiparsky 1985), but the non-assimilated nasals occur in derived environments as well as the assimilating morphophoneme N: *minba* 'he comes' in (36) is /min-/ 'to come' +/-pa/ (incomplete), for example. The Strict Cycle does not help.

one onset Place node.<sup>27</sup> N can exist by linking to an independently licensed place (and could be the sole onset consonant if there were vowel-initial stems) but otherwise must stray erase. The unassimilated nasals in (36), in contrast, are licensed by occurrence in the coda. This approach then motivates the word bracketing *ha[ŋgyena?s]<sub>wd</sub>* noted above, where ŋ is assimilated N: according to Wonderly, N deletes before fricatives even after the prefix *hay-*. N must then be an onset even in these cases.

Under either account, deletion and place assimilation are necessarily related: deletion occurs when (underlyingly placeless) N fails to acquire a place specification by assimilation. This sort of account predicts that nasal consonants that have their own underlying place specification and are not subject to the place assimilation rule will show no special behavior – deletion or default place assignment – before fricatives. We saw in (36) that Zoque allows unassimilated nasal-consonant clusters, as in *minba* ‘he comes’, and so we can test this prediction. In fact, these nasals do occur before the fricative *s*, as in *winsa?u* ‘he revived’ and *apsis* ‘lips’.<sup>28</sup>

### 1.3.2. Lithuanian

A nasal assimilation rule in Lithuanian parallels the Zoque facts to a large degree. Here I rely on Kenstowicz (1972). The nasal *n* assimilates in place to a following stop or affricate:<sup>29</sup>

- |        |              |                       |
|--------|--------------|-----------------------|
| (39)a. | sé[m]bernisa | ‘old fellow (nom sg)’ |
| b.     | da[n]tis     | ‘tooth (nom sg)’      |
| c.     | da[n]čiui    | ‘tooth (dat sg)’      |
| d.     | pì[ŋ]kite    | ‘plait (imper pl)’    |

The nasal assumes the coronal place before vowels. Compare these related forms:

- |        |         |                    |
|--------|---------|--------------------|
| (40)a. | sē[n]as | ‘old (nom sg)’     |
| b.     | pì[n]a  | ‘plait (3rd pres)’ |

Once again assimilation fails before the fricatives; the nasal deletes, as

<sup>27</sup> Zoque does allow a second onset place that is vocalic: *pyama* ‘his clothing’ from /y + pama/, etc. Wonderly cites other complex onsets that are due to Spanish borrowings, e.g., *flawia* ‘harmonica’.

<sup>28</sup> Other expected cluster types cannot be adduced because they are excluded on independent grounds. See Wonderly (1951) and Padgett (1991).

<sup>29</sup> Kenstowicz presents the data in Lithuanian orthography. Where this may be confusing, I will enclose portions of words in square brackets, giving a phonetic transcription. Note that a hook under a letter indicates a long vowel, not nasalization.



shown in (41) with the prefix *sán-*, and the preceding vowel compensatorily lengthens. Compare *sámburis* ‘assembly’, *sántaka* ‘confluence’, *sa[ŋ]kaba* ‘coupling’.

- (41)a. *sá skambis* ‘harmony’  
 b. *sá šlavos* ‘sweepings’  
 c. *sá žine* ‘conscience’

Assimilation creates the non-phonemes  $\eta$  and  $\eta$ , as in (39)c and d. Yet the rule must apply lexically because we find exceptional behavior before the future morpheme *-si*, where the nasal does not delete. I assume that the nasal here has its own place specification:

- (42)a. *gyvénsiu* ‘live (1st sg fut)’  
 b. *mínsiu* ‘trample (1st sg fut)’  
 c. *gìnsiu* ‘defend (1st sg fut)’

Lithuanian provides yet another example of the failure of marking conditions (prohibiting palatal and velar nasals) to be enforced lexically. However, the nasal/continuant marking condition *is* enforced. Lombardi (1990) discusses these facts and posits the following condition for Lithuanian:

- (43)  $*C]_{\sigma}$   
 |  
 [ +nas ]  
 [ cor ]

We can recast this condition in terms of licensing: the coda cannot support a coronal nasal. Such a condition is independently motivated, since the coronal nasal typically does not appear word-finally (Kenstowicz, p. 16), where it is present in the underlying form. (Kenstowicz discusses other ‘sporadic’ instances where it does not appear). Place-linked nasals again will escape this condition, since an onset place is licensed. Because the nasal cannot become place-linked to a fricative, it cannot be licensed in that environment and predictably deletes.<sup>30</sup>

I assume that nasal place assimilation in Lithuanian, as in English and

<sup>30</sup> The licensing constraint is not enforced before the future suffix, then, assuming the nasal receives its own place. (Examples in (42)). Following Kiparsky (1982), Inkelas and Cho (1993), we might wish to account for such exceptionality by invoking prespecification (of Coronal) along with the Elsewhere Condition. It is not clear how this would work, since the exceptionality is brought in by the suffix and yet involves the stem nasal. I leave the question open.

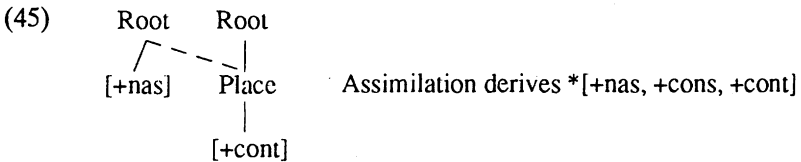
Zoque, spreads place to an underlyingly placeless (coronal) nasal. Just as with Zoque, nasals that have an underlying place specification and are not subject to assimilation do not delete before fricatives, as this account predicts:

- (44)a. *kriṁsti* 'chew (inf)'
- b. *grīṁzti* 'sink (inf)'
- c. *glámžyti* 'rumple (inf)'

Compare *brésti* 'ripen (inf)', with the related form *bréndo* (3rd past). Here the nasal may receive its place specification only by assimilation; yet assimilation to a fricative is impossible. Hence it deletes in the infinitive form.

1.4. Summary

Let us review the account of nasal place assimilation developed in the preceding sections. The proposed feature geometry, along with a marking condition requiring that nasal consonants be stops, makes strong predictions about nasal place assimilation. Languages perhaps universally prohibit nasalized fricatives underlyingly, and the marking condition prevents their derivation in the phonology. This, in turn, entails that nasals may not assimilate in place to fricatives, given the proposed geometry:



The cross-linguistic evidence strongly supports this view. Assimilation to fricatives is highly disfavored, while assimilation to stops and affricates is pervasive.

The cases we have examined in the preceding sections bear out the predictions very clearly. We observe variation among languages in how assimilation to fricatives is avoided. Sometimes the nasal does not assimilate but assumes a default place value. Sometimes it deletes altogether, and, as we will soon see, sometimes it assimilates and hardens the fricative. Yet under the theory I am arguing for, these different processes are closely related, all instances of structure preservation at work. Further, they are all necessarily related to place assimilation.

The standard view that [cont] is independent of place does not make these predictions. The fact that nasals assimilate to stops and affricates but not fricatives must be stipulated in the rule for each language. The connection between the failure to assimilate, nasal deletion, and hardening does not follow from such a theory. Moreover, the connection between these processes and place assimilation itself does not follow. Therefore, the standard account must be abandoned. On the other hand, the current proposals cannot be readily embraced unless they provide a means of dealing with known apparent counterexamples.

### 1.5. *Apparent Counterexamples*

We must confront instances where nasal place assimilation to a fricative does seem to occur. These can be divided into three classes: instances that are more properly viewed as phonetic processes to which the structure preservation account is irrelevant; cases in which the proposed marking condition is no longer enforced in the phonology — such cases ought to be uncommon; and, the most interesting group, cases in which apparent counterexamples simply involve hardening. I examine each group in turn.

#### 1.5.1. *Gestural Overlap*

In the discussion of the English prefix *in-*, the casual speech pronunciations ‘i[m]famous’, ‘i[m]variable’ (with the labiodental nasal) were mentioned. These forms parallel casual speech forms like ‘i[n]capacity’, where the marking condition \*[+nas, dorsal] no longer prevents assimilation to the velar, assuming there is such a marking condition in English. (See Borowsky 1986 and references therein for discussion of this issue). Here we seem to have a case of nasal place assimilation to a fricative, contrary to the proposed marking condition.

However, some phonetic studies of English suggest an alternative view: this is not a rule of phonological feature spreading but a phonetic process involving the overlap of gestures. Browman and Goldstein (1990) present preliminary articulatory evidence showing a hidden coronal gesture in a phrase like *seve[m] plus*, with an ‘assimilated’ nasal. The appearance of assimilation, Browman and Goldstein claim, follows from the overlap in articulations associated with the *n* and those associated with the *p*, along with some possible reduction in the magnitude of the now hidden coronal gesture. Such changes in the ‘gestural score’ and in gestural magnitude are argued to be typical of casual speech. (See Browman and Goldstein 1990 and references therein). If this interpretation extends to ‘i[m]variab-

le', etc., then we should not treat these cases as instances of phonological spreading, a categorical process resulting in a fully labiodental nasal and no coronal gesture. If there are both coronal and labiodental articulations, then there is no assimilation in the relevant sense, and no issue of structure preservation.

Such considerations suggest the need for care in bringing data to bear on issues of assimilation and structure preservation. Processes that are gradient in a way that depends on speech rate or casualness are abundant and are typically seen as governed by mechanisms (of the phonetics) having different properties from those of the phonology. (See for example Liberman and Pierrehumbert 1984; Keating 1990; Pierrehumbert 1990 and Cohn 1990).

### 1.5.2. *The Marking Condition is not Enforced?*

One of Sagey's (1986a) arguments for the standard theory comes from facts of place assimilation by nasals in Kpelle. I repeat her data below (from Welmers 1973, p. 67). Tone is not indicated; the nasal is syllabic and tone-bearing.

(46)a.	/N + polu/	[mbolu]	'my back'
b.	/N + tia/	[ndia]	'my taboo'
c.	/N + kɔɔ/	[ŋgɔɔ]	'my foot'
d.	/N + fela/	[mvela]	'my wages'
e.	/N + sua/	[nʃua]	'my nose'

Crucial to the point is example (46)d, where the nasal assimilates in place to the fricative *f* and yet is said to remain a stop.<sup>31</sup> As Sagey notes, with [cont] located under Place we predict instead a [+cont] nasal. Hence, she concludes that [cont] cannot be Place-dependent.

In fact, in a more thorough discussion of Kpelle phonology, Welmers (1962, p. 79) states that the nasal before *f/v* is labiodental [m]. Even if Kpelle is not just another instance of gestural overlap (note that nasal place assimilation applies across words as well, according to Welmers 1962), the [-cont] status of the derived [m] is far from clear.<sup>32</sup> For non-nasal segments, where the value of continuancy is usually obvious, labiodentality is always indicative of a [+cont] segment. Let us consider

<sup>31</sup> The hardening of *s* to an affricate [ʃ], seen in (46)e, is due to a preceding tone, not to the nasal per se. (See Welmers 1962, p. 76–77). It is prepalatal due to the vocalic environment (op. cit., p. 76).

<sup>32</sup> Researchers sometimes transcribe [m] for phonetic [m], since the latter is never distinctive, making the issue even more difficult.

the possibility, then, that [m] is [+cont]. It is true that there is likely to be little or no oral air flow in the case of [m], and the presence of such air flow is taken by Chomsky and Halle (1968) to define [+cont] segments. However, another view of [+cont] suggests itself: a [+cont] segment is one that involves a degree of oral constriction — possibly even a complete though non-compressed closure — such that air flow results given *other* specifiable conditions, where these conditions include the capacity to maintain some air pressure in the oral cavity. This capacity is notably reduced when the velum is lowered, accounting for the rarity of nasalized fricatives (Ohala 1975). Under this analysis, [m] is [+cont] by virtue of the constriction degree executed by the labial articulator; the absence of actual oral air flow follows from other conditions obtaining. This seems consistent with the definition of [+cont] assumed by Browman and Goldstein (1989, 1990), and it is in the spirit of the definitions of [voice] and [sonorant] in Chomsky and Halle (1968). These features are defined (though not without controversy) not in terms of the anticipated result of implementation but in terms of the articulatory states required to achieve them under some assumed conditions. From this perspective, r does not cease to be [+sonorant] when it is (perhaps partially) devoiced in a word like *cry* due to the neighboring voiceless segment; the conditions for spontaneous voicing simply happen not to be met.<sup>33</sup> Given these considerations, cases like Kpelle do not obviously challenge the proposed geometry. If the nasal in [mv] is [+cont], then the articulator group makes the correct prediction. However, the nasal/continuant marking condition no longer seems to be in force.

We have assumed that nasalized fricatives cannot be derived phonologically — that is, that the proposed marking condition is always enforced — and so assimilation such as in Kpelle should not occur. Perhaps we must weaken our claim about the domain of the marking condition, allowing it to ‘turn off’ in the phonology for some languages. In fact, contrary to the fiction maintained until now, we know independently that a condition against deriving nasalized fricatives cannot be absolute. Such segments are derived by nasalization in some South American languages (Anderson

<sup>33</sup> Other examples of features defined in this way include the laryngeal features of Halle and Stevens (1971) (though see the discussion and criticism of these features in Keating 1988); voicing in Hayes (1984); [nasal] in Cohn (to appear). Cohn defines [+nasal] as involving an open velo-pharyngeal port, rather than nasal air flow per se, noting that this is the widely-held view. In a language where nasality spreads across a glottal stop (a fairly common occurrence), we would otherwise be led to the questionable conclusion that the glottal segment itself is [-nasal], since it obviously allows no air flow, even though the velum is lowered.

1975) and in certain Celtic dialects by initial consonant mutations which apply lexically. (See de Bhaldraithe 1975; Ó Siadhail 1989).<sup>34</sup> Such a finding does not negate the enterprise, since we must stipulate domains for other marking conditions. (Recall the discussion in §1.1 about how such a theory might look). The nasal/continuant marking condition differs from many others actually in being unusually robust.

Another instance of nasal place assimilation that may create [+cont] nasals is provided by Spanish (which seems similar in essential respects to Catalan, discussed in Kiparsky 1985; Mascaró 1976). Here I rely on the analysis of Harris (1969, 1984). In Spanish, nasals in the syllable coda assimilate in place to any following obstruent, giving six places in all. The assimilation is obligatory within words in normal speech.<sup>35</sup>

- |        |          |              |
|--------|----------|--------------|
| (47)a. | ca[mp]o  | 'country'    |
| b.     | á[ɱf]ora | 'amphora'    |
| c.     | ma[nt]o  | 'cloak'      |
| d.     | ma[ns]o  | 'gentle'     |
| e.     | ma[ńč]o  | 'I stain'    |
| f.     | ma[ŋk]o  | 'one-handed' |

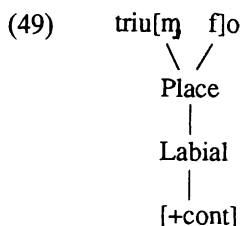
Following Harris (1984), I assume that the assimilation is feature-filling; coda nasals lose their place specifications independently. The point of interest is that assimilation occurs before fricatives as well as stops:

- |        |           |            |
|--------|-----------|------------|
| (48)a. | triu[ɱf]o | 'triumph'  |
| b.     | á[ɱf]ora  | 'amphora'  |
| c.     | aje[ŋx]o  | 'wormwood' |

Given what was said above, we might conclude that the nasal is in fact [+cont] in these cases:

<sup>34</sup> Ladefoged and Maddieson (1986) report that nasalized 'fricatives' are sometimes realized as merely approximant, with no frication, and question whether cases such as those reported by Anderson might not be the same. If a [+cont] value entails a certain oral constriction degree, and not always oral air flow per se (in the case of nasals), then discerning the [cont] value becomes more complex, requiring articulatory studies. One instance where frication is clearly described is that of the nasalized fricatives of Icelandic (Pétursson 1973, Einarsson 1940).

<sup>35</sup> The data in Harris (1969) pertain to the Spanish of Mexico City, though the facts are quite similar across dialects. In more casual speech, assimilation is reported across words as well: u[m] peso 'a peso', u[ŋ x]uego 'a game', crece[ɱ] flores 'flowers grow', etc. However, according to Navarro Tomás (1965) and discussed in Harris (1969), the across-word cases seem to be the result of gestural overlap. The nasal does not assimilate to the following consonant as much as get articulated simultaneously with it. We should not lump this process together with the rule under discussion, then.



This account predicts a reduced constriction degree in nasals in the words *aje[ɣx]o*, *manso* as well, in comparison with those in *ma[ɣk]o*, *manto*, etc. No articulatory studies illuminating the issue exist, to the best of my knowledge.<sup>36</sup> Should such studies cast doubt on the [+cont] status of these segments or should other considerations lead us to reject this general view of [cont], then place assimilation like that in Kpelle and Spanish can be treated along the lines suggested in the following section. If instead these cases do involve a relaxation of the marking condition, then we expect them to be uncommon for the same reason that nasalized fricatives in general are uncommon.

### 1.5.3. *Hardening*

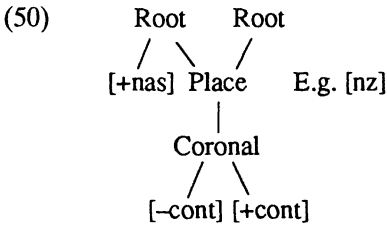
We find cases that clearly involve a nasal stop before a fricative under place assimilation. As we will see, these cases are consistent with the articulator group (but not with the standard theory). These do not violate the proposed marking condition. Clements (1991) cites the discussion of such a case by Doke (1931) on Shona:

It must be noticed that Shona does not employ the denti-labial nasal *m̥*, as do Zulu, Lamba, Bemba, etc., homorganically before *f* or *v*, but the full bilabial nasal in the combination *mv*. This is parallel to the affricative forms *pf* and *bv*, where the assimilation of elements is not complete, being only semi-homorganic. (p. 55)

More telling than this quote are the palatograms offered by Doke for the

<sup>36</sup> However, in parallel cases from Japanese just this state of affairs obtains, according to Vance (1987). That is, nasals homorganic with fricatives are described as having the constriction degree of the fricatives, again without appreciable oral air flow. In contrast, homorganic nasals in Icelandic share both the constriction degree and oral air flow of following fricatives (Pétursson 1973, Einarsson 1940), a rare occurrence presumably due to articulatory difficulties, as discussed above.

alveolar clusters [nz] and [nz̥] (the latter involving the alveolar-labialized fricative). The palatograms for these clusters clearly show complete contact between the tongue tip or blade and the alveolar ridge. In contrast, palatograms for [z] or [z̥] alone show that there is not complete contact in these cases: a groove is left open down the center of the alveolar ridge. Therefore, the obstruction in the clusters must be due to the nasal portion. Beyond a doubt, then, we have a [-cont] nasal and a [+cont] fricative. Given the articulator group, there is only one possible representation of stricture here:<sup>37</sup>



To explain these clusters I therefore adopt a proposal of Steriade (1991) (one that fits well with Doke's description quoted above): such clusters are simply affricates. Steriade's arguments for this view are compelling. I briefly present two of them below:<sup>38</sup>

First, Steriade claims that there is never a distinction made between place assimilated nasal-fricative and nasal-affricate clusters, and my own observations support this view. Further, as she shows, the distinction between fricatives and affricates is lost under nasal place assimilation. I cite here two cases discussed by Steriade. In Venda (Ziervogel et al.

<sup>37</sup> I treat prenasalized sequences as true clusters, distinguished from the more usual NC clusters only in syllabifying as onsets. Following Sagey (1986a), many have instead assumed that prenasalized sequences are single segments involving a contour in nasality or alternatively a two-Root contour with single segment status encoded at the level of a segmental skeleton (Piggott 1988, Rosenthal 1992). There are strong arguments against the single segment view, including the lack of underlying contrasts between prenasalized and 'true' NC sequences, but space does not permit their exploration here. For the arguments and discussion, see Herbert (1986), Duanmu (1990), Padgett (1991) and references therein. It should be noted that the cluster representation perhaps does not extend to a class of prenasalized sounds called 'Type B' by Piggott (1992), who treats them as simple sonorants unspecified for nasality (thus, they are not contours either). None of the cases discussed here are of this type.

<sup>38</sup> I should emphasize here that Steriade couches her proposals within a theory of segmental primes that is quite different from that assumed in this paper and holds significantly different views on the treatment of these facts.



1972, p. 42–3), affricates and fricatives preceded by a nasal are realized identically with affrication apparent on the non-nasal portion of the cluster. The latter is an instance of the common process of fricative hardening under assimilation, yet another means by which assimilated nasal-fricative clusters are avoided:

- (51)a. N + bvuda → mbvudɔ ‘a leak’  
 b. N + vuledza → mbvuledzɔ ‘finishing’

In Rwanda, on the other hand, neutralization is in favor of apparent nasal-fricative clusters (Coupez 1980, p. 124, 134):

- (52)a. n-tsirim-a → nsirima ‘I rub’  
 b. ni-n-sogot-a → ninsogota ‘if I pierce’

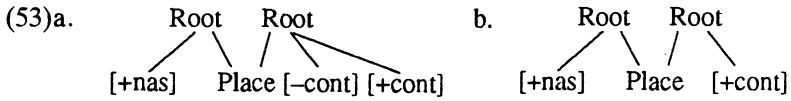
As Steriade argues, the lack of a distinction between place assimilated nasal-fricative and nasal-affricate clusters, and neutralizations like those shown here, can be understood only if our representations do not distinguish such clusters. Under this view, clusters like [nz] are phonologically identical to those like [ndz], both represented as in (50) above.<sup>39</sup> The difference between them is simply one of implementation: in the latter, the stop portion of the articulation exceeds the nasal portion in duration, while in the former it does not. In fact, we are led otherwise to the claim that place assimilation in Rwanda, shown above, involves ‘softening’ of the affricate to a fricative, surely an implausible interpretation, given the facts of nasal place assimilation that we have seen in this paper.<sup>40</sup> Further, in this vein we might mention languages in which there is variation in pronunciation between, e.g., [ns] and [nts], [mf] and [mpf], etc. (Steriade 1991, Herbert 1986).

Second, treating nasal-fricative clusters as affricates moves us toward a solution to a puzzle raised by Rosenthal (1989): why are they always strident — why don’t segments like  $\beta$  give [mb $\beta$ ] or [m $\beta$ ] under place assimilation? Instead they commonly give [mb], e.g., in Kikuyu (Rosenthal 1992; Padgett 1991). If nasal-fricative clusters are affricates, this reduces to the more general question of why affricates are virtually always strident (to which I offer no answer here).

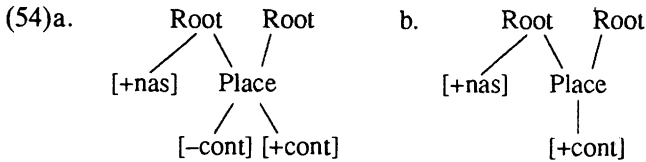
<sup>39</sup> It is important to bear in mind that [ndz], etc., are meant to refer to place assimilated affricate clusters as in (50) and not clusters of three segments, about which these arguments make no claim.

<sup>40</sup> Myers (1991a) presents two more cases, one from Zulu, to be discussed below, where the hardening to an affricate is overt, and the other the Shona case already mentioned, where there is apparent softening of affricates to fricatives again. Both are cases of hardening in our terms.

Clusters like [mv], [nz], at first sight a problem for the articulator group theory, now become an argument against the standard theory, a striking fact. As Steriade points out, the standard theory has no account for the facts just seen short of ad hoc stipulations. It (wrongly) distinguishes nasal-affricate from nasal-fricative clusters. (I do not show the nasal's [-cont] value below):



The theory proposed here, on the other hand, cannot make this distinction, for the familiar reason: (54)b is simply ill-formed.



This distinction will be possible only when the marking condition is not in force, an occurrence that must be uncommon, as noted before. The standard theory cannot relate the lack of non-strident nasal-fricative clusters to the lack of non-strident affricates either, since nasal-fricative clusters are not affricates.

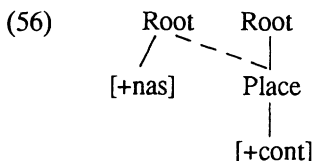
If there is nothing exceptional about clusters like **mv**, **nz**, then why are they reported relatively rarely? I follow Steriade in attributing this to two joint causes: first, these clusters are only variant phonetic implementations of affricate **mbv**, **ndz**. Second, affricates are less common than stops.

We have not addressed the source of the [-cont] value in these clusters. Up to this point I have interpreted the nasal/continuant marking condition as a type of filter, a condition that blocks the application of rules that would violate it. However, most of the many cases of hardening under place assimilation seem instead to involve 'repairs' at work: the marking condition allows assimilation to a fricative but then serves as a 'trigger' in some sense for 'fixing up' the representation. To see this, consider hardening in Zulu, as discussed in Myers (1991a) (see also Doke 1926; Rycroft and Ngcobo 1979). Prefixation of a nasal-final morpheme leads to hardening of the following fricative, as shown below:

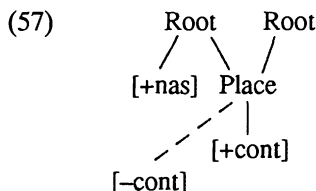
(55)a. **izimpfudu** 'tortoises' cf. **u:fudu** 'tortoise'

- (55) b. *izintsizi* 'sorrows'      u:sizi 'sorrow'  
 c. *izindzime* 'walking staffs'      u:zime 'walking staff'

Nasal place assimilation occurs as shown here:



We must then understand hardening as a mechanism that brings the representation in line with the proposed marking condition. The minimal hardening involves insertion of [-cont]. (Since non-strident segments cannot be affricates, they will require a further delinking of [+cont], e.g.,  $N + \beta \rightarrow mb$ ):



Clusters like [mv], [nz] of Shona are to be understood in just the same way: they undergo hardening, though the hardening is covert, due to the difference in implementation noted above.

The notion of repairs operating in tandem with constraints has a long history. Recent work along this line includes Calabrese (1987), Rice (1987), Yip (1988), Paradis (1988), Goldsmith (1990), Prince (1990), Myers (1991a) and Mohanan (1991). Clearly, there are questions looming about their workings that we would like to have answered. Why are rules seemingly blocked in some cases but allowed to apply with a repair in others? What principles determine the nature of the repair, if any? These questions are addressed by some of the works cited, though it seems fair to say that principled answers have been somewhat elusive.

Recent work in Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993; cf. the Harmonic Phonology of Goldsmith 1990, to appear) represents an intriguing new approach to the issue: the 'blocking versus repair' problem is viewed as an artifact of current theories, which

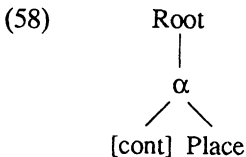
see constraints as surface-true statements enforced over derivations. Optimality Theory instead sees them as ranked and violable and enforced over a 'candidate set' of possible forms. Differences among languages that give the appearance of blocking versus repair are the result of language-specific constraint rankings imposed on a universal constraint set. Given these underpinnings, we might suppose that the difference between Lithuanian, in which a nasal deletes before fricatives, and Zulu, in which the fricatives are hardened, involves a difference in ranking between perhaps two constraints: one militates against loss of material (e.g. 'PARSE', in Prince and Smolensky 1993); the other against the *insertion* of material (e.g., '\*INSERT FEATURE', in Itô, Mester and Padgett 1993). While both languages rank the nasal/continuant marking condition higher than such constraints — requiring that one of them be violated in order to satisfy it — Lithuanian ranks '\*INSERT FEATURE' above 'PARSE' (making deletion optimal). Zulu does the reverse, making hardening optimal. This characterization of the facts is only a speculative sketch; further research is required.

## 2. ALTERNATIVES AND OTHER ASSIMILATIONS

The arguments of Section 1 may be summarized in the following way: place assimilation entails [cont] assimilation. It is this idea which, in conjunction with a notion of structure preservation, explains the odd behavior of place-assimilating nasals before fricatives as well as the behavior of apparent nasal-fricative clusters as affricates.

### 2.1. *Alternative Geometries*

Consider in this light an alternative account that suggests itself within the standard theory. While maintaining that [cont] is independent of Place, we might nevertheless posit a grouping of these features under a node I will call  $\alpha$ :

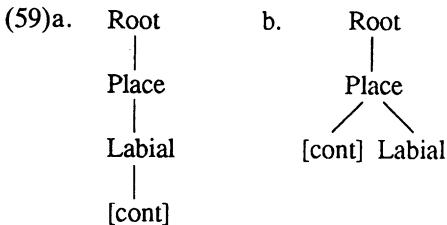


Under this view, it is the node  $\alpha$  which spreads under nasal 'place' assimilation, and we derive the effects surveyed in Section 1. In fact, Clements

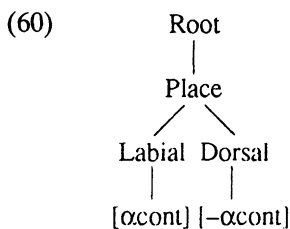
(1987) argues for such a node, his ‘Oral Cavity’ node, as does Davis (1989), who argues that this is the content of Supralaryngeal, (although neither argues on the basis of nasal place assimilation facts).

The argument against (58) is a particular version of one by McCarthy (1988) against a class node Supralaryngeal. McCarthy points out that there is a great deal of complementarity between Place and the proposed Supralaryngeal nodes. Let us weigh this point, given the facts of Section 1. Both the articulator group and the node  $\alpha$  in (58) predict that Place and [cont] may spread together. The latter theory also allows for Place spread *without* [cont] spread, unlike the articulator group. However, it is just this latter possibility that I claim does not exist; it has been the burden of Section 1 to show that there is no need for, and in fact no room for, the notion of place spread independent of [cont] spread. Even the facts that seem to support such a notion at first sight, i.e., clusters like **mv**, **nz**, etc., argue against it upon a closer look, as we saw in the last section. Therefore, there can be no node  $\alpha$  independent of Place.

Consider now the grouping of [cont] with the articulator repeated in (59)a (what is here called the ‘articulator group’), as opposed to the separate placement of [cont] and the articulator shown in (59)b.



I cannot argue in detail here for either representation, though I will mention two reasons for preferring (59)a, a representation first advanced by Sagey (1986b). First, as Sagey notes, it solves a problem concerning stricture in complex segments. The two articulations of a complex segment may differ in stricture, something easily represented by a theory in which any articulator carries its own stricture specification:



(59)b provides no means to identify a [cont] value with any particular articulator, a general problem for the standard theory. Since in later work Sagey (1986a) adopts the standard theory (on the strength of facts reanalyzed in this paper), she must argue for a ‘pointer’ notation by which such information can be read (indicating a relation between stricture and the relevant articulator). In our terms Sagey’s original insight is maintained, and the ad hoc pointer device is not required. It is true that differences in stricture are rarely contrastive within complex segments, and so we will often require only one *underlying* [cont] value.<sup>41</sup> Yet this observation does not address the question of how we are to know which articulator is associated with even this underlying [cont] specification.

Second, (59)a allows for a simpler view of the phonology-phonetics relation. The articulator group may be interpreted directly in terms of an articulation, something which necessarily involves both place and oral stricture specifications at the level of implementation. (Note that [son] is not an *oral* stricture feature, in the sense that it is not ‘executed’ by a particular articulator, but rather represents a ‘computation’ over the entire vocal tract. It is in this light that the independence of [son] from the articulators can be understood). The articulator group is in fact consistent to a large extent with the notion ‘gesture’ of Browman and Goldstein (1986, 1989). Browman and Goldstein posit gestures, which are unitary entities consisting of articulator, place and stricture specifications, as primes of the phonetics/phonology.

Within the articulator group (under the Place node), [cont] is viewed

<sup>41</sup> But only rarely — not never, as claimed by Sagey. See Padgett (1991), which assumes that the rarity of contrastive multiple stricture values requires a functional explanation. The theory must appeal to such considerations in any case to explain other underattested but predicted segment types. To name two, there are many more labiovelars than labiodorals attested (the latter may not exist at all) and no complex segments consisting of three stop articulations. Maddieson and Ladefoged (1988) suggest phonetic explanations for these gaps; perhaps we must do the same to explain why stricture is rarely contrastive within complex segments.

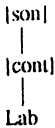
as dependent on the articulator on the assumption that [cont] can spread independently of place features, as in the well-known ‘Iberian’ spirantization cases of Mascaró (1984). (See Padgett 1991 for discussion). Without this assumption (e.g., Mascaró 1991b argues against [cont] spread), other possibilities are imaginable, including an unordered feature bundle of articulator and [cont], a matter I leave for further exploration.<sup>42</sup>

## 2.2. *Alternative Principles*

Let us consider a possible objection to the articulator group account. We observe that in some languages nasals that undergo place assimilation do not appear before voiceless segments. In some cases, a nasal deletes in this environment (e.g., Kihungan, Clements 1987); in others, an NC cluster implies that both segments are voiced (e.g., Zoque, Wonderly 1951). Given the abundance of evidence to the contrary, we do not want to conclude that [voice] is grouped with place features. Therefore, these facts might involve some sort of sequential constraint rather than a segment-internal featural constraint. That is, it might somehow rule out a sequence of nasal consonant plus voiceless consonant. If we can appeal to such constraints in any case, why not a sequential constraint to explain the stop/fricative asymmetry in nasal place assimilation?<sup>43</sup>

First, the facts with voicing are not so analogous as they would seem at first sight. Nasals may trigger voicing of a following consonant even without being place assimilated (this is in fact true in Zoque and in Gilyak, see Krejnovich 1937, p. 38; Korean, see Cho 1967). In contrast, Herbert

<sup>42</sup> Compare the structure proposed by Selkirk (1990, 1991), who posits no Place node and makes articulators dependent on [cont], e.g.:



Rules of place assimilation (which target all articulators) can here spread articulators independently of [cont]. However, Selkirk employs an independent constraint that requires that the mother [cont] nodes to which an articulator is doubly linked be identical, guaranteeing place-structure entailments like those seen in this paper.

<sup>43</sup> In fact, the appeal to sequential constraints to explain post-nasal voicing itself is dubious. At the very least, a constraint that states in effect that obstruents following nasals must be voiced would lack explanatory depth and be unlikely to extend to other facts. Itô, Mester and Padgett (1993) argue for an understanding of such facts based on quite general notions of licensing and underspecification.

(1986, p. 163) states that he knows of no definitive cases of post-nasal hardening without place assimilation. As we saw earlier, there is also no nasal deletion without place assimilation. A sequential constraint must rule out not nasal-fricative clusters generally, but exactly *place-assimilated* nasal fricative clusters – without simply stipulating the important generalization. Moreover, nasal place assimilation to voiceless stops is nevertheless common, while assimilation to fricatives (without hardening) is at the least highly marked, as I have argued.

Second, the account here has the appeal of linking the facts of nasal place assimilation to the scarcity of nasalized fricatives in languages, since both facts involve the issue of structure preservation. It is not clear how a proposed sequential constraint would make this connection. Further independent support for the connection is not hard to find: a process of long-distance [nasal] spreading is arrested by continuant consonants in Sundanese – due to the marking condition, and not simply an intervening feature or node – as convincingly argued by Cohn (1989). Cohn (to appear) mentions other languages in which [nasal] spread to a continuant hardens the latter.

To explain the behavior of nasals before fricatives by a sequential restriction, we might appeal, for instance, to the notion of sonority sequencing. Perhaps **nt** is preferable to **ns** in languages because the former evinces the greater sonority distance, whether within the coda or across the syllable boundary (the latter a ‘syllable contact’ phenomenon, Hooper 1972; Murray and Vennemann 1983). This proposal would seem to fail on grounds just considered. Most notably, it fails to make the connection to place assimilation. As the facts of Lithuanian, Zoque and many other languages make clear, unassimilated nasal-fricative clusters do not behave in the same way. Moreover, assimilated **mf** and **ns** are disfavored even as onsets, where they are presumably *preferable* to **mp**, **nt** in sonority sequencing, as seen in §1.5.3.

Our structure preservation account predicts that we should find the same stop-fricative asymmetry under progressive nasal place assimilation, not only regressive, since the relevant effect is really segment-internal and hence should not be directional. Though such rules are rare, some relevant facts from German confirm the prediction:

- |        |                 |        |               |
|--------|-----------------|--------|---------------|
| (61)a. | hakən ~ hak ŋ   | hacken | ‘to hack’     |
| b.     | vaxən ~ *vax ŋ  | wachen | ‘to be awake’ |
| c.     | habən ~ hab m̩  | haben  | ‘to have’     |
| d.     | hɔfən ~ *hɔf m̩ | hoffen | ‘to hope’     |

Some forms show variants with a syllabic nasal assimilated in place to :a



previous consonant. This consonant must be a stop. Sequential constraints, on the other hand, seem to be typically asymmetric. Sonority sequencing is a case in point: generally, where **tr** is bad, **rt** is good, and vice versa, assuming a language allows such clusters at all. By sonority sequencing, **hakŋ** wrongly seems to be worse than **vaxŋ**.<sup>44</sup>

### 2.3. Other Place Assimilations

Finally, a word must be said about place assimilation involving non-nasal consonants. Such place assimilation rules are somewhat hard to find (as distinguished from gemination on the one hand or the spreading of a single Coronal-dependent feature like [anterior] or [distributed] on the other). Among the cases that exist, some evince stricture and place assimilation together, as expected under our account. A few seem not to. (See Padgett 1991 for examples). A well-known case from Sanskrit is used by Sagey (1986a), who builds on an analysis of Steriade (1982), to argue for the standard theory: word-final *s* assimilates in place to a following consonant as follows (Whitney 1889):

- (62)a. *divas putras* → *divaϕ putrah* 'son of a god'  
 b. *Nalas kāmam* → *Nalax kāmam* 'Nalas at will'

Another case involves epenthetic consonants in Lardil, which share place of articulation with a preceding (sonorant) consonant. The last consonant in each form below is epenthesized, as part of an 'augmentation' process enforced by word minimality and other constraints. (Hale 1973; Itô 1986; Wilkinson 1988; references therein). Of concern here are the homorganic liquid-stop clusters.

- (63)a. *wunta* 'rain'  
 b. *kanta* 'grass'  
 c. *rilta* 'neck'  
 d. *maṛta* 'hand'

<sup>44</sup> Thanks to Michael Kenstowicz for this argument and to Armin Mester for confirming the data. Mester notes a further fact: the assimilated nasal is illicit also following an affricate, as in *schöpfen* 'to hoist', where we do not find \*[ʃœpfm̩]. If affricates are phonologically [-cont] and [+cont], then the nasal/continuant marking condition does not rule out this form. However, consider the phonetic implementation of the place-linked structure. The two-segment span contains two contours, non-nasal to nasal and stop to fricative. (See Lombardi 1990 on the phonetic ordering of affricates). Thus, there is an unavoidable span of fricative nasality; we may assume that German rules out such segments even phonetically. Recall that the marking condition is in fact phonetically motivated.

Such facts, on first sight, seem to argue for the standard theory of stricture. Yet we have seen that the standard theory fails to account for the great bulk of place assimilation data: that involving nasals. In this light, it would seem reasonable to seek alternative explanations for facts like those of Sanskrit and Lardil.

The Sanskrit place assimilation is optional; where it does not occur, *s* is invariably reduced to placeless [h̥] (the 'Visarga Rule'), as seen in [putrah̥]. This 'complementarity' of Visarga and place assimilation suggests an alternative view: the only phonological rule is Visarga. [Φp] and [xk] are simply alternate realizations of effectively preaspirated [h̥p] and [h̥k], perhaps due to some overlap of aspiration and the oral closure gesture, in the vocabulary of gestural phonology (Browman and Goldstein 1989). Hence, they are optional.

As for Lardil, the most pressing question is how [rt] can be place-linked, since [l] is a stop in some languages (e.g., English, see Clements 1987). Lardil has two series of liquids, the alveolar [l] and [r], and the apico-domal (retroflex) [ɽ]. Though epenthesis of a homorganic stop occurs following [l] and [ɽ], it mysteriously fails to occur after [r]:

- (64)a. *tera* 'thigh' cf. \**terta*  
 b. *yura* 'body' cf. \**yurta*

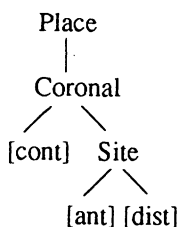
Hale suggests that epenthesis occurs here, since it would be expected, and that epenthesized [t] is then deleted by a late rule. Perhaps instead epenthesis fails here because [r] is [+cont]. Since epenthesis normally results in a homorganic sonorant plus stop sequence, suppose epenthesis involves the insertion of a [-son] (Root) node, with place features supplied by spreading from the sonorant. Spreading from [r] is blocked because Lardil has no continuant obstruent. What then, of [ɽ]? This sound has no lateral counterpart in the inventory, a suggestive gap. In fact, Hale (p. 421) reports that [ɽ] has [l] as an allophone. For some speakers, this allophone predominates, and for most speakers [l] surfaces word-initially. If we have in fact phonological [l], then there is no obvious problem involved with place-linking. Thus, the Lardil data, rather than simply challenging the articulator group, may be illuminated by it.<sup>45</sup>

Turning to one final area, Coronal sibilant harmony systems are a well-known instance of obstruent assimilation below the level of Place. Most can be analyzed as involving the spreading of a single feature like [anterior] or [distributed] (e.g., see Poser 1982 on Chumash), and so they are not relevant to the issues of this paper. However, a small number have been

<sup>45</sup> Thanks to Junko Itô for helpful discussion on Lardil.

argued to require Coronal spreading, since both Coronal-dependent features are involved (e.g., Steriade 1986 on Sanskrit; Shaw 1991 on Tahltan). In Tahltan, harmony involves both fricatives and affricates, yet there is no assimilation of stricture with place, as the articulator group seems to predict. However, if both [cont] and minor place features like [anterior] are Coronal-dependent, there is another way to ensure spreading of only the latter: they may form a class themselves, under a node we might call Site, as suggested in Padgett (1991):

(65) *Structure below the Coronal node*



Under this interpretation, Tahltan coronal harmony involves not Coronal but Site spread. Independent support for this view is found in Ní Chiosáin and Padgett (1993).

These considerations are not meant to be conclusive, of course, but simply to make a familiar point: facts are not labeled as counterexamples. In the absence of an appealing alternative account for the nasal place assimilation facts, we have strong reason to explore reanalyses of 'counterexamples' to the articulator group like those seen here.<sup>46</sup>

### 3. IMPLICATIONS AND CONCLUSION

In attempting to derive the facts of nasal place assimilation from proposals about the geometry and structure preservation, I follow others who seek explanations that follow from representations and general principles. Past accounts of nasal place assimilation have had to stipulate restrictions on the stricture of the trigger segment and so are inadequate in this respect.

<sup>46</sup> Consider also consonant-to-vowel place assimilations like Tulu *pi* → *pu* (Bright 1972). If assimilation here involves the spreading of primary Labial from consonant to vowel, as in Clements (to appear), why is stricture not assimilated also? In recent work, Ní Chiosáin and Padgett (1993) argue on independent grounds that such rules always involve the spreading of redundant secondary vowel place features from the (plain) consonant. Hence, basic stricture values ([cont], [cons], etc.) are shared.

There are aspects of nasal place assimilation left unexplained here, such as why place assimilation virtually always involves nasals and why it is almost always regressive.<sup>47</sup>

The articulator group draws support from a range of phonological phenomena besides those considered here in detail, as Padgett (1991) argues, including non-nasal place assimilation, complex segment types, underspecification effects, spirantization and OCP effects. In each area, we find an interaction of place features and [cont] that is not explained in the standard theory of feature geometry. Indeed, as shown in the same work, there is strong evidence in some of these domains (including nasal place assimilation) for extending the articulator group analysis to other oral stricture features like [consonantal] and [approximant], though the issues will require further research.

In conclusion, I mention two other implications of this research. First, the facts surveyed here bear on the question of whether assimilation is ever truly feature changing or whether it instead always involves neutralization and spreading, as advocated by Kiparsky (1985), Mascaró (1991a), Mester and Itô (1989), Cho (1990) and references therein, interpreting the Prague tradition.<sup>48</sup> However we analyze the nasal place assimilation facts, they show that assimilation must at least sometimes be feature changing. To see this, consider Malayalam (Mohanán 1986), a language in which both *m* and *n* assimilate in place across words to a following stop, but not to a fricative. In the neutralization and spreading approach, the place specifications of the nasals are delinked in the relevant environment (the syllable coda, for instance). Assimilation will then fail before fricatives, and we predict that (former) *m* and *n* will be treated identically, e.g., deleted or neutralized to the same (default) place of articulation. In fact, *m* and *n* instead retain their identity before fricatives. There is failed assimilation but no neutralization. Hence, delinking cannot precede assimilation but must result from it in Malayalam.

A second consequence of the proposals made here concerns the status of marking conditions in relation to repair operations. Myers (1991a) has proposed that marking conditions as filters, i.e., conditions that block rule application, can be eliminated from the theory in favor of 'persistent rules' which undo the effects of rules that appear to be blocked. More important for our concerns, Myers suggests that there is no need for conditions independent of the relevant persistent rules, since the latter will do what

<sup>47</sup> See Mascaró (1991a) and Mohanán (to appear) for recent discussion of these questions.

<sup>48</sup> Thanks to J. McCarthy and to S. Inkelas and Y. Y. Cho for pointing this issue out to me.

is required. The facts reviewed in this paper suggest that this latter claim is too strong. We require different persistent rules to account for the different patterns of default place assignment, nasal deletion, hardening and total assimilation that occur in languages before fricatives under nasal place assimilation. Yet these different effects are clearly unified by some broader requirement — in our terms, the requirement that nasalized fricatives not be derived. In fact, different strategies to avoid assimilation to a fricative may be found within one language. In Attic Greek, for example, we find nasals either assimilating in all features to fricatives or deleting before them, depending on the phonological and morphological conditions (Sommerstein 1973). To capture the larger generalization, we must give some status to the nasal/continuant marking condition.

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