Chapter: Five

Spirantization and Strength relations in Assamese: an Optimality theoretic account

5.0 Introduction:

Phonological strength can play a central role in the analysis of phonological patterning not only in the areas of language acquisition, pitch accent patterns and tonal phenomena but also in the well documented cases of segmental asymmetry. Strength relations can be understood to reflect on asymmetric licensing relations holding between units in representation. This issue of strength asymmetries in the patterning of segments can be correlated with the process of lenition, which has been described from various perspectives in the domain phonological literature, such as feature spreading, sonority promotion and minimization of articulatory effort etc. This chapter revolves around the theme of spirantization that can be subsumed under the rubric of lenition. This chapter is designed to address the process of spirantization in Optimality theoretical model with the data drawn from Assamese, an Indo Aryan language.

In Assamese aspirated stops /pʰ/ and /bʰ/ are spirantized as [f] and [v] in word final position, leaving the unaspirated stops intact. In word initial and medial positions spirantization is blocked in Assamese. Deaspiration in Assamese does not apply at the end of a phrase when no following consonant occurs. In Assamese, coda is deaspirated when it is followed by an aspirated onset. However the fricatives /ʃ/ and /v/ never lose their feature [+Asp] despite the fact that both of these consonants occur in the word final position or in coda position, being followed by aspirated onset. They turn in to /pʰ/ and /bʰ/ respectively when they are followed by obstruents. Nevertheless, the feature [+Asp] is maintained in the onset position which does not undergo alternation. By looking at the distribution of Assamese aspirated phonemes at word boundary it is observed that only the labial stops spirantize at the word final position unlike coronal and velar stops which are not susceptible to the process of spirantization.

5.1 Lenition from the perspective of feature spreading and sonority promotion:

The process of lenition in the domain of phonology has been analysed from various perspectives ranging from feature spreading under autosegmental framework to lenition as sonority promotion treatment, but both the processes failed to offer an explicit and
 empirically adequate account of unified formal account of lenition or account for the contexts in which lenition normally occurs. Let us first treat the autosegmental treatment to analyse lenition which have been proposed (e.g. Harris 1984, Mascaro 1983, Jacobs and Wetzels 1988, Selkirk 1980, Mascaro 1987, Cho 1990, Lombardi 1991). However this treatment of feature spreading is confined to degemination, debuccalisation and elision as deletion or delinking of phonological material. It fails in providing an explicit account of most typical lenition context, that is the intervocalic position as it suffices to spread the relevant feature from either adjacent vowel and hence the role of the other vowel in conditioning the lenition is unexplained. Next, we can take into account the other perception of lenition as sonority promotion theory which has been proposed (e.g. Foley 1977, Churma 1988, Clements 1990, Hock 1991, Elmedlaoui 1993, Lavoie 1996). But this notion also suffers on explicit and unified phonetic grounds in explaining the process of lenition. As, for instance, consider the sonority scale as given below: (as proposed by Dell & Elmedlaoui 1985)

\[(5/1)\]

\[
\text{Stops} > \text{voiceless fricatives} > \text{voiced fricatives} > \text{nasals} > \text{liquids} > \text{high vowels/glides} > \text{low vowels}
\]

From this sonority scale it will be convenient for us to predict wrongly that fricatives ought to be able to lenite to nasals. Secondly, sonority account says nothing about the environment and the contexts in which lenition occurs.

### 5.2 Lenition and Articulatory Effort:

Kirchner (1998) proposed that lenition is driven by phonetic factors: minimization of articulatory effort, thereby proposing explicit and unified phonetic properties in characterizing the notion of lenition, in particular the effort cost associated with a given set of articulatory gesture. Language specific lenition constraints emerge, according to Kirchner, from the effort minimization constraint, which is termed as LAZY, interacting with some lenition blocking constraints, within Optimality theoretic constraint. The conflict between Lazy and faithfulness can be extended to all sorts of lenition phenomena. The type of structural change occurring in a given language depend on which of the lenition blocking
constraints are ranked below: if PRES (length) degemination will occur; if PRES (voice) voicing, if PRES (sonorant) then reduction of an obstruent to an approximant, if PRES (place feature) then debuccalization, if PRES (continuant) despirantization will be the outcome in the language. Lenition, thus assumes a unified characterization, in terms of ranking schema:

\[(5/2)\]

\[\text{LAZY} \gg \text{lenition blocking constraint}\]

Spirantization as lenition phenomena: Spirantization is a process in which a segment turns into features along with its features associated with it. Following Kirchner, it can be argued when the PRES (continuant) will be dominated by LAZY; the resultant output will be spirantization in the language. It will be clear from the following diagram.

Spirantization: \(\text{LAZY} \gg \text{IDENT (cont)}\)

<table>
<thead>
<tr>
<th>/d/</th>
<th>LAZY</th>
<th>PRES (cont)</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>**!</td>
<td></td>
</tr>
<tr>
<td>(\sigma) d</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Table 5/a: Representation of spirantization where \(\text{LAZY} \gg \text{IDENT (cont)}\)

no spirantization: IDENT (cont) \(\gg\) LAZY


<table>
<thead>
<tr>
<th>/d/</th>
<th>PRES (cont)</th>
<th>LAZY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\sigma) d</td>
<td></td>
<td>(\sigma)*</td>
</tr>
<tr>
<td>(\sigma) (\delta)</td>
<td>(*!)</td>
<td></td>
</tr>
</tbody>
</table>

Table 5/b: Representation of non spirantization where IDENT (cont) \(\gg\) LAZY
Spirantization occurs in 5/a where LAZY dominates PRES (cont); and under the opposite ranking as exhibited in 5/b spirantization is blocked. Such kind of rankings drive home the point that stops involve higher effort cost than continuants, due to the greater distance which the articulator must travel in the former.

Before going into the optimality analysis let us see how spirantization process is interpreted within the rubric of autosegmental model and what are the favourable positions in which spirantization can be assigned crosslinguistically. Rhee (1999) claims that Spirantization in most cases takes place in the contexts where a target stop is adjacent to a [+cont] segment: prevocalic, postvocalic or intervocalic position. Nevertheless intervocalic position flanked by both preceding and following [+cont] is found cross linguistically to be the most favourable environment where a stop loses its [-cont] and turns in to a segment bearing [+cont].

(5/3)

Examples of intervocalic spirantization:

a. Kupiya (Christmas & Christmas 1975)


[su:pu] - [su:fu] ‘winnowing basket’

b. Shina (Rajpurohit 1983)

/babo/ - /baβo/ ‘father’

/darbak/ - /darβak/ ‘race’

c. Florentine Italian (Kirchner 1996)

/la tavola/ - [la øavola] ‘the table’

/le dorme/ - [e ðorme] ‘s/he sleeps’
The cases of prevocalic and postvocalic spirantization are also reported in phonological literature. In Boro (Bhat 1968, Bhattacharya 1977), it is found that a voiceless stop spirantizes in prevocalic position and in Nepali (Bandhu & Dahal 1971) aspirated stops spirantize in postvocalic word final position. Even Tigrinya (Kenstowicz 1982) and Tiberan Hebrew (Malone 1993) are also reported to exhibit postvocalic spirantization.

(5/4)

a. Boro (Bhat 1968, Bhattacharya 1977)

\[ /pʰipʰa/ - [φipʰa] \quad \text{‘father’} \]

\[ /kʰun/ - [xun] \quad \text{‘cotton’} \]

b. Nepali (Bandhu & Dahal 1971)

\[ /gəpʰ/ - [gəf] \quad \text{‘gossip’} \]

\[ /cəbʰ/ - [cəβ] \quad \text{‘dip’} \]

The fact that spirantization always involves the assignment of the feature [+cont] to a stop can be addressed in the following manner, with the help of the example drawn from Nepali postvocalic word final spirantization, as shown in 6.

(5/5)

Typical autosegmental analysis: assimilation to [+cont]

\[
\begin{array}{c}
V \\
\hline \\
[+cont] \\
\hline \\
| b^h | \rightarrow | V | β \\
\hline \\
[+cont] | [-cont] \\
\hline \\
[+cont] | [-cont]
\end{array}
\]

From the above representation in 4 it is quite evident that spirantization is an instance of [+cont] assimilation. It may not be explicitly addressed in all cases but what comes out conspicuously is that spirantization is an instance of ‘ease of articulation’.
The concept of ease of articulation for spirantization is more explicitly and formally expressed in Kirchner (1996, 1997, 1998) embedded in terms of ‘articulatory effort minimization’. Kirchner (1998) claims that the phonetic imperative involved in the phonological interpretation of spirantization, is to minimize the effort expenditure by means of reducing the magnitude of the articulatory gesture involved in consonant in question. This phonetic imperative is named in OT framework as ≥LAZY≤ constraint which interacts with the faithfulness constraint to the continuancy that regulates the exactness of the correspondence between the input and the output specifications. A faithfulness constraint that militates against LAZY in the case of spirantization in IDENT (cont).

The constraints can be defined in the following fashion:

\[(5/6)\]

LAZY

Minimize articulatory effort

IDENT (cont)

Correspondent segments in input and output have identical values for continuancy.

Kirchner (1998) upholds this approach by virtue of the fact that spirants involve less articulatory effort than stops under the definition of effort as “a mental estimate of the neuromuscular activation levels required to achieve some set of gestures (Kirchner 1996:1). From this perspective an assumption has been drawn by Kirchner that an articulatory gesture of greater displacement is more effortful than the one of lesser displacement. Hence, fricatives involve lesser articulatory effort than stops as articulatory displacement for target constriction for fricatives is lesser than that for stops. However this view of Kirchner appears contradictory with the observation made by Boersma. It is not fair to measure the effort merely by articulatory displacement. Boersma (1998) claims that it is rather likely that a ballistic movement for a stop, despite greater articulatory displacement, is easier articulatorily than a controlled articulatory movement found in a fricative. Underlying his belief lies is that fricative is more difficult to produce than a stop in articulation, and thus demands more effort than the stops which stands in contradiction with the assumption put forward by Kirchner. Silverman (1997:5) also gives the view which is in consonance with Boersma when he says
“fricatives are marked and presumably involve more effort to properly implement in comparison to stops.” Even the data from language acquisition contradict the views put forward by Kirchner. Stops are acquired earlier than fricatives, thereby standing as a setback to provide a positive conclusion that fricatives involve less effort than stops. In Boersama’s analysis (1997) articulatory effort is calculated with six primitives: energy, the presence of articulatory gestures, synchronization of gestures, precision, systemic effort and coordination. Without a proper combination of all these parameters a study concerning articulatory effort expenditure, Kirchner’s approach remains elusive.

However there are two studies conducted by Jacob (1994) and Hahn (1998) concerning the process of spirantization bear affinities with that of Kirchner with some alternations. In his analysis of diachronic French spirantization, Jacobs proposed a consonantal markedness constraint called anti association constraint which plays a central role given below:

(5/7)

*LE/ [+vce, -cont]

Within LE (LE stands for lenition context), do not associate [+voice, -cont] to a margin after a peak.

The above constraint claims that a voiced stop is disfavoured in lenition context. So spirantization from voiced stop can be represented by ranking *LE/ [+vce, -cont] over IDENT (cont). In the similar fashion Hahn (1998) in his analysis of German final spirantization has given a constraint *LENI (-cont]σ. The dominance of this constraint over IDENT (cont) is responsible for the final spirantization process in German.

(5/8)

*LENI (-cont]σ.

Stops in syllable final position are banned (i.e. do not associate [-cont] in the lenition context).
Both the processes given by Hahn and Jacob are somewhat similar with that of Kirchner although the methodology which they have employed for exhibiting the instance of spirantization is different. However in the approaches of Hahn and Jacob it will be difficult to make a correlation between spirantization and other closely related lenition processes such as intervocalic voicing and elision.

Before proceeding to the phenomenon of spirantization lets consider the case of coda deaspiration in Assamese.

5.3 Coda deaspiration in Assamese:

(5/9)

Assamese data on spirantization

In Assamese aspirated stops /pʰ/ and /bʰ/ are spirantized as [f] and [v] in word final position, leaving the unaspirated stops intact. Consider the following data:

\[
\begin{align*}
/kʰpʰ/ & \quad [kʰf] \quad \text{‘phlegm’} \\
/mapʰ/ & \quad [maf] \quad \text{‘excuse’} \\
/sapʰ/ & \quad [sa f] \quad \text{‘clean’} \\
/bʰpʰ/ & \quad [bʰaf] \quad \text{‘ice cream’} \\
/ⁿoʃpʰ/ & \quad [ⁿoʃf] \quad \text{‘profit’} \\
/xulbʰ/ & \quad [xulⁿf] \quad \text{‘cheap’} \\
/kʰjobʰ/ & \quad [kʰjov] \quad \text{‘anger’} \\
/nispʰbʰ/ & \quad [nispʰov] \quad \text{‘lustreless’}
\end{align*}
\]

Sometimes the coronal stop /tʰ/ spirantizes to dental /tʰ/ as displayed in the following data:

\[
\begin{align*}
/zetʰ/ & \quad [zetʰ] \quad \text{‘the second month of the Assamese year corresponding to May-June’}
\end{align*}
\]
However, what is noticeable is that unlike the labial and coronal stops the velar stops sometimes resist spirantization as exemplified in the following data, but in the speech of some speakers (very rare) the coronal stop spirantizes to velar fricative.

(5/10)

/snkʰ/ [snkʰ] vs. [snx] ‘style’
/dekʰ/ [dekʰ] vs. [dex] ‘to see’
/lakʰ/ [lakʰ] vs. [ lax] ‘lacs’
/jukʰ/ [jukʰ] vs. [lux] ‘measurement’
/xukʰ/ [xukʰ] vs. [lux] ‘happiness’
/dokʰ/ [dokʰ] vs. [dux] ‘sadness’

In the word initial and medial positions spirantizations never occur in Assamese as exemplified from the following data in (5/11).

(5/11)

/pʰəli/ [pʰəli] ‘slate’
/pʰulam/ [pʰulam] ‘colourful’
/pʰol/ [pʰol] ‘flower’
/pʰuara/ [pʰuara] ‘fountain’
/pʰagun/ [pʰagun] ‘name of a month’
/pʰoņiŋ/ [pʰoņiŋ] ‘cricket’
/bʰuṃwa/ [bʰuṃwa] ‘an insect’
/bʰoņi/ [bʰoņi] ‘foot’
<table>
<thead>
<tr>
<th>Word</th>
<th>Pronunciation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>/bʰomokapʰolia/</td>
<td>[bʰomokapʰolia]</td>
<td>'very colourful'</td>
</tr>
<tr>
<td>/bʰaltik/</td>
<td>[bʰaluk]</td>
<td>'beer'</td>
</tr>
<tr>
<td>/eʃʰɔi/</td>
<td>[eʃʰɔi]</td>
<td>'a unit of measurement'</td>
</tr>
<tr>
<td>/dubʰag/</td>
<td>[dubʰag]</td>
<td>'divide'</td>
</tr>
<tr>
<td>/gabʰɔrɔ/</td>
<td>[gabʰɔrɔ]</td>
<td>'young girl'</td>
</tr>
<tr>
<td>/gɔmbʰɔ/</td>
<td>[gɔmbʰɔ]</td>
<td>'womb'</td>
</tr>
<tr>
<td>/tʰɔui/</td>
<td>[tʰɔui]</td>
<td>'ear rings'</td>
</tr>
<tr>
<td>/tʰai/</td>
<td>[tʰai]</td>
<td>'small branch'</td>
</tr>
<tr>
<td>/tʰikɔna/</td>
<td>[tʰikɔna]</td>
<td>'address'</td>
</tr>
<tr>
<td>/tʰeh/</td>
<td>[tʰeh]</td>
<td>'offended'</td>
</tr>
<tr>
<td>/tʰik ʰak/</td>
<td>[tʰik ʰak]</td>
<td>'ok'</td>
</tr>
<tr>
<td>/tʰɔga/</td>
<td>[tʰɔga]</td>
<td>'a place where holy books are kept'</td>
</tr>
<tr>
<td>/atʰɔa/</td>
<td>[atʰɔa]</td>
<td>'net'</td>
</tr>
<tr>
<td>/gatʰi/</td>
<td>[gatʰi]</td>
<td>'joint'</td>
</tr>
<tr>
<td>/gatʰɔlu/</td>
<td>[gatʰɔlu]</td>
<td>'dwarf'</td>
</tr>
<tr>
<td>/jatʰi/</td>
<td>[jatʰi]</td>
<td>'a tool used in warfare'</td>
</tr>
</tbody>
</table>
Assamese word final spirantization of the stops /pʰ/ and /bʰ/ in to /f/ and /v/ can be explained in the framework of Kirchner’s model as shown below within OT framework:

Spirantization: LAZY >> IDENT (cont)

<table>
<thead>
<tr>
<th>/pʰ/</th>
<th>LAZY</th>
<th>IDENT (cont)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pʰ</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>f</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Table No 5/c: Spirantization of /pʰ/ in Assamese where LAZY>> IDENT(cont)

Spirantization: LAZY >> IDENT (cont)

<table>
<thead>
<tr>
<th>/bʰ/</th>
<th>LAZY</th>
<th>IDENT (cont)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bʰ</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Table No 5/d: Spirantization of /bʰ/ in Assamese where LAZY>> IDENT (cont)

These data of spirantization can be examined in the light of the data on Assamese coda deaspiration. Deaspiration in Assamese does not apply at the end of a phrase when no following consonant occurs. In Assamese coda is deaspirated when it is followed by an aspirated onset. However the fricatives /f/ and /v/ never lose their feature [+Asp] despite the fact that both of these consonants occur in the word final position or in coda position, being followed by aspirated onset. They turn in to /pʰ/ and /bʰ/ respectively when they are followed by obstruents. Nevertheless, the feature [+Asp] is maintained in the onset position which is never susceptible to change, as shown in the data below in 7.4.
kot\textsuperscript{b} k\textsuperscript{von} - kot k\textsuperscript{von}  (the mat)

mth khun - mth k\textsuperscript{von}  (the chariot)

adh b\textsuperscript{bag} - ad b\textsuperscript{bag}  (middle part)

at\textsuperscript{b} k\textsuperscript{ila} - at k\textsuperscript{ila}  (eight pieces)

kat\textsuperscript{b} p\textsuperscript{ota} - kat p\textsuperscript{ota}  (wood splitting)

bag\textsuperscript{b}al\textsuperscript{k} - bag b\textsuperscript{al\textsuperscript{k}}  (tigers and beers)

duk\textsuperscript{b} k\textsuperscript{ini} - duk k\textsuperscript{ini}  (the sadness)

b\textsuperscript{n}\textsuperscript{f} b\textsuperscript{a\textsuperscript{n}a} - b\textsuperscript{n}\textsuperscript{f} b\textsuperscript{a\textsuperscript{n}a}  (breaking of the ice)

duk\textsuperscript{b} b\textsuperscript{ag} - dug b\textsuperscript{ag}  (portion of the sadness)

bag\textsuperscript{b} g\textsuperscript{\textnu} - bag g\textsuperscript{\textnu}  (tigers and leopard)

b\textsuperscript{n}\textsuperscript{f} k\textsuperscript{ini} - b\textsuperscript{n}\textsuperscript{f} k\textsuperscript{ini}  (the ice)

kat\textsuperscript{b} b\textsuperscript{a\textsuperscript{n}a} - kat b\textsuperscript{a\textsuperscript{n}a}  (breaking of the wood)

k\textsuperscript{f} k\textsuperscript{ini} - k\textsuperscript{f} k\textsuperscript{ini}  (the phlegm)

saf b\textsuperscript{\textnu} - sab\textsuperscript{h} b\textsuperscript{\textnu}  (clean feet)

saf g\textsuperscript{\textnu} - sabh g\textsuperscript{\textnu}  (clean house)

k\textsuperscript{f} b\textsuperscript{\textnu} - k\textsuperscript{f} b\textsuperscript{\textnu}  (filled with phlegm)

lak\textsuperscript{b} k\textsuperscript{\textelimeli} - lak k\textsuperscript{\textelimeli}  (dozens of problems)

lav k\textsuperscript{ini} - lab\textsuperscript{h} k\textsuperscript{ini}  (the profit)

x\textsuperscript{\textnu}\textsuperscript{\textnu} b\textsuperscript{\textnu} - x\textsuperscript{\textnu}\textsuperscript{\textnu} b\textsuperscript{\textnu}  (admission at cheap rate)
5.3.1 Assamese coda deaspiration and autosegmental representation:

This process of coda deaspiration can be represented in the following fashion in autosegmental framework:

```
C       C
/       /
[spread glottis] [spread glottis]
```

Figure No 5/A: Representation of coda deaspiration in autosegmental module

Here the C connected to the node of delinking line represents the consonant segment occurring in the coda position which is deaspirated, but the consonant in the onset position retains its feature [spread glottis] thereby enhancing the onset coda asymmetry in phonological literature. But there are some exceptions to this pattern as exhibited by the segments /bʰ/ and /pʰ/.

What is noticeable in this context is that only the labial and velar consonants (optionally) are subject to spirantization. The coronals are never subject to spirantization in word final position. Secondly, the process of spirantization is blocked when the word final fricatives are followed by the stops. Rather the fricatives lose their feature [+cont] and turn in to [+Asp] stops. Thirdly, it is observed that coda deaspiration in Assamese followed by another aspirated stop in the onset position is blocked in the case of spirants.

As, for instance, consider the cases

pʰ → f / - # and when followed by liquids, nasals and fricatives. However, when it is followed by obstruents it becomes pʰ or bʰ.
knf snf - knph snf (phlegm etc)
saf sikun - saf sikun (cleanliness)
saf zilikil - saf zilikil (crystal clear)
bnmf xara - bnmph xara (sweeping of ice)
bnmf pray - bnmph pray (falling of ice)
bnmf k'ua - bnmph k'ua (to have ice cream)
bnmf lua - bnmph lua (to take ice cream)
bnmf nai - bnmph nai (no ice)
saf zuta - sav zuta (clean shoes)
saf goti - sabh goti (spices)

bh → v/- # or when followed by fricatives, nasals and liquids. But it becomes bh when it is followed by obstruents.

lav sabh - lav sav (profit etc)
lav zau - lav zau (whose profit)
lav ximan - lav ximan (that much profit)
lav hua - lav hua (to make profit)
lav hui - labh hui (profits)
lav dija - labh dija (to give profit)
lav gol - labh gol (to lose profit)
lav ghuma - labh ghuma (to return profit)
lav kusa - labh kusa (to make profit)
5.3.2 Spirantization, coda deaspiration and OT constraints:

Autosegmental representation fails to show the process of spirantization in Assamese in an explicit manner. Hence it becomes imperative on our part to analyse this phenomenon evident in the data of Assamese with the help of some constraints within Optimality theoretic framework which are addressed below:

(5/15)

a) Coda Condition (Coda Con): (Kager, 1999)

The feature spread glottis [s.g] is not allowed in the coda position.

This constraint prohibits the feature spread glottis [s.g.] from appearing in the coda position.

b) *s.g.: (Davis and Cho, 2003)

The feature spread glottis is prohibited.

It can be treated as a general markedness constraint militating against the feature [s.g.].

c) Max-sg: (Davis and Cho, 2003)

The feature spread glottis [s.g.] in the input must have a corresponding feature [s.g.] in the output. This constraint implies- maximize input segments in the output in terms of feature spread: one violation for each segment in regard to feature spread does not appear in the output. The main function of this constraint lies in the fact that it prevents segments to be deleted.

d) *OCP-sg: (motivated by Goldsmith, 1976; ‘No identical adjacent autosegments’) 

This constraint implies: avoid two instances of adjacent [s.g].

The roots of this constraint can be traced back to the Obligatory Contour Principle, which was originally conceived for tonal dissimilation phenomena in Mende and other African tone languages (Leben 1973), and manifested in proper fashion in Goldsmith (1976):
The Obligatory Contour principle (OCP)

"At the melodic level, adjacent identical elements are prohibited."

In OCP the central notion revolves round ‘adjacency’ (Archangeli, Archangeli & Pullyblank 1987, Myers 1987, and Oden 1994) which can be categorised in to segment adjacency and tier adjacency. It is the second aspect of adjacency that is instrumental in classical aotosegmental theory, as developed by Leben 1973 and Golsmith 1976, with the pursuit of reducing apparent action at a distance of locality. In the further pursuit of this theory additional representational assumptions became important which include feature geometric separation of feature groups (Clements 1985, Sagey 1986, Mester 1986), morphemically defined tiers (Mc Carthy 1981, 1986) and crucial underspecification of certain features (Kiparsky 1982, Archangeli 1984, Ito & Mester 1986, 1989, Steriade 1987 and many other works).

OCP is analysed in the framework of Optimality theory too (Prince & Smolensky 1993) the main motivation of which lies in understanding the process of OCP, and of featural dissimilation in general. In OT two types of principles have emerged regarding the notion of OCP: one group of phonologists want to maintain the principle in a more or less unchanged form, with diversification in terms of special features and feature groups, as one of rankable and violable constraint that make up an OT grammar and this assumption has been reflected in the works such as the tonal area (Myers 1997) and in segmental phonology (Mc Carthy & Prince 1995). Another group is more interested to explore whether it is possible in OT to reduce the OCP to more fundamental notions and restrictions, thereby achieving a deeper level of explanation. Ito & Mester (1998) claim that there is no Obligatory Contour principle per se: Universal Grammar is not concerned about adjacent identicals qua identicals. Rather, OCP effects arise when markedness constraints are violated more than once.

OCP effects obtain when a given marked type of structure is present more than once within the same local domain.

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Multiple violations of one and the same markedness constraint do not simply add up, but interact more strongly, so that a double violation within a given domain is worse than simply the sum of two individual violations. This notion of violation enhancement can get a formal expression by means of self conjunction of constraints (Smolensky 1995).

e) Local conjunction of constraints (LCC)

Kager (1999) claims that under Local Conjunction, two constraints are conjoined as a single composite constraint which is violated if and only if both of its components are violated within some domain. However this constraint can be traced back to Smolensky (1993, 1995, 1997) according to whom in addition to a set of Con of universal constraints, Universal Grammar contains an operation on Con: local conjunction. In addition to reranking of constraints, local conjunction drives home the way in which a line of demarcation can be drawn between individual grammars by making use of combined constraints. The chief motivation of combined constraints lies in allowing grammars to capture a particular type of constraint interaction that cannot be obtained in a theory exclusively built on direct strict domination (Prince & Smolensky 1993), but is attested in the phonologies of natural languages. We can express this constraint in the following manner following Ito & Mester (1998).

Definition:

Local Conjunction is an operation on the constraint set forming composite constraints:

Let $C_1$ and $C_2$ be members of the constraint set $\text{Con}$. Then their local conjunction $C_1 \land C_2$ is also a member of $\text{Con}$.

Interpretation

The local conjunction $C_1 \land C_2$ is violated if and only if both $^*C_1$ and $^*C_2$ are violated in some domain $\sigma$.

Ranking (universal)

$C_1 \land C_2 >> C_1$

$C_1 \land C_2 >> C_2$
C1 & C2 is potentially active when there is some constraint Cα (typically, but not necessarily a faithfulness constraint militating against violations of C1 and or C2) ranked between the conjoined constraint and at least one of the two basic constraints, as shown below:

\[ C1 \& \delta C2 \gg C\alpha \gg C1 \text{ or,} \]

\[ C1 \& C2 \gg C\alpha \gg C2 \]

The constraint of Local Conjunction can better be analysed in the constraint based analysis of German Coda Devoicing, which implies that voiced obstruents are marked elements, and syllable codas are marked positions. The phonology of German permits both, thereby emphasizing on the faithful parsing of the input and what is ruled out is the marked in the marked position: a voiced obstruent as a coda. Following Ito & Mester (1998) below is given the constraint conjunctive analysis of German final devoicing where the two individual constraints involved are the syllable structure constraint NOCODA and the segmental markedness constraint against voiced obstruents, which is termed Voiced Obstruent prohibition (VOP):

\[
\text{NOCODA} \& \text{VOP}
\]

(Composite constraint)

\[
\text{NOCODA}
\]


\[
\text{VOP}
\]

(basic constraint)
The additional factor which is responsible for coda devoicing, while at the same time limiting it to coda position, is the faithfulness ranking: the position of IDENT[F] below the conjoined constraint NOCODA & VOP and above the simple feature markedness constraint VOP.

NOCODA & VOP
  IDENT [F]  “avoid feature changes”
  NOCODA & VOP  “avoid voiced obstruents as coda”
  NO CODA  VOP
  “avoid codas”  “Voiced Obstruent Prohibition”

Figure No 5/B: Representation of constraint conjunctive analysis of German final devoicing

Indeed, the chief motivation for Local Conjunction of constraints resides in chain shift (Kirchner 1996). According to Kager (1999) a chain shift implies a situation in which sounds are promoted or demoted stepwise along some scale in some context. The chain shift crucially does not result in neutralization, since each input occupies one step precisely. This can be represented in the following schemata:

(5/16)

A → B and B → C, but not *A → C
### 5.4 Assamese data on spirantization and the OT constraints: an analysis

<table>
<thead>
<tr>
<th>Final consonant</th>
<th>Voiceless unaspirated stop</th>
<th>Voiced unaspirated stop</th>
<th>Voiceless aspirated stop</th>
<th>Voiced aspirated stop</th>
<th>Voiceless aspirate</th>
<th>Voiced aspirate</th>
</tr>
</thead>
<tbody>
<tr>
<td>f = p&lt;sup&gt;h&lt;/sup&gt;</td>
<td>p&lt;sup&gt;h&lt;/sup&gt;k</td>
<td>b&lt;sup&gt;h&lt;/sup&gt;g</td>
<td>p&lt;sup&gt;h&lt;/sup&gt;k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>b&lt;sup&gt;h&lt;/sup&gt;g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>f s</td>
<td>v z</td>
</tr>
<tr>
<td>t&lt;sup&gt;h&lt;/sup&gt;</td>
<td>t&lt;sup&gt;h&lt;/sup&gt;k</td>
<td>d&lt;sup&gt;h&lt;/sup&gt;g</td>
<td>t k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>d g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>t s</td>
<td>d z</td>
</tr>
<tr>
<td>k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>k&lt;sup&gt;h&lt;/sup&gt;k</td>
<td>g&lt;sup&gt;h&lt;/sup&gt;g</td>
<td>k k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>g g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>k s</td>
<td>g z</td>
</tr>
<tr>
<td>v = b&lt;sup&gt;h&lt;/sup&gt;</td>
<td>b&lt;sup&gt;h&lt;/sup&gt;k</td>
<td>b&lt;sup&gt;h&lt;/sup&gt;g</td>
<td>b&lt;sup&gt;h&lt;/sup&gt;k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>b&lt;sup&gt;h&lt;/sup&gt;g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>v s</td>
<td>v z</td>
</tr>
<tr>
<td>d&lt;sup&gt;h&lt;/sup&gt;</td>
<td>d&lt;sup&gt;h&lt;/sup&gt;k</td>
<td>d&lt;sup&gt;h&lt;/sup&gt;g</td>
<td>d k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>d g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>d s</td>
<td>d z</td>
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<tr>
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<td>g&lt;sup&gt;h&lt;/sup&gt;k</td>
<td>g&lt;sup&gt;h&lt;/sup&gt;g</td>
<td>g k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>g g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>g s</td>
<td>g z</td>
</tr>
<tr>
<td>P</td>
<td>p k</td>
<td>b g</td>
<td>p k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>b g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>p s</td>
<td>b z</td>
</tr>
<tr>
<td>T</td>
<td>t k</td>
<td>d g</td>
<td>t k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>d g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>t s</td>
<td>d z</td>
</tr>
<tr>
<td>K</td>
<td>k k</td>
<td>g g</td>
<td>k k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>g g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>k s</td>
<td>g z</td>
</tr>
<tr>
<td>B</td>
<td>b k</td>
<td>b g</td>
<td>b k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>b g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>b s</td>
<td>b z</td>
</tr>
<tr>
<td>D</td>
<td>d k</td>
<td>d g</td>
<td>d k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>d g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>d s</td>
<td>d z</td>
</tr>
<tr>
<td>G</td>
<td>g k</td>
<td>g g</td>
<td>g k&lt;sup&gt;h&lt;/sup&gt;</td>
<td>g g&lt;sup&gt;h&lt;/sup&gt;</td>
<td>g s</td>
<td>g z</td>
</tr>
</tbody>
</table>

Table No 5/e: Assamese data on spirantization

The above table represents the distribution of assamese aspirated phonemes at word boundary where it is observed that only the labial stops spirantize at the word final position unlike coronal and velar stops which are not susceptible to the process of spirantization. This can be represented within OT constraints following Kirchner (1998) as has been shown in section.
The fact the coda deaspiration in fast tempo in Assamese following another aspirated stop in the following onset position can be analysed from the perspective of Obligatory contour principle, that is, identical segments do not occur in adjacent position. Consider the following example:

\[ \text{knt}^b \text{k}\text{bn} - \text{knt} \text{k}\text{bn} \]  (the mat)

In the above example the coda is deaspirated when it is followed by another aspirated stop in the onset position. It implies that two consecutive aspirated stops can not occur. Here, *OCP-sg is higher ranked than MAX-sg, Coda con and *sg as evident from the following tableau:

(5/17)

/ \text{knt}^b \text{k}\text{bn}/-- [ \text{knt} \text{k}\text{bn} ]  (the mat)

<table>
<thead>
<tr>
<th>knt\text{bn}/--</th>
<th>*OCP-sg</th>
<th>MAX-sg</th>
<th>Coda Con</th>
<th>*sg</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) knt^b. k\text{bn}/</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>* * *</td>
</tr>
<tr>
<td>b) knt. k\text{bn}</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>c) knt^b. k\text{bn}</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
</tr>
</tbody>
</table>

Table No 5/1: Representation of coda deaspiration in / knt^b k\text{bn}/ where *OCP-sg > MAX-sg > Coda Con > *sg

Here from this tableau we get the winning candidate b) which, in addition to violating lower ranked *sg, violates MAX-sg and it is higher ranked than Coda Con and *sg. In this tableau the candidate a) violates *OCP-sg which outranks all other constraints. On the other hand candidate b) and candidate c) violate *sg twice and MAX-sg once yet candidate b) appears as winner. It is because candidate c), in addition to violating *sg and MAX-sg, violates Coda
Con. So in this instance of coda deaspiration the ranking schemata can be represented in the following way

\[(5/18)\]

Constraint ranking: \(^{*}\text{OCP-sg}>>\text{MAX-sg}>>\text{CodaCon, *sg}\)

But this OCP constraint is violated in case of spirants following by another aspirated stops in onset position. As, for instance, the fricatives /ʃ/ and /v/ never lose their feature [+Asp] despite the fact that both of these consonants occur in the word final position or in coda position, being followed by aspirated onset. They turn in to /pʰ/ and /bʰ/ respectively when they are followed by obstruents. Nevertheless, the feature [+Asp] is maintained in the onset position which is never susceptible to change. An analysis is given below in the light of the example given below:

\[(5/19)\]

/ḅọọf kʰini/ - [ḅọọpʰ kʰini]

\[
\begin{array}{c}
\text{f} \\
\text{kʰ} \\
\text{[+cont]} \\
\text{[+sg]}
\end{array}
\overset{\text{OCP}}{\leftarrow}
\begin{array}{c}
\text{*p} \\
\text{*[+cont]} \\
\text{pʰ} \\
\text{[-cont]} \\
\text{[-sg]}
\end{array}
\]

faithful

This phenomenon can be observed by using OT theoretical model by ranking constraints. In the above example it is evident that the continuancy is a feature which is not susceptible to OCP constraint whereas the stops having the features [-cont] lose their feature [s.g] under OCP when it is followed by another aspirated stop in onset position. In the above
interpretation of /θ/ three possible outputs can be expected: segments having the feature ([-cont], [-sg]) which is violable under faithfulness constraint. The segments having the features ([+cont] [-sg]) is not phonetically plausible. It is ruled out by the phonetic constraint */+Cont, -sg/. So it assumes the feature [+asp] inspite of occurring in the coda position thereby being faithful to the feature continuancy in input. In contrast, in Assamese the segments having [-cont] and [+sg] undergo transformation and lose their [+asp] feature when they are followed by another aspirated stop. This issue can also be analysed from the perspective of derivational steps. In the case of coda deaspiration in Assamese the final stop undergoes only one transformation, that is deaspiration under the contact of the following aspirated stop. But in case of spirants in the final coda position, there is not a single derivational step involved in the process of deaspiration. The feature [+cont] blocks the spirants to lose the feature [+sg] although they are bound to lose [+cont]. It is evident from the following diagrammatic representation:

```
<table>
<thead>
<tr>
<th>/θ/</th>
<th>/tʰ/</th>
</tr>
</thead>
<tbody>
<tr>
<td>changing</td>
<td>loss of aspiration</td>
</tr>
<tr>
<td>continuancy</td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
</tr>
<tr>
<td>pʰ</td>
<td>t</td>
</tr>
<tr>
<td>loss of aspiration</td>
<td></td>
</tr>
<tr>
<td>*Step2</td>
<td></td>
</tr>
<tr>
<td>p</td>
<td></td>
</tr>
</tbody>
</table>
```

Figure No 5/C: Representation of steps involved in the transformation of features

In order to authenticate this notion I am going to take in to consideration some OT constraints that I have discussed in the previous section:
Consider the example

\[ \text{bmnf p\text{\textacuten}a - bmnph p\text{\textacuten}a} \quad \text{(falling of ice)} \]

\[ \text{bmnf k\text{\textacuten}a - bmnph k\text{\textacuten}a} \quad \text{(to have ice cream)} \]

Now consider the input /f kʰ/

<table>
<thead>
<tr>
<th>Input</th>
<th>*[+continuant][-continuant]</th>
<th>Faith[s.g.] &amp; Faith[cont]</th>
<th>*OCP-s.g.</th>
<th>*[s.g.]</th>
<th>CodaCon</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) f kʰ</td>
<td>!*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b) c̅pʰkʰ</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) pʰk</td>
<td>!*</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>d) pʰk</td>
<td>!*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Table No 51g: OT analysis of the Assamese input /f kʰ/

Here, in this OT framework, the candidate b) appears as the optimal candidate as the constraints violated by b) are lower ranked in Assamese.

The candidate a) violates *[+continuant] [-continuant], that is, a consonant which is [+continuant] can not be followed by another consonant which is [-continuant]. In addition it violates the constraint *OCP-s.g., that prohibits identical adjacent segments. It violates *[s.g.], that is a markedness constraint militating against the feature spread glottis, and CodaCon, which implies that the feature spread glottis is not allowed in the coda position.

The candidate c) violates Local conjunction constraint, that is Faith[s.g.] & Faith[cont], that implies that the output must be faithful in terms of feature spread glottis and continuancy to its input counterpart. This Local conjunction is violated if both *C1 and *C2 are violated in a local domain. The candidate c) violates LCC by virtue of violating not only Faith [s.g.] but
also Faith[cont]. Candidate d) is ruled out on the ground of violating Faith [s.g] & Faith[cont] apart from *[s.g.] and CodaCon.

The fact that spirantization of labial fricatives at word final position in Assamese is blocked when followed by stops can be thus represented through the re-ranking of the constraints within OT framework.

The ranking of the constraints held responsible for this process can be depicted in the following fashion:

(5/21)

*+[cont][-cont] >> Faith[s.g] & Faith[cont] >> *OCP-s.g >> *s.g >> CodaCon

5.5 Conclusion:

Spirantization is treated in this chapter as a process of lenition which is found to be attested in the word final position. Like coda deaspiartion it is seen that spirantization is found in the coda or the word final position and thereby supports the claim of positional asymmetry or positional privilege. Spirantization is never attaested in word initial and medial position as evident from the data on Assamese. However cross linguistically word medial position is found to be the suitable place for spirantization to occur. Hence it must be argued that language specific phonotactics is bound to play a special role in the patterning of speech sounds. As we have seen in our previous discussion that the fricatives /l/ and /v/ never lose their feature [+s.g.] despite the fact that both of these consonants occur in the word final position or in coda position, being followed by aspirated onset. They turn in to /ph/ and /fh/ respectively when they are followed by obstruents. Nevertheless, the feature [+s.g.] is maintained in the onset position which does not undergo alternation. The distribution of Assamese aspirated phonemes at word boundary it is observed that only the labial stops spirantize at the word final position unlike coronal and velar stops which are not susceptible to the process of spirantization. Hence the ranking of the constraints responsible for spirantization in Assamese is:

*+[cont][-cont] >> Faith[s.g] & Faith[cont] >> *OCP-s.g >> *s.g >> CodaCon