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Locality and the nature of nasal harmony☆

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Abstract

There is a general consensus in phonology that relations conform to a locality requirement imposing a strict adjacency condition on related entities. One pattern of nasal harmony adheres to this condition; nasality extends over a sequence of segments that may include vowels, semivowels, liquids, nasals and fricatives, and no segments can be skipped. In another pattern, locality appears to be violated, because obstruents are invariably transparent. This paper proposes a novel solution to the locality problem posed by the latter by advancing a theory in which nasality always spreads locally either at the segmental level or at the level of the heads/nucleus of syllables. The apparent skipping of obstruents arises in the second mode of spreading, a type of vowel harmony. The analysis attributes the obligatory nasalisation of sonorant consonants when harmony is the nucleus-to-nucleus type to an independent principle of Syllable Nasalisation, which is necessarily in effect when Nasal is a syllabic feature.

1. Introduction

In this article, we address the issue of locality in the context of an examination of harmony processes. We focus primarily on cases where [nasal] is the harmonic feature. Piggott (1992) identifies two types of nasal harmony. In one variety, called Type A, spreading is always blocked by some segment, while the process in the

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other variety, called Type B, is never blocked. Moreover, obstruent stops and fricatives appear to be skipped in the latter. The basic claim we make in this article is that strict locality as a property of phonological relations forces us to recognise two fundamentally different ways in which the nasal element is distributed in the two types of harmony. Developing an idea in Humbert (1995), we claim that the Type A pattern involves spreading at the level of segmental positions, whereas in the other variety spreading is local at the level of syllable heads. Type B, then, is essentially a form of vowel harmony, explaining why it can skip obstruents in apparent violation of strict locality.

2. Locality

Considered from an abstract point of view, many linguistic generalisations (rules, conditions) take the form of establishing a kind of identity relation between two units in a representation.

(1) ... A..... B...
        | |
        ———

In syntax, semantics, morphology and phonology, there has been a general assumption that such relations are subject to a form of locality which essentially states that A and B must be adjacent, i.e. that no unit C may intervene between A and B. In phonology, we encounter locality in the form of a condition on autosegmental spreading. If some feature F is said to spread from one node A to another node B, or, to state this in less dynamic terms, if some feature F is associated to both A and B, no other segment C may intervene between A and B. Hence, (2a) is well-formed, but (2b) is not, if A, C and B are the same type of elements.

(2) a. *Licit*

```
    F
  / | \
 A C  B
```

b. *Illicit*

```
   *F
  /  \
 A C  B
```

This specific instance of locality has been termed the condition against discontinuous association (Archangeli and Pulleyblank, 1987, 1994; van der Hulst and Smith, 1986).

Many cases of multiple association are indeed local in the sense of (2a), notably those instances of assimilation in which two (or more) strictly adjacent segments share elements like place or voice. For example, homorganicity, the sharing of all place elements, is a very common relation in nasal-obstruent sequences, but it never holds when the nasals and obstruents are separated by vowels. Thus, such a relation is local in the sense that multiple association holds between strictly adjacent segments.

While many phonological relations obey this form of locality, there are also cases of feature sharing that appear to violate the locality condition, the most familiar examples being the vowel harmony patterns. These systems show that locality cannot be defined with reference to the segmental level (or root nodes) only; vowel harmony must be expressed in a manner that permits consonants to be ignored. We will sketch a way in which locality in relation to such a phenomenon can be defined and then turn to some apparent problem cases where vowel harmony seems to ignore certain vowels. We feel that going over these cases serves the additional purpose of forcing reconsideration of why they constitute a serious threat to locality. In the recent literature, the toughness of these cases has been taking as decisive on the status of the locality condition, leading various phonologists to reject it as an absolute constraint on representations. Instead, locality is viewed as a constraint that can be violated on a language-particular and construction-particular basis (see, for example, Cole and Kisseberth, 1994a). We will not have time to discuss all of the problematic cases of unexpected vowel transparency in this paper, but we ourselves are not convinced that the time has come to give up the absoluteness of locality. We will suggest the type of alternative analyses that must be thoroughly investigated, before we abandon the more restrictive theory that maintains the universality of the locality condition. We then turn our attention the central topic, nasal harmony, and demonstrate that the type in which the feature [nasal] appears to spread across obstruents without affecting them does not constitute a problem for locality, if it is analysed as fundamentally a vowel harmony system.

3. Locality in vowel harmony systems

In the prototypical case of vowel harmony, all vowels within some domain (usually the word) must agree in the presence or absence of some property, for example frontness, roundness or ATRness. Usually, in systems of this type, except for coarticulation effects, consonants may intervene between the vowels without being affected by the process. We also know of cases where intervening consonants may block or trigger a harmonic process, but this is a consequence of these consonants having a vocalic secondary articulation or of a separate local relation holding between a consonant and an adjacent vowel. In Turkish, for example, stems containing a back vowel in the last syllable may acquire suffixes with front vowels, when the stem-final consonant is (underlyingly) palatal (Clements and Sezer, 1982; Van der Hulst and Van der Weijer, 1991). Such cases of consonantal interference, however we deal with them, do not constitute violations of locality at the level where vowels must be targets, since no vowel is being skipped.

To deal with the problem of intervening consonants, the harmony rules of SPE-type phonology (Chomsky and Halle, 1968; Odden, 1977) have to contain variables and complicated restrictions on what these variables may stand for. The following is a typical statement.

(3) $V \rightarrow [\text{round}] / \begin{matrix} V \\ [\text{round}] \end{matrix} X —$

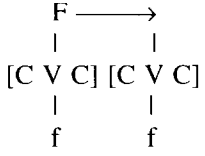
(Where X may contain any number of C's but not another V)

An alternative to (3) in linear models is to identify the potential intervening entities directly in the rule.

(4) $V \rightarrow [\text{round}] / \begin{matrix} V \\ [\text{round}] \end{matrix} C_0 —$

The notation 'C_0' is interpreted as meaning 'any number of consonants'. One can infer from this reading that consonants are really of no relevance. Consequently, any reference to consonants in the rule misses the point of what vowel harmony is; it is fundamentally a relation between vowel positions.

With the rise of non-linear (or rather multi-linear) models of phonology, reference to variables or irrelevant intervening material in rules became unnecessary. In fact, the elimination of variables like those in (3) and (4) has often been put forward as one of the basic reasons for rejecting uni-linearity. Van der Hulst and Van der Weijer (1995) identify two ways of describing vowel harmony as a local phenomenon in the non-linear model. The first relies on the adoption of syllabic constituent structure and the second makes crucial use of a segment-internal hierarchical representation of features. Vowel harmony is described in the first approach as a relation between syllable nuclei or heads, but the harmonic feature is realised on the vowels, the occupants of head positions.[1] Such an account is captured in the following schema, where V represents the syllable nucleus/head and syllable boundaries are marked by square brackets. In this illustration, F represents the abstract association of the harmonic feature F with the syllable head, and the lower case is the phonetic instantiation of this feature as a property of segments.

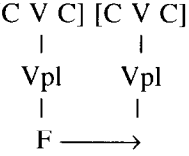
(5)


An equivalent description in terms of moraic theory has also been proposed (Archangeli and Pulleyblank, 1994; Pulleyblank, 1994).

In the second approach to the problem of the transparency of consonants in vowel harmony, a model of feature organisation which groups features into a constituent structure is assumed. The constituents in this models, often referred to as feature geometry, represent the classes to which the features belong. In one version of this

[1] An explicit head-based theory of syllable structure is proposed in Anderson and Ewen (1987), Levin (1985) and Van der Hulst (in prep.).

model, the place features of vowels are organised as dependents of a special class node, the V-Place (Vpl) node, which is usually not present in the structure of consonants (Clements and Hume, 1995). Vowel harmony can, therefore, be characterised as a relation between V-Place nodes.

(6)


The feature-geometric and syllable-head approaches to vowel harmony have the same implications for the locality of the process. However, the latter is adopted in this article, because it is based on properties and relations that are motivated independently of their role in harmony. For many (perhaps, most) phonologists, phonotactic restrictions are often expressed in terms of syllable constituency, and all theories of syllable structure recognise vowels as the central segments within syllables. In addition, it is generally accepted that many morphological, syntactic and semantic phenomena can be explained in terms of relations between heads of constituents. We, therefore, opt for the syllable-head approach to vowel harmony and add to the strength of the arguments that support it by showing how it improves on our understanding of nasal harmony. In adopting this view of vowel harmony, we do not deny the possibility that the place features of consonants and vowels are organised under different nodes in a feature geometry.

Certain vowel harmony patterns present a more serious problem than consonant transparency for the locality condition. The problem is posed by the behaviour of so-called neutral vowels. These are vowels that cannot fully participate in the harmonic process because they do not have harmonic counterparts in the vowel system.[2] One of the manifestations of this neutrality is that harmony may appear to skip a vowel. The harmony patterns in Finnish and Wolof are characterised by this type of transparency. Finnish is generally considered to have a harmony pattern in which vowels agree for backness/frontness. Nevertheless, syllables containing the high, front vowel /i/ may occur between syllables with harmonizing vowels (data reproduced from Van der Hulst and Van der Weijer, 1995).

(7) *Finnish Front/Back Harmony*

a.	værttinæ	'spinning wheel'
	værttinæ-llæ-ni-hæn	'with spinning wheel, as you know'
b.	palttina	'linen cloth'
	palttina-lla-ni-han	'with linen cloth, as you know'

[2] Vowels may lack a harmonic counterpart absolutely (e.g. /i/ in Hungarian), contextually (e.g. /a/ in Turkish) or lexically as represented by the occurrence of disharmonic morphemes.

In Wolof (Ka, 1988; Pulleyblank, 1994) where vowels harmonise for ATRness, the application of the process to non-high vowels seems to ignore the presence of an intervening high vowel.

(8) *Wolof ATR Harmony*

a.	tɛkki-lɛɛn	'untie!'
	sɔppiwu-lɛɛn	'you have not changed'
b.	lettu-leen	'breaid hair'
	toxi-leen	'go and smoke!'

The observation that certain vowels are neutral to vowel harmony does not necessarily signify that we must give up the idea that locality is a universal condition on phonological relations. Before we reach such a conclusion, we must consider the phonological status of the neutral vowels in the particular grammar and determine that there is no analysis of the harmony pattern which is consistent with the locality condition. The Finnish case can be used to illustrate the problem and show a type of solution that must be considered. This language contains the following underlying vowels.

(9) *Finnish Vowels*

Front	*Back*
i ü	u
e ö	o
æ	a

When we consider these vowels as entities in a harmonic system which enforces agreement for backness/frontness, we see that there are three harmonic pairs (10a) and two vowels (i.e. /i/, /e/) which stand out because they do not have back counterparts (10b).

(10) a. *Harmonic Pairs*

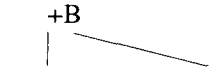
Front	*Back*
ü	u
ö	o
æ	a

b. *Neutral Vowels*

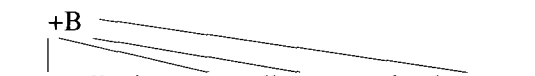
Front
i
e

Returning, now, to the data in (7a), we note that the first stem contains all front vowels and affixes following this stem also have front vowels. In contrast, we see in the second stem that the front vowel /i/ can occur between back vowels. More significantly, the vowel of the last suffix *han* appears to harmonise with the back vowels of the stem, ignoring the front vowel in the intervening suffix *ni*. Thus, it seems as if the vowel /i/ is skipped, thereby appearing to create the pattern of discontinuous association illustrated in (11).

(11) a.



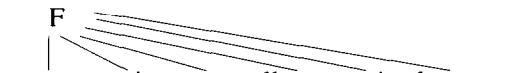
b.



Cases of this type present a different problem for locality from the one posed by consonants, because a segment that should be visible at the relevant level seems to be ignored.

A solution to the Finnish problem is offered by van der Hulst and Smith (1986). Their analysis builds on the idea from Dependency Phonology (DP) (Anderson and Ewen, 1987) that phonological features are unary. This means that in any kind of opposition one member does not have the status of an autonomous entity but is interpreted as the absence of the property that the other member has. This can be identified as *the active property* of an opposition. If it is assumed that in the front-back dimension *frontness* is the active property, whereas *backness* is simply the absence of [front], the picture in (11) changes radically. Feature spreading is now represented as in (12a), while the equivalent of (11a) and (11b) are (12b) and (12c), respectively.

(12) a.



b. palttina
c. palttina-lla-ni-han

In this alternative account of Finnish front-back harmony, the vowel /i/ in (12a) is not transparent but bears the compatible harmonic feature [front]. In contrast, there is no harmony (i.e. no feature spreading) in (12b, c). The vowel /i/ which appears in the latter acquires frontness (perhaps, at the phonetic level), because this is a redundant property of such a vowel in the Finnish vowel system. In this analysis of the front-back harmony pattern, there is no spreading of [back] across /i/, and, hence, no violation of the locality condition. An alternative account of the occurrence of the feature [front] in (12b, c) might assume that this feature is an underlying property of /i/ but that such a feature, being non-contrastive or redundant, is inert and cannot be harmonic.[3]

In Wolof, the vowels /i/ and /u/ are neutral. On the assumption that [ATR] is the active property, the examples in (7bi) involve no spreading, whereas [ATR] spreads in (7bii) to all vowels, including the neutral /i/ and /u/. Wolof, then, behaves like Finnish in some respect.

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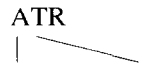
[3] We are not concerned here with the details of how to represent /i/ nor with the fact that /i/'s sometimes may require following vowels to be front. Although these are interesting issues, the behaviour of /i/ does not create a problem for locality, when [front] is considered to be the harmonic feature.

Van der Hulst and Smith (1986) and Van der Hulst (1988) take the very strong position that there are really no transparent vowels in the sense that, for some reason, these are unable to bear a harmonic feature and are skipped by the harmony process. In their approach, a vowel will block harmony, if it cannot be associated with the harmonic feature. They predict the occurrence of such opacity in languages in which non-ATR /a/ is the sole underlying low vowel. When ATR is the harmonic feature, we expect to find harmonic relations like that in (13a) rather than the one in (13b).

(13) a. *Opacity*

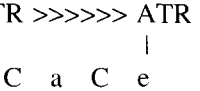
*b. *Transparency*



In this approach, the association of ATR to the low vowel is prohibited by a feature cooccurrence restriction, banning low, ATR vowels. Such a restriction would combine with the locality condition to prevent the relation in (13b) where ATR is shared by vowels preceding and following /a/.

Our assumption that the locality condition is absolute leads us to reject the possibility of attributing a harmonic effect to feature copying (Archangeli and Pulleyblank, 1994).

(14)



Copying (depicted by '>>>') results in a representation that respects the condition against discontinuous association, but it is obvious that the copying operation itself (or, in non-derivational terms, the identity relation between the two instances of ATR) is non-local. The strict interpretation of locality also rules out the possibility that a representation like (14) can result from epenthesis of an feature to satisfy some constraint (cf. Pulleyblank, 1994).

We are aware of instances of vowel harmony in which vowels appear to be skipped, given assumptions about what the harmonic features are (cf. Van der Hulst, 1988). The best-known example is that of labial/round harmony in Khalka Mongolian, where a non-rounded vowel /i/ seems to be invisible to labial spreading. Another case might be a pattern of Tongue Root Harmony in Tungusic languages as analysed by Bing (1996). According to this analysis, RTR is the spreading element and non-RTR /i/ and /u/ are skipped. In both cases, skipping is unexpected because the neutral vowel does not bear the active, spreading feature. At present, we cannot offer solutions to these problematic cases, but we tentatively suggest an approach in the concluding section of this article. The difficulty of such cases does not automatically entail that the locality condition is a language-particular option.

In our analysis of nasal harmony in the next section, we maintain the more restrictive position that locality is an inviolable condition on phonological relations. First, we review how nasal harmony patterns are manifested. This is followed by the out-

line of an analysis which satisfies the locality condition and which also accounts fully for the difference between Type A and Type B harmonies. The section concludes with an evaluation of the merits of the new description of Type B harmony as fundamentally vowel harmony over the alternative feature-geometric account of Piggott (1992).

4. Locality in nasal harmony

As we point out in the introduction, Piggott (1992) groups nasal harmony patterns into two types, called Type A and Type B. Type A harmony causes nasalisation of sequences of segments that always includes vowels and may also include semivowels, liquids and fricatives, but the process is invariably arrested by some supraglottally articulated segment. Within a span of nasalised segments, the only non-nasal segment that may occur is a glottal stop; all other segments, including /h/, must bear nasality. Piggott argues that the occurrence of a glottal stop in such a span does not constitute evidence of transparency, because, if is a phonological target of nasal spreading, it would invariably surface as non-nasal segments for purely phonetic reasons. The analysis proposed in the present article ignores the behaviour of laryngeals; these segments are adequately dealt with in Piggott (1992).

With regard to the locality condition, Type A harmonies are unproblematic. Type B, on the other hand, presents a different picture. In the latter pattern, harmony always targets sonorants and is not arrested by any segment.[4] Obstruents are invariably transparent. The segments bearing nasality in Type B harmony are, therefore, not necessarily adjacent.

4.1. Patterns of nasal harmony

The following data sets illustrate how nasality is manifested in the attested Type A harmonies.

(15) a. *Sundanese:*

ɲãĩãn	'wet'	mõlohok	'stare'
mĩʔãsih	'love'	mãro	'halve'
mãwur	'spread'	ɲãtur	'arrange'

b. *Malay*

mãỹãn	'stalk'	mõlaran	'forbid'
mẽw̃ãñ	'be luxurious'	mãkan	'eat'
mãʔãp	'pardon'		

[4] This claim does not mean that nasalisation is never blocked in languages that manifest the Type B pattern. In Section 5.1, we explain how blocking can occur in such a pattern.

c. *Warao:*

mõỹõ	'cormorant'	tewẽke	'kind of bird'
nãõ	'come'	nãõte	'he will come'
nãõỹã	'he comes'	mẽh̃õkohi	'shadow'
yã	'walking'	yãte	'he will walk'
yããẽ	'he walked'	tãẽ	'it fell'

d. *Urhobo:*

bẽĩ(n)	'be full'	iRĩr̃ĩ(n	'nine'
õw̃ẽĩ(n)	'bite'	oRw̃ẽ(n)	'hunter'
ỹãr̃ĩ(n)	'shake'	evũ(n)	'belly'

e. *Applecross Gaelic:*

f̃r̃ĩã:ṽ	'root'	str̃ãĩ:ỹ	'string'
kʰɔ̃ĩ̃špaxk	'wasp'		

Malay and Warao illustrate the same subtype. The two cases differ in that Malay nasal spreading requires the presence of a nasal consonant, whereas Warao has distinctive nasal vowels that trigger the process. Those aspects of the above data sets which are relevant to the analysis of harmony are summarised in the following table.

(16)

Targets segments	Opaque segments	Transparent	Language
vowels,	stops, fricatives, liquids, semivowels	–	Sundanese
vowels, semivowels	stops, fricatives, liquids	–	Malay, Warao
vowels, semivowels, liquids	stops, fricatives	–	Urhobo
vowels, semivowels, liquids, fricatives	stops	–	Applecross Gaelic

While Type A has a number of subpatterns, the manifestation of nasalisation in Type B pattern is less variable. The Barasano data in (17) reflect the typical features of this pattern.[5] The two columns of forms in (17ii) are included to show that the direction of harmony is rightward in this language.

[5] The Barasano data from Smith and Smith (1971) are supplemented by material from Jones and Jones (1991).

(17) *Barasano:*

a. *Nasal words*		b. *Oral words*	
i. mãhãɲĩ	'comer'	^{m}baŋgo	'eater'
mãnõ	'none'	ta^{m}boti	'grass'
eonõ	'mirror'	^{n}diro	'fly'
mãsã	'people'	wesika	'above'
w̃ãtĩ	'demon'	wati	'going'
kãmõkã	'rattle'	hikori	'tail'
ii. mãhã-mã	'go up!'	wa-^{m}ba	'come!'
mãsɨ̃-w̃ɨ̃	'I knew'	ʔoha-wɨ	'I wrote'
hũnẽ-nẽ	'to hurt[	yi-re	'to say'
mĩnõ-ɲã	'leaf stream'	ŋgahe-ya	'another stream'
yikõã-mɨ̃	'I did completely'	wa-^{m}bɨ	'I went'

A table that displays the salient features of Type B harmony is fairly simple.

(18) Targets	Opaque segments	Transparent segments	Language
sonorants	–	obstruents	Barasano

Languages like Barasano with Type B harmony have words in which all segments except for obstruents are nasal (17a). A second characteristic is the appearance of prenasalised stops in words in which segments are otherwise oral (17b). The prenasalised stops sometimes vary freely with plain voiced stops (e.g. *ta^{m}boti/taboti* 'grass'). Rice (1993) maintains that these stops are best analysed as oral sonorants, and Piggott (1992, 1995) contends that the prenasalisation and voicing are entirely epiphenomenal, a phonetic manifestation of sonorancy. The prenasalised voiced stop that may appear in oral words is, therefore, phonologically an oral segment, contrastive with the voiceless obstruents.

In the next section, we explain how the facts of Type A and Type B harmonies can be reconciled with the demands of the locality condition. Although we will focus only on the progressive harmonies, our analysis can be readily extended to regressive harmonies such as those found in Capanahua (Type A) and Guarani (Type B).

4.2. Capturing the difference between Type A and Type B harmonies

In Type A harmony, there is no discontinuity in the association of the feature [nasal] to segments. The patterns can be depicted by means of conventional autosegmental representations like the following.

(19) a. *Warao*

i. m ẽ h̃ õ k o h i ii. y ã ã ẽ


b. *Applecross Gaelic*

i. k^h ɔ̃ ĩ s̃ p a x k ii. f̃ r̃ ĩ ã: ṽ


Prima facie, Type A harmony is a relation between segments. It is usually attributed to a process which spreads [nasal] from segment to segment, until it is blocked by a segment which cannot bear the feature.

Two types of explanations for the opacity or blocking power of a segment are encountered in the literature. Some analyses attribute opacity to the presence of the spreading element in the representation of the opaque segment (cf. Piggott, 1988, 1992). In other words, spreading is arrested when the process encounters a segment that bears the harmonic feature. The flaw in such an explanation is that the evidence indicating that the opaque segment bears the harmonic feature is often the same as the evidence that it blocks harmony. Hence, there is obvious circularity in argumentation. An alternative proposal claims that spreading is blocked by a segment that cannot bear the harmonic feature (cf. Van der Hulst and Smith, 1986; Van der Hulst, 1988; Pulleyblank, 1989). This proposal is rescued from circularity by giving feature cooccurrence restrictions a phonetic grounding (Archangeli and Pulleyblank, 1994).

Walker (1944) develops the second approach in her account of opacity in Type A nasal harmony. She observes that segments which are subject to nasalisation in Type A harmony can be ranked on a scale which is correlated with the familiar sonority scale. The implication is that the more sonorant a segment, the more likely it is to undergo nasalisation. Obstruent stops, being the least sonorant, are the most resistant to nasalisation, while vowels, being the most sonorant, are most likely to be nasalised.

(20) *The Nasalisability Hierarchy*[6]
Vowels >> Semivowels >> Liquids >> Fricatives >> stops

Walker, then, proposes that languages may choose to prohibit nasalisation of a particular segment-type, but the effect of the choice is controlled by the hierarchy; a ban on the nasalisation of one type entails a ban on nasalisation of all segments with lower sonority. For example, the prohibition of nasalised liquids entails that neither liquids nor obstruents can be nasalised.

The link between the nasalisability of a segment and its sonority has an interesting pay-off. From it, Walker derives an explanation for the fact that obstruent stops

[6] Pulleyblank (1989) also introduces the idea of hierarchical effects in determining the targets of nasal spreading. Walker's hierarchy does not include nasal consonants. Presumably, this is an implicit recognition of the fact that [nasal] is never incompatible with a sonorant stop.

are always among the opaque segments in Type A harmony. The explanation emerges from the interesting hypothesis that segments must have some minimum sonority to bear the feature [nasal]. Obstruent stops, the lowest segments on the sonority scale, are assumed to have no sonority at all and, therefore, can never be specified as [nasal]. Consequently, these segments will always block segment-to-segment nasal spreading.

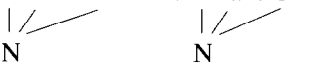
Walker's description of the opacity of segments to nasal harmony is expressed in terms of Optimality Theory (Prince and Smolensky, 1993), but, for our purpose, it is only necessary to assume that grammars can be regulated by devices which prohibit the cooccurrence of certain features. In a theory absolutely constrained by the locality condition, feature cooccurrence restrictions must result in segmental opacity, when harmony is a relation between segments. Therefore, the following types of representation should not be possible in any language and, indeed, have never been systematically encountered.

(21) a. m ã w ũ r b. m ã r õ

In a language that prohibits the nasalisation of semivowels and, derivatively, all other consonants, only vowels would be targeted by nasal spreading, but the process could not skip any consonant to reach a potential target.

The theory that prohibits the representations in (21) makes it impossible to attribute nasal harmony in a language like Barasano to the same relation that underlies harmony in a language like Sundanese. In Barasano, whenever a nasal vowel precedes an obstruent, a vowel following this segment must be nasal. This is an indication that, although obstruents cannot be nasalised, they cannot arrest the spreading of nasality. Therefore, segment-to-segment spreading cannot be responsible for the distribution of nasality in words like *māsã* 'people' and *w̃ãtĩ* 'demon'. Whatever device rules out the unattested skipping patterns in (21) should prohibit those in (22).

(22) a. m ã s ã b. w̃ ã t ĩ

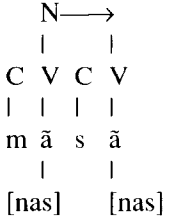


An analysis which argues that voiceless obstruents are targets of nasal spreading but simply fail to manifest nasality because of phonetic incompatibility would undermine the idea that incompatibility results in opacity, as argued above and elsewhere (e.g. Van der Hulst and Smith, 1986; Van der Hulst, 1988). In addition, if stops are targets, fricatives would have to be targets too. Yet, fricatives fail to nasalise in Barasano (as they do in Applecross Gaelic).

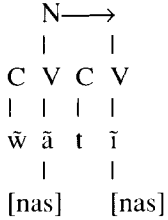
While harmony as a relation between segments does not appear to allow for any instance of segmental transparency, we know that consonants are skipped in vowel harmony. Consonant transparency is an automatic consequence of an analysis of vowel harmony as a relation between syllable heads. The option of analysing nasal

harmony as this type of relation (Humbert, 1995: 143) is extended to Type B harmony, resulting in the representations in (23) below as alternatives to the illicit ones in (22).

(23) a.



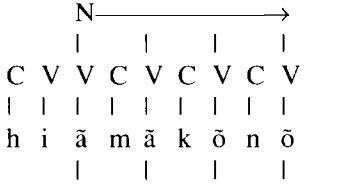
b.



The representations in (23) obey the locality condition, since the elements that are the targets of the spreading feature, the syllable heads, are adjacent at the appropriate level. The presence of nasality on non-adjacent vowels is simply a consequence of the fact that these segments occupy head positions.

The Barasano words in (23) are from the group in which all sonorants bear nasality. In the standard analysis of such cases, the harmonic feature is underlyingly a morphemic feature in the sense that it a lexical property of an entire morpheme rather than of a particular segment (see Piggott, 1992). But head-to-head spreading can also be initiated by a segmentally-affiliated feature. The distribution of nasality in the disharmonic word *hiãmãkõnõ* 'ten' requires that the first nasal vowel bear the harmonic feature underlyingly. In such a case, nasal harmony is no different from a vowel harmony pattern initiated by a feature which is lexically-linked to one of the vowels of a root or affix.[7] Any analysis that treats vowel harmony or nasal harmony as a relation between syllabic constituents assumes that the harmonic feature can be projected from a segment. The harmony in the word *hiãmãkõnõ* can, therefore, be readily attributed to a head-to-head relation rather than a segment-to-segment one.

(24)



The analysis of nasal harmony in Barasano as a relation between syllable heads explains why consonants never block the process. However, this story is either incorrect or incomplete, because it predicts that every consonant is transparent. This prediction is clearly false. In nasal harmony systems that lack opaque segments, while obstruents are always among the transparent segments, sonorant consonants are

[7] An example is the Hungarian word *sofför-nek* (**sofför-nak*) where the harmonic feature Front is lexically associated with the second root vowel.

always nasalised. Consequently, the vowel harmony hypothesis can be maintained only if it can be supplemented by a principled explanation for the nasalisation of sonorant consonants. In other words, it must be demonstrated that the mechanism responsible for vowel nasalisation is different from the one which produces nasalised sonorant consonants and that the latter necessarily cooccurs with the former.

The evidence for the distinction between the two sources of nasalisation is, actually, quite robust. In Barasano as in all languages with Type B harmony, nasalised approximants (i.e. liquids and semivowels) are always followed by nasal vowels and their oral counterparts must be followed by oral vowels. This complementarity extends to the distribution of fully nasal consonants and their oral counterparts, the prenasalised contours.[8] For example, in Barasano, where harmony is demonstrably rightward, the following are among the possible disharmonic words.

(25) a. rimã 'poison'
b. romĩõ 'woman'
c. yi-mã 'they say'
d. tu^{n}di-amĩ 'he returns'
e. hati-amĩ 'he sneezes'

In contrast, there are no disharmonic words with shapes like those in (26) where a nasal vowel is preceded by an oral approximant or a nasal contour.

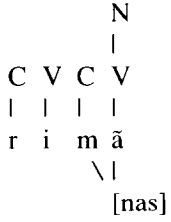
(26) a. *tu^{n}dĩ
b. *ti^{m}bã
c. *wãtĩ
d. *yurã

The observation about the occurrence of nasality in Barasano sonorants can be restated as follows. Although harmony in the language is progressive, sonorants to the left of a nasal vowel cannot be oral.

The absence of words with shapes like those (26) and the occurrence of the patterns in (25) point to the operation of some process/constraint which is independent of the progressive harmony itself. It must force sonorant to agree with the nasality of a following nasal vowel. Since this obligatory leftward nasalisation of sonorant consonants is obviously bounded by the syllable, we will refer to it as Syllable Nasalisation. However it is formulated, it must provide for the transmission of the feature [nasal] from a vowel to a preceding onset sonorant in Barasano words. For the moment, we represent the result of the process as feature-sharing between segments (27).

[8] Piggott (1992) argues, on the basis of the evidence from the complementary distribution of the nasal and its prenasal counterpart, that the underlying segment must be an oral sonorant stop.

(27)



We now propose that Syllable Nasalisation is the source of nasals and nasalised approximants in Barasano, while vowel harmony is responsible for vowel nasalisation. The representations in (28), reflecting the results of the two processes, fill in the parts which are missing from the picture in (23).

(28) a.

b.

The coincidence of Syllable Nasalisation and vowel harmony creates the illusion that nasalisation in the Type B pattern should be treated as a unified phenomenon.

Strong evidence for the independence of Syllable Nasalisation is found in a number of languages which do not manifest the long distance nasalisation characteristic of the Type B pattern. These languages include Yoruba (Pulleyblank, 1988), Isekiri (Omamor, 1979), Jukun (Welmers, 1973), Gbe (Capo, 1981) and Kaingang (Wiesemann, 1972; Piggott, 1995). In each case, nasalisation is limited to a syllable domain and affects only vowels and sonorant consonants. We will briefly discuss the Kaingang pattern, because it shows that Syllable Nasalisation affects both onset and coda segments. To illustrate the pattern, we start with the observation that this language has underlying nasal vowels. In data like the following, there is no other source for the nasality. Syllables with either oral or nasal vowels appear freely in Kaingang words.

(29)

a.	kutæ̃	'fall'	d.	kãtə	'guts'
b.	hapæ̃	'good'	e.	ʔæ̃pɾɨ	'road'
c.	tiỹõ	'his anger'	f.	ỹãra	'spit'

Kaingang has open (C(C)V) and closed (C(C)VC) syllables, but coda consonants are restricted to sonorant stops. With certain systematic exceptions (see Piggott (1995) for discussion), when a syllable contains a nasal vowel, sonorants in onset and/or coda positions must be nasal or nasalised.

(30) *Kaingang Nasalisation*

a. *C(C)V Syllables*		b. *C(C)VC Syllables*	
mãrɛru	'yellow'	põn	'burn'
r̃ə̃mæ̃	'warm'	nĩm	'dare'
mr̃æ̃ỹæ̃	'ashes'	ŋãm	'break'
nã	'lie'	tãŋ	'new'
ŋãr̃ã	'corn'	ỹæ̃nkɨ	'mouth'
r̃ã	'sun	hõmti	'bee'
ỹãtõ	'dull'	mə̃nyɔka	'yucca'
kur̃ã	'day'	r̃ãŋɸɔrɔ	'straight'

Notice that the occurrence of words like *ŋãr̃ã* 'corn' and *ỹãtõ* 'dull cannot be taken as evidence of long distance nasal spreading in Kaingang. Such a process would not allow for the contrast between *ỹãra* 'spit' and *kur̃ã* 'day'.

Sonorants in onset and/or coda positions have different profiles from those shown in (30), when they are tautosyllabic with oral vowels; they are either fully oral approximants or nasal contours. The contours are prenasalised in onset position and postnasalised as codas.[9]

(31) a. *C(C)V Syllables*		b. *C(C)VC Syllables*	
^{m}ba	'carrying'	kib^{m}	'cut'
^{m}bro	'float'	tɛd^{n}	'kill'
^{n}da	'arrow'	^{m}bɛd^{n}	'husband'
^{ŋ}ga	'earth'	^{ŋ}gɔg^{ŋ}	'cloud'
ra	'toward'	yɔg^{ŋ}	'father'
kara	'all'	wɨd^{n}	'carry'
^{ŋ}goyo	'water'	yɔg^{ŋ}y^{ɔ}	'parrot'

The analysis that best accounts for the postnasalised and prenasalised contours in Kaingang considers them to be contextually-determined manifestations of non-nasal sonorant stops (Piggott, 1992, 1995). They are phonologically the oral counterparts of fully nasal stops.

A syllable nasalisation process which causes all sonorants in a syllable to agree for nasality accounts for the nasalisation of sonorant consonants in both Kaingang and Barasano. However, there is no explanation for why the nasalisation of sonorant consonants is not just a language-particular option in Type B harmony. In other words, the analysis of Type B nasal harmony as vowel harmony leaves unexplained why there is no pattern in which vowels are nasalised, while both sonorant and obstruent consonants are skipped. We now offer a solution to this problem.

Consider, again, the distribution of nasality in Kaingang. The guiding assumption in our analysis is that, when a syllable contains a nasal vowel, all nasalisable seg-

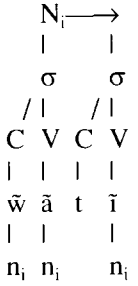
[9] A voiceless unreleased stop appears instead of the expected contour in some contexts (see Wiesemann, 1972; Piggott, 1995).

ments in that syllable must be nasalised. This would be the expected outcome, if the feature [nasal] is a property of the syllable in this language. Our proposal, then, is that Syllable Nasalisation is not a process which spreads [nasal] from a vowel to an adjacent consonant; it is a consequence of the association of the feature with the syllable itself. In a sense, Kaingang segments inherit nasality from the syllable which contains them. This analysis of how nasalisation can occur explains why sonorant consonants must be nasalised in languages with Type B harmony.

Our analysis considers Type B nasal harmony to be a relation between syllable heads. The harmonic feature is, therefore, a property of the nucleus or head of the syllable. It is a fundamental principle of linguistic structure that the properties of the head of a construction are simultaneously the properties of the entire construction.[10] Consequently, when [nasal] is associated with the head or nucleus of a syllable, it is automatically a feature of the syllable itself. It should, therefore, be realised on all the segments in the syllable that can be nasal-bearing. This description of the source of nasality in the surface representation of Barasano consonants means that the representations in (27) and (28) are potentially misleading. They leave the impression that the nasalisation results from a segment-to-segment process of feature transmission. More appropriate representations are those in (32a, b) below, where **N** identifies the harmonic feature and lower case **n** its instantiation.

(32) a.

b.



In the above structures, each realisation of [nasal] is treated as an inheritance from the syllable itself. There is no direct relation between one instance of this feature as a segmental property and another.

Nasalisation in both Barasano and Kaingang must distinguish between sonorants and obstruents, since only the former are affected. Two proposals in the phonological literature distinguishes [nasal] as a constituent of a sonorant from the same feature as a property of an obstruent. Let us consider each proposal in turn. According to Piggott (1992), the feature [nasal] is organised in a feature-geometric model as a dependent of a node, abbreviated as SV; this node is present in sonorants but not in obstruents.[11] From such a perspective, the representations in (33) are better illustrations of how [nasal] is organised than those in (32).

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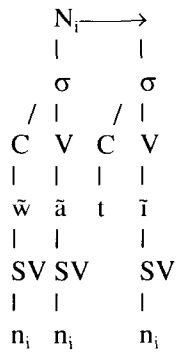
[10] This is, of course, what is captured by the X-bar theory of phrase structure.

[11] Rice (1993) makes a similar proposal, although there are minor differences in details.

(33) a.

b.



The structural difference between sonorants and obstruents is obvious in the above. Nasalised obstruents (i.e. fricatives) do occur in some Type A languages (e.g. Applecross Gaelic), but for Type B harmony to produce such an output, the inherited feature would have to be associated with some node other than SV.

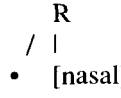
Let us turn to the second proposal that distinguishes between sonorant and obstruent nasalisation. It is developed in the model of Dependency Phonology which assumes that head-dependent relations are fundamental properties of linguistic structure (Anderson and Ewen, 1987). Representations must, therefore, show whether a particular feature is in a head or a dependent position. Following recent elaborations of the DP model (Humbert, 1995; Van der Hulst, 1995), we can encode the head/dependent status of features roughly as indicated in (34), where R is the familiar Root node of the feature-geometric model.

(34) a. *Head Feature (F)*

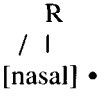
b. *Dependent Feature (F)*

The status of a feature F as a head or dependent element is correlated with different segment-types. In Humbert's representation of nasality, the element which is the equivalent of the feature [nasal] is in a dependent position when it expresses the nasalisation of a fricative, but it is in a head position for nasalised sonorants.

(35) a. *Nasal/Nasalised Sonorant*



b. *Nasalised Obstruent*



What is important in the above configurations is the syntagmatic relation of head-dependency and not the 'mother-daughter' relation that feature-geometric models appeal to.

The DP model and feature-geometry evidently agree that the difference between nasalised sonorants and obstruents should be expressed as a difference in dependency relation, although they differ in how the relation is defined. Given the necessity for such a distinction, we attribute the transparency of obstruents to nasalisation in languages like Barasano and Kaingang to a principle we call the Consistency of Dependency Relations (CDR).

(36) *Consistency of Dependency Relations (CDR)*
Every occurrence of an inherited feature must manifest the same dependency relation.

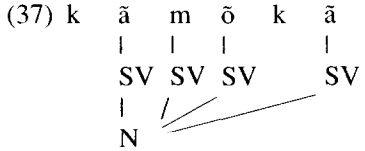
We assume that, when [nasal] is a property of syllable heads and syllables, it must appear on vowels, because these segments occupy head positions. CDR, construed in DP terms, then requires the feature to maintain a head position in all its manifestations. The same constraint, considered in feature-geometric terms, demands that [nasal] be consistently dominated by the SV node. The evidence from Type B harmony does not help us to choose between the alternative models, but it is not crucial that we do so.

CDR can control the realisation of the feature [nasal] in languages with Type B harmony, because the feature is associated with a suprasegmental category. Important evidence that [nasal] is a suprasegmental feature in languages with Type B harmony is the obligatory agreement for nasality between tautosyllabic sonorants. This agreement is not expected to show up in a Type A pattern and, as far as we are aware, it does not. In Warao (15c), an oral sonorant consonant can be followed in the same syllable by a nasal vowel (e.g. *yā* 'walking', *yāte* 'he will walk'). More significantly, there is no known language which is like Warao in that harmony is arrested by obstruents, but the tautosyllabic sonorants must agree for nasality.

Since [nasal] is not a syllabic feature in Type A harmony, nasalisation does not have to be restricted to sonorants. It can affect a heterogenous group consisting of voiced and voiceless fricatives, liquids, semivowels and vowels. From the perspective of the DP model, the nasalisation of these segments is represented by the adjunction of [nasal] to the root node in the manner illustrated in (34b).

The analysis of Type B nasal harmony as a type of vowel harmony resolves the problem of the transparency of obstruents, while maintaining the locality condition in its strongest form. However, the account by Piggott (1992) also appears to successfully circumvent the locality problem. Type B is the latter account is a process which spreads the feature [nasal] between adjacent SV nodes as illustrated in (37).

(37)



Obstruents must be skipped by such a spreading process, but the transmission of nasality is locally constrained.

The description in (37) overcomes the locality problem, but for Barasano and all languages with Type B harmony it must be supplemented to account for the obligatory agreement for nasality within syllables. Piggott proposes a rule which makes such agreement mandatory, when vowels are underlyingly specified for the feature [nasal], but there is no direct link between the rule enforcing tautosyllabic agreement for nasality and the harmony process itself. This is a crucial difference between the Piggott (1992) analysis and the one proposed here, and this is where the earlier analysis is flawed. It predicts that possibility of tautosyllabic agreement for nasality in a language like Warao with Type A harmony. In fact, such agreement should show up in Warao itself, because it has underlying nasal vowels. Our new analysis of nasal harmony does not falsely predict the possibility of tautosyllabic agreement for nasality in Type A harmony patterns.

Let us now summarise the features of our analysis of the two types of nasal harmony. Type A patterns are instances of segment-to-segment relations. In derivational terms, [nasal] spreads from one segment to another until it encounters a segment which lacks the degree of nasality demanded in a particular language. These patterns do not pose problems for the hypothesis that the locality condition is inviolable, because there are never gaps in the configurations resulting from nasal spreading. Obstruent stops are universally nonnasal-bearing, probably because they have zero sonority, but fricatives can be nasalised. The nasalisation of fricatives is possible in Type A patterns, because segment-to-segment feature spreading is not constrained by principle of the Consistency of Dependency Relations (36) and, hence, it does not matter whether the occurrences of [nasal] in a representation report to the same node or are in the same head/dependent relation.

The conclusion we draw from Type A harmony is that nasal spreading cannot skip a segment. This conclusion appears to be contradicted by Type B harmony. However, the apparent contradiction is resolved by an analysis which attributes the distribution of nasality in these patterns to separate processes of vowel harmony and Syllable Nasalisation. The latter instantiates a universal requirement that the properties of the heads of constituents be projected maximally. We argue that the manifestation of Syllable Nasalisation follows from the hypothesis that vowels, being the occupants of head positions, dictate how the feature [nasal] can be realised on tautosyllabic segments. By reducing the nasalisation of sonorant consonants in Type B systems to the same mechanism that accounts for nasalisation in languages like Kaingang and Yoruba, which do not manifest long distance harmony, we have provided a unified explanation for the invisibility of obstruents to nasalisation.

5. Resolving some potential problems

Our analysis identifies properties that are unique to each of the nasal harmony patterns. It associates the obligatory nasalisation of tautosyllabic sonorants with Type B and obstruent opacity with Type A. Certain patterns appear to undermine the valid-

ity of these claims. In the next section, we discuss problematic cases from two Tucanoan languages, Orejon and Tucano, and refine our analysis to accommodate them. Finally, in section 4.2, we speculate on why languages that manifest Type B harmony have a different profile from Type A languages.

5.1. Nasal harmony in Orejon and Tucano

Based on data like those in (38), Pulleyblank (1989) attributes nasalisation in Orejon to a progressive harmony.[12]

(38) *Orejon Nasalisation*
- a. mõnĩ 'come'
- b. ŋãnã 'fly'
- c. sẽmẽʔ 'wild pig'

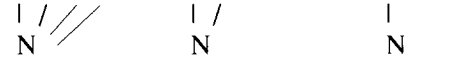
This pattern has the Type A signature, because obstruents are opaque.

(39) *Obstruent Opacity in Orejon*
- a. ŋ̨ãkoaʔ 'eye'
- b. nãki 'chew'
- c. tãkeʔ 'monkey'
- d. kõsaʔ 'ant'

Although this looks like a Type A harmony, it appears that the sonorants in an Orejon syllable always agree for nasality. Nasal vowels can be preceded by oral obstruents, but there seem to be no forms in which nasal vowels are preceded by oral sonorants. If there are underlying nasal vowels, we would expect Orejon to be like Warao and permit sequences of oral sonorants and nasal vowels.

The perception of a problem in the Orejon pattern is clearly based on the assumption that nasal vowels are underlying in the language. However, the evidence does not support such an assumption. The occurrence of nasality in the data in (38) and (39) can be accounted for, if [nasal] is an underlying morphemic or floating feature. This is indeed the analysis proposed by Pulleyblank. The floating feature associates with the first nasal-bearing segment in a word and spreads rightward. Obstruents cannot be nasal-bearing in Orejon and, therefore, must be skipped, when the floating feature is associated with the leftmost segment in the word. These segments must also block rightward spreading. The following representations capture the pattern.

(40) a. m õ n ĩ b. n ã k i c. k õ s a ʔ



[12] There appear to be two varieties of Orejon. The harmony facts described by Pulleyblank (1989) differ from those discussed by Cole and Kisseberth (1994b). We focus here only on the Pulleyblank dialect, but nothing in the other variety undermines our central thesis that nasal harmony respects the locality condition.

The fact that tautosyllabic sonorants always agree for nasality is a just an accident of the combination of the initial association and rightward spreading of [nasal].

The second case requires a different explanation. Tucano is closely related to Barasano. Given its genetic affiliation, it is not surprising that there are words in which all sonorant segments are nasalised and others containing only oral segments. Many of the examples provided by West and Welch (1967) are identical in form and meaning to Barasano words.

(41) a. *Nasal Words*

ỹãmã	'deer'
ẽmõ	'howler monkey'
ỹõkã	'a drink'
w̃ãtĩ	'demon'
mãsã	'people'

b. *Oral Words*

^{m}biʔi	'mouse'
^{n}dase	'toucan'
yuka	'vulture'
waʔi	'fish'
patu	'coca'

The absence of disharmonic roots containing oral vowels followed by nasal ones is indicative of a progressive harmony pattern. It is also obvious that obstruents are transparent to the harmony, signalling a Type B pattern.

However, the Tucano facts are more complicated. The pattern illustrated by the data in (41) only holds within roots. In root-suffix combinations, nasalisation usually spreads to the suffix if it begins with a sonorant, but, when a suffix begins with an obstruent, nasal harmony is systematically arrested. These two sub-patterns are illustrated below.

(42) a. *Sonorant-initial suffixes*

ʔĩʔã-w̃ĩ	'I saw'	ʔoha-wi	'I wrote'
ʔĩʔã-mã	'Let me see'	ʔoha-^{m}ba	'Let me write'

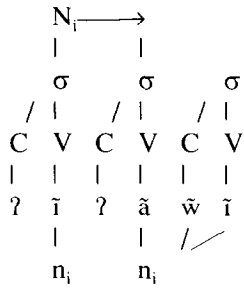
b. *Obstruent-initial suffixes*

nĩã-pɨ̃	'I was'	^{m}baʔa-pɨ̃	'I ate'
ʔãỹũ-se	'pretty thing'	ʔote-se	'seeds'

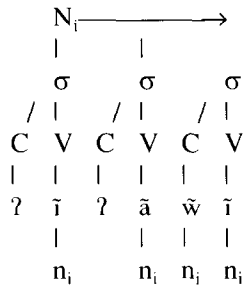
The data in (41b) are not consistent with a description of Tucano harmony as Type B, while the data in (41a) are incompatible with a Type A harmony. We are faced with the paradox that nasal harmony in Tucano seems to instantiate both types.

The apparent paradox posed by Tucano can be resolved, if it is hypothesized that Type B harmony applies at the root level but at the word level the Type A pattern holds. The assumption that different levels can be subject to different phonological restrictions is one of the important contributions of Lexical Phonology (Kiparsky, 1985). Exploiting this idea, we propose to analyse Tucano nasalisation as a nucleus-to-nucleus relation within roots, but a segment-to-segment relation within suffixes. The distribution of nasality in the word *ʔĩʔã-w̃ĩ* 'I saw' is, therefore, determined by the configuration of features in (43a) rather than the one in (43b), although they yield the same phonetic results.

(43) a.

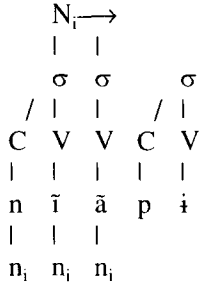


b.

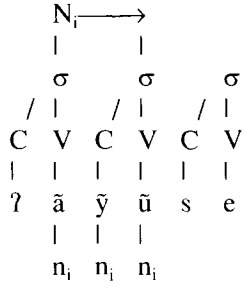


It is as a segmental feature that [nasal] spreads from root to suffix. A segment-to-segment relation would not permit obstruents at the beginning of suffixes to be skipped, but these segments could block nasal spreading, thereby resulting in the following representations.

(44) a.

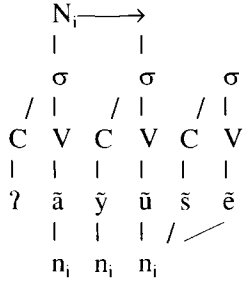


b.



Assuming that harmony is a segment-to-segment relation in Tucano suffixes, our theory actually predicts that the process must be blocked by an obstruent-initial suffix. In other words, in such a situation, nasalised obstruents (i.e. fricatives) could never be derived. Let us see why this must be the case. Within Tucano roots, [nasal] is associated with a suprasegmental category. Consequently, the realisation of the feature is controlled by the Consistency of Dependency Relations (36), thereby restricting the feature to sonorants. When this feature spreads from a root to a suffixal segment, CDR prevents it from being associated with obstruents. A representation like (45) is universally prohibited.

(45)



We see now that even the very difficult case of Tucano nasal harmony yields to a fairly insightful analysis, if we make the reasonable assumption that harmony can apply differently in different morpho-lexical domains.

5.2. *Sonorancy, voicing and nasality*

According to our analysis, languages with obligatory Syllable Nasalisation (necessarily including those manifesting Type B harmony) belong to a group where consonants contrast for sonorancy (Anderson, 1976). In other words, the phonetic voiced-voiceless opposition of these languages must be analysed as fundamentally a sonorant-obstruent contrast. The evidence that the voiced consonants are sonorants is considered to be found in the variant realisation of the stops as full nasals or nasal contours. Languages like Barasano and Kaingang lack a set of voiced sonorant stops (e.g. /m, n, ŋ/) contrasting with voiced (e.g. /b, d, g/) and voiceless (e.g. /p, t, k/) obstruent stops.[13] The apparent strict correlation between the occurrence of Syllable Nasalisation and the consonantal contrast for sonorancy is unexplained. While we have not yet worked out the details of the explanation, the general outlines are fairly clear.

Because the occurrence of nasal and nasalised consonants is completely predictable from the presence of a nasal vowel in languages with Syllable Nasalisation, the logical conclusion is that the underlying inventories contain a set of voiced sonorant stops which are not specified for nasality. Generally, such systems do not contain the voiced obstruent stops. The seemingly universal prohibition against the cooccurrence of both the sonorant-obstruent contrast and the voiced-voiceless one in a language suggests that the same feature is involved in the encoding of the two distinctions. From the feature-geometric perspective, this feature would be the SV node. Rice (1993) has already demonstrated that the voicing of obstruents in some languages is best represented by this node. Radical CV phonology (Van der Hulst, 1995, in prep.) is even more explicit; in this model, the element V represents both sonorancy and voicing. Both proposals entail that voiced consonants are always sonorant and sonorant consonants are always voiced.[14] If the sonorant-obstruent and voiced-voiceless contrasts are fundamentally the same, we would not expect a language to contain two sets of voiced non-nasal consonants, but the presence of distinctive nasality within the voiced set would produce a nasal-oral contrast.

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[13] The Nigerian languages, Jukun, seems to contradict this claim. The very brief description by Welmers (1973) indicates that Syllable Nasalisation is active, but the language seems to have a distinct set of voiced obstruents which are not affected by nasalisation. Hence, there are surface contrasts between /m/ and /b/ (e.g. mã vs. bã) and /^{m}b/ and /b/ (e.g. ^{m}ba vs. ba). However, the limited amount of available date on this language does not permit us to reach any definite conclusion about its underlying consonant system.

[14] We are aware of cases like Japanese where some phonological distinction between voicing in obstruents and sonorants is required. We believe such a difference can be reconciled with our proposal to treat all voiced consonants as sonorants. The outlines of a possible solution may be found in the work of Kawasaki (1995).

The representation of all voiced consonants as sonorants means that when a language is subject to Syllable Nasalisation all voiced consonants are affected. The transparent segments in Type B harmony must, therefore, be voiceless obstruents. The occurrence of Syllable Nasalisation can be reduced to the language-particular choice to designate [nasal] as a syllabic rather than a segmental feature. Nasality would have such a phonological status whenever a language lacks a set of underlying nasal consonants but has nasal vowels. Such a description of this feature permits us to adhere to the conventional position that [nasal] as a distinctive segmental feature is an unmarked property of sonorant stops.

6. Summary and conclusions

This paper presents a novel analysis of the nasal harmony pattern in which obstruents appear to be transparent to harmony. The analysis is consistent with the hypothesis that phonological relations like other linguistic relations are governed by a universal locality condition. The crucial part of the analysis is the characterisation of the Type B pattern as a relation between syllable heads, a type of vowel harmony. From this, we derive by general principles an explanation for the fact that sonorant consonants are nasalised but obstruents remain oral. Another argument in favour of our analysis is that it explains attested nasal harmony patterns without overgenerating unattested ones. Our theory allows only one of the patterns described in the following table (46c), and it is the only one that has been documented.

(46)	Targets	Opaque segments	Transparent segments	Language
a.	vowels	–	obstruents, liquids, semivowels	??
b.	vowels, semivowels	–	obstruents, liquids	??
c.	vowels, semivowels, liquids	–	obstruents	Barasano
d.	vowels, semivowels, liquids, fricatives		obstruent stops	??

Theories that do not enforce locality in harmony would seem to allow for the other possibilities.

We have analysed Type B nasal harmony as involving a relation between the heads of syllables. However, it is clear that the distribution of nasality can also be derived from harmony as a syllable-to-syllable relation. This is a predictable out-

come. Given that the properties of the head of a syllable must be properties of the syllable itself, a harmonic relation between nuclei must simultaneoulsy be a harmonic relation between syllables. Because this entailment follows from general principles of linguistic structure, we do not have to explicitly provide for it in the analysis proposed in this paper.

When this conception of harmony is pursued to its logical conclusion, it is a reasonable expectation that harmonic relations might hold not only at the level of the syllable but also at a higher prosodic level like the Foot. Foot-level harmony might occur in two forms. One possibility is for the Foot to define the domain within which harmony holds; Van der Hulst and Van der Weijer (1995) point to cases that seem to qualify as members of this type. A second possibility is that harmony might be instantiated as a relation between adjacent Feet. While the published literature does not attribute any instances of harmony to such a relation, an explanation for vowel transparency in certain harmony patterns (e.g. Mongolian and Tungusic vowel harmonies) might emerge from the postulation of Foot-to-Foot harmony. We leave this possibility open for future research.

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