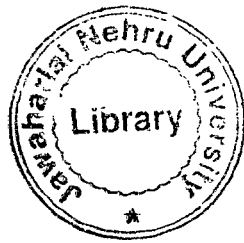# Feature Spread and Nasals in Hindi

Dissertation submitted to Jawaharlal Nehru University
in partial fulfilment of the requirement for
the award of the degree of
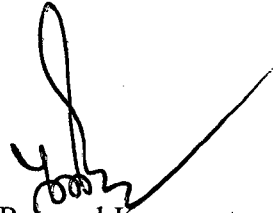
MASTER OF PHILOSOPHY

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India

2001

Declaration

This dissertation entitled "**Feature Spread And Nasals in Hindi**" submitted by me for the award of the degree of Master of Philosophy, is an original work and has not been submitted so far in part or in full, for any other degree or diploma of any University.

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Dated: 20/07/2001

CERTIFICATE

This dissertation entitled "FEATURE SPREAD AND NASALS IN HINDI" submitted by Pramod Kumar, Centre of Linguistics & English, School of Language, Literature & Culture Studies, Jawaharlal Nehru University, New Delhi, for the award of the degree of Master of Philosophy is an original work and has not been submitted so far in part or in full for any other degree or diploma of any other University.

This may be placed before the examiners for the evaluation for the award of the degree of Master of Philosophy.

PROF. R. S. GUPTA
(Chairperson)

PROF. ANVITA ABBI
(Supervisor)

ACKNOWLEDGMENT

This is the column where everybody wants to wash his/ her hands of the obligations he/ she had to finish the work. On the contrary, I am not to finish obligations by expressing words of gratitude only but to say you will always remain in my heart and memory.

First of all, I would like to express my deepest gratitude to my supervisor Prof. Anvita Abbi who not only accepted to supervise my work but also supported me constantly with all kinds of help whether it be of materials, encouragement or discussion. I learnt the dedication and rigour of academics and academician from her. Her openness, mild and cooperative attitude is one of the few qualities that impressed me. Without her regular guidance it would have been difficult to bring the dissertation in the present shape. Despite being busy, her benign presence in my hour of need enlightened and emboldened my spirit. I am really grateful to her.

Secondly, I am much obliged to Dr. Ayesha Kidwai, who kept me providing useful materials, kind co-operation, constant encouragement, valuable suggestions and whatever I needed through out this work.

Prof. R. S. Gupta, who has been my teacher as well as our chairperson, furnished me with whatever he could. I wish to thank and express my gratitude to him also.

I would like to use this opportunity to express my gratitude to the teachers of CLE who in one way or other provided me sharpness and intellectual insight in Linguistics.

I will never forget my three juniors, S. Winston Cruz, Masum Ali, and Himanshu Upadhyay, without whose help it would have been extremely difficult to bring out the dissertation in this form. I owe them a debt of gratitude for how they supported me during my stay at Hyderabad. It is unforgettable and inexpressible.

It would be injustice if I miss to thank Ashish, my junior, who rendered me help in every possible way.

My sincere thanks go to my junior Samar Sinha who helped me finish this dissertation. I am really grateful to you 'Samar'.

I would like to thank my friends Keshari (CLE), Surendra (SIS), Alok (SIS), Bibek (CESP), Pranab (MCA), Rajesh (MCA), Dharmendra (MCA), Sachin

(MCA), Vinay (CFFS) Pawan, Dinesh, and Vikram who did more than what I could have expected.

I would like to mention special thanks to Sanjay (CFFS) for helping me timely and having patience even after rendering him regular disturbance.

I owe much gratitude to my former teacher Prof. R. N. Jha who introduced me Linguistics and inspired me to join JNU.

I must thank my parents and the members of family for their moral support, encouragement and whatever I asked for.

I owe my gratitude to the Librarians of DU, HCU, CIEFL, and CIIL where I got the materials because of their cooperation. I am thankful to them. I express my special thanks to Mr. L. N. Mallik, our Librarian who helped me a lot.

My acknowledgement would be far from complete if I miss to thank Mr. R. S. Rawat and Mrs. Bhagwati who rendered their kind help throughout my dissertation and encouraged me to finish the work.

Finally but not the least, I express my sincere gratitude to 'My Love' distance from whom, though, irked me the most, but her benign presence in my heart at every moment, inspired, and encouraged me to finish this work.

I am also thankful to those persons who helped me with their valuable materials and suggestions. They are:

John J. McCarthy

Jean Francois Prunet

Abigail C. Cohn

Elizabeth Hume

Paul Kiparsky

Uma Maheshwar Rao

Probal Dasgupta

Ved Prakasham

Vijaykrishanan

Pramod Kumar

List of Abbreviations

ant	Anterior
C	Consonant
cons	Consonantal
cor	Coronal
nas/N	nasal
obst	Obstruent
skt	Sanskrit
son	Sonorous
syll	Syllabic
V	Vowel
Voc	Vocalic
σ	Syllable node
μ	Mora
Σ	Foot
+	Morpheme boundary
/	Slash: 'In the environment of'
—	Dash: 'lace of occurrence'
.	Syllabic boundary
α	
β	Variables
γ	
/ /	Systematic phonemic representation
[ ]	Systematic phonetic representation
→	Rewrite as or changed to
|	Association line (solid)
⋮	Associatin line (broken)

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Acknowledgement

Abbreviation

Chapter 1

Introduction

The feature [Nasal] has been the topic of discussion in linguistic theory not only because of its phonetic implications but also for its phonologically different behaviours. It is no doubt that the feature [Nasal] is more sensitive to undergo phonological change (i.e. in its feature property) than any other segment whether it is the matter of assimilation or dissimilation or something else. Barring its assimilatory behaviour, it sometimes spreads its feature onto the vowels and in some languages onto consonants, too. The process where a vowel gets nasality due to the presence of a nasal segment is known as 'vowel nasalization'. The nasalization process may be phonetic or phonological. The Phonetic occurrence means the occurrence of nasalization due to anticipatory movement of the articulatory organ due to the presence of a nasal segment, usually referred to as co-articulation whereas phonological means the occurrence of nasalization due to the presence of a nasal segment in underlying representation but not necessarily bears surface manifestation. There has been a long controversy over whether phonological nasalization has a nasal segment in underlying representation not. The present work is an attempt to inquire into the different behaviours of nasals, particularly in Hindi.

1.1 Introduction

Any linguistic inquiry like a scientific investigation is not simply the formulation of rules for given data rather it is the explanation of whole phenomenon involved in, i.e. how it happens (rules), what the constraint there are, what the motivation are, and so on vis-à-vis the universality to specificity. The objective of linguistic inquiry is to enquire the relation between sound and meaning, which raises the obvious question what the nature and form of the phonetic and semantic levels are.

1

If linguists are interested in finding out the relation between sound and meaning, the question that may strike anybody is where and how this relation exists. There has been long tradition of such discussion in philosophy in ancient European tradition and ancient Indian grammarians and philosophers who tried to answer these questions but they had discussed much about epistemological and ontological knowledge of language. However, after the advent of modern linguistics in the twentieth century the question is re-asked in terms of how a language is acquired by a child. Relation between sound and meaning of individual word can be understood in terms of Saussurean notion of signified and signifier, and arbitrariness, but when we take this correspondence in a broader sense we need to enter into the depth of language behaviour.

Language is, no doubt, a corpus of infinite set of utterances, however, these utterances can be analyzed or reformulated within a finite set of rules, which are recursively applied to form utterances. Moreover, it involves a number of constraints, which along with rules determine the well-formedness of an utterance. The rules and constraints are parts of the grammar of a language; i.e. grammar[1] is a system, which enables an individual to produce and understand the utterances of his/ her language which he/ she has never encountered with before. The grammar is thus a system of rules and constraints, which help one produce and understand the utterance. However, different rules apply at different levels: some rules, for example, apply at the phonological level, some at the morphological level, and some at the syntactic level; and sometimes some rules intersect at all these levels. Such complexities of a language bring forth other questions: how humans produce or understand the language of his/ her community? Is it that the brain/ mind of a human being possesses this relation, or is it that it is like other human behaviours that is learnt in the course of one's development? For this we need to enquire into

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[1] The term grammar, as Chomsky & Halle (1968: 4) describes, seems to be ambiguous in the sense that it may refer to both the formal construct constituted by linguist and the cognitive system, the speaker has in brain/ mind and uses that for the production and comprehension of utterances. Similar view was presented in Prunet (1986). Henceforth, I am using the term grammar in the latter sense as Prunet (1986).

how a child acquires a language. The last forty years of study has demonstrated that language is not like other human behaviours rather that it is in the brain/ mind from birth what Chomsky calls innate or genetically endowed.

1.2 Organization of grammar

After the advent of Generative Grammar, it is widely accepted that language is totally a mental process traced from the intuitive knowledge of the native speaker who knows unconsciously much more about his/her native language and has ability to distinguish between well-formed and ill-formed words and sentences in his/ her language which can be formulated within a formal and abstract system consisting of several levels of representations along with rules and constraints.

The grammar or linguistic competence consists of lexicon, computation, phonetic form (i.e. phonological component or articulatory- perceptual interface), and logical form (i.e. semantic component or conceptual-interpretative interface). I am giving brief introduction of every part of the grammar, since it is difficult to go by each part in detail here due to constrains of space (see for further details, Chomsky, 1995 and other subsquent works).

Lexicon:

It contains following information of a lexeme:

(1) Its phonological representation

(2) Sound meaning correspondence

(3) Categorical information

(4) Semantic information

(5) Subcategorization framework

(6) Idiosyncratic properties

Computation:

Computation is the system of the grammar where syntactic operations or derivations happen or in the term of the Optimality Theory, it is the interface where constraint-interaction for syntactically optimal candidates happens

Spell out

In the history of syntactic derivation, this is the point from where the syntactic output is submitted to PF.

Logical Form:

LF is the semantic component of grammar in usual sense. Thus, it is the interpretative interface where we have derivation related to interpretation.

Phonetic Form:

PF is the phonological component of the grammar. The chief function of the phonological component is to take care of morphological formation made available after syntactic derivation, and necessary phonological transformation in the strings of segments which may be universal or language specific and then pass the information on to the vocal apparatus to actualize the sounds. Or in the Optimality Theory the constraint-interaction for phonological optimal candidates happens. The phonologists' concern is in the lexicon (mainly in the phonological representation) and phonological component.

The lexical item or morpheme taken from lexicon has the phonological, morphological, and syntactic information throughout derivation, however the use of the linguistic information is largely restricted to its defined domain; for example, syntactic information is used only in computation and phonological information in phonological component.

1.3 Theoretical Assumptions

My concern in this dissertation is to explain the different behaviours of nasals in Hindi where sometimes nasals assimilate to the following consonant, sometimes they spread their feature [+nasal] on the preceding vowel. To Explain I will work within the framework of the Prosodic Theory and Feature Geometry. The former involves the hierarchical organization of prosodic categories and hierarchical structure of segments which indicates dependency between segments; the latter, on the other hand, involves the hierarchical organization of distinctive features which

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informs the dependency between features. I assume the following schema for the prosodic hierarchy:

1)

$$PWd$$
$$|$$
$$\Sigma$$
$$|$$
$$\sigma$$
$$|$$
$$\mu$$
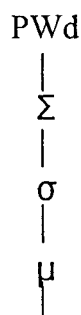
In (1) PWd stands for prosodic word that may be a root, a stem, or an affix. The lowest in the prosodic hierarchy are segments which are linked to the syllable where mora mediates between the two in the case of a vowel or other sonorous sounds. This syllable is further linked to the foot which ultimately constitutes the prosodic word. I will deal with the moraic theory in detail in Chapter 3.

Segments are not the end of the prosodic category, rather these segments are composed of bundle of features. It was widely accepted after the introduction of distinctive features in phonological theory (Jakobson, Fant & Halle, 1952) that the phonological processes involve the change in segmental properties of these features and phonemes are conceived as bundle of features in the Bloomfieldian sense. There was no organization of these features in terms of similarity of articulatory or acoustic correlates as there is the functional coherence of the features in phonological processes. For example, there is a common phenomenon where the nasal assimilates to the following consonant in terms of place feature, i.e. Np → mp, Nt → nt, and Nk →ŋk. To explain this process we need to formulate the rule like:

$$[+nas] \rightarrow \begin{bmatrix} \alpha \ cor \\ \beta \ ant \\ \gamma \ back \end{bmatrix} / \underline{\hspace{2cm}} \begin{bmatrix} \alpha \ cor \\ \beta \ ant \\ \gamma \ back \end{bmatrix} ,$$

' McCarthy (1988: 86) points out that this rule uses the mechanism for assimilation, variables over + and –, in a nonassimilatory way. Secondly, it was widely accepted that for the actualization of speech, the features of a phoneme serve as providing information to vocal tract to activate its articulators in accordance. Thus, there are similarities between the features and their articulatory correlates which lack in non-hierarchical feature organization. For example, some articulators are independently controlled, while other combinations of articulators are linked. For example, the features [nasal] or [back] are executed by a given articulator; on the other hand, the features [continuant] or [lateral] are executed by several different articulators. Halle (1995) calls the former as articulator-bound features and latter the articulator-free features.

However, after Clements' (1985) seminal article "The geometry of phonological features", features are conceived of as hierarachically organized where phonological features are the terminal node of the hierarchical structure. The most of the features correspond to those proposed in Chomsky and Halle (1968) except laryngeal features ([stiff vocal cords], [slack vocal cords], [spread glottis], and [constricted glottis] as proposed by Halle & Stevens, (1971) and the feature [labial] as proposed by Anderson, (1971) (Cited in McCarthy, 1988)). The non-terminal nodes correspond to the classes of features. Different features are bifurcated into subgroups where the entire structure is dominated by a node called Root, corresponding to the unity of a single segment. Manner and Place feature classes are the part of the supralaryngeal node with which the laryangeal features constitutes the root node. [And the Halle (1992, 1995, 2000), McCarthy (1988), Clements (1985, 1987), Sagey (1984, 1987) These class features constitute their own tiers. This can be represented as below:

2)
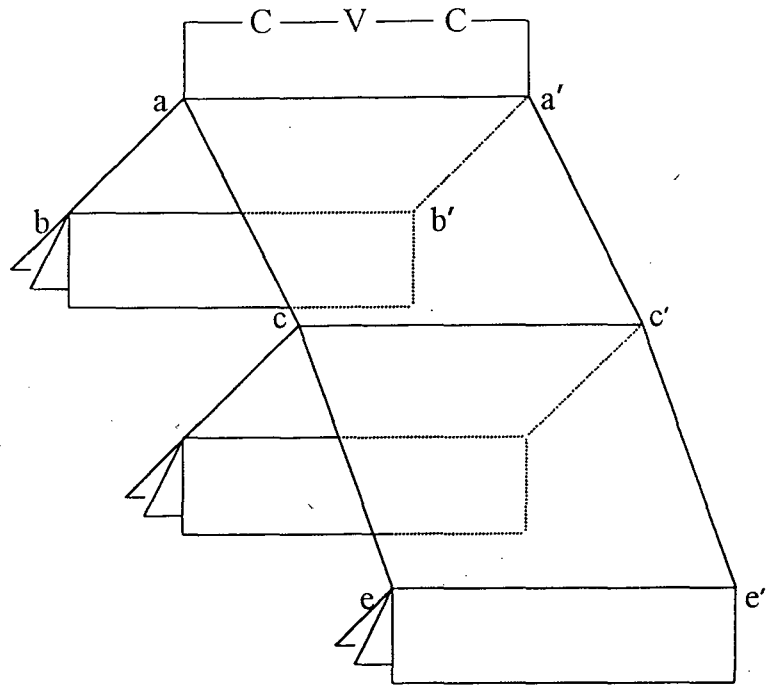
aa′= root tier, bb′ = laryngeal tier, cc′ = supralaryngeal tier,
dd′ = manner tier, ee′ = place tier

Clements (1985: 229)

The above organization of features is like cut and glued paper in which each fold represents a class tier. The lower edges are feature tiers and upper edge is the CV tier. Each segment of the CV tier is individually linked to the root tier. The organization of features into node is as follow:

3)

a)
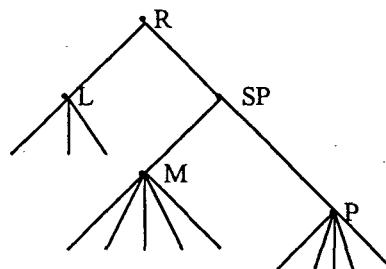
R = root, L = laryngeal, SP = supralaryngeal

M = manner, P = Place

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b)

L

[constr]   [spread]   [voice]

SP

[nasal]   [son]   [cont]   [lat]   [cons]   [strid]

c)

P

[lab]   [cor]   [dor]   [tongue root]

d)

Place

L   [round]

[ant]   [dist]   C   [high]   [back]   [low]   D   TR   [ATR]
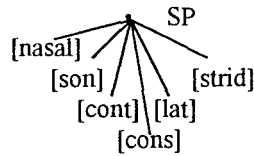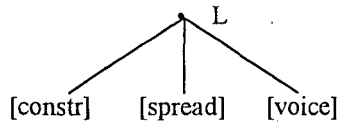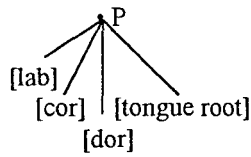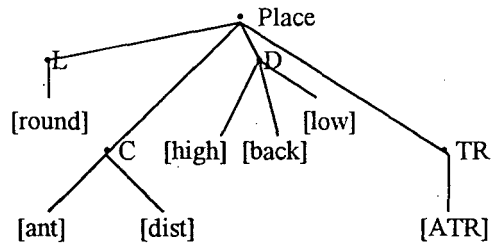
Sagey (1987: 452)

In this theory assimilation is seen as feature spreading rather than feature copying as it was widely accepted in the SPE model. Now, the feature spreading involves the spreading of class feature. For example, if a segment A agrees with a segment B in place feature, the place feature of the segment B will spread to the segment A depending upon the direction of assimilation, i.e. either leftward or rightward. This can be represented as follow:

4)

A B   or   B A
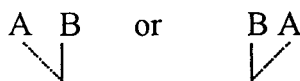
Thus, nasal assimilation can be represented as below:

5)

$$N \quad C$$
$$\diagdown \mid$$
$$[Place]$$
$$\mid$$
$$[+coronal]$$
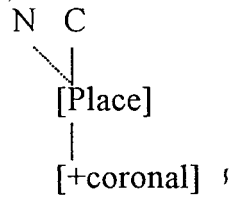
Since this dissertation deals with the phonology-morphology interface where segments are affected when two morphemes are adjoined, I will follow the general idea of morphological concatenation as presented by McCarthy and Prince (1993b) in their seminal paper:

6) Alignment Schema

ALIGN (Cat₁, Edge₁, Cat₂, Edge₂) = $_{def}$

$\forall$ Cat₁ $\exists$ Cat₂ such that Edge₁ of Cat₁ and Edge₂ of Cat₂ coincide

where

Cat₁, Cat₂ $\in$ P Cat $\cup$ G Cat

Edge₁, Edge₂ $\in$ {right, left}

(McCarthy & Prince 1993b: 2)

1.4 Hindi: An Introduction

Hindi is an Indo-Aryan language, which is chiefly spoken in northern part of India. The term 'Hindi' is taken here in a broader sense where it subsumes the regional varieties, though, it is a matter of great controversy whether these regional varieties are really the offshoots of Hindi or it is the creation of Indian Polity. What people call standard variety is now in books and I feel that once upon a time it may fall into the fate of Sanskrit which could never become the language of general masses rather it was limited in the books. Here I do not want to go into this controversy, rather I stick to the standard variety of Hindi spoken by the educated masses. Hindi is a late product of Khari Boli, which has largely borrowed its

lexicon from Sanskrit and other languages and thus the grammarians and linguists, too, have divided its lexicon into four stocks, namely *tatsama*, *tadbhav*, desaj, and *videšaj*.

Tatsama: The term '*tatsama*' is referred to those lexical items which are taken from Sanskrit in its original form without any modification or change.

    7.1

        əgni   'fire'

        riši   'sage'

Tadbhava: The term '*tadbhava*' is referred to those lexical items, which are taken from Sanskrit but were modified in the *Prakrit-Apabhramsa* period,

    7.2

Skt	Hindi	
həst	ha:th	'hand'
əkši	ã:kh	'eye'
əgni	a:g	'fire'

Desaj: The term '*desaj*' is referred to those lexical items, which are country made, i.e. borrowed from other regional varieties. This stock also includes those lexical items whose origin is unknown.

    7.3

        kɒri   'score'

        khot   'blemish'

        muga   'coral'

Videšaj: The term '*videšaj*' is referred to those lexical items which are borrowed from other foreign languages like Arabic, Persian, Turkish, English, Portuguese etc.

7.4 a.

Arabic

ɪmtihan   'examination'

mʊkədma: 'trial'

əmir   'rich'

7.4 b

Persian

Qəmər   'waist'

Qəm   'less'

gʌm   'lost'

7.4 c

Turkish

ca:ku   'knife'

top   'canon'

laš   'dead body'

7.4 d

English

bonəs   'bonus'

bæŋk   'bank'

sɪnema   'cinema'

1.5 Organization of the dissertation

The objective of the present work is

problematic areas. To achieve this I have divided the dissertation into the following chapters:

Chapter 2 explains the views of various scholars on this problem and the solutions suggested by them. It simply presents the critical review of the researches done so far on the topic under consideration. It ends with foregrounding the unsolved problem of representation.

Chapter 3 describes the notion of the Moraic theory and its architect. It introduces its implication for assimilation phenomenon and then develops the idea to solve the problem arising from assimilation.

Chapter 4 analyzes the problems of nasals. An attempt has been made to provide the solution to the problem within the framework of the Moraic theory and the Feature Geometry.

Chapter 5 concludes the work.

Chapter 2

BEHAVIOURS OF NASALS IN HINDI

Different behaviours of nasals have been the matter of inquiry right from the beginning. Though, many interesting researches on vowel nasalization and nasal assimilation have been undertaken in different languages, linguists have attempted to explain these phenomena in Hindi, too in different theories. For example, Kelkar (1968), who worked in the structuralist framework; Pray (1970), Srivastava (1969, 1970(a, b & c) , 1974, 1979, 1987), Narang and Becker (1971), Ohala (1972, 1974, 1977, 1983, 1985, 1987), Bhasin (1979) attempted to answer in the linear framework; D'souza (1985), Bharati (1984) and Sethi (1994) explained these processes in the non-linear framework. The present chapter will discuss the approaches of various scholars and the problem underlying thereafter.

2.1 Ancient Indian Grammatical Tradition

Different behaviours concerning nasals had been the matter of controversy among the ancient Indian grammarians, too. According to them the process of nasal production involves the combination of various intra-buccal processes (Allen 1959: 39). To differentiate the different behaviours of nasals, the ancient Indian grammarians had identified three terms according to their behaviours: *naasika*, *anusvaara* and *anunaasika*. However there is no clear-cut distinction between these terms. For example, *Taittiriiya Praatisaakhya* (ii: 52) states about the mechanism of the process of nasals as:

"naasika-vivaranaad anunaasikyam".

(Cited in Allen 1953: 39)

i.e. nasality is produced by opening the nasal cavity. This definition distinguishes nasals from oral sounds where lowering of the velum is

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recognized to maintain this distinction. However the *Taittiriiya Praatisaakhya* (ii: 51) further points out:

"vargavac caiṣu"

(Cited Allen 1959:39)

i.e. the articulator is as for the corresponding oral consonants. I think that here *Taittiriiya Praatisaakhya* talks about homorganic nasals but Allen (1959) relates with the nasal consonants. Moreover, if we take stop series of the oral consonants, it would give rise to the following nasal consonants: ŋ, ñ, ṇ, n, m (Allen 1959: 39). Similarly, Panini (I.i.8) takes both mouth and nose for the production of nasals as it is stated:

"mukha-naasikaa-vacano 'nunaasikaḥ".

(Cited in Allen 1959: 39)

The term *anunaasika* is referred to nasalized vowel in contrary to *sudha* or pure oral vowels. Some schools recognize another term for the process of nasalization, i.e. rakta, 'coloured'. That is to say, vowels take nasal colour. For example, Ṛg *Veda Praatisaakhya* and *AtherVeda Praatisaakhya* describe nasalized vowels in terms of nasal colour which spreads to vowel in the environment of nasal consonant.

The third term *anusvaara* which might literally translated either as 'after sound' or as 'subordinate-sound' is referred to homorganic nasals. This kind of sounds is restricted to the post-vocalic positions only and its primary context is before the fricatives /s/, /ṣ/ and /š/. However as Allen (1959) points out that there is no phonological difference between the sequence VŋS (where V= any vowel and S= any fricative) and VLL (where L= any semivowel except r) or VNT (where T= any stop and N= homorganic nasal).

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However, they used the three terms *naasika, anunaasika,* and *anusvaara* with overlapping semantics. For example, for the *Ṛg Veda Praatisaakhya naasika* stands for both nasals and nasalized vowels. In the *Taittiriiya Praatisaakhya anusvaara* is taken as a nasal archisegment and its variants. For the *AtherVeda Praatisaakhya, anunaasika* stands for both the actual variants of nasals and the nasalized vowel. Moreover, they have not given clear picture of why and where we have different realizations of nasals.

2.2 The Views of Traditional Hindi Grammarians

• So far as the grammars of Hindi are concerned, Gilchrist (1820) is the first person who undertook the study of Hindi, which he termed as Hindoostani, from the phonetics point of view. However his listing of nasalized vowels with English pronunciation as oral vowel plus nasals is not exhaustive since it includes only inflection endings and limited range of words which has segments like /s/, /h/, /w/ or morpheme boundary (in the case of inflection), e.g.

1)

[moonh]	'mouth'
[hunsna]	'to laugh'
[panw]	'leg/ foot'
[anten]	'intestine'

Except such examples, he posits /n/ regardless of whether the preceding vowel is short or long. For example:

2)

[dant]	'tooth'
[zunjeer]	'chain'
[rungna]	'to colour'
[kampna]	'to shiver'

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He describes nasals as dental and the other variants as realizations of the same phoneme.

Kellog (1938/ 1965) also discussed about homorganicity and nasalization. He was the first person who discussed about the orthographic symbol of Devnagari to describe the process. For example, he used the diacritic marks '$\smile$' and '$-$' for nasalization and homorganic nasal respectively. He points out that after long vowels the anusvaara represents nasalization and after short vowels it represent homorganic nasal. However, it is not the case since short vowels also undergo nasalization and there are words where we have homorganic nasals even after long vowels as given in (17) and (18).

Kishori Das Vajpeyi (1957) claims that what was anusvaara in Sanskrit has become anunaasika in Hindi. He gives examples as:

3)

Skt.	Hindi	
aŋguṣth	ãgutha:	'thumb'
dant	dã:t	'tooth'

However, he gives the word for 'grape' with anusvaara: [aŋgur]. Thus, from his such examples we can say that both the short and the long vowels get nasalized, as well as become homorganic nasals which itself creates doubt about his claim.

2.3 The Views in Modern Phonology

Jones (1962) considers nasalized vowel of Hindi as di-phonemic. He says that they occur 'incidentally' as well as 'expressly'. He writes:

> " In this language (i.e. Hindi) vowels are regularly nasalized when a nasal consonant precedes. Thus the agentive suffix commonly written 'ne' is usually pronounced nẽ though Indians are not, as rule, aware,

of the fact, they think they pronounce 'ne' and the pronunciation 'nē'

would be accepted as correct. The nasalization is 'incidental'. The

sound ē occurs also 'expressly' as a phoneme separate from e. It

generally occurs after non-nasal consonants, e.g. in pē (Singing) ghēt

(throat) Degi (boat). But it sometimes occurs 'expressly' after a nasal

consonant, it does so, for instance, in the word 'mē' (in) and in the

case of this word a Hindustani speaking Indian will not accept 'me' as

correct substitute. It, therefore, seems advisable in Hindustani to

assign the sound ē to the e phoneme in some words where a nasal

consonant precedes but not in others".

<p align="right">(Jones 1962: 99)</p>

What he calls 'incidentally' and 'expressly' is similar to allophonic and phonemic nasalization. He considers nasalization of vowels as di-phonemic where there is the environment of nasal consonants. However, he recognizes a very few vowels which gets nasalized.

Kelkar (1968) provides a good description of word phonology of contemporary Hindi-Urdu which he calls as Hirdu. He presents a large amount of data including variations in the language which is useful to uncover many complex facts. His analysis is, nonetheless, based on the structuralist approach which restricts him to go beyond segmentation and classification of the utterances; consequently, he looks for functional contrasts like minimal or subminimal pairs and other structuralist approach to describe the phonology of Hindi-Urdu and finally setting up phonemes. He identifies two nasal phonemes /m/ and /n/ and an archiphoneme /N*/. He sets up phonemes /m/ and /n/ on the basis of minimal pairs like [mata] 'mother' and [nata] 'relation', and archiphoneme in the case of homorganic nasal formations in the words [sampann] 'prosperous', [saNgit] 'music' etc. He states that such

<p align="center">17</p>

variations occur in the Sanskrit loanwords which can be stated in the form of rules. These variations are the allophones of one morphophonemic unit /N*/ and are realized as:

4)

[n] before a dental consonant or nasal or affricate or a /l/ or /r/.

[ṇ] before a retroflex consonant.

[ŋ] before a velar or h.

[ỹ] before [y]

[ũ] before [u]

and [m] elsewhere.

However, he misses the generalization by positing /m/ as elsewhere condition because we have words like [ka:n] [pa:ṇi] etc which forces us to establish /ṇ/ as a phoneme, too.

Srivastava (1969) in the review of Kelkar's book "Hindi-Urdu Phonology: An Introduction" criticizes Kelkar's position of nasalized vowel as phonemic saying that actually at the systematic phonemic level nasalized vowel is VNC sequence which is realized at the systematic phonetic level as nasalized vowel. He further points out that nasal assimilation also has the same underlying representation on the systematic phonemic level- the difference between the two is captured through positing a diacritic feature F marked on the lexical item, which triggers its realization one way or the other. Thus, according to him the diacritic feature makes the difference between the two realizations as follow:

5)

/daNta/ → [dã:t] 'tooth'
+F/

/daNta/ → [dant] 'tooth'

— F/

Then, he gives the following rule to derive [dã:t]:

6)

$$\begin{bmatrix} +\text{voc} \\ -\text{cons} \end{bmatrix} \quad [+\text{nasal}] \quad \begin{bmatrix} +\text{cons} \\ -\text{voc} \end{bmatrix} \quad \Rightarrow \quad \begin{bmatrix} +\text{tense} \\ +\text{nasal} \end{bmatrix} \quad \emptyset \quad 3$$

$$\quad\quad 1 \quad\quad\quad 2 \quad\quad\quad 3 \quad\quad\quad\quad 1 \quad\quad 2$$

Srivastava (1969, 1970c) while describing the different surface manifestations of nasals adopts the ancient Indian grammatical tradition's classification of nasals into *anusvara, anunasika,* and nasal mute which can be represented as:

7)
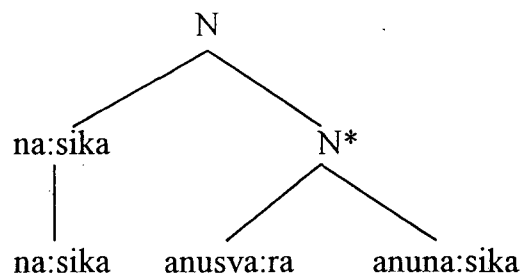
(Srivastava 1970c:115)

However he tries to clarify the terms which seem to be confusing in the ancient Indian grammatical traditions. He says that nasals which undergo place of assimilation are *anusva:ra,* and those which affect nasalization of vowels are *anuna:sika* and those which stands on its own or which are phonemes are nasal mutes. He claims that occurrence of N* is confined to the post-vocalic position followed by a consonant or a morpheme boundary.

Ohala (1983) criticizes Srivastava's approach and gives three arguments to reject his proposal which I summarize as follow:

a) There is no evidence for the psychological reality of relatedness between doublets such as [dant] and [dã:t]. They are not alternating forms in the usual sense of the term.

b) The first member of this pair only exists in the vocabulary of certain speakers and enters their vocabulary only after they receive formal education.

c) Her third argument is about abstractness. To quote:

Deriving [dant] and [dã:t] from the same underlying form is similar to, though perhaps less drastic than, positing a common underlying form for English 'tooth' and 'dental' or 'queen' and 'gynecology'."

(Ohala 1983: 97)

Following Srivastava (1969), Narang & Becker (1971) treat nasal vowels as an underlying sequence of oral vowel and nasal consonant. The generalizations that Narang & Becker have formulated are:

a) Hindi has long nasalized vowels, and short vowel does not carry nasalization. However, there are some exception such as:

8)

hə̃s-na	'to laugh'
mɛ̃hŋga:	'dear'
khĩ:č-na:	'to pull'
lɛ̃hŋga:	'skirt'

b) Within a morpheme, long vowels never occur before a consonant cluster in which the first member is nasal. The word [ša:nt] 'quiet' is an exception.

c) To derive nasalized vowels from an underlying sequence consisting of oral vowel and nasal consonant makes the phonemic inventory less costly.

They formulate following P-rule to account for nasalization:

9)

$$\begin{bmatrix} +\text{syllabic} \\ +\text{tense} \end{bmatrix} \quad [+\text{nasal}] \quad C \rightarrow [+\text{nasal}] \quad \phi \quad 3$$

$$\qquad\quad 1 \qquad\qquad 2 \qquad 3 \qquad\quad 1 \qquad 2$$

They look on the problem of nasalization as the interaction between schwa syncope and vowel nasalization where schwa syncope precedes vowel nasalization.

Bhatia & Kenstowicz (1971) point out that this rule ordering leads to ordering paradox. For example, Narang & Becker's rule ordering fails to account for the following forms if they order the rule of syncope to precede nasalization:

10)

a:nəs	ma:nsi	'mind'
mət	ki:mti:	'price'
da:nəw	da:nwõ:	'demon'

Bhatia and Kenstowicz (1971) suggest that this problem is one of derivational history where derivational history is defined in terms of the global rules. They further suggests that nasalization applies to underlying V:NC sequence and not derived ones. They describe nasalization in this framework as:

11)

$$\bar{v} \to \bar{v}^n / \text{---} /NC/$$
$$N \to \phi / V \text{---}$$

(i.e. nasalize a long vowel before a nasal plus consonant sequence only if the member of this sequence were adjacent in the underlying representation.)

However, Kiparsky (1973) criticizes the use of global rules and considers them as undesirable since they add too much power to the grammar.

However, whether it is the analysis of Narang & Becker or Bhatia & Kenstowicz, all of them have considered the nasalization as morpheme based rule, i.e. the rule for nasalization applies in the environment of a consonant to the right of nasalized vowel while there are plenty of words where nasalized vowels are found at the end of the words. For example:

21

12)

     mã: 'mother'

     dhuã: 'smoke'

     hã: 'Yes'

Ohala (1983), Ohala & Ohala (1991) mostly rely on the phonetic manifestation of the nasalized vowels and demonstrate by the spectrographic analysis that the nasalized vowel does not have a vowel + a nasal sequence. However, the acoustic analysis can only demonstrate what we really actualize rather than what we have in mind. Their argument is similar to find out the sum total of output in terms of what is given input or other way round. But it is not possible every time. For example, when we mix sugar and water, we would never get the sum total of input (i.e. the quantity of sugar and water we actually mix up). It is because water absorbed the quantity of sugar in itself. Similarly when we have the nasalized vowel, we have two processes working together- the passing of air through the oral cavity and the nasal cavity at the same time. At this moment we can not get the sum total of the two- the duration of the oral vowel and the duration of the nasal segment. Nonetheless, the motivation behind such assumption (underlyingly oral vowel plus a nasal segment) is that the underlying representation of the nasalized vowel is an oral vowel plus a nasal which is transformed into the nasalized vowel at the phonetic level.

D'souza (1985) suggests following Narang & Becker (1971) that all nasalized vowels are long and she derives nasalized vowels from the underlying sequence of the short vowels and the nasals. Moreover the nasal consonant is in the coda and linked to an X slot in the underlying representation. Thus, the underlying representation for a word like /ãːngən/ would be

13)
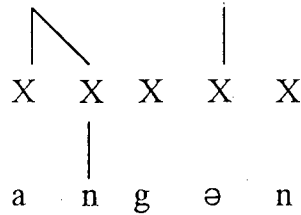
Here, nasal spread and vowel length are coexisting processes. Thus, she proposes derivation like (14)

14)

a. Nasal spread
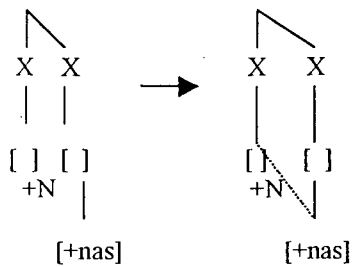
b. Vowel spread
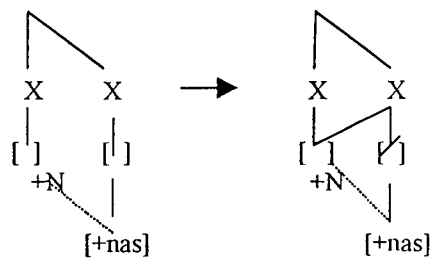
Her proposal is undoubtedly somewhat right but problem is that it can account for only long nasalized vowels but Hindi has plenty of short nasalized vowels as given in (18).

Sethi (1994) takes Prosodic Phonomorphological Component (PPM) to describe the phonology of Hindi. This PPM interacts with lexicon and the output of syntactic component. Since it is the analysis of Phonology-Morphology interface, it takes word as an important unit, like Lexical Phonology Morphology she divides the application of rules at the different

Word Level. For example, nasalization takes place at Word Level2 phonology. Thus, nasalization in word like g□ga can be represented as follow:

14.a)   14.b)
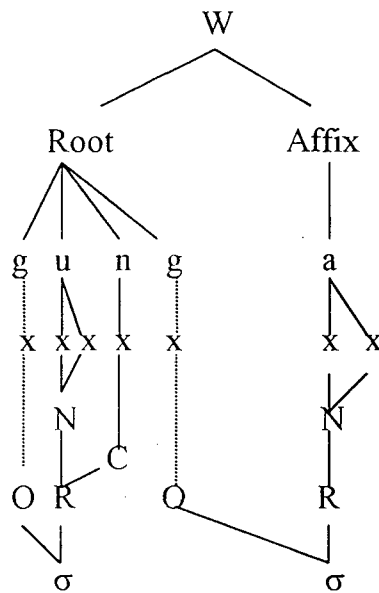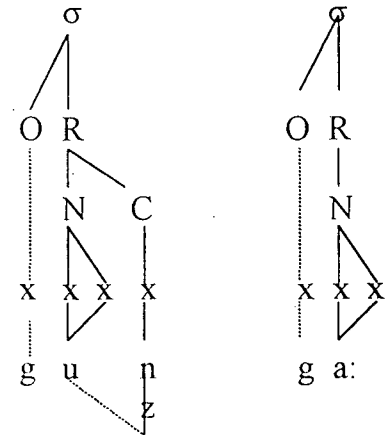
(Sethi 1994: 188)

However she does not mention why we do not have nasalization in forms like:

16)

        aːm   'mango'

        šaːm   'evening'

Like Narang & Becker (1971) she assumes that only long vowels undergo nasalization. For short nasalized vowels she suggests that they are found in derived words where the root forms have nasalized vowels and thus, in derived forms short vowels also exhibit nasalization. She demonstrates by following examples:

17)

        sĩːñč   →   sĩc-aːĩː   'irrigate'

24

jã:c	→	jə̃č	'examine'
bã:t	→	bə̃ṭ	'distribute'

But her suggestion fails to account for the following words:

18)

hə̃s	'to laugh'
sə̃wər	'beautify'
ḍə̃k	'sting'
kə̃wər	'name'

Secondly, she does not talk about the homorganicity within the syllables as in

19)

čəmpa:	'name of a flower'
ta:mba:	'copper'
bənd	'close'
ka:nt	'surname'

When she talks about homorganicity, she takes those homorganic nasals which happen across morpheme boundary. For example:

20)

səm	+	ṭap	→	sə̃ṇtap	'fury'
səm	+	ləgn	→	sə̃lləgn	'enclosed'

But she fails to give any account for the non-homorganicity of nasals in words like:

21)

səm	+	təl	→	səmtəl	'level'
səm	+	koṇ	→	səmkoṇ	'equiangle'

Moreover, she also follows the classification of nasals into *naasika*, *anunaasika*, and *anusvaara*, but both of them fail to provide the phonological differences between the three which result into different surface manifestations. They fail to address the question: What are the characteristics of nasal mutes which block them to undergo either nasalization or homorganicity? For example, in Hindi we have words where nasals even staying in the coda position .do not spread its nasality onto vowels while their analysis demonstrates that nasals in coda position leads to vowel nasalization.

2.4 Defining the Problem

Amidst the prevalent controversy in the phonological analysis of nasalization, it is difficult to discard one theory over the other; however, it is mandatory to select one over other at least on the ground of simplicity. At this juncture, I would like to follow Halle's argument.

> *"Given two alternative descriptions of a particular body of data, the description containing fewer ... symbols will be regarded as simpler and will, therefore, be preferred over the other" /*

(Halle 1962: 55).

Secondly, Ohala & Ohala (1991) argue for the epenthesis of a nasal segment in the words which contain a nasalized vowel plus a voiced consonant. Their argument stands on the ground that in some words of old Hindi, which have nasalized vowel followed by a voiced consonant, we have now nasal epenthesis in modern Hindi. Though they provide phonetic description for that change, however we can see it other way round, too, i.e. nasal epenthesis may be a kind of unpacking of nasalized vowel, which after sometime might turn into an oral vowel and a nasal segment.

As demonstrated by Paradis & Prunet (2000) nasal vowels are actually oral vowels plus nasal segments and I think it holds true on the perceptual ground

which obviously results into phonetic illusion to a naïve speaker. No doubt, this argument again brings the psychological reality into the scene. Yes, if any naïve speaker pronounces nasalized vowel as the oral vowel plus the nasal segment, the speaker of Hindi may without hesitation interpret it as a nasalized vowel which leads to the conclusion that somewhere, in the mind, does such nasalized vowel exist as the oral vowel plus nasal as the component of phonological word.

Discussion of the different approaches resulted into the following problems concerning different behaviours of nasal:

(1) Does the nasalized vowel have an oral vowel and a nasal segment in underlying phonological representation?

(2) As in the various approaches we have encountered that the nasals in the nasalized vowel and homorganic position are archiphoneme. Then the question arises "What is the difference between those nasals which spread their features to the preceding vowels and those which undergo place assimilation?"

(3) Similarly, What is the phonological difference between archiphoneme nasal and nasal mutes?

Chapter 3
Moraic Theory and Assimilation

The problem of the different behaviours of the nasals in Hindi can be captured if we identify the correct underlying representation or input representation which will help us get the correct rules in the derivational theory or find out constraints in the non-derivational theory like the Optimality Theory. This chapter deals with the prosodic structure and the development of the Moraic theory and its implications for assimilation in the phonological theory. It is the methodological premise of my dissertation within which I will make an attempt to find the solution for the different behaviours of the nasals.

3.1 Introduction

With the dissatisfaction with the classical generative phonology, as proposed in Chomsky and Halle (1968) The Sound Pattern of English (and henceforth, SPE), a new era of phonological research emerged. SPE assumes phonology as homogeneous system where the interaction of phonology with the rest of the grammar is restricted to an interface with the syntax and the output of syntactic component serves as the input of the phonological component with the possible intervention of the Readjustment Rules. The focus of then research was to inquire the phonological representations which were assumed to consist of a linear arrangement of segments and boundaries where the segments are conceived of as unordered sets of features and boundaries interspersed between the segments. They are dependent on the morphological and syntactic structure according to their nature and location; and then to formulate rules system which relates the underlying phonological representations to the phonetic representations. After the mid seventies, phonology took a new direction of research where phonology was

conceived as heterogeneous system interacting with many subsystems which may otherwise be called domain of the application of phonological rules, and representations of continuous flow of speech are taken as hierarchically arranged chunks. This second phase of the phonological development witnessed a long run of enquiry into the phonological representations and constraining the rules which transform the phonological representations into the phonetic ones as well as constraining the way the phonological representations get arranged hierarchically. The phase yielded the autosegmental theory, the metrical theory, and the syllabic theory which recognize a syllable as a phonological unit. The recognition of syllable as a unit in phonological rule application gave a new insight in the phonological theory.

3.2 Syllable in Phonology

The role of syllable in the phonological study was not recognized to the extent it should have. In the legacy of the traditional approach to study language, it was on par with the concept of word rather than having independent recognition as a phonological unit. In the era of American descriptivism was to pass directly from the phoneme to the morpheme without recognizing any intermediate unit of phonological organization, though some attempt was made to define syllable in terms of distributional patterns (cf. O'Connor & Trim 1953) or articulatory patterns (cf. Pike & Pike 1947, and Hockett 1955). Even in the classical generative phonology (SPE model), the syllable has no theoretical status, and generalizations were stated in terms of features and boundaries via rules and the morpheme-structure conditions. However, in the various European approaches, Trubetzkoy, Hjelmslev and Firth had recognized the independent status and the structural importance of the syllable. It is after Fudge (1969), Anderson (1969), Brown (1970), Vennemenn (1972), Hooper (1972) and Fischer-Jorgensen (1972) the phonologists came to recognize syllable as an undeniable phonological unit.

Selkirk (1982) following Hooper (1972) and Fischer-Jorgensen (1972) states that the syllable is the natural domain for the statement of phonotactic patterns, i.e. certain grouping of segments is sensitive to or can be predicted on the basis of a division into syllables whether it is initial or final positions, since in any environment a given sound or sounds have limited distribution within a language. Anderson (1974) demonstrated that syllable is required as an environment in the statement of phonological processes whereas Kahn (1976) attempted to reconstruct the theoretical edifice of the generative phonology in order to let the syllable to act as a conditioning environment for phonological rules.

It is only after the emergence of the autosegmental phonology (Goldsmith 1976), the phonologists started to realize that there are more structures in a phonological entity than simply a string of feature matrices. To account for tonal processes, for example, it was realized that it is inevitable to recognize the tone as sequential units on its own tier, which provides more insightful account. This paved the way to identify syllabicity on its own tier and consequently, we had establishment of a CV tier differentiated on the basis of the feature [± syllabic] where C stands for consonant slot, i.e. [− syllabic] and V stands for vowel slot, i.e. [+ syllabic] (McCarthy 1979, Clements & Keyser 1983). These Cs and Vs are also referred as skeletal or timing units. This skeleton provides a kind of hub, which mediates between the melody, or segmental tier and higher level of prosodic tiers.

The next approach to the skeleton tier was to eliminate the distinction between C and V, and have uniform timing units represented as Xs (Levin1983, 1985). They assumed syllabic structure as hierarchically represented unlike the CV phonology which advocates for flat structure (cf. Clements & Keyser 1983). But it was soon realized that the prosodic category that determines the syllable structure is mora and many phonological rules can be explained through this theory which seems more restrictive than X-notation theory.

3.2.1 Syllable Structure

Syllables have hierarchical structures associated to the melody tier. Halle & Vergnaud (1980, 1982), Selkirk (1982) etc. propose that the grammar of a language defines a set of structures that characterize the syllable types possible in that language where the creation of onset and coda are determined by the permissible clusters allowed in a given language. The statement about the consonant cluster can be formulated in terms of the Positive syllable structure condition and the Negative syllable structure condition (PSSC and NSSC, respectively) (cf. Clement & Keyser 1983). However, there is no simple procedure for determining the syllable structure. Actually, the nature of the mechanism for syllabification is an empirical hypothesis and its authenticity depends on the extent to which we can get linguistically significant generalizations. Nonetheless, the languages may vary in terms of syllabification of a given sequence of sounds. Thus, there are some universal as well as language specific rules of syllabificaiton. Clements & Keyser (1983) propose universal principle for syllabification as:

The Onset First Principle

a. *Syllable initial consonants are maximized to the extent consistent with the syllable structure conditions of the language in question.*

b. *Subsequently, syllable final consonants are maximized to the extent consistent with the syllable structure conditions of the language in question.*

(Clements & Keyser 1983: 37)

According to this principle the morpheme of the form VCCV will be syllabified as VC.CV as shown in (1), though the languages may syllabify the same form as VCC.V. This kind of syllabification violates onset maximization principle. Hence, to capture such variations found in the languages Ito (1989) reduces the onset maximization principle to the onset satisfaction principle where a syllable may be saturated in terms of the onset through the ambisyllabification of the consonant.

Moreover CV phonology assumes syllabic structure as flat structure where there is no hierarchical organization of nucleus, onset, and coda. However, Fudge (1969) proposes that the syllable is hierarchically organized where the nucleus and the coda form the rhyme, and then the rhyme and the onset constitute a syllable. There are many phonological processes which consider nucleus and coda as one part and onset another. Thus, we have asymmetry between the onset and the coda. For example, in compensatory lengthening deletion of a coda consonant results into lengthening of the preceding vowel but not the onset deletion affects in this fashion. Similarly, for determining the phonological weight of a syllable the coda plays role but not the onset. For instance, the languages treat the syllable having a short vowel as light and having a long vowel as heavy, but languages vary in treating CVC as light or heavy. We miss such asymmetrical relation in the flat structure as we had in the Phrase-structure grammar of the early generative theory (Chomsky, 1957, 1965 etc.)

1)

$$
\overset{\sigma}{\overbrace{\overset{}{\underset{C\ V\ C}{\diagup | \diagdown}}}}\ \overset{\sigma}{\overbrace{\overset{}{\underset{C\ V\ C}{\diagup | \diagdown}}}}
$$

C V C C V C
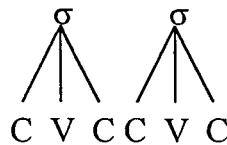
Levin (1985) proposes that the syllabic structure is not flat but it is hierarchically arranged. She derives the hierarchical structure according to the X-bar theory where all the constituents of a head are represented asymmetrically, i.e. some constituents may land on the specifier of the maximal projection of the head X, some constituents may land on the complement position of the head X. She applies this asymmetry in phonology where she proposes that the nucleus is the head of the syllable; the onset lands on the specifier position of the head; and the coda elements land on the complement position of the head. Thus, she formulates schema as:

2)

Syllable

Onset
Rime

Nucleus   Coda

X ...   X ...   X ...
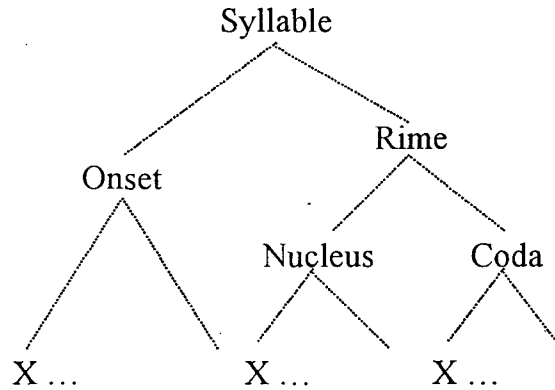
(Levin 1985:16)

This hierarchical representation is transformed into the X-bar theory where the nucleus functions as the head of the syllable and the onset functions as the specifier of the head 'nucleus' and the coda serves as the complement of the head 'nucleus'. She explains this asymmetry according to the hierarchical structure. This can be represented as:

3) a.   b.   c.

N″   N″   N″
| | |
N′   N′   N′
| |
N   N   N
| | |
X X   X X X   X X   X
| | | | | | |
t a   t a: t a   n
[ta]   [ta:]   [tan]
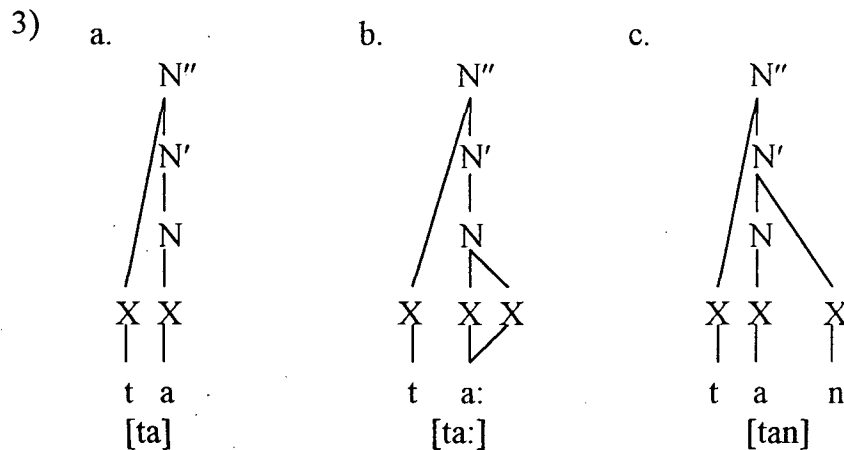
By this hierarchical structure we can get generalization about the asymmetry I discussed above. Thus, we define the light syllable as the non branching nucleus and heavy syllable as the branching nucleus. We can extend this definition to the rhyme for getting generalization about the CVC structure, as the branching rhyme will be heavy.

Following Levin (1983), Archangeli (1984) divides the syllable structure into the heads and the domains where domains have no status in isolation rather it can be defined in the terms of heads. She proposes the syllabification rule for the structural description as:

Heads are denoted by vertical lines over X slots:

4)

$$\mid$$
X

And domains are denoted by angled lines over X slots:

5)

a. $\diagup\mid$ b. $\mid\diagdown$
X X   X X
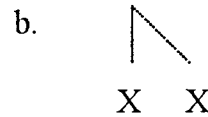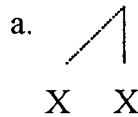
The syllabification rule is similar to Clements & Keyser (1983) which states syllabification in form of the onset maximization principles, though she differs from Clements & Keyser (1983) in the sense that she replaces the CV-skeleton tier by the X-skeleton tier. The syllable formation at the initial stage is called the core syllabification which takes place as follow:

6)

    a) Syllable formation

X X

    b) Rime formation

X X

(Archangeli 1984: 176)

Nonetheless, it is not the end of the mechanism of the syllabification rather it continues at every stage of derivation which is otherwise called the resyllabification. Thus, the grammar not only incorporates the rule of the core syllabification, but we also have the rules for the desyllabification when a segment is deleted in the course of derivation, and the resyllabification which may continue throughout the derivation. The rules for the desyllabification apply at a point of derivation and unless the desyllabified segment is resyllabified as a syllable head or to the syllable head, it does not surface, i.e. it is not phonetically realized. Thus, the desyllabification of a segment can be represented as:

7)

$$\begin{array}{c} | \\ X \ \rightarrow \ X \end{array}$$

However, the rules for the resyllabification apply after every derivation, i.e. when the core syllabification applies at the latter stage, the syllabification is called the resyllabification. For example, the roots are syllabified before it enters the concatenation with the other affixes. After concatenation the rules of core syllabification apply again (which is known as the resyllabification). Thus, the resyllabification may result into a new kind of syllabic structure different from the core syllable. For, example, the root has syllable like CVCC which concatenates with a suffix VC, the resyllabification will create the new syllables like CVC.CVC. It can be shown as:
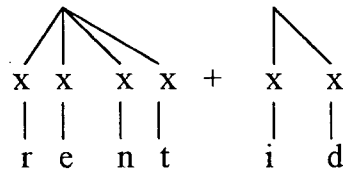
8)

a.

$$\begin{array}{ccccccc} & | & & & | & \\ x & x & x & x & + & x & x \\ r & e & n & t & & i & d \end{array}$$

UR

35

b.

x x   x x   +   x   x
| | | | | |
r e   n t   i   d

Core Syllabification

c.

x x x x x
| | || | |
r e nt i d
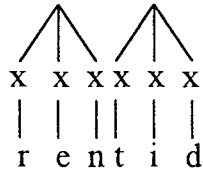
Resyllabification

3.3 Moraic Theory

The notion of mora is a traditional one emerged from the study of languages where the two subsequent segments in a syllable rhyme may carry different pitches or where the position of stress, accent, or tone depends on whether the syllable is light (CV) or heavy (CVV or CVC). It was, though, recognized somewhat in every school of linguistics, but after emergence of the generative accounts it had not got the due place until Hyman (1985) published his work 'The Theory of phonological weight' where he replaces the representation of the timing tier as CV or Xs by μ where μ represents the traditional concept of mora. Hyman (1984, 1985), McCarthy (1986) proposed uniform assignment of a mora to every segment in the underlying representation and then the onset creation rules delete the irrelevant moras; whereas Hock (1986) proposes for a separate tier for moraic representation. However, Hayes (1989) proposes that only vowels and geminates bear mora underlyingly. However, the coda consonant can also get moraic value by the weight-by-position (the evidence comes from the compensatory lengthening in which deletion of a coda consonant results into the compensatory lengthening of

the preceding vowel) which is a language-specific rule. It is widely accepted that the onsets do not play any role in determining the syllabic weight, thus they are assumed to have no moraic value, As Hyman (1985) demonstrates that only coda consonants contribute to the syllable weight by citing examples from varieties of languages. Hayes (1989) thus concludes that only vowels have mora in the underlying representation. The rest of the syllabification takes place later in accordance with the syllabification rules.

Following Dell & Elmedlaou (1985) and Ito (1986), Hayes (1989) suggests the following rules for the syllabification:

(a) Selection of certain sonorous moraic segments on language-specific basis for domination by a syllable node ;

(b) Adjunction of consonants to the syllable node, and of coda to the preceding mora.

However, adjunction is subject to language-specific conditions on syllable well formedness and the division of intervocalic clusters.

(Hayes 1989: 257)

Thus, in the Moraic Theory the syllabification takes place as follow:

9)

   a.   b.   c.

μ   μ   μ μ μ   UR
| | | | |
a t   t a t   a t a

σ   σ   σ   σ   Onset formation
μ   μ   μ μ μ   & σ projection
| | | | |
a t   t a t   a t a

σ   σ   σ   σ
μ   μ   μ μ μ   Coda formation
a t   t a t   a t a
[at]   [tat]   [atta]
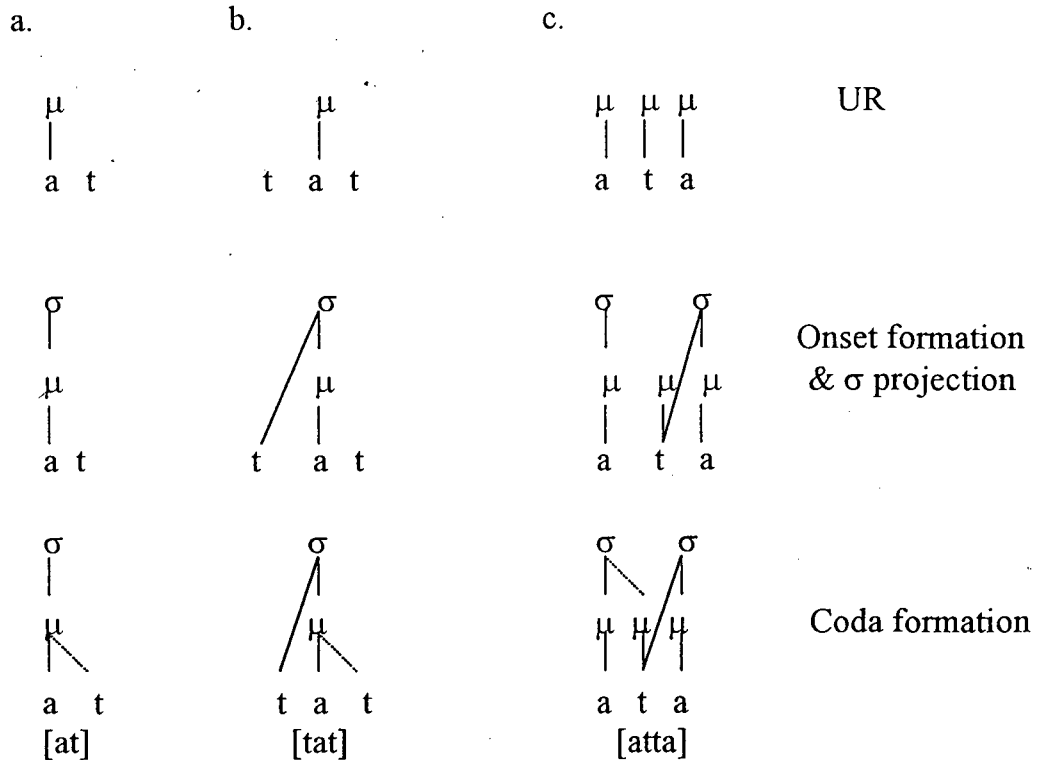
3.3.1 Structure of the Onset

Selkirk (1984) proposes that each segment is dominated by a mora in accordance with the Strict Layer Hypothesis. Similarly Hyman (1985) assumes that each segment is associated with a mora in the underlying representation but the universal Onset Creation Rule removes the mora from a prevocalic consonant and associates that consonant to the following mora as in the following instance:

10)

| | | \
μ μ μ   μ μ
| | | | |
p i n   p i n
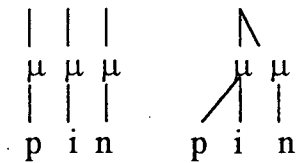
However, Hayes (1989) proposes that since onsets do not contribute in syllabic weight or the compensatory lengthening, it is unnecessary to increase the burden

of the phonological processes. A theory must be restrictive, and hence we should abandon the notion of assigning every segment a mora in the underlying representation. Thus he proposes that onsets report directly to the syllable node as shown below:

11)

$$
\begin{array}{c}
\sigma \\
| \\
\mu \\
| \\
\text{t a}
\end{array}
$$

3.3.2 Structure of Rhyme

There is no consistency in the structure of rhyme since languages vary in terms of counting syllabic weight. All languages count CV as a light syllable and CVV as a heavy but languages differ in counting CVC or CVVC as heavy. For example, Engl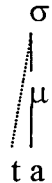ish, Latin, or Arabic counts CVC as heavy while Mongolian, Huasteco, and Lardil count CVC as light. Hayes proposes that vowels are anchored to a mora underlyingly- the short vowels to one mora and long vowels to two moras since every language treats open syllables with short vowel as light and open syllable with long vowel as heavy. To account for the differences in treating CVC as light or heavy, he proposes structural difference in associating the coda consonants to the syllable or the mora. The structure of the coda consonants varies in these two kinds of languages: in the languages which treat CVV and CVC as equivalent, the coda consonants adjoin to the preceding mora while in the languages which treat CVC as light, the coda consonants directly adjoin to the syllable node as shown in (12a) and (12b) respectively:

12)

a)

```
σ          σ
|          |
μ          μ
|          |\
a  t       a  t
```

b)

```
σ          σ
|          |\
μ          μ \
|          |  \
a  t       a   t
```
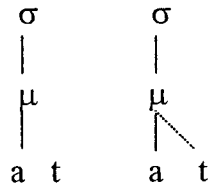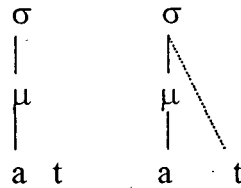
However, the inclusion of mora at the cost of elimination of the timing tier or skeleton tier still needs to be evaluated carefully, since this theory does not recognize any timing tier for the consonants unless it is geminate. But if we look on the languages where the compensatory lengthening had taken place, we would notice that the loss of a single consonant may also prompt for the compensatory lengthening of either a vowel or a consonant whereas it is the fact that the consonants do not play any role in determining the phonological weight (in comparison to the vowels). Nonetheless, it is also true that when we take the prosodic word for phonological description, it also includes length of consonants. For example, argument for the child acquisition of a word in the initial stage is like to mimic a prosodic word (in terms of timing) which includes the timing of consonants, too.

Secondly, it yields confusion over the notion of locality condition between the two segments, i.e. if we take two coda consonants as sisters of the preceding mora, the generalization about locality would become confusing in explaining some phonological processes like assimilation if a language use two processes

simultaneously. For example, if we take VNC sequence where loss of a nasal consonant incurs first increase in the vowel length and then nasalization of the vowel, while in other words the same sequence results into homorganicity. The occurrence of these two processes, in which former takes VN as the local domain while latter takes NC as the local domain yields a problem not only for locality but for getting generalization also. For instance, in Hindi we have examples of occurrence of such processes. Consider the following data:

13)

a)	dənt	→	dã:t	'tooth'
b)	kəmp	→	kãp	'shiver'
c)	sənt	→	sənt	'pious person'
d)	prã:nt	→	prã:nt	'province'
e)	krisṇa:	→	krisṇa:	'name of a person'

In the examples (13a & b) the nasal spreads its feature to the preceding vowel while in the examples (13c & d) the nasal assimilates to the following consonant and in the example (13e) the segment /s/ assimilates to the nasal. If we take these two processes happening in the local domain of a mora, we would be in a problem to explain these two processes.

3.4 Assimilation in Moraic Theory

Assimilation of segments is a natural phenomenon in the natural languages. It can be complete or partial- complete in the sense when all the features of the source segment spread over the target segments, we have complete assimilation and when some of the features of the source segments spread over the target segment we get partial assimilation. This kind of phenomenon may occur within a syllable or a morpheme or across morpheme boundary. To capture the partial assimilation within a syllable, phonologists put restrictions on the patterns of onset and coda

formation. As we have seen that in the X-skeleton theory we had onset as a constituent and coda as another which are separated from the nucleus. Thus, if we have assimilation in the onset or the coda clusters, we may reduce the problem by either putting the Morpheme structure conditions or the restriction on the onset formation or coda formation. For example, Goldsmith (1990) proposes one of the constraints as:

14)   Coda Formation Rule

If a coda contains a nasal followed by an obstruent, the nasal must be homorganic to the final consonant.

It may, thus, be said that such codas are specified for one distinctive place of articulation not two distinctive points of articulation or in the Feature Geometry it may be said that such constituents may have two root nodes but associated with one place node. This can be represented as below:

15)   a.

b.

```
                        σ
                       ╱ ╲
                  Onset   Rhyme
                         ╱ ╲
                  Nucleus   ╲
                            Coda
                            ╱ ╲
                      Nasal   Obstruent
                        │        │
                        │        │
                     [P of A]  [P of A]
```
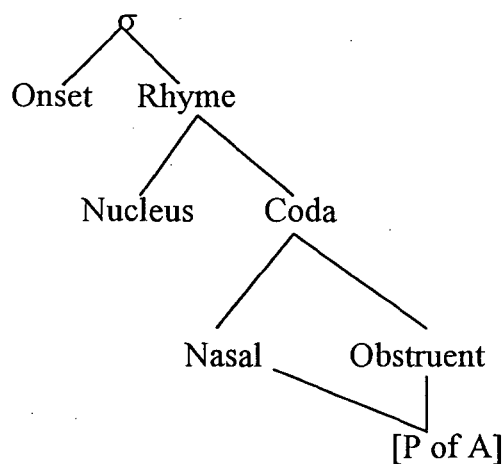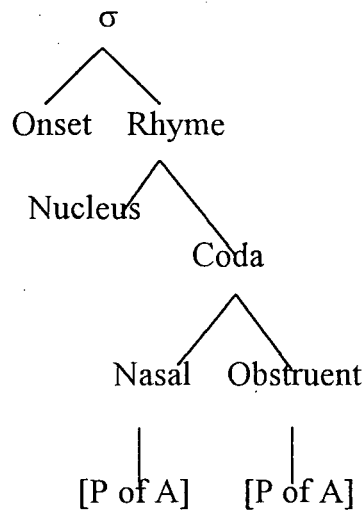
(Goldsmith 1990: 130)

Languages only allow (15a) as the coda cluster but not (15b). Here, for the assimilation of the nasals in terms of place of articulation with the following consonant can be seen as feature spreading within the local domain, i.e. coda. Any kind of assimilation or phonological processes, of course take locality into consideration. Then the question arises what locality is. Archangeli & Pulleyblank (1994) defines locality as:

16)

> *Locality condition*
>
> *Phonological relations respect Adjacency and Precedence.*

17)

> *Adjacency*
>
> α *is structurally adjacent to* β
>
> *(a) at least one of the two is unassociated, both are on the same tier, and no element intervenes between the two on that tier; or*
>
> *(b) both* α *and* β *are associated to the same anchor tier and no anchor intervenes on that tier between the anchors to which* α *and* β *are associated.*

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I modify the definition of locality as given by Archangeli & Pulleyblank (1994) a little bit to capture the variations in the languages

18)

Locality Principle

α is local to β iff

a) α and β are adjacent and the Precedence relation holds between the two,

b) α and β are in the dependency relation, and

c) α and β are in the same tier.

First, let us see the problem from a hypothetical language and the hypothetical examples to describe the problems and look for the solution. Let us suppose that there is a language which has CVCC or CVVCC[1] syllabic structure. In the Moraic Theory, its possible representations will be as given below depending on how the language treats this structure, i.e. light or heavy or super-heavy:

19)

a.   b.   c.

C V C C   C V   C C   C V C C
Heavy   Light   Superheavy
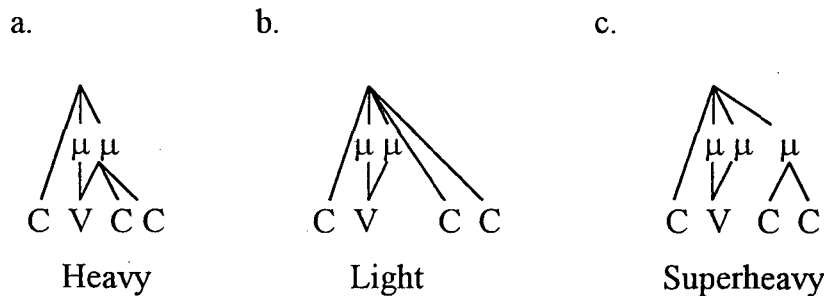
Moraic representations of CVVCC Structure

Suppose there is a morpheme consisting of three segments X, Y, and Z (where X = V, Y = C and Z = C) which have a set of feature(s) F, G, and H respectively[2], and the features spread to the left. In cases where a syllable is heavy, X, Y, and Z

---

[1] Here VV is a long vowel.

[2] Here the features F, G, and H stand for the class feature as proposed in the Feature Geometry.

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would be in the same domain and the precedence relation will hold between the three. Thus all the constituents X, Y, and Z are local. What will happen if in a language the features spread in this fashion?

20)

$$X \leftarrow Y \quad \text{(in some words or morphemes)}$$

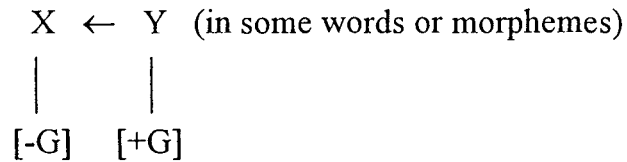$$[\text{-G}] \quad [\text{+G}]$$

Here the feature [-G] of X changes to [+G] and the segment Y deletes. However in some other words the phenomenon works like

21)

$$Y \leftarrow Z \quad \text{(in some words or morphemes)}$$

$$\begin{bmatrix} +G \\ \alpha^3 H \end{bmatrix} \quad [\text{+H}]$$
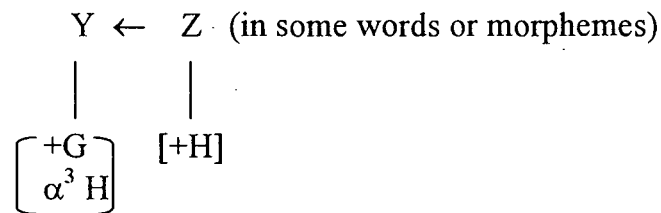
Here Y assimilates to Z in terms of one of the class features.

This can be formulated into rules like:

22)

a) $X \rightarrow X / \underline{\quad} Y$

$[\text{-F}] \quad [\text{+F}] \quad [\text{+F}]$

then,

b) $Y \rightarrow \phi$

23)

$$Y \rightarrow Z / \underline{\quad} Z$$

What will happen if this language has the sequence XYZ and sometimes it follows rule (1) and sometimes it follows rule (2)? This seems to me a tough question to answer. The answer that comes to my mind is that we may presume that there may

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[3] Here α is a variable of + or –.

be some structural differences between the two. The difference in the underlying representations results into the different dependency relations which, in turn, yields the different surface manifestations.

At this point we must look at the basic structure it has, since there is no other way to analyze. In natural science, too, we have such variations but the representations matter there a lot where differences in the representations yield different results. For example, in Chemistry the chemicals having similar number of elements but different representations are called by different names (the problem of nomenclature does not matter here) and when these chemicals are reacted with other chemicals, they yield different results. Let us see one of such examples:

24)

C_3H_5-OH
(Ethanol)

```
        H   H
        |   |
  H — C — C — O — H
        |   |
        H   H
```
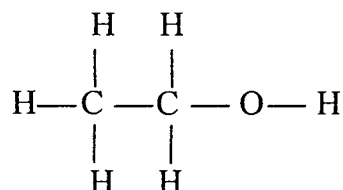
C_2H_6O
(Di-methyl ether)

```
        H           H
        |           |
  H — C — O — C — H
        |           |
        H           H
```
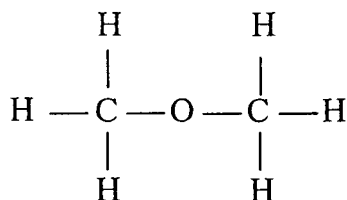
We must enquire our problem in this premise to get the solution. It leads us to think of the differences in the underlying representations, which result into the different surface manifestations. Thus, we can postulate the difference in structure as follow:

25) a.

$$\overset{\displaystyle \text{X \ Y \ Z}^4}{\wedge \quad |}$$

X Y Z⁴

b.

X Y Z
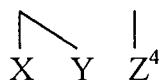
In (25a) X, Y and Z are in the local domain (if we take the Precedence relation) but the dependency relation holds between X and Y as the representation shows. Similarly, in (25b) again X, Y and Z are in the local domain but here the dependency relation holds between Y and Z.

However in the Moraic Theory there is no such node where Y and Z may dock over as shown in (25.b). To get the desired output, we need to create a node between the segment and either the mora or the syllable (in the case of a light syllable), from where the coda consonants dissect having common mother node. For this we can posit a node called 'c' (i.e. coda) which mediates between the two. It can be represented as shown below:

26)

a)   b)

σ   σ
| |
μ   μ
V c   V c
   | | /\
   C C   C C

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c)
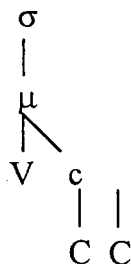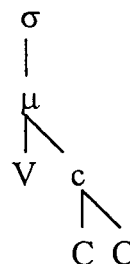
$$\sigma$$
$$\mu \quad c$$
$$|$$
$$V \quad C \quad C$$

This kind of representation can predict any kind of the feature spreading without losing the fundamental notion of the phonological weight as proposed in Hayes (1989).

3.5 Conclusion

In this chapter I have discussed about the notion of the syllabic structure in the various theories. This chapter depicted about the rules for the syllabification in the various theories. Though the Moraic Theory is restrictive over the other theories, it has the implications for the phonological theory. I tried to develop an idea to account for the different kinds of assimilation within the syllable. I have also demonstrated that assimilation takes place within the locality domain where the dependency relation between the segments determines the assimilation of the segments rather than the Precedence relation. It will help us to get the generalization about the different behaviours of the nasals in Hindi, too.

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[4] Here Z is extrametrical.

Chapter 4

PROSODIC STRUCTURE AND NASALS IN HINDI

This chapter explicates the data afresh within the framework of the Prosodic Phonology and the Feature Geometry. An attempt will be made to provide the solutions to the problems concerning the different behaviours of the nasals as pointed in the chapter 2. The attempt is here to explicate the different underlying phonological representations of the nasal which in turn lead to the different surface manifestations of the nasal. In Hindi, the consonants are linked to a mora, sometimes weight-by-position and sometimes they are specified in the lexicon. The assignment of a mora to the consonant is subject to the sonority principle, i.e. the sonorous segment will get associated with a mora in a syllable.

4.2 Nasals in Hindi

There is a controversy over how many nasal sounds Hindi does have. Most of the scholars agree that Hindi has five nasal segments phonetically [m, n, ṇ, ñ, ŋ]; however, Kelkar (1968) identifies [m, n] as the part of the core system or in the other words only /m/ and /n/ are the phonemes and rests are the allophones. Srivastava (1969) and Bhasin (1979), on the other hand, claim three nasal phonemes [m, n, ṇ] and rests as the surface manifestations of the archiphoneme N. However, I assume that Hindi has only /m/, /n/, and /ṇ/ as phoneme taking distributional criteria to set up the phonemes. Among these phonemes /m/ and /n/ occur word initially and finally and /ṇ/ can only occur word medially and finally. However, these phonemes occur as the variants of

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the archiphoneme N* also but /ñ/ and /ŋ/ can occur only in the environment where the following consonant is palatal or velar respectively. For example:

1)

a)	ma:ta:	'mother'
b)	a:m	'mango'
c)	na:ta:	'relation'
d)	ka:n	'ear'
e)	kəṇ	'particle'

2)

a)	pra:nt	'province'
b)	rəñj	'five'
c)	rəŋk	'poor'

4.3 Nasalization in Hindi

There is also a controversy over whether a nasal vowel in Hindi is phonemic or it is derived from an underlying oral vowel plus nasal sequence. I hold that a nasalized vowel in Hindi is an underlying oral vowel plus nasal sequence. This is because

a) Assuming the nasalized vowel as phonemic unnecessarily increase the burden of the phonemic inventory

b) it is not always necessary to establish what we have at the performance level would also occur at the competence level as Postal (1968) says :

> *The discovery of phonetically minimal pairs does not necessarily permit an immediate conclusion about underlying phonological contrasts.*

c) Ohala & Ohala (1991) argue for the epenthesis of a nasal segment in the words which contain a nasalized vowel plus a voiced consonant. Their

argument stands on the ground that in some words of old Hindi, which have a nasalized vowel followed by a voiced consonant, we have now the nasal epenthesis in modern Hindi. Though they provide the phonetic description for that change, however we can see it other way round, too, i.e. the nasal epenthesis may be a kind of unpacking of the nasalized vowel, which after sometime might turn into an oral vowel and a nasal segment.

d) I believe that whatever theory we take non-derivational or derivational, our ultimate aim is to provide the solution having economy and simplicity.

Though, both of the interpretations are prevalent in the linguistic theory, I proceed with the presumption that the nasalized vowels are the realizations of the underlying oral vowel plus nasal sequence rather than of the nasalized vowels at the underlying level. Srivastava (1969, 1970) while setting up the nasal phonemes maintains the ancient Indian grammatical tradition's classification of the nasals into *anusvara*, *anunasika*, and nasal mute. However, he tries to clarify the terms which seem to be confusing since they are used differently in the different ancient Indian grammatical traditions. He says that the nasals which undergo place of assimilation are *anusavara*, and those which yield the nasalization of the vowels are *anunasika* and those which stand on its own or which are phonemes are the nasal mutes. Sethi (1994) also follows this classification but both of them fail to provide the phonological differences between the three which result into the different surface manifestations. They fail to address the question: What are the characteristics of the nasal mutes which block them to undergo either nasalization or homorganicity? For example, in Hindi we have words where the nasal even staying in the coda position does not spread its nasality onto the vowels while her analysis demonstrates that the nasal in the coda position leads to the vowel nasalization as shown below:

3a)

(gung.a) → (gun.ga) → (gũ.ga)

But she does not mention why we do not have nasalization in the following words:

4b)

a:m   'mango'

ša:n   'dignity'

Following Narang & Becker (1971), D'souza (1985) suggests that all the nasalized vowels are long and she derives the nasalized vowels from the underlying sequence of the short vowels and the nasals. Moreover, the nasal consonant is in the coda and linked to the preceding vowel in the underlying representation. Thus, the underlying representation for a word like /ã:ngən/ would be

5)

```
      ┌─┐          │
      │  \         │
   X  X  X  X  X
      │
      │
   a  n  g  ə  n
```
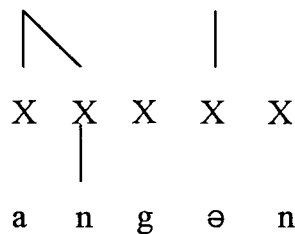
Thus, according to her, the nasal spread and the vowel length are the coexisting processes. Thus, she proposes the derivation like (6)

6)

a. Nasal spread

```
    ┌─┐              ┌─┐
    │  \             │  \
   X   X            X   X
   │   │            │   │
  [ ] [ ]     →    [ ] [ ]
  +N   │           +N  \
       │                \
     [+nas]           [+nas]
```

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b. Vowel spread

Her proposal is, undoubtedly, somewhat right but the problem is that it can only account for the long nasalized vowels, though there are short nasalized vowels also as discussed in the Chapter 2.

However, Ohala (1983) rejects this assumption on the ground that there is no evidence for the psychological reality of such occurrences. If we start looking on the psychological reality of every word and even the words where the two morphemes concatenate, we will not be able to find the evidence for the psychological reality of every concatenation. For example, if we 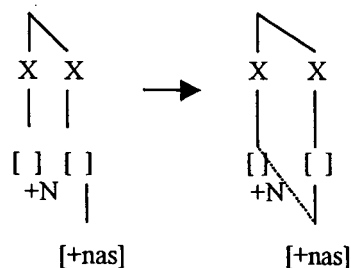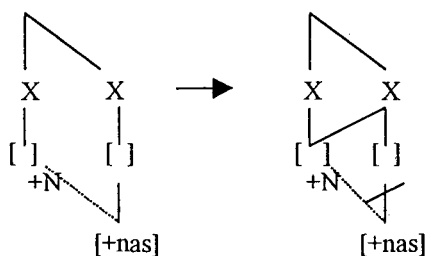ask any native speaker whether the word sənta:p has two morphemes (səm+ta:p), he/ she may say "no" until he/ she has got formal education. That does not mean that the word sənta:p does not have two morphemes. I assume that any instance that demonstrates the occurrence of such processes can be taken as evidence. There is historical evidence which establishes that the development of the nasalization in Hindi occurred in the diachronic process. That's why I assume here that the nasalization in Hindi is the outcome of the historical development. Let us, first of all, consider the following data where we have compensatory lengthening and nasalization:

7)

a)	[dənt]	→	[dã:t]	'teeth'
b)	[kəmp]	→	[kã:p]	'shiver'
c)	[bhəŋg]	→	[bhã:g]	'hemp'

d)	[čənd]	→	[čã:d]	'moon'
e)	[pəňč]	→	[pã:č]	'five'
f)	[kəṇṭa:]	→	[kã:ṭa:]	'thorn'

In the examples given in (7) we have three processes: the deletion of the nasal, the compensatory lengthening of the vowel, and the nasalization of the vowels. These examples show that the nasalization of the vowels takes place at the some point of time in the history of the language change. Now it is the job of linguist to explain how this process happened. Before going into the details of the process of the compensatory lengthening we should see more examples which are given below:

8)

a)	[cəkr]	→	[ca:k]	'wheel'
b)	[səpt]	→	[sa:t]	'seven'
c)	[əṣṭ]	→	[a:ṭh]	'eight'
d)	[həst]	→	[ha:th]	'hand'
e)	[sərp]	→	[sã:p]	'snake'
f)	[həsy]	→	[hãs]	'laugh'
g)	[əkši]	→	[ã:kh]	'eye'
h)	[əgni]	→	[a:g]	'fire'

In the examples given in (8) we have the consonant cluster in which we ⃰have [–nasal] segments. The deletion of one of the consonants results into the compensatory lengthening of the vowel, however in the examples (8.e-g) we have nasalization, too, without having the nasal in the coda cluster. This seems to be the result of the process what Ohala (1983) calls the

spontaneous nasalization. However, the compensatory lengthening in the word *sarp* (8.d) has undergone two developments which is attested. This is as follow:

9)

Skt		MIA		Hindi
sərp	→	səpp	→	sã:p

This shows that the change in the language has not taken place at one time in the history, rather it passed through many stages which is unknown to us and there is no single etymological dictionary by which we can reach to some logical conclusion. However, the evidence for every words at the present moment is not available, but it can be said that at some point in the history the language has passed through this process where *səpp* may have become *səmp* and then *sã:p*. This is my presumption, which in the lack of the evidence can not be denied. Now let us turn to the process of the compensatory lengthening.

These forms show that at a time there was a trend to delete the coda and in turn we have the compensatory lengthening in the process of the language development but this phenomenon stopped at some point of time in the history of the language change. However, the nasalization process continued for sometime thereafter. Kiparsky (1972) proposes the rule re-ordering for such diachronic phenomenon, i.e. a language at some point in the history re-orders its phonological rules and after sometime it acquires its previous rule-ordering which he calls the re-rule ordering. Hindi exhibits the same phenomenon where we had deletion of a coda consonant which in turn resulted into the compensatory lengthening of the vowels and then after sometime it stopped.

Now let us turn to the phenomenon of compensatory lengthening where the deletion of a coda consonant resulted into the compensatory lengthening of the preceding vowel. Here according to Hayes (1989) we can state that the coda consonant gets a mora by the weight-by-position. However, we can take another option in which the coda consonant cluster can be considered as having a mora underlyingly, since Hindi distinguishes the syllables as light, heavy, or superheavy (cf. Pandey 1990). Whatever option we adopt, the consonant is the anchor of the non-head mora. Thus, we can explain the compensatory lengthening in the examples given in (7) and (8) as the deletion of the consonant leaves mora stray to which the mora of the vowel docks resulting into the compensatory lengthening of the vowel.

Thus, we can represent this compensatory lengthening as in (10)

10)

a. σ   b. σ   c. σ
UR   delinking   stray codas

d a n t   d a n t   d a n t

d. σ   e. σ   f. σ

d a: n t   d a: n t   d a: n t

vowel spread   re-linking of nasal   nasal spread

g. σ   h. σ

d a: n t   d ã: t

de-linking of   PR
nasal
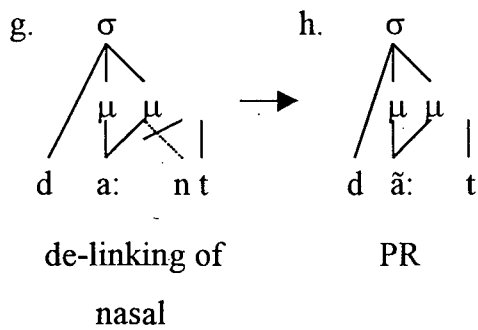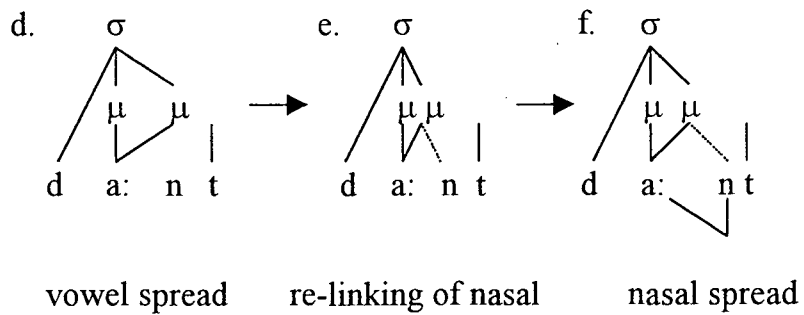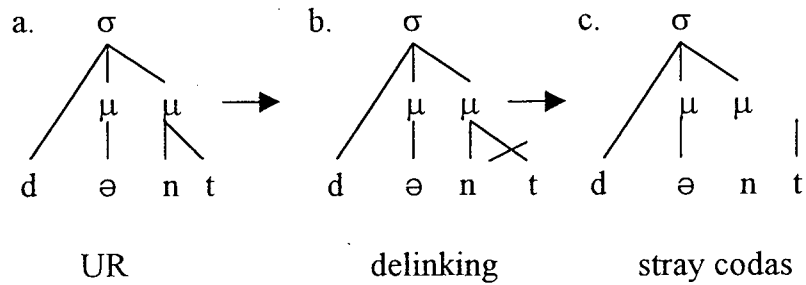
The two processes are involved in this whole phenomenon of the
compensatory lengthening: first, the de-linking of the nasal and then the re-
linking of the nasal. That is to say, in this whole process, first, the nasal is de-
linked from the mora. This de-linking of the nasal leaves the second coda
stray which behaves as extrametrical. Then the vowel is linked to the second
mora, and thus becomes long. In the next step the nasal which got de-linked
from the mora re-links to the preceding mora and then it spreads its feature
[+nasal] to the vowel. This process of the compensatory lengthening had gone
for some time and then stopped. Nonetheless, the language continued to

nasalize the vowel. The process of nasalization[1] in the examples given in (7) can be reduced to the following two statements:

11)

Nasal Re-linking

Re-linked the de-linked nasal to the preceding vowel (i.e. the preceding mora).

12)

Nasalization

Nasalize the preceding vowel if the following nasal is moraic.

Thus, the nasalization is a historical process where the environment of the nasal made the vowel nasalized. However, when the compensatory lengthening of the vowel was abandoned, the process of nasalization continued to take place for some time resulting into the nasalization of the short vowels, too.

However, it is difficult to find the trace of every nasal vowel emerging from this process. Nonetheless, this may operate as a clue to explain the nasalization in the other nasalized vowel. If we assume that the nasalized vowel has the underlying oral vowel plus a nasal segment as we have seen in the case of the compensatory lengthening, we may explain the nasalization of the vowels with a single parameter, otherwise we will have to have two phonological rules: the first to account for the nasalization of the vowels given in (7) and the second as the MS condition for the other nasalized vowels as Ohala (1983) does. Thus, as shown in the case of the compensatory lengthening, the nasal spreads to the preceding

---

[1] McCarthy (personal communication) suggests that this may be a kind of coalescence or merger of a vowel and a nasal consonant. The output of this coalescence combines the feature(s) of the two input segments that are fused into one. Each input segments' mora is also preserved, for example in Sanskrit, we have such process, e.g. /ai/->[e:] and /au/-> [o:]. However, we have the short nasalized vowels, too, where the second mora of the input is not preserved.

vowel when it is a moraic coda, we can deduct that every nasalized vowel is stored in the lexicon as an oral vowel and a nasal segment. Thus, we can explain all other nasalized vowels with the single parameter that can be stated as:

(13)   Nasalization

If a nasal segment is a moraic coda associated with a broken line, the nasal spreads its feature [+nasal] to the preceding vowel.

This can be represented as in (14)

(14)

$$
\begin{array}{c}
\mu \\
\diagdown \\
V \quad N \\
\diagdown \\
[+\text{nas}]
\end{array}
$$
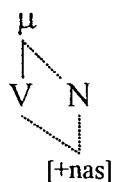
Thus, the representation of a word like /ḍə̃k/ would be like:

$$
\begin{array}{cc}
\sigma & \sigma \\
& \\
\mu \quad \mu & \mu \quad \mu \\
& \\
\text{ḍ ə N k} & \text{ḍ ə̃ k} \\
\text{UR} & \text{PR}
\end{array}
$$
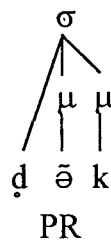
This kind of linking of the nasal is specified in the lexicon as D'souza (1985) suggests. However, I do not take every long nasalized vowel as derived from the underlying sequence of the short vowel and the nasal, rather only those nasalized vowels which have historical evidence undergoing the compensatory lengthening are short in the underlying representation, and the rests are similar to the surface form, since there are short nasalized vowels, too. For example:

15)

        sə̄wər   'beautify'

        kə̄wər   'son-in-law'

Secondly, the feature spread is taken as it is assumed in the Feature Geometry where features are assumed to be arranged hierarchically. When the features of a segment spread to the preceding or the following segments, the spread is of only those features which are dominated by that non-terminal node. For example, if the assimilation is partial, as in the case of the coda restriction principle stated in (18) where the coda cluster agrees in the place feature, the spread will be of only class feature not the whole root. But in the case of complete assimilation the root of the segment spreads to another segment and thus replaces the root of that segment. In the case of nasalization, the nasal is unspecified for other features except [+nasal].

4.4 Nasal Assimilation

In Hindi, homorganicity can be studied under two headings: first, where homorganicity takes place within a morpheme or within a syllable, second, where homorganicity takes place across morpheme boundary. First, I will discuss about homorganicity within a morpheme or a syllable.

4.4.1 Partial Assimilation

Consider the following set of data:

16)

        ša:nt   'quiet'

        pra:nt   'province'

        mənd   'dull'

        rəñj   'sorrow'

        pəñč   'a member of village panchayat'

        rəŋk   'poor'

In these words the homorganicity of the nasal can be seen as the restriction on the coda formation assumed in Goldsmith (1990) which was discussed in the Chapter 3 also. I am reproducing that as follow:

(17) Rules for Coda Formation

If a coda contains a nasal followed by an obstruent, the nasal must be homorganic to the final consonant.

(Goldsmith 1990: 129)

In this case a coda will be specified for the one distinctive place of articulation as shown below.

18.a)

```
                    σ
                   /  \
                 /      \
              Onset    Rhyme
                       /  \
                     /      \
                 Nucleus    Coda
                            /  \
                          /      \
                       Nasal      \
                           \     Obstruent
                            \        |
                             \       |
                              \     |
                              P of A
```

18.b)

$$
\begin{array}{c}
\sigma \\
\diagup \quad \diagdown \\
\text{Onset} \quad \text{Rhyme} \\
\diagup \quad \diagdown \\
\text{Nucleus} \quad \diagdown \\
\text{Coda} \\
\diagup \quad \diagdown \\
\text{Nasal} \quad \text{Obstruent} \\
| \qquad | \\
[\text{P of A}] \quad [\text{P of A}]
\end{array}
$$
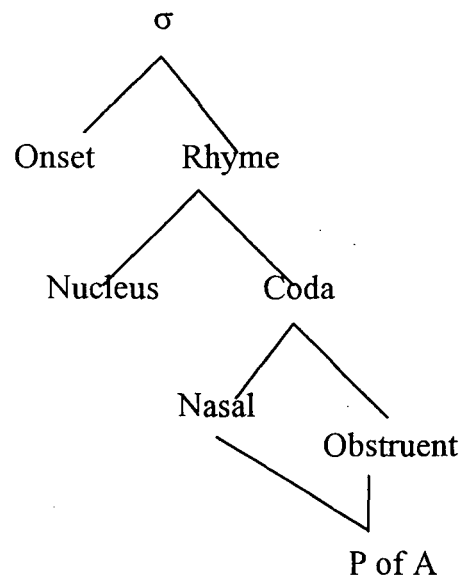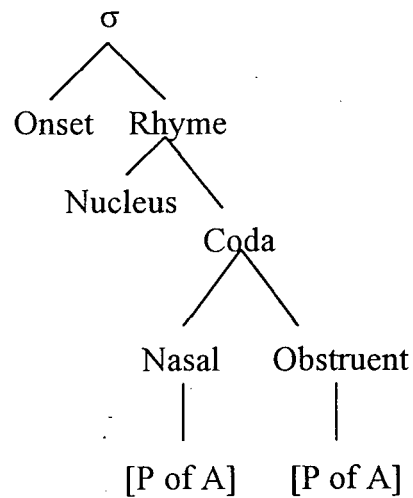
Goldsmith (1990: 130)

The languages allow only (18a) as the coda cluster and (18b) is barred. Thus, homorganicity in such words can easily be explained in terms of the constraint on the coda formation. However, some words do not seem to fall in this category if we take the syllabification according to the onset maximization principle. Let us consider the following words:

19)

/čəmpaː/	'a type of flower'
/khəmbhaː/	'pillar'
/kaːnti/	'name of a person'
/gəndaː/	'dirty'
/ən̥ḍaː/	'egg'
/puñǰiː/	'capital'
/pəñčʰiː/	'bird'

These words have the CVCCV structure. As it is a rule in phonology that the onset formation precedes the coda formation. Hence, the syllabification of CVCCV will be CVC.CV. However, in a morpheme when there are more than one syllables, the onset formation may take recourse to only onset satisfaction which can be achieved through the ambisyllabic consonant where the last coda of the preceding syllable also serves as the onset of the following syllable. I hereby propose that the ambisyllabicity of the consonant should not be restricted to the only CVCV structure but it may be extended to the CVCCV structure where the third consonant is ambisyllabic. Thus, the onset formation must be reduced to the onset satisfaction where the second syllable saturates in terms of onset. Thus, a CVCCV form can be represented as in (20) (I have suggested this type of representation in the chapter 3 also):

20)
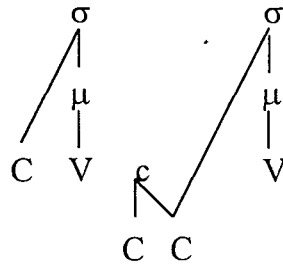
By such analysis we can impose restriction on the coda formation as given in (17) and at the same time we can get onset satisfaction for the second syllable. This leads us to postulate that the core syllabification in a morpheme takes place step by step where we have, first, the syllabification of the first syllable and it continues till we have the phonotactic constraint violation. Then, we turn to the syllabification of the second syllable.

By this generalization we can predict the assimilation of any kind of the consonant clusters within a syllable. For example, in English we have words like:

21)

/tempər/

/mentər/

/entər/

/tendər/

/θiŋkər/

In (21) also, we have the CVCCV structure. If we take the onset maximization principle, we need an extra rule to account for such homorganicity, whereas if we assume the syllabification as CVCC.V, we will have only one principle, i.e. the restriction on the coda formation as given in (17). In such forms the second consonant of the coda can be assumed to be ambisyllabic. Thus, the word /gənda:/ can be represented as below:

22)
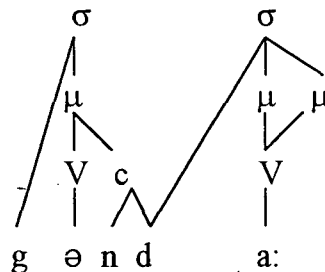
Not only have we homorganicity within a syllable but such homorganicity can be seen at the morpheme juncture, too. However, homorganicity within a syllable and across morpheme boundary are the two different phenomena. Homorganicity within a syllable follows the restriction on the coda. But when the two morphemes combine, the coda of the first syllable assimilates to the onset of the second syllable. For example, consider following data:

23)

səm	+	giːt	→	səŋgit	'music'
səm	+	jog	→	səñjog	'chance'
səm	+	taːp	→	səntaːp	'fury'
səm	+	bhəv	→	səmbhəv	'possible'
səm	+	ghərṣ	→	səŋghərṣ	'fight'

This is the case of the Phonology- Morphology interface where after the alignment of an affix to a root, the nasal of the affix undergoes assimilation. The alignment of the two morphemes can be accounted according to McCarthy & Prince (1993b) schemata given in the Chapter 1.

Now, the assimilation of the nasal can be seen as the feature(s) spread to the left and it can be formulated as (24)

24)

$$[+\text{nasal}] \rightarrow [\alpha \text{ place}] \ / \ \_\_\_ + \begin{bmatrix} + \text{ obst} \\ \alpha \text{ place} \end{bmatrix}$$

Thus homorganicity across morpheme boundary can be descriptively stated as

25) Nasal Assimilation

   Spread the feature to the left if there is a nasal preceding an obstruent.

But it would be too hasty to formulate any generalization by looking at these limited data because there are words in Hindi where we do not have such assimilation. Before formulating any statement to account for these data we should consider data given below before:

26)

səm	+	təl	→	səmtəl		'level'
səm	+	koṇ	→	səmkoṇ		'equiangle'
səm	+	ta:	→	səmta:		'equality'
səm	+	tulya	→	səmtulya		'equal weight'

The meanings of the morpheme /səm-/ considered in (23) are different from those considered in (26): the former means 'with' and the latter means 'equal'. Nonetheless, we need to enquire what are the phonological differences between the two which leads the former to undergo assimilation whereas prevents the latter from the same. No doubt, if we look for a solution in the Lexical Phonology Morphology (see, Mohanan, 1982, Kiparsky 1982 and other subsequent works), we will conclude that these two affixes are placed in the two different strata and assimilation is restricted to the strata 1 where the former affix is put. However, it can be explained if we try to see the differences in their representations at the underlying level, we will soon realize how the differences in the underlying phonological representations would provide us with more power to describe other facts, too. Let us see this problem in the broader context. In Hindi, schwa syncope is a very productive phenomenon in which it deletes the final schwa of a verb stem, if the stem is followed by a vowel initial suffix. For example:

27)

	PrT form	root		suffix		Pst form	
a)	nikəl	nikəl	+	a:	=	nikla:	'come out'
b)	pəkəṛ	pəkəṛ	+	a:	=	pəkṛa:	'catch'

c)   səməjhː   səməjh   +   aː   =   səmjhaː

'understand'

This rule applies to the noun stems, too. For example:

28)

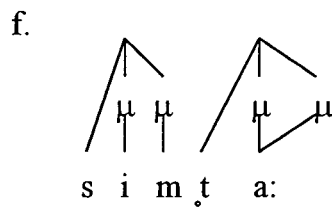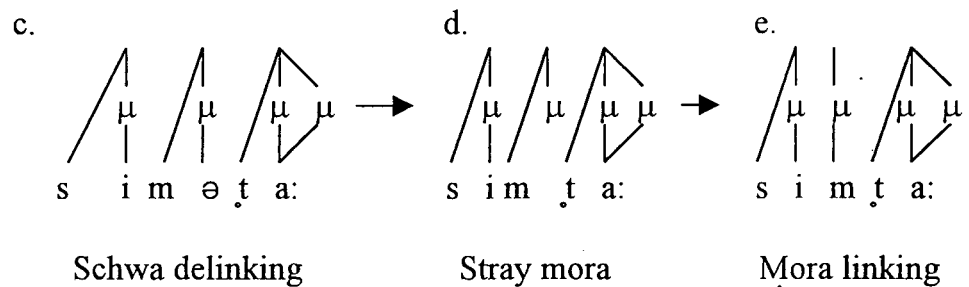| čiməṭ	ciməṭ	+	aː	=	čimṭaː
siməṭ	siməṭ	+	aː	=	simṭaː
sənək	sənək	+	aː	=	sənkaː

In the above examples, especially (27c) and (28) we see that after schwa syncope the nasal assimilation does not apply. Why? There are many solutions regarding schwa deletion, but it is not feasible to go into its details here. However I will go into the details of why the nasal assimilation does not take place here. The core syllabification contains a schwa in the underlying representation, but after suffixation the schwa is deleted. This leaves a mora stray. There can be two possibilities:

a) The mora gets deleted, or

b) The mora is linked to the nasal

Here I adopt the second solution, which seems to be more plausible since if I go by the accentuation patterns of Hindi, the nasal of the (27 and 28) seems to behave syllabic after the schwa deletion. Thus, it can be resolved that the nasal after the schwa deletion docks with the stray mora. However, this mora behaves like a non-head mora. Let us see the phenomenon of linking of the nasals to a mora.

29)

a.

s i m ə t̥   a:

Core Syllabification
And affixation

b.

s i m ə t̥ a:

Resyllabification

c.

s   i m ə t̥ a:

Schwa delinking

d.

s i m t̥ a:

Stray mora

e.

s i m t̥ a:

Mora linking

f.

s i m t̥   a:

PR
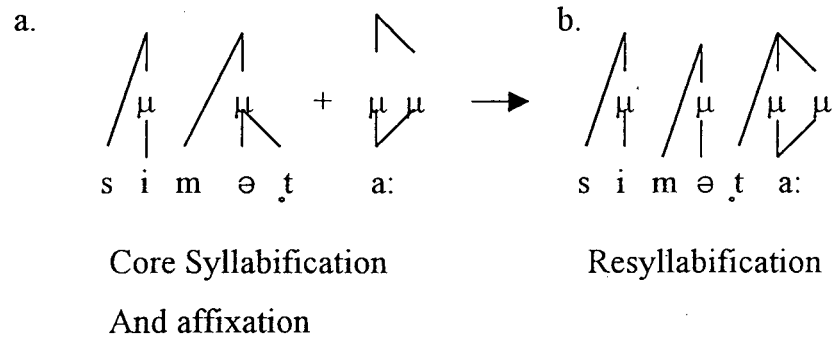
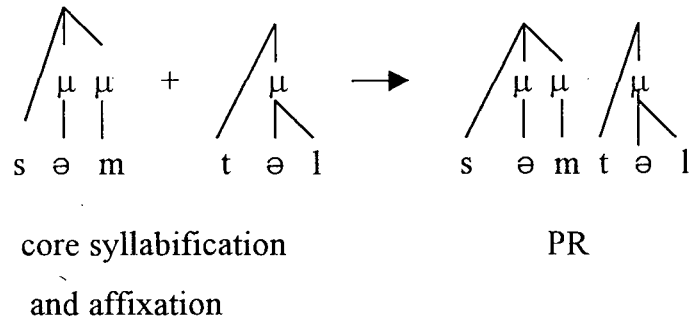Anyway the motivation behind this derivation is to demonstrate that when the nasal is moraic, it does not undergo assimilation. This will help us get generalization to explain the other behaviours of the nasal. Similarly, in the affix /səm-/ given in (26) the nasal is syllabic, that is to say, it bears a mora, and hence we do not have assimilation.

Thus, the phonological process involved in (26) can be explained as:

30)

$$\sigma \quad\quad \sigma \quad\quad\quad \sigma \quad\quad \sigma$$

$$/\!\!\backslash \quad\quad /\!\! \quad\quad\quad /\!\!\backslash \quad /\!\!$$

$$\mu\ \mu \quad + \quad \mu \quad \longrightarrow \quad \mu\ \mu \quad \mu$$

s   ə   m   t   ə   l   s   ə   m t   ə   l

      core syllabification   PR
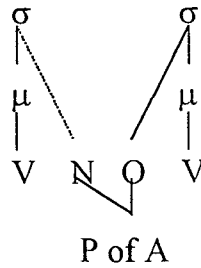
      and affixation

However, the analysis of the examples given in (23) could be that in such affixes the nasals are not moraic, and they are linked to the syllabic node directly because this affix behaves as a light syllable as opposed to the affix given in (26) which behaves as heavy. It is widely recognized in the Moraic Theory that the coda of a light syllable is directly linked to the syllable node. Thus, it can be assumed that in the affix /sam-/ of (23) the nasal is linked to the syllable node directly, since this structure behaves like light syllable. The homorganicity across morpheme boundary can be stated as follow:

31)   Nasal Assimilation

When the two morphemes concatenate, if the nasal segment is a syllabic coda of the affix associated with a broken line and followed by an obstruent of the root, the obstruent triggers its place feature onto the nasals.

According to the parameter given in (31) we can state that homorganicity across morpheme boundary takes place only when the nasals are the syllabic coda as represented below:

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32)

P of A

Thus, the derivation of a word like /santa:p/ could be as shown below:

33) a.

s   ə   m   t   a: p
    [P A]   [PA]

Core Syllabification and affixation

b.

s   a   n t   a: p

PR
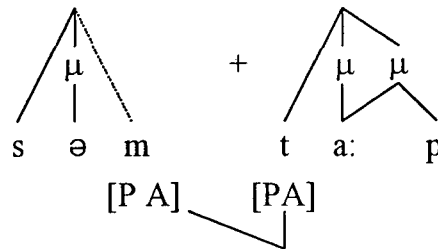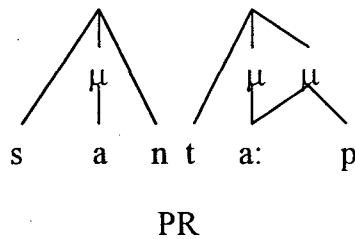
4.4.2 Nasal Suppression or Complete Assimilation

Sometimes nasal gets suppressed by another following segment and thus we have complete assimilation. For example, see the following data:

34)

səm	+	ləgn	=	sə̃lləgn	'enclosed'
səm	+	la:p	=	sə̃lla:p	'discourse'
səm	+	yəm	=	sə̃yyəm	'restraint'
səm	+	wa:d	=	sə̃wwad	'dialogue'

In examples given above, we have the lateral or the glides as the onset of the root morphemes whereas the, affix has the same structure as in (23). This phenomenon can be equated with the affix /in/ of English. In English, this prefix undergoes place assimilation if the following consonant is [– sonorous] and if there is a sonorous segment, it results into the nasal suppression. For example,

35)

in	+	impossible	=	impossible
in	+	decent	=	indecent
in	+	legal	=	illegal
in	+	regular	=	irregular

However, there is a little difference between the phenomenon of English and that of Hindi. In Hindi, the strategy applies to the glide and the lateral only. Secondly, the deletion of the nasal leads to the nasalization of the preceding vowel. The nasalization of the vowels in these words poses the problem for the phonological analysis, since the same affix does not display nasalization where we have homorganicity as given in (23). Then question arises how we can explain such differences. The solution is not so easy, rather we have to look back to the whole derivation procedure of the compensatory lengthening once again where we had first the delinking of the nasal and then again the relinking of the nasal. The nasal suppression functions in the same manner

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where the feature spread of the glides or the lateral is to replace the root node of the nasal of the affix. However, before the replacement of the root node, the nasal gets delinked from the syllable node leaving the root node intact there. This placeless nasal docks with the preceding mora and then the root node of the syllabic coda is replaced by the following lateral or glide through the feature spreading. Thus, the rule for the nasal suppression can be formulated as (36):

36) a.

$$[\text{+nasal}] \rightarrow \begin{bmatrix} \alpha \text{ cons} \\ \beta \text{ voc} \\ -\gamma \text{ high} \end{bmatrix} \Big/ \underline{\hspace{1cm}} + \begin{bmatrix} \alpha \text{cons} \\ \beta \text{ voc} \\ -\gamma \text{ high} \end{bmatrix}$$

b.

$$\begin{bmatrix} + \text{ voc} \\ - \text{ cons} \end{bmatrix} \longrightarrow \begin{bmatrix} + \text{ voc} \\ - \text{ cons} \\ + \text{ nasal} \end{bmatrix} \Big/ \underline{\hspace{1cm}} [\text{+ nasal}]$$

To account for the data we need two rules as given above and these rules apply simultaneously. Thus, descriptively we can formulate the rule of nasal suppression into a statement as in (37)

37)   Nasal Suppression

When the two morphemes concatenate, if the nasal of a prefix is a syllabic coda associated with a broken line which concatenates with the root morpheme whose onset is a glide or a lateral, the nasal segment is replaced by a glide or a lateral.

Along with this parameter, we need one more parameter which will state the process of the nasalization in these words. For this we need to formulate a statement regarding the re-linking of the nasal to the preceding mora. For that

the rules I have proposed in (11) and (12) can explicate the nasalization in these data. I am reproducing the same rules as (38) and (39) respectively:

38)

Nasal Re-linking

Re-link the delinked nasal to the preceding mora.

39)

Nasalization

Nasalize the preceding vowel if the following nasal is moraic.

Thus, the derivation of the nasal suppression and the nasalization in a word like /sə̃waːd/ can be represented as given in (40)

40)
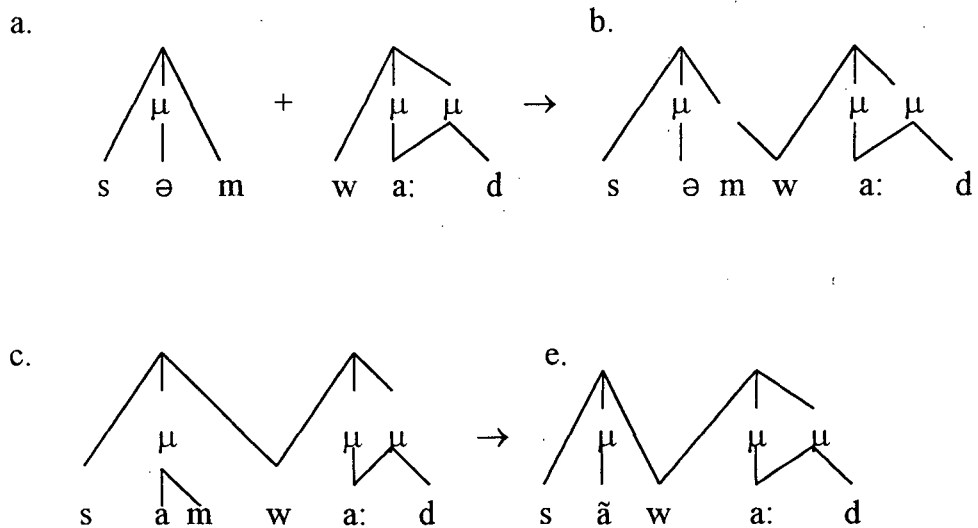
Thus, the process of the nasal suppression and the nasalization can be explained in terms of the two phonological processes occurring simultaneously: the delinking of the nasal segment from the syllabic coda which in turn let the onset of the root morpheme to spread its root feature to the stray node and then the relinking of the nasal with the preceding mora results into the nasalization of the vowel as we have seen earlier in the process

of the nasalization in the case of the compensatory lengthening. Thus the process of the nasalization can be seen as the spreading of feature [+nasal] to the preceding vowel if it is a moraic coda otherwise we do not have nasalization.

4.5 Nasal Mutes

The term 'nasal mutes' is referred to those nasals which neither spread their features to the preceding vowel nor do they undergo assimilation. In other words it is referred to the nasal phonemes as opposed to the archiphoneme nasal. As we have seen the archiphoneme nasal spreads its features to the preceding vowel resulting into the nasalization of the vowels or it assimilates to the following consonant. However, the description of the different behaviours of the nasal is far from complete until we give some phonological reason for such behaviours. Let us consider some examples from Hindi:

41)

a)	ma:n	'respect'
b)	na:m	'name'
c)	gəṇəna:	'counting'
d)	ša:m	'evening'
e)	kšəmta:	'capacity'
f)	səmdhi:	'son's father-in-law'

If we take nasals in (41) as the coda of the syllable, this will certainly raise the problem of why we do not have nasalization while, as discussed earlier, the coda nasal lead to the nasalization of the preceding vowels. Similarly, in (41e) and (41f) the nasal does not assimilate to the following consonant. In this situation we certainly need to look for something that differentiates the behaviours of the nasals. The problem can be defined as: what are the

differences in the nature of the two kinds of nasals which lead to such manifestations? As we have seen earlier in the examples of the schwa deletion and the affix /səm-/ that if the nasal is moraic, it does not assimilate to the following consonant. The examples in (41) support my proposal that if the nasal is moraic, it does not spread its feature onto the preceding vowel nor does it assimilate to the following consonant. For example, the words like /aːm/, /šaːm/, /šaːn/ are superheavy according to Sethi (1994). If these words are superheavy, it means that the nasal is moraic here. This can be represented as follow:

42)
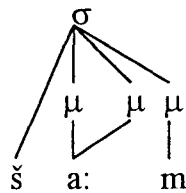
In the entire words where the nasal is syllabic (i.e. moraic according to the Moraic Theory), we do not find nasalization. On this basis a suggestion can be made if a nasal is moraic, it does not spread its feature [+nasal] to the preceding vowel. Moreover, one incident we have seen in the case of homorganicity where we found that if the nasal is moraic, we do not have assimilation with the following consonant. Thus, we can form a rule to account for this kind of the phonological behaviour as:

43)   Nasal Mutes

If the nasal is moraic, it does not spread its feature onto the preceding vowel nor does it become homorganic.

This can be represented as below:

44)

$$
\begin{array}{cc}
| & | \\
\mu & \mu \\
| & | \\
V & N
\end{array}
$$
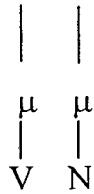
This analysis can also account for the data where we do not have homorganicity within the morphemes like:

45)

/tinka/	'bit of dry grass'
/ manka/	'bread'
/kənkhi/	'sideways glance'
/kunba/	'family'
/čingari/	'spark'
/inkar/	'denial'

There may be two possibilities to account for these data:

a) In these words, the segment /n/ and the subsequent consonant do not form the coda of the first syllable.

b) The /n/ in these words is moraic.

In these examples, I posit that the nasals are syllabic or in other words moraic. Hence, we do not have homorganicity. Nonetheless,I leave here both the possibilities open because both the options can explain the problem of non-homorganicity in these examples.

4.6 Conclusion

In this chapter I have attempted to analyze the problems concerning the different behaviours of the nasal and tried to provide the solutions to the problems.different realizations of the nasal in Hindi words and words

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formation can be explained in terms of their different representations. This solution can be applied to the other languages which exhibit the similar phenomenon. For instance, we find similar situation in French where the nasalization occurs in some words and does not in others. My proposal can be applied to account the phonological processes in French as if the nasal is a moraic coda, the nasalization process occurs. If the nasal bears mora, it does not nasalize the preceding vowel.

Chapter 5

Conclusion

The present paper is an attempt to study the different behaviours of the nasals in Hindi where sometimes the nasal spreads its feature [+nasal] onto the preceding vowel, sometimes it assimilates to the following consonant, and sometimes we have neither nasalization nor assimilation rather it remains as an independent segment. The present work is an attempt to inquire into the different behaviours of nasals, particularly in Hindi. To explain this problem I have worked within the framework of the Prosodic Theory and the Feature Geometry. Though, many interesting researches on vowel nasalization and nasal assimilation have been undertaken in the different theories, still many facts and issues remained unsolved which I have tried to unfold them and then provide solution to those issues in this dissertation.

First of all, it has been assumed throughout my dissertation that what seems to be different at the phonetic level is actually the realizations of the same phoneme [+nasal]. Thus, the nasalized vowel is considered as an underlying sequence of a vowel and a nasal consonant which is a better option for the reason of economy and simplicity. This synchronic analysis has been supported by the historical evidence. The process of historical change is better evidence to account for the synchronic phonological shape. This oral vowel plus a nasal sequence is mentioned in the lexicon through the association line which at time of actualization becomes nasalized vowel.

Assimilation can be understood as feature spreading of the source segment to the target segment. Assimilation or any phonological processes take place within the local domain where local domain has been defined in terms of dependency

relation. However, it would be difficult to establish dependency relation among the segments in the Moraic Theory, since the coda consonant cluster is taken as a part of either the preceding mora or the syllabic node. For this I advocate to have a node which may mediate between either the syllable node and coda consonants or between the mora and coda consonant. I have taken "c" as the node which mediates between the two. Through it, I have tried to show that the different dependency relation between the vowel and the coda consonant cluster. This will help us to get generalization about assimilation within the syllable. Thus, I have demonstrated that the different underlying representations of the nasals hold different dependency relations which affect phonological processes resulting into the different surface manifestation of the nasals in Hindi.

Similarly, in the case of homorganicity, I presumed that the nasals in such process are same as in the case of the nasal in the nasalized vowel. However, they differ in terms of their representations. For example, the nasal in the nasalized vowel is moraic coda while the homorganic nasals are directly linked to the syllable node in the case of assimilation occurring across the boundary. But the homorganicity within the syllable has been considered as the restriction of the coda formation rule adopted from Goldsmith (1990). The nasals in these forms are specified for [+nasal] only in the underlying representation. The rest of the features are filled in at the phonetic level via default rule and complement rule as proposed in the Underspecification Theory of Archangeli (1984). However, the nasal mutes contain of the feature in the underlying representations.

The spread of the feature is taken as in the Feature Geometry advocated. However, in Hindi, the nasal suppression across the morpheme boundary poses the challenge for the feature geometry, since in the Feature Geometry the complete assimilation is taken as the spreading of the root node to the target segment. However, in the case of the nasal suppression in Hindi, we have nasalization of the vowel, too. If the root of the nasal is substituted by the lateral or the glide, we can not expect that the feature [+nasal] is still present in the root node as happens in the case of

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English. Nonetheless, I have attempted to answer this problem by first the delinking of the nasal from the 'c' node. Then, it relinks to the preceding mora which results into the nasalization of the vowel and delinking of the nasal leaves the root node intact. Then, the feature of the following lateral spreads to the root node from where the nasal is delinked.

I have also pointed out that the ambisyllabicity is not restricted to the CVCV structures only, rather it may be extended to CVCCV structure, too, if there is no phonotactic constraint violation.

Thus, the different behaviours of nasal can easily be explained through the parameters I proposed. Though, I have adopted derivational theory to account for the different behaviours of the nasal, my parameters postulated to elucidate the aforesaid issues, can be translated into constraints to explicate the problems in non-derivational theory like the Optimality Theory and make typological generalizations.

Thus, the present work has dealt with some major aspects of the phonology of nasals and nasalization in Hindi and in the process attempted to identify the solution of the problems related to them.

Appendix-1

Nasalization

ə̃kit	'name'	j̃ã:č	'examine'
ã:čəl	'sari-fold'	kɛ̃či	'scissors'
ã:gən	'courtyard'	kə̃wa:ra:	'bachelor'
ã:kh	'eye'	kəhã:	'where'
ã:kra:	'estimate'	kã:p	'shiver'
ã:su	'tear'	khəra:ũ	'wooden slipper'
ã:t	'intestine'		
bã:h	'hand'	khã:si	'cough'
bã:s	'bamboo'	khĩ:č	'pull'
bã:t̥	'distribute'	kə̃wər	'name'
ba:yã:	'left'	kyõ:	'why'
bhɔ̃	'eyebrow'	mɛ̃	'I'
bhɔ̃k	'bark'	mã:	'mother'
bhɔ̃ra:	'beetle'	mã:s	'meat'
bhə̃wər	'reeling'	mẽ	'in'
cã:d	'moon'	pəhuč	'reach'
čhḁ̃t-na:	'selection'	pã:č	'five'
də̃k	'sting'	pã:w	'leg/ foot'
dã:t	'tooth'	pũ:ji	'capital'
da:yã:	'right	sə̃kra:	'narrow'
dhə̃s	'slide'	sə̃wər	'beautify'
dhuã	'smoke'	sa:ĩ	'name'
ḍhõ:gi	'hypocrite'	sã:p	'snake'
ḍə̃s	'snake bite'	sã:s	'breath'
gã:dhi	'surname'	sã:wəla:	'fair'
ga:õ	'village'	sĩ:č	'irrigate'
gehũ:	'wheat'	t ã:ga	'chariot'
ghõ:səla	'nest'	wəhã:	'there'
gũ:ga:	'dumb'	-wã:	'suffix' (ordinal)
hə̃s	'laugh'		
hã:	'yes'	yəhã:	'here'
h□:g	'asafoetida'	yũ	'like this'

Appendix 2

Homorganicity

əňɟən	'name'
ənt	'end'
əndha:	'blind'
əntrim	'internal'
bənd	'close'
bəŋgla:	'bungalow'
čumbən	'kiss'
gəňɟa:	'bald'
gəňɟi	'vest'
gəŋga:	'name'
gend	'ball'
guňɟ	'buzz'
ɟəŋgəl	'forest'
ɟhəṇḍa:	'flag'
kəndha:	'shoulder'
pələŋg	'bed'
prəsəŋg	'context'
pra:nt	'province'
rəŋg	'colour'
səŋkhya:	'number'
səntra:	'orange'
šətrəňɟ	'chess'
ša:nt	'peace'
siŋg	'horn'
sundər	'handsome'
ta:mba:	'copper'

Appendix 3

No Nasalization/ No Assimilation

ənʊbhəv	'experience'
ənʊkul	'favourable'
ənvit	'name'
či:ni:	'sugar'
gəmla:	'pot'
imli	'tamarind'
ina:mda:r	'surname'
kəmla:	'name'
ɲki̪ta:n̪ʊ	'micro-organism'
kšəmta:	'capability'
məndakəni	'name'
ma:n̪əwi	'name'
mun̪d̪ən	'hair-shaving ceremony'
ma:nəs	'mind'
nada:n	'innocent'
səma:ča:r	'news'
səmdhi:	'son's father-in-law'
ša:m	'evening'
sa:ma:n	'luggage'
sa:mna:	'encounter'
ša:n	'dignity'
vigya:n	'science'

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