PATTERNS OF FEATURE COOCCURRENCE: THE CASE OF NASALITY*

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1 Introduction

It is widely acknowledged that certain feature combinations are more likely to occur than others. For example, the feature of nasality is much more likely to appear on segments that are voiced than on segments that are voiceless (see discussion below). Several properties of such combinatorial restrictions are important, including the following: (i) the motivation or source of such restrictions, (ii) their cross-linguistic variability, (iii) their language-internal strength, (iv) the manners in which they manifest themselves. This paper examines certain aspects of the phonology of nasal segments that bear on these issues.

The paper focusses on the phenomenon of nasal opacity[1], where opacity is used to refer to the arresting of a process of feature propagation. When some feature (in this paper, nasality) is transmitted throughout some domain, the presence of certain *opaque* segments interrupts such a transmission. It is shown that in a wide range of cases involving nasality, the class of opaque segments is systematically defined. Blocking is not due to the lexical idiosyncracy of particular segments; the class of blockers is defined in terms of particular phonological features. This property raises two important issues. On the one hand, how can the possible classes of blockers be characterised in terms of their feature composition? On the other hand, by what mechanism do the opaque elements actually accomplish blocking.

In the following sections, I first discuss certain cross-linguistic generalisations concerning cooccurrence restrictions involving nasality; I go on to demonstrate that the types of cooccurrence restrictions governing segmental inventories also define typical classes of opaque segments; finally, it is demonstrated that the actual mechanism for accomplishing the blocking of feature transmission involves feature cooccurrence restrictions in a central way.

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* Thanks to Diana Archangeli and Lauri Karttunen for discussion of some of the issues presented in this paper.

1. For a discussion of additional cases where opacity derives from cross-linguistically motivated feature cooccurrence conditions (both involving nasality and other features), see Archangeli and Pulleyblank (in prep).

2 Cross-linguistic Patterns

The following table illustrates the frequency of certain types of nasalised segments found in the 317 language sample of Maddieson (1984).[2]

(1)

OBSTRUENTS		SONORANTS				
STOPS	FRICATIVES	NONAPPROXIMANTS	LIQUIDS	GLIDES	VOWELS	
PRENASALISED [18] 5.7%	PRENASALISED [1] 0.3%	NASAL [260] 82.0%	-----	NASALISED [1] 0.3%	NASALISED [53] 16.7%	+VOICED
-----	-----	VOICELESS NASAL [9] 2.8%	-----	-----	-----	-VOICED

This table is a representation of cross-linguistic markedness. As pointed out in work such as Ferguson (1963) and Maddieson (1984), certain patterns involving nasal segments are considerably more widely attested than others. For example, the following (not entirely unrelated) generalisations can be observed in the table in (2).

(2)

a. With the exception of the highly marked possibility of *voiceless nasal nonapproximants*, [+nasal] does not appear in combination with [-voiced].

b. [+nasal] combines with a range of [+sonorant] segments, the class of *nasal nonapproximants* occurring in over 80% of the languages of the sample.[3]

c. With respect to the feature value [-sonorant], the class of *prenasalised stops* is the only class that occurs with any

2. The figures in this table are restricted to three places of articulation: bilabial, dental/alveolar and velar for consonants; for vowels, high front unrounded, central low unrounded, and high back rounded. Clicks and diphthongs are not included in the table.

3. The percentage of languages with at least one nasal sonorant would be even higher if places of articulation other than labial, alveolar/dental and velar were taken into consideration.

frequency, and even that class is quite highly marked, occurring in less than 6% of the languages of the sample.

d. With respect to sub-classes of sonorants, it is noteworthy that there are no examples at all of nasalised liquids. That is, [+nasal] is incompatible with a sonorant that is [+approximant, +consonantal].

Consider the motivation of such generalisations. Although one could logically imagine the feature specification [+nasal] being ruled out in combination with a wide variety of arbitrarily selected segment types, in fact such restrictions occur in combinations that can plausibly be explained on phonetic grounds. Ohala (1975), for example, discusses reasons for considering the class of voiceless nasals as being phonetically marked. A plausible assumption, therefore, is that the gaps in (1) reflect phonetic imcompatibilities.[4]

Another issue concerns the role of such restrictions on nasality with respect to aspects of the phonology other than the determination of inventories. This question is examined in the remainder of this paper. It is shown that the classes of segments that are opaque to the transmission of nasality in a cross-linguistic survey appear to be the same sorts of classes as those observed in (1) to resist nasality within inventories. To account for this generalisation, it is proposed that the major factor contributing to phonological opacity is the presence of feature cooccurrence restrictions governing the application of phonological processes.

2.1 Formalisation of conditions

Conditions on feature combinations constitute implicational statements and can involve either positive or negative conditions (Kiparsky 1982, 1985; Itô 1986). In this paper, conditions are expressed somewhat prosaically to emphasize their implicational nature. Note that the direct or indirect effects such conditions might have in triggering changes to phonological representations are not discussed here; the cases discussed all involve conditions governing a representation's well-formedness.[5]

4. It needs to be stressed that the issue is one of markedness. Individual languages exist that have marked nasal segment-types as members of their segmental inventories. The claim that is important here with respect to the pattern exhibited in (1) is that certain segment-types are common while others are rare.

5. Thanks to Lauri Karttunen for discussion of the manner in which conditions are formulated.

(3) Conditions

a. POSITIVE: If α then β.
b. NEGATIVE: If α then not β.

Such conditions impose no constraints on the distribution of a class other than that defined by α. Formulated positively, a condition establishes that the presence of α is contingent on the presence of β; formulated negatively, a condition rules out the cooccurrence of α with β.

Although positive and negative statements are equivalent within fully specified representations involving binary features, this is not necessarily the case in approaches where certain feature values are not present, or in theories where at least some features are single-valued. As such issues are not considered in this paper, I formulate all cases discussed here both positively and negatively (cf. Archangeli and Pulleyblank in prep).

3 Voicing

The first restriction on the feature nasal to be considered is that of (2a), that nasality does not combine with voicelessness. A segment may be [+nasal] only if the segment is [+voiced]; a segment may be [+nasal] only if it is not [-voiced]:

(4) NASAL/VOICING

a. POSITIVE: If [+NASAL] then [+VOICED].
b. NEGATIVE: If [+NASAL] then not [-VOICED].

A consideration of Maddieson's (1984) sample shows that while exceptions to this restriction are possible, for example with voiceless nasals, such exceptions have a highly marked status. Even a segment-type like *voiceless prenasalised stop* is of a status so marked that it does not occur at all in Maddieson's sample.

In the following subsections, I consider two examples where this restriction on the combination of nasality with voicelessness plays an active role in a language's phonology.

3.1 Akan

In Akan (Schachter and Fromkin 1968, Hyman 1972), vowels may be underlyingly oral or nasal. Compare for example the following pairs of forms:

(5)

a.	nsa	"hand"
	nsã	"liquor"
b.	pam?	"sew"
	pãm?	"confederate"
c.	tçi?	"hate"
	tçĩ?	"squeeze"

Consonants that precede a nasal vowel are themselves nasalised -- provided that the consonants affected are *voiced*:

(6)

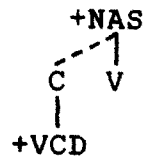
a.	/bã/	--> [mã]	"give"
b.	/dã/	--> [nã]	"and"
c.	/yã/	--> [ỹã]/[ɲã]	"receive"
d.	/wãdɛ̃/	--> [w̃ãnɛ̃]/[ŋwãnɛ̃]	"scrape"
e.	/hũ/	--> [m̃ũ]	"fear"

Two issues are central to an account of this pattern of nasalisation. First, one must account for the fact that the voiced segments of (6) are subject to nasalisation but that the voiceless segments of (5) are not. It is proposed here that this pattern derives from the restriction in (4), a restriction assumed to have its roots in properties of the phonetics of nasal segments. The second issue involves the actual mechanism invoked to derive the observed pattern. Several possible mechanisms are considered below.

3.1.1 Conditions on rules

A possible expression of a pattern such as that of Akan would be to assign a condition to the rule of nasal spreading such that the target of spreading can only be [+voiced].

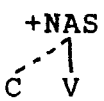
(7) Conditioned spreading:



Such an approach, while descriptively adequate, serves only to side-step the real problem, namely why language rules should reflect patterns of cross-linguistic markedness. In this case, cross-linguistic observations of nasalised segments indicate a clear pattern whereby nasality combines straightforwardly with a variety of voiced segment-types, but is incompatible with voiceless segments (except in extremely marked circumstances). Since the rule in (7) reflects the unmarked pattern concerning the cooccurrence of nasality with particular values of voicing, it should not be necessary for a language to include a specific stipulation to produce the desired pattern. To employ such a

target condition incorrectly implies that different conditions could also occur, for example, the condition that targets be [-voiced] (rather than [+voiced]), the related condition that the trigger be [-voiced] and so on. Of additional importance is the fact that considerations of rule simplicity would lead us to conclude that the rule in (7) is more complex, and therefore less likely, than a rule such as the following:

(8) Unconditioned spreading:



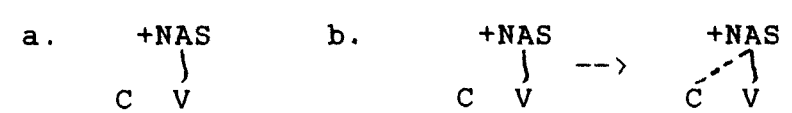
If a rule such as (8) is interpreted as meaning that nasality can be assigned to any consonant *without qualification* then it is predicted that the Akan-type spreading is to be dispreferred to a a situation where *all* consonants are nasalised in the appropriate environment. And yet a survey such as Maddieson's appears to demonstrate that this is an incorrect expectation. In an approach that builds cooccurrence restrictions into rules, notions of "formally simple rule" and "unmarked rule" are in conflict (cf. Clements 1985, Mohanan 1988).

The conflict is resolved by assuming that the rule in a language like Akan is indeed as formulated in (8), but that targets are restricted to segments that are voiced by an independent mechanism. Two types of rule-independent mechanisms are considered here.

3.1.2 Conditions

Under this approach, none of the potential targets of *nasalisation are specified for nasality in any way. Voiced* segments receive [+nasal] specifications when in the appropriate context; voiceless segments cannot receive such a specification because the NASAL/VOICING condition (4) applies actively in the phonology.[6]

(9) Conditions



pãm? "confederate"

bã

mã "give"

The conditions approach captures straightforwardly the basic properties governing the distribution of nasality in a language

6. For a range of cases requiring such use of conditions, see for example Kiparsky (1985).

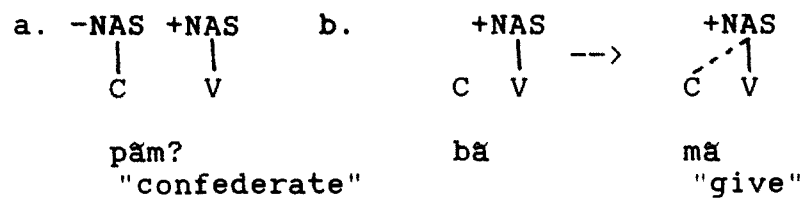
like Akan. Vowels, a segment-type exhibiting a contrast with respect to nasality, bear one of two possible specifications: (i) unspecified for nasality, surfacing as [-nasal] (the unmarked case both cross-linguistically and formally), (ii) specified as [+nasal] (the marked case both cross-linguistically and formally). With regards to consonants, nasality values in Akan are completely predictable, consonants receiving [-nasal] according to the predictions of cross-linguistic markedness except in positions where a [+nasal] specification is contextually determined. This pattern is reflected formally by assigning no nasality values at all to consonants underlyingly.

The conditions approach makes essentially the minimal assumptions. Specifications are required underlyingly only to express the marked value in a segment-type exhibiting a contrast. A maximally simple rule of nasal spreading applies except in cases where its application would violate the NASAL/VOICING cooccurrence restriction (4) -- a restriction that is independently required to capture the cross-linguistic distribution of nasal segment-types.

3.1.3 Prespecification

An alternative to the conditions approach would be to assume that voiceless targets are prevented from receiving a [+nasal] specification because they are prespecified as [-nasal].[7]

(10) Prespecification



Although adequate for a simple case such as Akan, conceptual considerations argue against the prespecification approach. Consider the required distribution of nasal specifications in underlying representations. As with the conditions approach, vowels may either be specified as [+nasal] or be unspecified for [nasal]. Consonants, on the other hand, are divided into two classes -- those that are underlyingly unspecified (receiving their nasality specifications via spreading or else by default) and those that are underlyingly [-nasal]. These two classes are necessary even though *all* consonantal specifications of nasality are predictable.

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7. For some recent discussion, as well as application to a wide number of languages, see Piggott (1988). For arguments against deriving at least some cases of opacity via prespecification, see for example Archangeli and Pulleyblank (1989, in prep) and Cohn (in press).

One could perhaps justify the establishment of two classes for consonants if one of the classes could be independently motivated in some way. But it is noteworthy in this regard that specifications of [-nasal], the type of specification employed in the prespecification approach, bear no direct relation to the type of cooccurrence restriction that is involved in this type of case. Restrictions on the assignment of [+nasal] such as that in (4) impose no restrictions on the specification of [-nasal]. Indeed, [-nasal] can be assigned to both vowels and consonants, with no segment-type excluded. Moreover, such assignment of [-nasal] constitutes the unmarked case for all segment-types. The phonological assignment of [-nasal] specifically to voiceless segments is therefore an ad hoc stipulation.

Moreover, the prespecification approach results in three classes of segments: (i) the class specified [+nasal], (ii) the class specified [-nasal], and (iii) the class unspecified for [nasal]. Since this configuration is firmly in place at a stage where rules affecting nasality are operating, it constitutes the ternary use of a binary feature.[8] One might of course choose to allow ternary power in at least certain types of configurations. Important in the present context, however, is the fact that ternary power is not required since the conditions alternative to prespecification exists.

A crucial distinction between the conditions and prespecification approaches concerns the feature values with which compatibility/incompatibility statements are formulated. To evaluate this distinction, it is crucial to keep in mind the following: all segment-types in Akan may be oral; only a subset of segment-types may be nasal. That is, restrictions relate to the feature value [+nasal], not to the feature value [-nasal].[9] This is directly accounted for in a conditions approach that imposes constraints on the combination of [+nasal] with other features. It is at best only indirectly accounted for in a

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8. For discussion of the ternary use of binary features, see for example Lightner (1963), Stanley (1967), Kiparsky (1982), Pulleyblank (1986).

9. Note in this regard that an additional argument in favour of the conditions approach might be proposed within the context of a monovalent approach to the feature [nasal]. If [nasal] turns out to be a single-valued feature, and if the specified value is (plausibly) NASAL, not ORAL, then it would be impossible to use an ORAL specification as a blocker. Conditions on the spread of NASAL would then become the only approach. In an effort to avoid entering into this issue which is essentially orthogonal to the general question of conditions on feature combination, I do not examine this argument here. For some recent discussion of monovalent features, see, for example, Sagey (1986), Mester and Itô (in press).

prespecification approach since constraints on [+nasal] play no formal role.[10]

3.2 Orejon

Striking evidence in favour of the conditions approach can be obtained from a consideration of cases involving long-distance spreading. In Orejon, for example, Arnaiz (1988) demonstrates that nasality is a morpheme-level feature, where both the manner in which the feature associates and the manner in which the feature spreads are predictable. Arnaiz demonstrates that the NASAL/VOICING condition prohibiting the assignment of [+nasal] to a voiceless segment governs both association and spreading. In the following examples of morphemes with a lexically specified nasal autosegment, observe that association assigns the nasal feature to the initial consonant if that consonant is voiced (11a-f) but not if the initial consonant is voiceless (11g-i). Spreading extends the domain of the nasal feature to the right (11a-f,i) until a voiceless segment is encountered (11a,c,d,e,g,h).

(11)

a.	[+N]bɨte?	--> mɨ̃te?	"mosquito"
b.	[+N]?bori-	--> ?mõnĩ-	"come"
c.	[+N]?daki-	--> ?nãki-	"chew"
d.	[+N]rɨka-	--> nɨ̃ka-	"stop"
e.	[+N]yakoa?	--> ñãkoa?	"eye"
f.	[+N]gara?	--> ŋãnã?	"fly"
g.	[+N]take?	--> tãke?	"monkey"
h.	[+N]kosa?	--> kõsa?	"ant"
i.	[+N]sebe?	--> sẽmẽ?	"wild pig"

3.2.1 Conditions

Assuming that the NASAL/VOICING cooccurrence restriction in (4) is active in the phonology, all that is needed to derive the attested cases of opacity is that spreading be *local*: a process spreading some feature F cannot skip an F-bearing unit.[11] In Orejon, since both consonants and vowels are nasal-bearing units,

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10. One might imagine an approach where the prespecification of features like [-nasal] would be conditioned by constraints of the following kind: "[-nasal] may be preassigned only to segment-types to which [+nasal] may not link (according to considerations of markedness)". Such a variant of the approach taken here would be warranted only if one could demonstrate the need for prespecification in addition to the conditions that govern prespecification. The crucial point continues to be the role of *conditions* in explaining patterns of opacity regardless of the formal mechanism utilised.

11. For discussion of locality, see Archangeli and Pulleyblank (1989, in prep).

no consonant or vowel can be skipped by the rule spreading [nasal]. Note that the initial association of nasality is unaffected by considerations of locality because a floating autosegment is in a local relation to every potential anchor X within its domain:

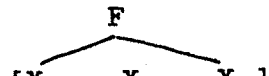
(12)

F — F = [+nasal], H, L, [+round], etc.

$[X_1 \ldots X_i \ldots X_n]$ — X = F-bearing unit

Once association has taken place, locality becomes relevant. For example, the relation between X_1 and X_n in the following example is non-local and therefore ruled out.

(13)

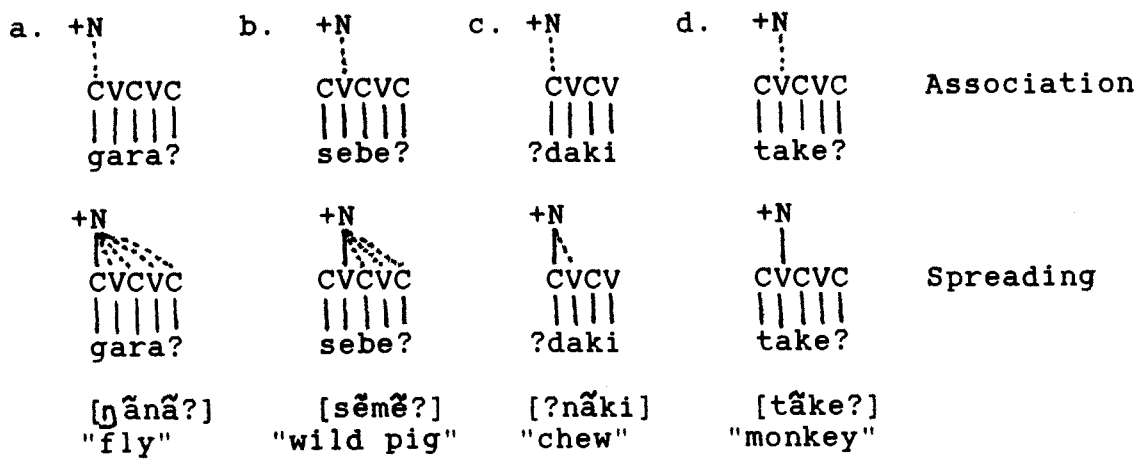


F = [+nasal], H, L, [+round], etc.

X = F-bearing unit

Consider representative derivations of forms from Orejon ("+N" = [+nasal]).

(14)



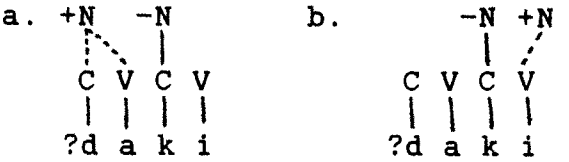
Examples (14a,c) involve association to the leftmost segment of the domain; examples (14b,d) involve association to the second segment of the domain, association to the initial segment being ruled out because of the NASAL\VOICING condition in (4). Examples (14a,b) spread nasality to the end of the domain; examples (14c,d) illustrate cases where such spreading is arrested by the presence of a voiceless segment, again because of the NASAL\VOICING condition.

3.2.2 Prespecification

The prespecification alternative for such a case produces a number of complications. The basic approach would be to prespecify voiceless segments with a [-nasal] feature value. As

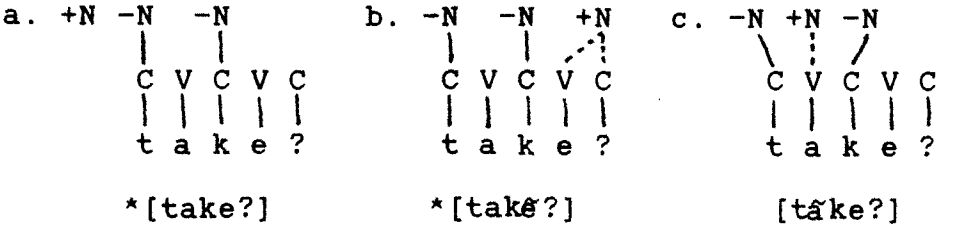
noted already in section 3.1.3, such assignment of [-nasal] poses a number of conceptual problems. In addition, for a case like that of Orejon, prespecification necessitates a completely ad hoc set of conditions on the application of the association conventions. Consider the derivation of a form like *?nãki* "chew" where the voiceless segment is intervocalic. Since the voiceless obstruent [k] defines two spans of nasalisable segments, to derive the correct surface result it is crucial that the morpheme-level [+nasal] feature precede the [-nasal] specification preassigned to [k].

(15)



But in a case like [tãke?], which contains both *initial* and *medial* voiceless segments, the wrong result is derived if the morphemic specification of [+nasal] precedes [-nasal]. To derive the correct results, [+nasal] must not be at the left periphery (preceding [-nasal] -- as in (16a)), nor at the right periphery (following [-nasal] -- as in (16b)); the [+nasal] specification would have to appear in between the two prespecified [-nasal] values (as in (16c)).

(16)



To correctly derive cases both like *?nãki* and like *tãke?*, stipulations on the ordering of a [+nasal] specification must be included in the grammar, where the stipulated order is sensitive to the location of any existing prespecified values of [-nasal]. What is clear is that the need for ordering stipulations is a direct result of including [-nasal] values as opaque elements, a situation that we might refer to as "prespecified trapping" (cf. Prince 1987). Since such prespecified values are not needed, as seen in section 3.2.1, the stipulations that they would necessitate argue against their inclusion.

4 Sonorants

The second condition that I will consider is one which restricts (in the unmarked case) the assignment of nasality to a sonorant (2b,c). A segment may be [+nasal] only if it is a sonorant; a segment may be [+nasal] only if it is not an obstruent.

(17) NASAL/SONORANT

a. POSITIVE: If [+NASAL] then [+SONORANT].
b. NEGATIVE: If [+NASAL] then not [-SONORANT].

With respect to the feature [sonorant], the class of *nasal nonapproximants* is extremely common, occurring in over 80% of the languages of the sample. And such a figure is conservative since the figures do not include languages with nasal sonorants only articulated at a place of articulation other than labial, coronal or dorsal. As concerns obstruents, nasality is quite rare. Only the class of prenasalised stops occurs with any frequency, and even that class is highly marked, occurring in less than 6% of the languages of the sample.

As in the discussion of restrictions with respect to voicing, I discuss below two examples illustrating the incompatibility of nasality with obstruents.

4.1 Yoruba

Vowels in Yoruba may be either oral or nasal (see, for example, Oyelaran 1971). Folowing Yoruba orthographic practice, nasal vowels are indicated by the letter "n" following a vowel.

(18)

a.	kú	"die"
	kún	"be full"
b.	ọkà	"guinea-corn"
	ọkàn	"heart"
c.	dí	"block up"
	dín	"fry"

When a nasal vowel follows a sonorant onset, the sonorant undergoes nasalisation:

(19)

a.	/rì/	--> [r̃ì]	"walk"
b.	/yú/	--> [ỹú]	"dispense"
c.	/hũ/	--> [h̃ũ]	"weave"
d.	/wí/	--> [w̃í]	"lend"

The segments that undergo nasalisation in this case are sonorants, not simply voiced segments. Consonants like [b, d, g, gb] are not affected, as illustrated in an example like *dín* "fry" (18c).

4.2 Kpelle

In a manner similar in many respects to Orejon, Kpelle (Welmers 1962) contrasts oral and nasal morphemes, the nasal morphemes including a floating [+nasal] specification. In examples with no [+nasal] specification, segments are oral:

(20) Oral morphemes

a.	síì	"tribe"
b.	kpaa	"'cedar' tree"
c.	kala	"husks, trash"
d.	sɔ́yá	"weaver bird"
e.	ɓoli	"goat"
f.	leɣi	"pot"
g.	ɣɛli	"vine, rope"
h.	wúrú	"tree"
i.	yá	"water"

In cases with a nasal autosegment, the first nasalisable segment and all following nasalisable segments are nasal:

(21) Nasal morphemes

a.	sĩĩ̃	"spider"
b.	kpãã̃	"tree (sp.)"
c.	kãlã̃	"box"
d.	pɔ̃yã̃	"a design, mark"
e.	gɛ̃ɣɛ̃	"his ribs"
f.	nũ̃ũ̃	"person"
g.	ŋ̃ĩlĩŋ̃	"termites"
h.	nɛ̃nĩ̃	"woman"
i.	mɔ̃lɛ̃	"suffer from hard work"

Of importance with respect to the role of conditions is that sonorants are affected by such nasalisation while obstruents are not. Hence obstruents remain oral even in such nasal morphemes (21a-e) while all sonorants are nasal (21f-i).

5 Liquids

In the preceding section, examples have been seen where the feature of nasality is restricted to sonorants. In (1), however, it was seen that it is not equally probable for all sonorant segment-types to appear in conjunction with the feature [+nasal]. The class of liquids, for example, is extremely unlikely to be nasalised. Subconditions such as the following can therefore be invoked to refine the characterisation of appropriate cooccurrence classes.

(22) NASAL/LIQUID

a. POSITIVE: If $\left[\begin{array}{l}\text{+NASAL} \\ \text{+APPROXIMANT}\end{array}\right]$ then [-CONSONANTAL].

b. NEGATIVE: If $\left[\begin{array}{l}\text{+NASAL} \\ \text{+APPROXIMANT}\end{array}\right]$ then not [+CONSONANTAL].

According to this condition, [+nasal] can attach to a sonorant approximant (vowels, glides, liquids) only if the relevant sonorant is either (a) [-consonantal], or (b) not [+consonantal] -- that is, nasality can be assigned to vowels and glides, but not liquids.[12] Note that this condition does not prevent nasality from being assigned to a non-approximant sonorant (the class of nasal stops) and is supplemental to the general condition prohibiting the cooccurrence of nasality with obstruents (17).

5.1 Malay

The NASAL/LIQUID condition can be seen to play a role in a language like Malay (Kenstowicz and Kisseberth 1979) where nasality spreads from a nasal consonant to vowels and glides, but not to liquids and obstruents. Spreading over a glide (w, y) is illustrated in examples (23b,c); spreading over a laryngeal (?, h) is illustrated in examples (23d,e). The blocking effect of an obstruent is illustrated in (23a,d,f) while the blocking effect of a liquid is illustrated in (23g).

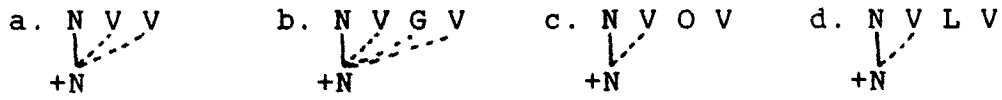
(23)

a.	/naik/	--> nãĩk	"ascend" (ultimately [nãɛ̃?])
b.	/mewah/	--> mɛ̃wãh	"to be luxurious"
c.	/mayaŋ/	--> mãỹãŋ	"stalk"
d.	/ma?ap/	--> mã?ãp	"pardon"
e.	/pənəŋahan/	--> pənə̃ŋãhãn	"central focus"
f.	/makan/	--> mɑ̃kan	"eat"
g.	/məlaraŋ/	--> mə̃laraŋ	"forbid"

Given the conditions in (22), the opacity observed to hold in a language like Malay follows straightforwardly as long as the rule of nasal assimilation applies in a local manner. Illustrated schematically, nasality can spread to vowels (24a-d) and to glides (24b); condition (17) blocks nasality from spreading to obstruents (24c) and condition (22) prevents nasality from being assigned to a liquid (24d):

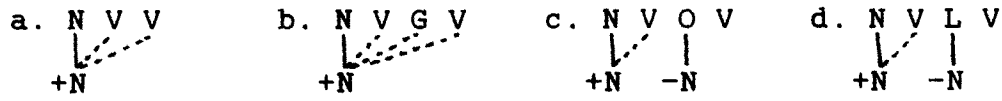
12. I adopt here the proposal for major class features made in Clements (1988) although nothing crucial depends on that choice of features provided that liquids can be distinguished from other sonorants in some way.

(24)



An alternative would be to assign the value [-nasal] to obstruents and liquids, thereby deriving opacity from the crossing condition (Goldsmith 1976):

(25)



There are problems with the prespecification approach. Liquids and obstruents do not form a natural class. As such, two rules would be required to express the generalisation that exactly those two segment classes are specified [-nasal]. Note that these two rules are not comparable to the two conditions posited in the approach using locality. Both the NASAL/SONORANT condition and the NASAL/LIQUID condition are motivated by cross-linguistic generalisations concerning the distribution of the feature value [+nasal]; neither obstruents nor liquids, however, show a marked distribution cross-linguistically with respect to the value [-nasal]. Comparable to earlier observations, the problem arises as to why it is precisely liquids and obstruents that are assigned [-nasal] since [-nasal] constitutes the unmarked value of nasality for all segments (see section 3.1.3).

6 Conclusion

I have argued in this paper that certain classes of opaque elements should be characterised as consisting of those segment-types that cross-linguistically resist bearing the feature being spread.[13] By formally relating opacity to cooccurrence restrictions on features, strong constraints are imposed on the classes of segments that can function as blockers. In particular, one can plausibly maintain the claim that opaque segment-types must be phonetically motivated.

But while it is plausible to assume the restrictive hypothesis that all opaque segment-types are phonetically motivated within an approach to opacity that combines locality with cooccurrence conditions, such a hypothesis cannot be

13. Note that I am not claiming that all opacity is of this type, nor that the only effect of cooccurrence constraints is opacity. See Archangeli and Pulleyblank (in prep) for discussion.

directly maintained within an approach based on prespecification and the crossing condition. With prespecification, it is not the case that the opaque classes bear some exclusive relation to the feature value with which they are lexically marked. Moreover, approaches based on prespecification pose a variety of problems, both conceptual and empirical.

Empirically, prespecification runs into problems in cases such as Sundanese. Cohn (in press) argues that certain segments opaque to the spread of nasality *cannot* be specified [-nasal] because their phonetic realisation as nasal or oral depends on contextual factors operating at a stage after the phonological application of nasal spreading -- the stage at which the relevant segments function as opaque.

Conceptually, prespecification raises the problem of trapping, the problem of correctly positioning a morpheme-level specification with the opaque values that are prespecified. In addition, the prespecification approach raises problems concerning the inclusion of redundant information in underlying representations. If a lexical entry includes (i) a morpheme-level specification of, for example, [+nasal], (ii) prespecified opaque values of [-nasal], as well as (iii) multiple segments unspecified for nasality, then the theory allows at least limited use of ternary power for an otherwise binary feature. Such power is not required in the conditions approach. Related to this point is the fact that a completely redundant feature like [-nasal] is being invoked as a blocker. How in such an approach does one prevent unmotivated classes from being preassigned [-nasal] (cf. Mohanan 1989)? For example, what prevents some language from preassigning [-nasal] to the class of coronal stops, or to the class of voiced fricatives? Presumably one might invoke *cooccurrence conditions* to govern the types of segments allowed to be prespecified as [-nasal] -- but the crucial point seems to be that given the appropriate *conditions*, prespecification itself is not required.

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