BRIBRI NASAL HARMONY FROM THE VANTAGE POINT OF THE UNIVERSAL THEORY OF HARMONY

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1. INTRODUCTION

After surveying vowel harmony processes in a number of languages, Tohsaku (1983) proposed a formal theory of vowel harmony. The formal devices that are part of this theory are developed so that they can capture significant generalizations regarding this phonological process. Specifically, these formal devices can a) distinguish the universal properties of vowel harmony from its language-particular properties, b) represent a natural, common or expected process in a formally simple, natural fashion, and c) capture significant similarities and differences among vowel harmony and such related processes as assimilation, and so on. Later, Tohsaku (In Press a) demonstrated that the proposed theory also can account for the universal properties of nasal harmony, and that it has more explanatory power than originally conceived.

It is obvious that a phonological theory incorporating an account of phonological universals into its general metatheoretical model has many advantages. For example, predictable features of a given process are attributed to the theory, while unpredictable, idiosyncratic features are assigned to language-specific systems. Thus, we need not repeat information pertaining to universals in the description of each process, which leads to a simple, natural analysis. More importantly, in terms of this kind of theory, it is possible to distinguish formal properties of each process from its substantive properties. In this sense, the theory attains a high level of explanatory power.

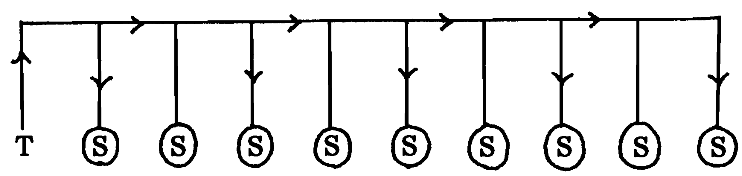
In this paper, I will apply the theory proposed in Tohsaku (1983, In Press a) to the analysis of Bribri nasal harmony and demonstrate that this theory makes it possible to analyze a seemingly complicated phonological process in a simple, natural manner. Section Two of this paper will consider four different types of non-harmonizing segments which are commonly observed in vowel harmony and nasal harmony. Section Three will go over Bribri nasal harmony. Section Four will briefly describe the formal devices proposed in Tohsaku (1983, In Press a). In Section Five, I will demonstrate the analysis of Bribri nasal harmony in terms of these new formal devices.

2. NON-HARMONIZING SEGMENTS IN HARMONY PROCESSES

Tohsaku (1983) examined various vowel harmony processes and identified their universal characteristics. Tohsaku also pointed out in his study of nasal harmony (In Press a) that most of these universal characteristics are shared by nasal harmony processes. For instance, some types of segments appear repeatedly in vowel and nasal harmony processes. In this section, we will look at the behavior of these segments.

Any harmony process has a type of segment which initiates the process, i.e. which determines the quality of segments affected by the assimilatory process. This type of segment is called a *triggering segment*. The function of a triggering segment (T) can be illustrated as follows:

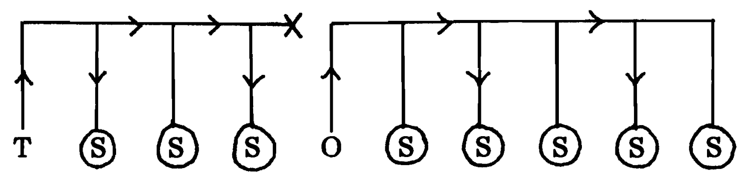
(1)



In illustration (1), the line with an arrow represents a flow or direction of a harmony process. Circled segments represent those affected by harmony. These segments are called *target segments* or *harmonizing segments*. In vowel harmony, the triggering segment is typically a vowel, while in nasal harmony, it can be either a nasal vowel or a nasal consonant. A triggering segment can be morphologically determined (e.g. a root-initial vowel) or phonologically determined (e.g. any [+ round] vowel in the word). In some harmony processes, such morphological features as [+ plural] and [+ 3rd person] trigger the process. Tohsaku (In Press b) claims that the directionality of harmony is universally bidirectional when the triggering segment is morphologically determined. On the other hand, it must be language-specifically specified when the triggering segment is phonologically determined.

The second type of segment is an *opaque segment*, which stops harmony initiated by a triggering segment (or other opaque segments) and triggers a new harmony process. Thus, it defines a new domain of harmony. The function of an opaque segment can be illustrated as follows:

(2)



In (2), the opaque segment is marked with the symbol O. The flow of harmony initiated by the triggering segment T is stopped by the opaque vowel and it, in turn, triggers a new harmony process. A triggering segment and an opaque segment differ in the value of a harmonizing feature. For instance, if [+ ATR] vowels are triggering vowels, [- ATR] vowels could be opaque.[2] Nasal harmony, in which [+ nasal] segments typically trigger the process, does not have an opaque segment, since [- nasal] segments cannot trigger the harmony. Tohsaku (1983) points out that the operation of a triggering vowel universally precedes that of an opaque vowel in a vowel harmony process when it has an opaque vowel.

The third type of segment is a *neutral segment*, which is represented by the symbol N in (3) below. This segment is not affected by harmony. The flow of harmony passes over it. The behavior of a neutral segment can be illustrated as follows:

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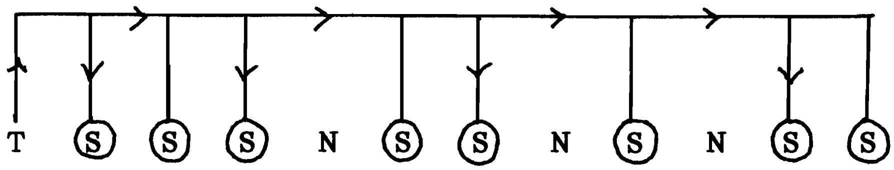
[1] S represents a segment.

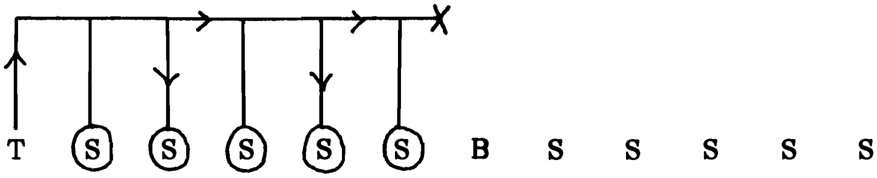
[2] ATR stands for the phonetic feature *Advanced Tongue Root*.

(3)



The fourth and last type of segment commonly observed in harmony processes is a *blocking segment*, which is shown with the symbol B in (4). This type of segment blocks the flow of harmony triggered by a triggering segment or an opaque segment. Unlike an opaque segment, however, it cannot define a new domain of harmony, i.e. it cannot trigger a new process of harmony as illustrated in (4):

(4)



In (4), it must be noted that all segments after a blocking segment are not circled, thus, not harmonized.

The four types of segments discussed above are not harmonized, contrasted with target or harmonizing segments, in harmony processes. Therefore, these four types of segments are called *non-harmonizing segments.*

3. BRIBRI NASAL HARMONY: FACTS

In this section, we will examine the nasal harmony process of Bribri and consider the behavior of the non-harmonizing segments discussed in the preceding section. The data presented here are all from Constenla (1981, 1985).

Bribri has an underlying contrast between oral and nasal vowels in a tonic syllable.[3] In other words, the occurrence of oral and nasal vowels in this context is unpredictable. Underlyingly, only oral vowels appear in an atonic syllable. Besides, there is no underlying nasal consonant in this language. The occurrence of surface atonic nasal vowels and nasal consonants is accounted for as the result of a nasal harmony process triggered by a tonic nasal vowel. Thus, a tonic nasal vowel is the triggering segment of this nasal harmony process. The possible harmonizing segments of this nasal harmony are atonic vowels and voiced consonants. Let us consider the following examples:

(5)	(a)	/d͡ʒaṹ̱/ (T)	[ɲã̀ṹ̱][4] (t t T)	'my pot'
	(b)	/d͡ʒaú/	[d͡ʒà̭ú]	'my house'

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[3] This language has four different tone types: high /ˊ/, low /ˋ/, high-low /ˆ/, and low-high /ˇ/.

[4] In these phonological and phonetic representations [ˬ] indicates lesser loudness and length. See Constenla (1981). /l̆/ is an alveolar lateral flap.

(c)	/dabú/	[nàmú]	'feline'
(d)	/baûk/	[màûk]	'to tie'

In this nasal harmony process, voiceless consonants function as a blocking segment. Consider the following examples:

(6)	(a)	/šakalâ/	[šakàlâ]	'smoke'
	(b)	/batsú/	[bàtsú]	'hummingbird'

Also, tonic vowels are blocking segments.

(7)	(a)	/bǎúk/	[bǎùk]	'to heat'
	(b)	/dʒábì/	[dʒámì]	'relative'

As seen from the following examples, the directionality of this nasal harmony process is limited to leftwards:

(8)	(a)	/badʒâlkà/	[màɲâlkà]	'three pounds'
			*[màɲâlkà]	
	(b)	/kaléb/	[kàléb]	'catfish'
			*[kàlém][5]	

The Bribri harmony process does not have a neutral segment.

This nasal harmony process can be summarized as follows:

(9) Bribri Nasal Harmony
- (a) Triggering Segments: Tonic nasal vowels
- (b) Blocking Segments: Voiceless consonants and Tonic oral vowels
- (c) Directionality: Leftward only
- (d) Harmonizing Feature: [+ nasal]

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5 Later, a local nasalization rule changes [kaléb] to [kalém].

According to Constenla (1985), Northern Cabécar, a neighboring sister language of Bribri, also has a nasal harmony process. In the northern dialect of this language, Constenla reports that some voiceless consonants do not block a nasalization process. Consider the following example:

(10) /batsú/ [mãtsũ] 'hummingbird'

In (10), the voiceless consonant [ts] functions as a neutral segment, so that nasalization passes over this segment.

4. A FORMAL THEORY OF HARMONY

Tohsaku (1983) proposed a non-linear analysis of vowel harmony which can account for the general, universal characteristics of this process, i.e. features which are commonly observed in this process, as well as the four types of segments discussed above, in a simple and natural way. Tohsaku (In Press a) further demonstrated that this formal theory of vowel harmony can account for the universal features of nasal harmony with a little modification.

This new theory of harmony requires the following set of formal devices:

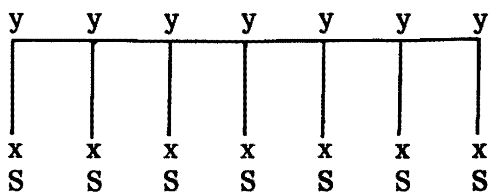
(11) A Set of Formal Devices
- (a) Projection
- (b) Foot Assignment
- (c) Labeling Assignment
- (d) Percolation

All harmony rules necessitate these four devices or subrules, which apply in the order shown above.

The notion of *projection* was first proposed by Vergnaud (1976). Halle (1979: vi) defines it concisely as "...given a phonological representation speakers readily construct various subrepresentations by deleting systematically certain specified items from the former". Many phonological rules effectively disregard certain segments and operate only on a string of specified segments. Vowel harmony processes apply to all and only vowels in the domain of a word, and consonants do not interfere with the application of vowel harmony nor are they affected by it. That is to say, vowel harmony effectively and systematically disregards consonants and operates on a subrepresentation in which all consonants are deleted, i.e. it operates only on the [+ syllabic] projection. I claim that vowel harmony operates universally on the [+ syllabic] projection in the domain of a word, unless otherwise stipulated. Vocalic segments separated by intervening consonants in the underlying representation become adjacent to one another after the [+ syllabic] projection. In this way, the phonological rule of vowel harmony need not refer to any consonants. Thus, if we use projection, it is possible to eliminate all variables from the phonological rule of vowel harmony and simplify it. On the other hand, in nasal harmony, all segments in a word are projected, unless otherwise specified in a language-particular rule. Arguments for this type of projection in nasal harmony are demonstrated in Tohsaku (In Preparation).

Segments in particular projection are gathered into a constituent-like grouping, according to Vergnaud (1976). Specifically, projected segments are grouped so as to join together into a tree-like structure called a *foot*. I will call this grouping *foot* *assignment.* Right-branching and left-branching trees are widely used in Metrical Phonology, while multi-branching trees are predominantly used in Autosegmental Phonology.[6] It would be unnecessary to mention the usefulness of these trees for the analysis of, especially, stress and tone. I use the following type of tree structure. Here S represents a segment projected by the vowel harmony or nasal harmony projection.

(12)



This structure looks like a wisteria trellis or grape trellis, so I will call this structure *trellis-branching tree.* Arguments for the trellis-branching rather than other branchings in the analysis of harmony are shown in Tohsaku (1983). In the trellis-branching tree structure in (12), x is called a tip, while y is called a node.

Vergnaud (1976), furthermore, claims that segments gathered into a single tree could share some features specified by a rule. Those features specified by a rule can move through a tree. This moving process is called *percolation.* In theories which use a right-branching or left-branching tree, percolation usually takes place from the head, tail, or highest node of a given tree.[7] If features move from one of the segments grouped into a trellis-branching tree, we must clearly specify which segment initiates the percolation of a specified feature, since the trellis-branching tree structurely does not have a head, tail, or a highest node from which Vergnaud claims percolation is initiated.

In the present framework, the mode of percolation is determined by labels assigned to parts of the trellis-branching tree, specifically, nodes or tips. After the vowel harmony or nasal harmony projection and foot assignment derive a subrepresentation for vowel harmony or nasal harmony, *labeling assignment* rules apply. Two labels are needed in the analysis of harmony: one is a Percolator (P)-label and the other is a Cork (C)-label. The assignment of these labels is language-specific, so vowel harmony or nasal harmony rules in each language must specify where these labels are assigned in the tree. The functions of labels, however, is determined universally, so that a language-specific rule of harmony processes need not include information about their functions.

A P-label has two functions: (a) it initiates percolation from the segment to which it is assigned; (b) it stops percolation initiated by any other P-label(s). A C-label has only one function: it stops the flow of percolation initiated by a P-label.

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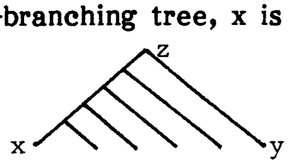
6 These three types of trees are illustrated as follows:

left-branching right-branching multi-branching

7 In the following left-branching tree, x is the head, y is the tail, and z is the highest node.

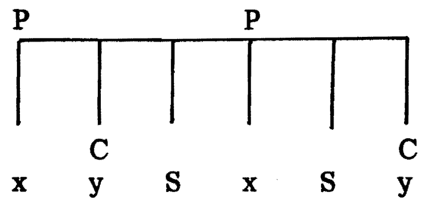


The following is a typical labeling assignment (sub)rule used in a rule of harmony:

(13) Schemata for Labeling Assignment Rules
(a) Assign a P-label to a node immediately governing a segment x.
(b) Assign a C-label to a tip immediately governing a segment y.

These rules apply to the subrepresentation for vowel harmony or nasal harmony, and the following representation is derived:

(14)



As seen in (14), more than one labeling assignment rule can apply to a single tree, so long as there is a segment which satisfies the condition described in labeling assignment rules.

Classes of segments which typically appear in harmony processes are accounted for by the following labeling modes:

15) (a) Triggering: a P-label assigned to its node
(b) Opaque: a P-label assigned to its node
(c) Neutral: a C-label assigned to its tip
(d) Blocking: a C-label assigned to its node

After labeling assignment rules assign labels to certain parts of trees (i.e. tips or nodes), percolation takes place. The following is a typical percolation rule for harmony processes:

(16) [+ featureα] percolates.

Percolation features are determined language-specifically, but the mode of percolation is determined by the universal function of the labels assigned to trellis-branching trees, and by the universal principle of percolation shown below:

(17) The Percolation Principle
The value for specified features of a segment with a P-label are percolated and spread to other segments where they distribute or supplant the value for these features.

Unless otherwise stipulated, percolation proceeds both rightwards and leftwards in a tree. In vowel and nasal harmony processes whose triggering segments are phonologically determined, the directionality is unpredictable. Therefore, it is specified in a language-specific rule. In these processes, percolation is restricted only to rightwards or leftwards. I shall call rightward percolation, *perc-right*, and leftward percolation, *perc-left*.

5. BRIBRI NASAL HARMONY: ANALYSIS

In this section, I will show an analysis of Bribri nasal harmony in the theoretical framework presented in the preceding section.

It is considered that the universal projection for nasal harmony, i.e. the projection of all segments inside a word, applies to this nasal harmony process. Therefore, we need not specifically include this information in the description of Bribri nasal harmony. Those segments projected are automatically assigned a trellis-branching tree. This is also taken care of by the theory.

In the theory introduced above, non-harmonizing segments are accounted for by labels. The Bribri nasal harmony rule has the following labeling assignment rules:

(18) (a) Assign a P-label to the node immediately governing a tonic nasal vowel.
(b) Assign a C-label to the node immediately governing a voiceless consonant or a tonic oral vowel.

The harmonizing feature is specified by the following percolation rule:

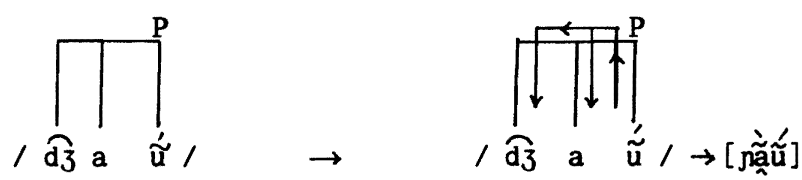
(19) [+ nasal] percs-left.

As discussed in Sections Two and Four, when a triggering segment is phonologically determined, the directionality of harmony must be specified in a language-specific rule. In Bribri, the triggering segment is a tonic nasal vowel, thus, phonologically determined. Therefore, the directionality is specified as 'percs-left' in the above rule.

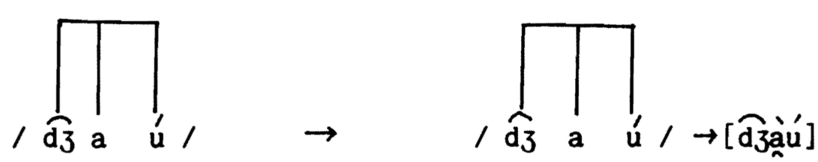
Let us apply these rules to some examples. In the following derivations, I will omit the universal projection and foot assignment. Instead, I will show the derivation after the application of these two universal rules.

The following is the derivation of (5a) 'my pot' and (5b) 'my house'.

(20) (a) Labeling Assignment Percolation



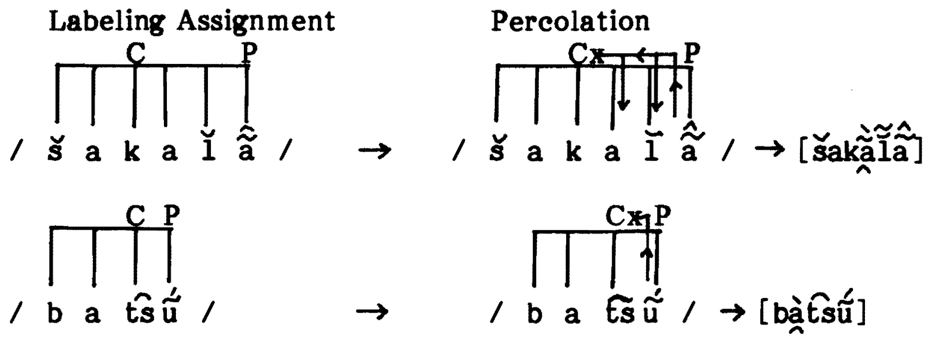
(b)



In (20a), the feature [+ nasal] is percolated from the word-final /u/, to which a P-label is assigned, and the remaining segments are nasalized following the Percolation Principle (17). In (20b), however, no P-label is assigned since there is no segment which satisfies the structural description of the rule (18a) above. Therefore, nothing takes place in this word.

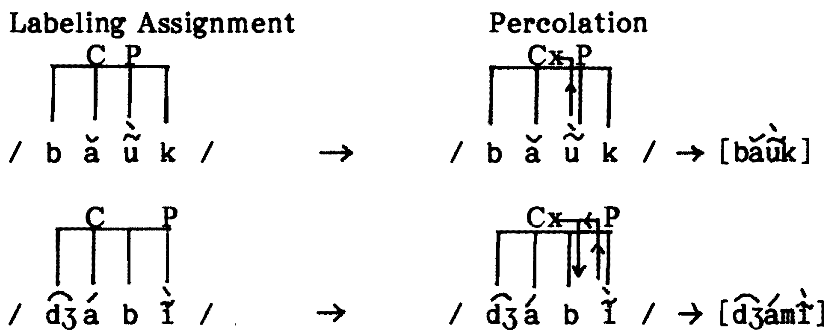
Next, let us consider the derivation of (6a) 'smoke' and (6b) 'hummingbird'.

(21) (a) (b)



In these words, the node governing a tonal oral vowel is assigned a C-label. By the universal function of a C-label, the percolation is stopped as shown by an X in (21). The same is true with the derivation of (7a) 'to heat' and (7b) 'relative'.

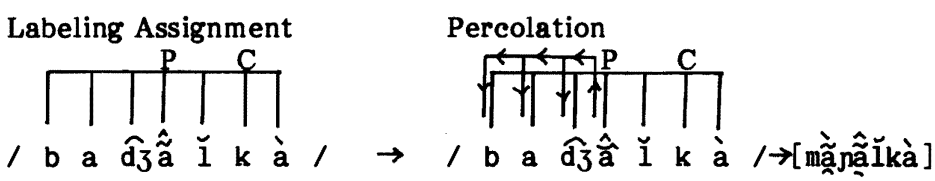
(22) (a) (b)



The node governing a tonic oral vowel is assigned a C-label. Therefore, percolation is stopped there.

Let us consider the derivation of (8a) 'three pounds'.

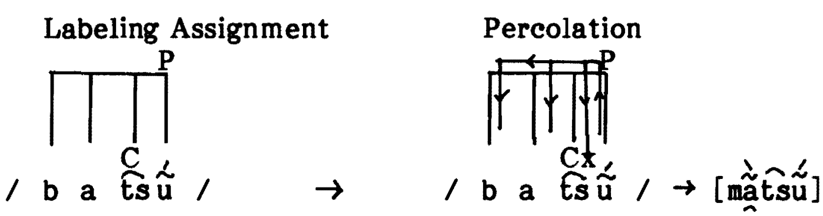
(23)



Although /ĭ/ is a possible harmonizing segment, the percolation is restricted to leftward direction by percolation rule (19), so that it is not nasalized.

As discussed in Section Three, in northern Cabécar, some voiceless consonants function as neutral segments. It is considered that these consonants are assigned a C-label at their tip in the tree, instead of a C-label at their node. Let us consider the derivation of (10) 'hummingbird'.

(24)



In (24), the percolation initiated by the word-final /u/ is stopped by the C-label at the tip of /t͡s/. Therefore, this voiceless consonant is not affected by the percolation process. However, there is nothing to stop the percolation at the node immediately governing /t͡s/. The percolation continues further forward, and /b/ and /a/, which are possible harmonizing segments in this language, are nasalized.

In conclusion, the universal theory of harmony presented here, to a great extent, simplifies the description of Bribri nasal harmony. All that we have to specify in this language-specific rule are: (a) non-harmonizing segments, (b) harmonizing feature(s), and (c) the directionality. The function of non-harmonizing segments and the mode of harmony are accounted for by this universal theory. Unlike traditional phonological theory, we need not specify them repeatedly in language-specific rules.

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