Chapter: Two

Literature Review on Strength Relations in Phonology

2.0 Introduction:

All language speakers are endowed with the intuitive or subconscious knowledge about strength asymmetries in their sound patterns as there is no language in the world which does not show the pattern of lenition or fortition of one kind or another, either diachronic or synchronic (Backley and Kuniya 2006). A great deal of effort has been spent in the domain of phonological literature to capture the notion of phonological strength in a non arbitrary way. The notion has been addressed both from phonetic as well as phonological perspectives such as positional faithfulness model, positional augmentation model, perceptual cue based approach etc.

2.1 Approaches to Strength relations:

Although the issue of strength is a topic that has been recently addressed in phonological literature yet the notion of asymmetric organization of segments and their representation in a phonological string can be analysed in the backdrop of various theories, the notable amongst which are Natural phonology, Government phonology, Optimality theory, Dependency phonology, Metrical phonology, the theory of Feature Geometry, theories of Positional Neutralization. In this chapter I try to address the main issues of the above phonological theories that I have mentioned above taking in to consideration the notion of phonological strength.

2.1.1 Natural phonology and Strength relations:

Natural Phonology is credited with providing for the first time the explanatory model of sound structure which assigned the central role to functional phonetic principles such as articulatory effort and perceptual distinctiveness (Dogil Grzegorz, 2007). These conflicting principles are operationalised in a procedural mechanism comprising of weakening processes (minimizing articulatory effort) and strengthening processes (maximizing perceptual distinctiveness). While the weakening processes are mostly categorical in nature, the formalization of the phonological strengthening has become a perennial subject of investigation for the procedural models of phonology. The theory of Natural Phonology, a theory of phonological structure, acquisition and change originated by David Stampe and
developed by Stampe and Patricia Donegan, operates with phonological processes, which constitute natural responses of the human vocal and perceptual systems to the difficulties encountered in the production and perception of speech. For instance, it is more difficult purely on aerodynamic grounds to produce a voiced stop than a voiceless one, as well as a voiced velar stop than an alveolar one while a bilabial one is the easiest of the three. Thus Natural Phonology tries to establish a correlation between phonological process and phonetic motivation.

Phonological processes are universal, since all humans exhibit the same potential to respond to difficulties of speech. A child learns to inhibit some of the natural responses in order to arrive at a language specific phonology and thereby implying the notion that the universality of the processes does not mean that they apply in all languages, only that they are motivated in all speakers (Donegan, 2002). This notion has been addressed by NP with special reference to the tension between two conflicting criteria (ease of production vs clarity of perception) and between paradigmatic (segmental) and syntagmatic (sequential) difficulty. Processes perform substitutions in order to adapt the speaker’s phonological intentions to his/her phonetic capabilities as well as enable the listener to decode the intentions from the flow of speech. They are thus either context sensitive, assimilatory substitutions (lenition) or context free dissimilatory ones (fortitions). Higher order prosodic processes map segmental material on rhythmic patterns prior to the operation of articulatorily and perceptually driven substitutions. In the framework of NP, phonemes are treated as fully specified, pronounceable percepts.

However, Stampe (1979) draws a line of demarcation between phonology and morphonology as in his words, morphological rules do not have any synchronic phonetic motivation and have to be learned by children in language acquisition. A phoneme in NP is an underlying intention shared by the speaker and the listener and this shared knowledge of intentions guarantees communication between the speaker and the listener within a given language, even if the actually pronounced forms diverge substantially from what is intended, for example in casual speech. The claim that phonemes are naturally pronounceable implies that they are derivable by means of phonological processes, which can manifest themselves in all types of phonological behaviour of language users in normal performance, in child language, in second language acquisition, in aphasia and other types of disorders, in casual speech in emphatic speech, in slips, errors, language games, whispered and silent speech, as well as in the changing phonological behaviour resulting in sound change.
Even the phenomenon of phonological substitution, a mental operation, is clearly motivated by the physical character of speech- its neuro-physiological, morphological, mechanical, temporal and acoustic properties. The fact that some phonological substitutions are more predominant in the speech of children bears ample testimony to the fact that they are ultimately motivated by the physical character of speech because substitutions are mental in occurrence, but are physical in teleology: their purpose is to maximize the perceptual characteristics of speech and to minimize its articulatory difficulties. From this perspective it can be claimed that phonological processes are mental operations performed on behalf of the physical systems involved in speech perception and production (Stampe 1979).

2.1.2 Metrical phonology and the issue of strength:

If we perceive the notion of phonological strength from the perspective of prominence it can be addressed in the backdrop of metrical phonology the framework of which was laid in the pioneering work of Liberman and Prince (1977). Prior to this work, prominence was represented as a segmental property associated with vowels and often classified into different levels (Trager and Smith 1951, Chomsky and Halle 1968). According to this model of phonology prominence is a syntagmatic feature unlike distinctive features which are paradigmatically contrastive. Prominence is not treated in this model as a primitive content feature but a relational feature. As a result, a given syllable is prominent not in absolute terms but only in relation to an adjacent syllable bearing lesser prominence. According to Liberman and Prince (1977) stress should not be treated as a phonological feature given some content by phonetic implementation rules but as assumed in the linear theories of SPE, but a structural position. This structural position is termed as foot which is assigned place above the syllable and below the word. Hayes (1980,1986), the main proponent of metrical phonology considers stress to be a strength relations between syllables. That is, stress is represented by using binary branching tree structure in which one node is dominant and the other recessive. They are labelled as strong (S) and weak (W). Thus stress assignment in metrical phonology involves denoting the relative prominence of sister constituents and consequently, representing nodes as S or W node in isolation can have no meaning. Thus, from this follows the assumptions that nodes must be in the relation [W S] or [S W] and not [S S] or [W W]. Hayes (1986) assumes four positions in metrical framework:

Right dominant [W S] vs. left dominant [S W]
Bounded vs. Unbounded. The parameter of boundedness implies maximally binary feet whereas there is no upper limit on the size of a foot.

Example of bounded feet

\[
\begin{array}{cccc}
\sigma & \sigma & \sigma & \sigma \\
S & W & S & W \\
\end{array}
\]

Unbounded

\[
\begin{array}{cccc}
\sigma & \sigma & \sigma & \sigma \\
S & W & W & W \\
\end{array}
\]

Figure No 2/A: Representation of bounded vs. unbounded feet in metrical framework

Quantity insensitive vs. quantity sensitive. In the former, the fact that the syllable is heavy or light does not influence the construction of foot. Trees are built on syllable projection. In quantity sensitive, the internal structure of syllable has to be taken care of. It shows that a W node does not have the potential to carry a heavy syllable. Trees are built on the rhyme projection.

2.1.3 Feature geometry and strength relations:

The fact that there lies an asymmetric fashion in patterning of sounds and their representation in a phonological string can be interpreted in the backdrop of the Geometry of phonological features (Goldsmith 1981, Mohanan 1983, Mascaro 1986) that assign some sort of hierarchical organization in the representation where all features are assigned to their own tiers and are linked to a common core or 'skeleton'. As, for instance, under the rubric of feature geometry model individual features are organized under hierarchically super ordinate nodes known as CLASS NODES. The class nodes themselves are dominated by a yet higher level class node, which is termed as ROOT NODE (Mohanan 1983). Following Clements (1985), Sagey (1986), McCarthy (1988) and others Rice (1992) draws a conclusion that segment structure involve two major components, constituency and dependency. The representation of feature geometry as given by Rice (1992) is given below for illustration:
In this above diagrammatic representation constituency is defined by the nodes Place, Sonorant Voice (SV), Supralaryngeal (SL), Air Flow (AF) and Laryngeal. These nodes are instrumental in providing information about major constituents and function as major units with respect to phonological features such as assimilation, OCP effects and delinking. As, for instance, the Place node dominates the features that are involved in rules of place of articulation assimilation (see Clements 1985; Sagey 1986; McCarthy 1988 for discussion). The arrangement of the nodes displays a pattern of hierarchy and thereby implying the notion of constituency and dependency. The organizing nodes are broader in scope in the sense that they take up the nodes as dependents which represent the features that make up the constituent and define the particular content associated with the node in a given segment. However it should be noted in this context that the organizing nodes themselves are in dependency relation: dependents of lower constituents can spread independently whereas if dependents of a higher level constituent spread, dependents of the lower one must also. For example, an assimilation rule may affect Place alone, Place and SV, or Place, SV and AF, but not Place and AF to the exclusion of SV.
2.1.4 Optimality theory and strength asymmetry

The predominance of certain phonological features and units in world languages, the primacy of certain phonological features in language acquisition can be correlated with the notion of phonological strength. Strength asymmetries in the patterning of segments can be addressed in Optimality theoretic module with the help of markedness constraints.

OT, enunciated by Prince and Smolensky (1993) is usually considered a development of generative grammar and a successor of harmonic grammar, which shares its focus on the investigation of universal principles, linguistic typology and language acquisition. This theory propagates the view that the observed forms of language arise from the interaction between conflicting constraints. Kar (2008) claims that in harmonic grammar, the maximal harmony lies on the optimal candidate, where harmony is calculated using a simple linear sequence. Given a representation's scores on a set of constraints, or weights, 'harmony' is the sum of the weighted constraint scores. It is this framework in the backdrop of which Alan Prince and Paul Smolensky developed the Optimality theory where the constraints assign scores based on the number of violations by the candidates, then the scores are the corresponding negative integers, and the weights are positive reals (Pater, 2007). OT was initially introduced in the field of phonology, but in recent years it found its application in other areas of linguistic studies, such as in syntax and semantics (see Legendre, Grimshaw and Vickner, 2001).

The three components such as GEN, CON and EVAL are universal in nature, but the differences existing in the languages of the world can be assigned to different rankings of the universal constraint set and in the light of this phenomenon language acquisition can be viewed as the process of adjusting the rankings of these constraints. OT assumes that there are no language specific restrictions on the input. This is richness of the base, according to which, every grammar can handle every possible input, that is, given any input, it is the task of the GEN to generate an infinite numbers of candidates or possible realizations of that input and it is the grammar of a particular language that determines which of the infinite candidates will be assessed as optimal by EVAL. In the framework of OT constraint is considered to be universal although there lies a distinction between faithfulness constraint and markedness constraint. Whereas the former require that the observed surface form (the output) match the underlying lexical form (the input) in some particular way; that is, these constraints require
identity between input and output forms, the latter impose requirements on the structural well
formedness of the output. Markedness constraints evaluate the output representations and
check for instance whether feet are binary, syllables have onsets and vowels do not contain
undesirable feature combinations such as [-back,+round] and on the contrary, faithfulness
constraints check whether the output representation has not changed from the input.
Markedness constraints and markedness constraints motivate change. In the literature two
genres of traditions are discerned in the formalisation of faithfulness constraints: one tradition
works with separate input and output representations, and correspondence relation between them and it is
appropriate to comment that most works in OT, following McCarthy and Prince (1995) falls
within this tradition. An alternative tradition, however, is based on the notion of containment
(Prince and Smolensky, 1993), according to which, every element of the phonological input
representation is contained in the output. In a containment model of faithfulness, all
constraints only evaluate one representation, the output.

However, it is the notion of markedness which can throw ample light upon the issue of
asymmetry in the patterning of segments. Phonologists have strong intuitions concerning the
notion of markedness, which is explicitly formulated in phonology literature as markedness
constraints in Optimality theory. In the field of phonological research the questions which are
raised are such as to what extent markedness theory should be based on phonetic principles
like ease of articulation and salience of perception (Fleming 1995, NiChiosain and Padgett
2001) and to what degree it is authentic to claim that markedness facts are best captured by
fixed universal scales (Prince and Smolensky 2004) and they are better accounted for
structurally (Avery and Rice 1989). In recent years the phonologista have gone to the extent
of claiming a correlation between markedness in phonology and a more general linguistic and
cognitive faculty although Hume and Tserdanelis (2002) and Hume (2004) have nurtured the
view that phonological markedness is to be abandoned.

Before going in to details regarding the markedness constraints in OT framework let us take
in to consideration other diagnostic tools of markedness which can broadly be divided in to
categories: implication and frequency.

a. Implication:

Implication is a diagnostic which is often referred to in literature: a feature X is more marked
than feature Y if the presence of X implies the presence of Y. As, for instance, if a language
has voiced obstruent it must have its voiceless counterpart. Hence, interpreted in terms of markedness voicelessness obstruents are unmarked with respect to voiced obstruents. In the same fashion the presence of coronals in the phonemic inventory of the language is generally implied by the presence of other places of articulation like labial and dorsal although counterexamples can not be negated. As, for example, Hawaiian lacks coronal stop but labial and dorsal stops although in its phonemic inventory coronal nasal is present. In markedness schemata nasals appear as unmarked with respect to liquids as crosslinguistic evidence bear ample testimony to the fact that some languages have nasals but may lack liquids (see Powell 1975 and Maddieson 1984). In the same way in vowel inventory if a language has high vowels it has mid vowels, thereby making high vowels as unmarked segments. However counterexamples to this vowel inventory is evident in Alabama, a language spoken in United States, that is reported to have [e,o a] vowel system without high vowels (Maddieson 1984). The strategy of implication is better applicable in the discussion of syllable types. Most of the languages display CV pattern and not all the languages have CVC pattern thereby making CV as the optimal syllable type. A general agreement holds that CV syllables are unmarked with respect to syllable shape (e.g. Clements and Keyser 1983, Clements 1990, Blevins 1995). In favour of this argument many cross linguistic evidences can be substantiated. Many languages do not permit syllables with codas and complex onsets (e.g. Hawaiian[Austronesian, United States], Elbert and Pukui 1979); those that permit syllables with codas and complex onsets also allow CV syllable shape (e.g. English). Based on this implication, CV syllables are considered to be optimal and unmarked: the existence of CVC and of V syllables in a language implies the existence of CV syllables in the language, but not vice versa.

b. Frequency:

In addition to implication there is frequency, another diagnostic tool which is widely used in the field of research to characterise marked features. Frequency can be studies both language internally and cross linguistically. Hamilton(1996) talks about the markedness of non coronals in final position in Australian languages on the basis of both implication and frequency. Australian languages with final labials/velars have final coronals; in addition, in languages with more than coronals in this position, coronals are of greater frequency than non coronals. Maddieson (1984) on the basis of cross linguistic frequencies draws the conclusion that unmarked features/segments are more frequent than marked ones. As, for instance, plain coronals occur more in more languages than do other places of articulation- in Maddieson
(1984:35) 263 languages have plain voiceless bilabials, 309 plain voiceless dental/alveolars, and 283 plain voiceless velars.

However, both these parameters of markedness have their own limitations. Implication faces complications when learnability issues are taken into consideration. In case of language acquisition, a child receives input only from the languages to which he/she is exposed and a line of correlation cannot be drawn between the source of the language data and the implication parameter. As the child has no idea, for instance, that a dental or alveolar stop appears in almost all languages (316 languages in Maddieson’s survey; p.32) while a uvular stop occurs in only some languages (47 in Maddieson 1984). Similarly a child acquiring a language with only voiceless stops may be aware of the existence of voiced stops; even the occurrence of voiced and voiceless stop is in itself not an indication of which is the marked pole phonologically. There is no reason to believe that the child will have an access to cross linguistic frequencies. Indeed, implication cannot be determined on the basis of an individual grammar. Other factors need consideration with respect to frequency as a markedness diagnostic. The criteria for counting must be firmly established—Trask (1996), following Lass (1984:132), states that the marked segment has lower text frequency, while Battistella (1990:48) claims that frequency refers to frequency of context rather than text frequency. It is the position which is instrumental in the selection of the material appearing there. Position is a broad umbrella term—for instance, initial or final position may refer to a morphological domain like stem or morpheme, a prosodic domain like syllable or foot, types of morphemes such as stem and affix, and sub types of affixes such as inflection and derivation and each of these positions are having their own set of constraints. Rice (1999) has claimed that all Australian languages allow a contrast between labial, dorsal and laminal coronals stem initially, but not all allow apicals in this position. In stem final position, all Australian languages with final consonants permit coronals; only some permit labial and dorsals in this position. Within the coronals, if laminals can appear, then apicals as well. Both implication and frequency are related to position, and no general statements can be formulated. So a consensus can be arrived that there lies differences between phonological markedness and natural markedness and hence, one must be cautious in using the results of phonological markedness and natural markedness to reinforce one another.

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2.1.5. Markedness and asymmetry:

Markedness is a contentious theme in phonology. This concept came into prominence in linguistics in the twentieth century and continues to play a pivotal role in the discipline. The notion of strength asymmetry under consideration in this thesis can be correlated with the theme of markedness in the sense that markedness drives home the point that not all elements in a phonological system are of equal status and thereby leaving space for the concept of asymmetrical behaviour of speech segments in the patterning. In this context mention must be made of Jakobson (1941/1968) who proposes that markedness constrains phonological inventories, systems and rules and plays a role in determining sound change and the order of acquisition of sounds; relative frequency, combinatorial capacity, and assimilatory power of features are determined by the priority relationships within the universal feature hierarchy that he proposed. The term was introduced by Trubetzkoy (1939/1969) to refer to relations between elements of a phonological class (e.g. place of articulation, phonation types) on a language particular basis. The characterization between marked/unmarked dichotomy can be represented in the following way.

(2/1) Markedness Terms

<table>
<thead>
<tr>
<th>Marked</th>
<th>Unmarked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less natural</td>
<td>more natural</td>
</tr>
<tr>
<td>More complex</td>
<td>simpler</td>
</tr>
<tr>
<td>Less common</td>
<td>more common</td>
</tr>
<tr>
<td>Unexpected</td>
<td>expected</td>
</tr>
<tr>
<td>Not basic</td>
<td>basic</td>
</tr>
<tr>
<td>Less stable</td>
<td>stable</td>
</tr>
<tr>
<td>Appear in few grammars</td>
<td>appear in more grammars</td>
</tr>
<tr>
<td>Latter in acquisition</td>
<td>earlier in acquisition</td>
</tr>
<tr>
<td>Early loss in language deficit</td>
<td>late loss in language deficit</td>
</tr>
<tr>
<td>Implies unmarked features</td>
<td>implied by marked features</td>
</tr>
<tr>
<td>Harder to articulate</td>
<td>easier to articulate</td>
</tr>
<tr>
<td>Perceptually more salient</td>
<td>perceptually less salient</td>
</tr>
<tr>
<td>Smaller phonetic space</td>
<td>larger phonetic space</td>
</tr>
</tbody>
</table>
These dichotomous categories are drawn from various sources, from Jakobson (1941/68) and Trubetzkoy (1939/69) through current linguistic dictionaries (e.g. Trask 1996, Crystal 2003), encyclopaedia articles (Kean 1992) and text books (e.g. Kenstowicz 1994, Roca 1994, Spencer 1996, Kager 1999a), works on phonological theory (e.g. Greenberg 1966, Anderson 1985, Harris 1994, Archangeli and Pulleyblank 1994, Blevins 2004) to writings on the theories of markedness (e.g. Battistella 1990, Mohanan 1991, Steriade 1995, Rice 1999 a, 2002, Lombardi 2002, de Lacy 2002a, 2006).

The markedness features stated above first found its articulation in Prague school, starting with Trubetzkoy (1939/1969). For convenience, it is possible to divide the characteristics into two groups. Those in 1 a) refer to what Anderson terms ‘natural markedness’ and what Bybee (2001) calls ‘frequency markedness’ which relate to a large part to the phonetic bases of an opposition and those in 1 b) relate to phonological markedness, called ‘structural markedness’ by Bybee (2001).

The notion of markedness can better be interpreted in the context of explaining phonological features. It is often cross linguistically observed that nasals are unmarked with respect to other sonorants (e.g. Rice and Avery 1991), that voiceless obstruents are unmarked with respect to voiced obstruents (e.g. Lombardi 1991), that high tone is unmarked with respect to low tones (e.g. Pulleyblank 1986), that coronals are unmarked with respect to other places of articulation (e.g. Paradis and Prunet 1991b), that high and low vowels are unmarked with respect to mid vowels (e.g. Beckman 1998). These generalizations are provided empirical foundations by Maddieson (1984). Featural markedness is established on the basis of asymmetries within a class. As for instance, the featural asymmetry can be derived from a study of the patterning of consonantal place of articulation, with focus on coronal asymmetries (Paradis and Prunet 1991b). The coronal place of articulation is considered the unmarked place with respect to labial and dorsal and this observation can be assigned various
empirical foundations. First, there are phonological reasons, with coronal consonants patterning asymmetrically to other places of articulation. Coronals are said to have different distribution pattern from labials and velars- they may be epenthetic and may result from neutralization, while labials and velars don’t display such patterning. Coronals, in addition, may be the target of asymmetric assimilation while labials and velars are the trigger of assimilation, but not target of assimilation. This can also be explained with natural markedness reasons: all languages have coronal segments, coronal places of articulation occur more frequently than other places of articulation, coronals are early in acquisition and coronals are considered to be articulatorily and perceptually simple. In optimality theory framework Lombardi (2002:221) proposes a place of articulation markedness hierarchy as follows:

\[
*\text{LABIAL}, *\text{DORSAL}>>*\text{CORONAL}>>*\text{PHARYNGEAL}
\]

This hierarchy specifies that pharyngeal places of articulations are the least marked place of articulation and labial and dorsal places of articulation are the most marked.

2.1.6. Government phonology and the notion of phonological strength

Strength relations in the patterning of sounds can be correlated to some extent with the idea of governing relations introduced in the model of Government phonology (Kaye, Lowenstamm & Vergnaud, 1985, 1990). According to the proponents of this theory, syllables are bound together in terms of a relation of government. KLV (1990) define a governing domain as follows:

A syllabic constituent is a governing domain where the government relation is characterized as strictly local and strictly directional. The direction of the government relies on the nature of the government. Constituent government is head initial and interconstituent government is head final. Most importantly, governors and governees require certain types of segments in order to fulfil their governing requirements. The governing properties characterizing the segments are defined by charm which can be defined as a kind of sonority measure. Generally, segments with negative charm such as stops and non strident fricatives are
potential governors and charmless segments such as sonorants are potential governees, as shown below:

Governors: negatively charmed segments (obstruents and fricatives e.g. p, t, k, f)

Governees: charmless segments (sonorants; e.g. m, n, l, r)

In Government phonology KLV (1990:219) have proposed the following constraints and principles in order to specify the government restrictions.

Empty Category Principle: A principle may be uninterpreted phonetically only if it is properly governed.

Proper Government: The governor may not itself be governed, and the domain of proper government may not include a governing domain. Kaye (1990a, 1990b) accounts for the Moroccan Arabic forms such as [ktb] ‘I write’ and [kittib] ‘he made x write’. In the former example, the final nucleus governs the first nucleus, and hence the first nucleus is not realized phonetically under the condition of the Empty Category Principle. On the other hand, in the latter example, not only the final nucleus but also the first nucleus must be realized. As the intermediate geminate constitutes a domain of interconstituent government, it creates proper government between the two impossible and the consequence is [kittib].

KLV (1985) proposes an additional determinant of governing capacity: the complexity associated with a segment and thereby trying to draw a correlation between segmental complexity and phonological governing principles. The following are the unary elements proposed by KLV by virtue of which consonant’s internal structure can be brought in to analysis:

\[
\begin{align*}
U^o & \quad \text{labiality} \\
h^o & \quad \text{noise} \\
P^o & \quad \text{palatality} \\
?^o & \quad \text{constriction} \\
v^o & \quad \text{velarity}
\end{align*}
\]
R* coronality
N* nasality
H* stiff vocal chords
CG* constricted glottis
SG* spread glottis
L* slack vocal chords

On the basis of these unary elements Harris (1990) proposes that segments in government configuration must satisfy complexity condition that is stated below:

Let x and y be segments occupying the positions A and B respectively. Then, if A governs B, y must not be more complex than x.

The organization of the segments in the phonotactics of a language can be analysed in this framework of segmental complexity. Some segments are licensed to govern other segments but not vice versa by virtue of the complexity condition. Cross linguistically it is seen that in word initial cluster liquids can never function as the first member but stops can. This can be argued from the perspective of segmental complexity condition. As stops are endowed with more unary elements than liquids, so the former can govern the latter, but not vice versa. It is shown with diagrammatic representation below:

```
  x
 /|
U* 
 /|
\ |  \ |  \ |
R'  r
 /|
\ |
p
```

Figure No: 2/C : Representation of segmental complexity

In the above diagram, the segment [p] has two unary elements labiality and constriction whereas the liquid [r] is assigned only one unary element coronality. So[p] can license
governing relation to [r] and thereby occurring as the first member of the word initial cluster, as we have seen above that the direction of the governing relation in constituent government is from left to right. In the above diagrammatic representation it is evident that [p] is more complex than [r].

2.1.7 Dependency phonology and segmental distribution:

The patterning of segments in a phonological domain can be analysed from the perspective of head modifier relations which is evident in the framework of Dependency phonology. This branch of phonology relies on the assumption that fundamental to phonological structure is the dependency or head/dependent relation and thereby implying the notion that phonological structure involve constructions and secondly, each of these constructions has a determinate head. Jacques Durand (1990) claims that like other modern theories of phonology DP assumes that segments are exhaustively decomposable to features known as components belonging to a universal set and thus drives home the point that unary features provide more appropriate account of phonological regularities unlike Generative phonology which takes for granted that features are inherently binary The notion of constituency which is of prime concern in theoretical linguistics, is supposed to be derivable from the dependency relation coupled with linear precedence and rules of association. All these phonological approaches including DP hold the view of asymmetric relation between components and thereby implying indirectly the strength asymmetries existing in the patterning of segments. DP recognises the fact that the components of a language can be combined in asymmetrical fashion; one component is more salient than the other. In DP framework, one component functions as governor and the other as dependent, as shown below:

```
/ɛ/     i          governor
     |                |
    - a            dependent
```

```
/ɛ/     a          governor
     |                |
    i          dependent
```

**Figure No: 2/D: Representation of governor and dependent in DP module**

From this representation what is evident is that the dominance in palatality gives rise to high mid vowel /ɛ/ and where lowness is dominant we get the low mid vowel /ɛ/. This
infrasegmental representation of governance and dependence can be represented by a semi colon within DP model. As, for instance, /e/ is represented as {i ; a} and /ɛ/ as {a ; i}. Here, semicolon implies dominance. The notation used in DP adheres to the principle of componentiality assumption (Anderson & Ewen 1987: 8).

2.1.8 Positional asymmetry and the notion of phonological strength:

The notion of strength in phonology can be addressed from various perspectives, amongst which the approach of positional neutralization bears significance. The term “positional neutralization” came in to fore with Steriade’s paper “Positonal neutralization and expression of contrast”, which denote the class of neutralization termed “structurally conditioned” by Trubetzkoy (1969:235-241), meaning that the contrast under consideration is neutralized whenever one of the terms involved comes to assume a particular structural position in the word or phrase. Barnes (2006) considers positional neutralization as any instance of an asymmetric capacity of two positions in the representation in order to license phonological contrast, such that one set of structural positions licenses a larger array of contrasts than another. It implies that the set of positions considered “weak” licenses only a subset of the range of contrasts available in another set of positions, termed “strong” thereby encompassing not only the cases in which contrasts are lost through mergers in weak positions, but also to cases in which licensesng asymmetries arise through, for example, the emergence of new contrasts in strong positions.

2.1.9 Integrated phonetics phonology model and patterning of sounds:

This model implemented by Flemming and kirchner (e.g. 1998) claims that phonological patterns of neutralization can be rooted in phonetic factors thereby making a correlation between phonetic cues and phonological organization of sounds. Behind the veneer of any phonological pattern there lies a vast array of phonetic factors, whether articulatory or acoustic in nature. Indeed, this approach links the licensing patterns directly to the phonetic effects and thereby avoiding the overgeneration characteristic of the phonetics free, abstract phonological model. As, for instance, Flemming(2001 b) claims that vowel reduction can be derived from the decreased duration of unstressed syllables which results in an unacceptable amount of effort necessary to reach articulatory targets for the production of non high vowels. This approach bears close affinity with “Licensing by cue” model which I am going to describe in the next section.
2.1.10. Licensing by cue model:

This theory is advanced by Steriade (1997) and implemented in numerous works of other authors adopting versions of this approach, such as Bradeley (2001), Cote (2000), Crosswhite (2001), and Zhang (2001). According to Steriade (1997) the occurrence of the same feature again and again with the same position in languages cross linguistically can not be termed accidental but can be correlated with specific phonetic characteristics of each position in a phonological string. Steriade’s claim implies the notion that features are licensed preferentially in positions in which phonetic conditions make them maximally robust perceptually, and are likewise eschewed in positions where they would be less perceptually robust, and hence easily overlooked. According to this approach it is not the position itself which has the potentiality to ban or license features, but the concrete phonetic cues pertaining to those features are responsible for those feature’s perception. Steriade (1997) shows that the contrasts involving voice, aspiration or glottality, which are potentially difficult to perceive, could be licensed on stops only in the presence of release bursts and following CV transitions, wherever those may happen to occur in a given language. In the same way, in order to maintain vowel height, such as between high or low, the vowels under consideration must display sufficient phonetic duration for their accurate perception. However, Steriade’s view has been criticised by the proponents of pure prominence model which I am going to illustrate in the next section.

2.1.11. Pure Prominence approach:

According to this model, phonetic factors hardly matter in the determination of positional neutralization (e.g., Beckman 1998; Zoll 1998). This approach to positional neutralization is largely unconcerned with the phonetic motivations for the alternations they model. This theory relies on the assumption that positional licensing restrictions are best expressed in grammar through the medium of constraints which have reference to a fixed set of phonological features and positions. Strong and weak positions are abstract positions which are freely combinable with phonological features to produce constraints generating the necessary alternations or regularities. Barnes (2006) is of the view that as far as the pure prominence approach is concerned strong or weak licensing capacity is an inherent capacity of a given position supplied by Universal Grammar, irrespective of language specific phonetic details. The roots of this approach can be traced back to a model employed in the
treatment of certain tonal and segmental phenomena in Bantu languages advocated by, e.g., Goldsmith (1982) or Hyman (1987), in which it was shown that the assignment of a particular syllable or mora with a grid mark or accent meant not the presence of metrical structure or anything interpretable as phonetic stress, but rather an abstract higher degree of relative phonological prominence, a prominence that might be expressed in increased licensing capacity for consonants and vowels or special behaviour of some kind in the system of tone assignment, or some combination of all these. Barnes (2006) claims that the fact that the same set of positions such as initial syllables, stressed syllables, root appear as strong licensors throughout the languages of the world has led Pure Prominence advocates that the strength or weakness of particular positions are properties of those positions supplied in Universal Grammar. By applying the principles of Prominence approach a following constraint can be formulated in the following way which excludes mid vowels from unstressed syllables, a pattern typical of many languages with contrast neutralizing vowel reduction.

Neutralization of a height contrast in unstressed syllables

(2/4)

a) $\text{Ident}[\text{hi}] \sigma' \rightarrow *\text{MidV} \rightarrow \text{Ident} [\text{hi}]

b) $*\text{MidV} / \text{unstressed } \sigma \rightarrow \text{Ident} [\text{hi}] \rightarrow *\text{Mid}$

The constraint ranking in a) shows the vowel height neutralization using Positional Faithfulness constraints as proposed by Beckman (1998). In this OT framework, a general constraint banning mid vowels (*MidV) is ranked higher than a general faithfulness constraint assigning faithful output realization of the input feature [hi]. If we reverse the ranking of the constraints there would be no alternation of underlying [hi] specifications despite a general dispreference for mid vowels. Such instances are evident only in the case of epenthesis, where the lack of underlying feature specifications makes the constraint Ident constraint irrelevant, allows markedness free rein in determining the identity of the new vowel. In the case of positional neutralization, however, the presence of the higherranked Positional Faithfulness constraint (Ident[hi]/σ') mandates faithful realization of the feature [hi] specifically in stressed syllables, with the effect that input mid vowels surface intact there
alone, whereas in other cases they are barred from the output representation. This is represented in the following tableau:

<table>
<thead>
<tr>
<th>/CeCe'/</th>
<th>Ident[hi]/σ'</th>
<th>*Mid</th>
<th>Ident[hi]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CeCe'</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>CiCi'</td>
<td>*</td>
<td>**!</td>
<td></td>
</tr>
</tbody>
</table>

Table No 2/a: Representation of No mid vowels in unstressed syllables

The second ranking, on the other hand, is a system of Positional Markedness constraints of the type advocated in Zoll (1998), which accomplishes the same banishment of mid vowels from unstressed syllables. In this system, a general markedness constraint against mid vowels is outranked by a general faithfulness constraint for the feature [hi]. The higher ranking Positional Markedness constraint *Mid V/unstressed σ, however, has the effect of leaving intact only input mid vowels located in stressed syllables.

2.2 Strength asymmetry and phonetic correlates:

The notion of strength can be addressed from phonetic perspective too, especially in relation to acoustic parameters, prominent amongst which are pitch, duration and intensity. Many researchers have recorded the complexity pertaining to the acoustic cues (e.g. Gimson 1956, Fry 1955, Vanvik 1961, Bolinger 1958, Lehiste 1970, Beckman 1986). Beckman (1986) has assigned the term ‘stress accent’ for languages like English where accentual patterns have considerable influence in loudness and other phonetic attributes such as higher pitch and longer duration. In contrast, the term ‘pitch accent’ has been used for the languages which use only an increase in pitch and no other phonetic correlate to indicate prominence e.g. Japanese.
2.2.1 Duration:

Duration is one of the major cues of prominence in many languages. Duration measurement can be categorised into two sub branches: vowel duration and syllable duration. Whereas the former is confined to the measurement of the voiced portion of vowel periodicity and the latter involves the computation of the duration of the entire syllable. Liberman (1960), Fry (1953), Lehiste (1973), Beckman (1986) have conducted extensive research in English and thus, they tried to correlate duration and prominence. Beckman (1986) calculated mean difference ratios and came to the conclusion that the stressed syllable nucleus is consistently longer relative to the unstressed syllable nucleus.

2.2.2 Fundamental frequency and pitch pattern:

Another cue for the study of prominence in language is pitch pattern. A prominent high pitch may not be a cue for stress pattern, but a regular and consistent change of pitch in all the tokens can quantify to be a cue for stress. By summarizing all the correlates of stress and pitch Lehiste (1970) concludes, "...it appears that in all studies fundamental frequency provided relatively stronger cues for the presence of stress" (p131). According to her "in many languages, fundamental frequency combined with intensity, provides the decisive cue: in others duration is the most dependable correlate of stressedness" (p138). According to Beckman (1986) English accentual patterns have significant correlates in the peak and average vowel amplitude patterns, fundamental frequency and mean vowel duration ratio patterns. However, Beckman deviates from the earlier researchers by claiming that fundamental frequency is not only the robust cue, but duration and amplitude patterns can also be considered equally important and any hierarchical ordering of cues can be misleading.

In addition, there is a close connection between frequency and pitch pattern. Although fundamental frequency and pitch are not synonymous these two terms are interchangeably used. However whatever we hear as pitch is merely dependent upon fundamental frequency. These observations are drawn from extensive research work done in this field. Beckman (1986) describes the pitch of a pure tone as a "non linear, monotonically increasing function of its frequency; the higher the frequency the higher the pitch, with identical increments of frequency producing smaller and smaller increments of pitch at higher and higher frequency ranges. However, the pitch of a complex tone is complicated by the presence of components at more than one frequency" (p107). Ritsma (1976) claims that the pitch values of different harmonic tones with equal fundamental frequencies will be equal. In the fundamental
frequency range relevant for speech, it is the third through fifth harmonics which are actually
dominant in the perception of pitch.

2.2.3 Intensity and loudness:

There are two more important acoustic cues intensity and loudness which deserve mention in
the analysis of prominence in language. If we want to put the relation between intensity and
loudness in simple way it can be observed that the intensity criterion is relative to the
loudness factor and vice versa, so that an increase in the intensity leads to a corresponding
increase in the loudness function. However, it can not be negated that loudness is affected by
other attributes like frequency, spectral energy distribution, duration and the presence of other
sounds in the environment.

2.3 Positional Faithfulness, Positional Augmentation and strength effects in phonology:

Phonological strength effects can be attributed to domain initial syllables, the best instances
of which are evident in the harmony systems or licensing asymmetries of the Uralic, Altaic
and Bantu languages. Beckman’s 1998 study of Positional faithfulness and Smith’s 2002
study of Positional Augmentation provide the most comprehensive recent account of
phonological licensing patterns in relation to initial syllables. Whereas Beckman’s analysis is
concerned with Positional faithfulness or phonological strength effects Smith is concerned
with both these and phonological weakness effects. Smith gives the concept of Positional
augmentation, the strong position where the licensing of contrasts are restricted. These strong
positions stem from phonetic strengthening process charged with increasing perceptual
prominence. As instance of augmentation pattern, mention can be made of the long or high
sonority vowels under stress and the relatively common demand for low sonority consonants
in initial or stressed syllable onsets. Beckman (1998) has talked about positional privilege
which can be divided in to broader categories: psycholinguistic prominence and phonetic
prominence. Whereas the former refers to those positions bearing the heaviest burden of
lexical storage, lexical storage and retrieval, and processing: root initial syllables, roots and
final syllables to a degree(Steraide,1993) phonetic prominence take in to consideration
different physical cues that include increased duration or amplitude, pitch extreme, release
bursts, etc (Kingston 1985,1990; Steriade 1993c, 1995 and Kirchner 1996). It is the intrinsic
strength of the segment which is instrumental on the part of the segment’s patterning and
distribution in a phonological string. According to Smith (2002) a position which is phonetically strong may show both Positional strength and Positional Augmentation effects, as phonetic strengthening is equipped with the potential to exempt a position from lenitions or reduction such as final resistance to VR and also of effacing contrasts, for example, lengthening or lowering the sonority of vowels.

2.3.1 Initial Strengthening:

The phenomenon known as “initial strengthening” in phonetic literature affects only the onset consonants of domain initial syllable thereby supporting the licensing asymmetries in initial position (Byrd 2000; Cho and Jun 2000; Dilley, Shattuck-Hufnagel and Ostendorf 1996; Fougeron 1999; Fougeron and Keating 1996; Keating et al, 1999; Oller 1973, inter alia). This initial strengthening phenomenon discards the notion that initial syllables are not the locus of phonetic prominence enhancement. This phonological process of initial strengthening does have phonetic underpinnings. Barnes (2006) claims that domain initial strengthening refers to a set of processes that have been shown to enhance various aspects of the articulations of domain initial consonants in a fairly wide variety of languages, including to date English, French, Taiwanese and Korean. Electropalatographic reports have shown an increase in the magnitude of the supralaryngeal gestures associated with initial consonants, assessed according to the amount of linguopalatal contact involved in the constrictions. In addition to gestural magnitude laryngeal gestures and closure durations are also found to be greater than their word internal counterparts. As for instance, glottal opening gestures have been shown to increase in magnitude in English (Pierrehumbert and Talkin 1992), as does VOT in Korean (Keating et al. 1999). Cho and Jun (2000) characterize certain pattern of initial strengthening as functioning specifically to enhance the syntagmatic contrast of the relevant segments. In addition, they also note that domain initial strengthening targets exclusively that first segment of the word of domain initial position which targets the entire final rhyme. In the same fashion, Byrd (2000) attributes the lengthening of domain initial material to a single articulatory phenomenon which can be characterized as a local decrease in gestural stiffness resulting in increased duration for the segmental material involved. This domain initial strengthening is phonetic in nature and “can not be directly related to true initial syllable augmentation effects” (Smith 2002:312). The line of demarcation can be drawn between stressed syllable and initial syllable with reference to this notion of initial strengthening. Although both positions undergo phonetic strengthening yet the nature of phonetic strengthening is different. It is the first segment of the word or phrase which the phonetic
initial strengthening targets and hence it is evident as why both Positional Augmentation and Positional Strength processes should select onset consonants. Even the absolute word initial vowels are characterized by greater duration that leads to the phonologization of an effect never observed on initial syllable vowels following onset consonants. Balasubramaniyam (1981) shows this longer duration experimentally for Tamil. Casali (1995) has demonstrated this phenomenon in the resistance of absolute initial front vowels to centralization. Absolute word initial vowels are characterized by somewhat longer duration than word internal vowels in French and English (Fougeron 1999; Turk and Shattuck-Hufnagel 2000). Thus the nature and attestation of initial segment effects (C and V) are assigned to the phonologization of phonetic initial strengthening patterns. However, literature contains reports of vocalic Positional Strength patterns in which the initial syllable is the strongest licenser.

However, Barnes (2006) has shown that in none of the cases reported in literature is it actually the initiality of the syllable per se which is in fact responsible for the licensing asymmetries. It is either the phonetic factors (additional duration) or morphological factors (the initial syllable is also the root) can account for phonologization of the patterns in question. Steriade (1994) documents asymmetries in initial syllable/ non initial syllable licensing in a variety of Uralic and Altaic languages as well as Tiv and Gokana. Most of the Dravidian languages display initial stress system (e.g. default initial with attraction to heavy syllables further right), and fixed initial stress is assumed for the proto language as well (Zvelebil 1970:40). The resistance of Dravidian initial syllables is especially apparent in the massive syncopations of non initial vowels found through out the language family and most dramatically attested in Toda and Kota (Zvelebil 1990:3). Bosch (1991) documents Tamil, a language with a restricted variety of vowel contrasts outside the initial syllable, also displays initial stress. However, Andronov (1975:6) argues that classical Tamil must have had initial stress while making the claim that stress must have shifted rightward in colloqial Tamil to account for central vowel deletions from etymological initial syllables. Balasubramanian (1980:456) has reported that it is the native speaker’s intuitive knowledge to place stress on initial syllable of words which are pronounced in isolation and lengthening of various elements take place when the relevant word “has to be said with special emphasis.” The similar pattern is evident in the case of Gujarati which Cardona (1965) describes as a close derivative of the accent system of Classical Sanskrit. Silverman (1997:115) claims that in Gujarati the contrast between plain and breathy voice vowel is realized only in initial syllables. In addition, Pandit (1955) has shown that the contrast between tense and lax vowels /e, o/ and
/e, ɔ/ is available only in the initial syllable. Pandit (1958) also claims that all syllables in Gujarati have even stress, except for those which are post junctural and most importantly, it is the initial syllables after juncture are bound to carry a stronger stress than others (Pandit 1958:216). Gujarati initial syllables license a contrast between breathy and plain vowels, and low and high mid vowels. These contrasts are neutralized elsewhere in the word. Pandit (1958) points out that all syllables in Gujarati have even stress except those which are post junctural. Initial syllables after juncture are to carry a stronger stress than others. Pandit (1961) draws evidence for a durational asymmetry in order to justify his claim that contrast is more predominant in initial syllables:

(2/5)

StageI: [e ɔ] and [e ɔ] originally allophonic variants in initial syllables (syllable structure and segmental context determining)

StageII: Monophthongization [a,j,a,w] becomes [e ɔ] in intial syllables, [e ɔ] elsewhere. Distribution is no longer predictable.

Lower, presumably longer realization of diphthongs in initial syllables suggests additional duration of initial syllable vowels.

According to Vijaykrishnan (2003) the loss of marked specification can be attributed to the prosodically weak positions; such as in syllable coda reduction in German, Dutch, Polish and coda deaspiration in standard colloquial Bangla.

While discussing on Weakening Process in Optimality Framework Vijaykrishan gives evidence from the onsets of non-head syllables such as lack of aspiration of voiceless stops in English, lack of aspiration in non initial stops in the Adilabad dialect of Gondi (Subramanian 1968), the Hooghli dialect of Bangla (Ghosh 1995). In both cases aspiration is distinctive in voiceless and voiced stops.

(2/6)

<table>
<thead>
<tr>
<th>Standard Bangla</th>
<th>Hooghli dialect</th>
<th>Gloss (Ghosh 1995)</th>
</tr>
</thead>
<tbody>
<tr>
<td>labær</td>
<td>laber</td>
<td>profit (genitive)</td>
</tr>
</tbody>
</table>
Lenition, the process of increasing the sonority of consonants, is attested in syllabic onsets—more widely in intervocalic position, but also initially (Lass 1984). Lenition can be characterized as an upward shift on the sonority scale. It may be argued to be a universal tendency grounded in articulation being an assimilatory process which increases the sonority of the prototypical consonant—the obstruent, in the neighbourhood of the prototypical sonorant—the vowel.

Adopting the harmonic approach to constraint formulation in Prince and Smolensky (1993) we can formulate lenition as “Harmonic Sonorancy”. It targets only onsets because the primary condition for lenition to take place is that the obstruent should be followed by a vowel and only onsets are possible in that environment. The operation of harmonic sonorancy can be illustrated with an instance of intervocalic lenition which is exception less in the verb phonology of contemporary Tamil.

(2/7) Tamil Consonantal inventory

<table>
<thead>
<tr>
<th>Labial</th>
<th>Coronal</th>
<th>Dorsal</th>
</tr>
</thead>
<tbody>
<tr>
<td>p b m v</td>
<td>t d n</td>
<td>k g h η</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Suffixal alternations</th>
<th>Input</th>
<th>ClassI</th>
<th>ClassII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present tense</td>
<td>kir</td>
<td>hir</td>
<td>kkir</td>
</tr>
<tr>
<td>Past tense</td>
<td>t</td>
<td>d</td>
<td>tt</td>
</tr>
<tr>
<td>Future tense</td>
<td>p</td>
<td>v</td>
<td>pp</td>
</tr>
<tr>
<td>Nominal suffix</td>
<td>kai</td>
<td>hai</td>
<td>kkai</td>
</tr>
</tbody>
</table>
The verbal paradigm can be analysed by setting up two lexical classes. If we assume that germination in class II verbs is either triggered by a rule or is the result of stem final root specification [-sonorant, +consonantal], then class I verbs exemplify lenition across place distinction as shown below

(2/8)

<table>
<thead>
<tr>
<th>Verb class I</th>
<th>Verb class II</th>
</tr>
</thead>
<tbody>
<tr>
<td>pani</td>
<td>padi</td>
</tr>
<tr>
<td>panihir</td>
<td>padikkir</td>
</tr>
<tr>
<td>paniv</td>
<td>padipp</td>
</tr>
<tr>
<td>panivi</td>
<td>padippi</td>
</tr>
</tbody>
</table>

Here we find that /p/ undergoes sonorization to /v/, /t/ gets voiced and /k/ fricativizes to /h/.

The three phases of lenition in Tamil are Labial, Dental and Dorsal. As for instance following examples can be taken into consideration:

(2/9)

tapa  tavam  penance
ati    adi     excessive
maka   maham   a star

Further evidence of positional asymmetries can be drawn from Kashmiri phonology. In Kashmiri all consonants undergo palatalization in word initial, medial and final position.
Labialization is another secondary articulatory process that influences consonants in Kashmiri phonological inventory, but this process is confined to word initial position alone and its following vowel is invariably an ‘a’ (Bhat, Rajnath).

(2/10)

{ts}*al    makeshift oven
{sr}*aj    tunnel
{kh}*an    lap
{g}*al    green outer layer of an unripe wall nut
{k}*al    stream

This phenomenon of positional asymmetry intends to take care of many interesting generalizations found in Indian languages. As for instance, geminates mostly occur in word medial position (intervocally), not in word initial or word final position, although exceptions are observed in Didayi, a language spoken in Madhya Pradesh which has word initial geminates and Punjabi has some word final geminates (Ashirvadam 1992, Ghosh 1996). The phenomenon of gemination in word medial position can be illustrated with the Oriya data cited below:

(2/11)

<table>
<thead>
<tr>
<th>Consonant cluster</th>
<th>Oriya words</th>
<th>English Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>ll</td>
<td>bʰɔllukɔ</td>
<td>bear</td>
</tr>
<tr>
<td>kk</td>
<td>cikkɔnɔ</td>
<td>smooth place</td>
</tr>
<tr>
<td>pp</td>
<td>kʰɔppa</td>
<td>angry</td>
</tr>
<tr>
<td>cc</td>
<td>uccɔ</td>
<td>high</td>
</tr>
</tbody>
</table>
2.3.2 Final Domain and strength effects:

Positional neutralization in relation to final syllables of a prosodic domain can be analysed from the perspective of strength asymmetries. From phonetic and phonological literature it is evident that final syllables display patterns both of phonological strength and phonological weakness. We can talk about the phonetic prominence associated with final syllables which have been shown in many research as the locus of a certain degree of vowel lengthening (Oller 1973; Klatt 1975, 1976; Beckman and Edwards 1987; Wightman et al. 1992; Keating, Wright and Zhang 1999, inter alia on English). Languages in which final lengthening has been identified experimentally include Bulgarian (Savitska and Bojadzhiev 1988), American sign language (Brentari 1995), Beijing Chinese (Zhang 2001), Brazilian Portuguese (Major 1985; Simons 1991), Creek (Johnson and Martin 2001), Dutch (Cambier-Langeveld 1997, 1999), French (Delattre 1966; Fletcher 1991), German (Kohler 1983), Hausa (Newman and Van Heuvan 1981), Israeli Hebrew (Bekovits 1984, 1993a, 1993b, 1994), Italian (Farnetani and Kori 1990), Japanese (Ueyama 1999), Jordanian Arabic (de Jong and Zawaydeh 1999), Korean (Cho 2000), Luganda (Zhang 2001), Russian (Zlatoustova 1981: 13-17), Spanish (Delattre 1996) and Swedish (Nord 1975, 1987). This phrase final lengthening can be observed in pre or non linguistic behaviour such as infant babbling, musical performance, bird song and insect chirps on the basis of which Johnson and Martin (2001) claim that final lengthening is a property of motor performance in general.

In addition to well document cases of phonetic enhancement, final syllables also exhibit special salience in psychological sense. Kehoe and Stoel- Gammon (1997) has talked about the psycholinguistic salience pertaining to final syllables on the basis of their study of prosodic acquisition. This study shows that in the truncated productions of polysyllabic words in English, children are most likely to retain internal stressed syllables and final syllables, stressed and unstressed. Kahoe and Stoel- Gammon (1997: 120-121) characterize their result as follows:
In WS words, children produced the stressed syllables; in S’S, ’SWS, and SW’S words, children produced both stressed syllables; in WSW, SWW, and WSWW, children produced the stressed syllable and the unstressed syllable in word final position; and in ’SWSW, SW’SW, and S’SWW words, children preserved both stressed syllables and the unstressed syllables in word final position. Children preserved a medial rather than a final unstressed syllable in their truncations only infrequently.

According to Kahoe and Stoel-Gammon (1997) children’s phonological representations are relatively intact compared to those of adults, but the production constraints give rise to omission of all but a few privileged portions of the word. This enhanced psycholinguistic salience accorded to prosodic heads and edge adjacent material can be modelled by using the device of parameterized faithfulness constraints within OT model.

The above discussion on final lengthening and psycholinguistic salience brings home the point that phonological strength effects should be attested in final position. This phonological strength effect can be found in preferential licensing of contour tones on final syllables. On the basis of Gordon’s (1999) cross linguistic study of the phonetic properties associated with tone bearing segments Zhang (2001) puts forward evidence in support of the strength of prosodic final syllables with respect to contour tones. According to Zhang (2001) the domain final syllables are assigned additional phonetic duration and contour tones, which require more duration for their realization, find their licensing on final syllables. In this context vocalic strength effect proposed by Steriade (1994) can also be cited according to which final syllables can behave sometimes as strong positions for other contrasts as well such as [round] and/ or [back] (Hausa, Timugon Murut, and Eastern Cheremis) or [lax]. In Hausa the feature combination [round]- [back] among short high vowel is distinctive only phrase finally (Steriade 1994:13). Vowel contrasts which are difficult to perceive are realized on final syllables because of the additional duration associated with the position and it can be supported with Steriad’s words, “extra duration means extra exposure to a dubious vowel quality and thus a better chance to identify it correctly” (Steriade 1994:20). The vocalic strength effects can also be observed on the part of final syllables in their resistance to reduction or assimilation process. Some of the languages in which final syllables resist reduction include Russian (Maturevic 1976: 96-120; Zlatoustova 1962: 109-139), Belarusian (Czekman and Smulkowa 1988:223-234), Ukranian dialects (Shevelov 1979: 218-240), Uyghur ( Hahn 1991), Central Eastern Catalan (Recasens 1986), English (Hammond 1997), Maltese (Puech 1978), Nawuri (Casali 1995) etc. This phenomenon of final syllable
resistance to assimilation or reduction can be assigned to phonetics of domain final syllable cross linguistically. Phonetic studies of final lengthening add an empirical value to the hypothesis of articulatory strengthening in domain final syllables in addition to the temporal augmentation. In a study of the gestural implementation of final lengthening in English, Edwards, Beckman and Fletcher (1991) show that a phrase final reduced vowel [ə] is not only longer, but also enhanced by greater gestural displacement in their measure of jaw height. Vayra and Fowler (1992) in their investigation of Tuscan Italian, draw the same conclusion of supralaryngeal articulatory declination from beginning to end in trisyllables uttered in isolation. Cho (2001) demonstrated vowel to vowel coarticulation for both accented and phrase final vowels in English that provides an insight into the phonetic origins of the phonological final strength patterns. So, phonetic implications bear ample testimony to the strengthening patterns of final domain.

Nevertheless, the vocalic strength effects can not establish the final domain as the locus of strengthening as there are ample counterevidence to this pattern the most important amongst which are vowel loss, final devoicing and stress retraction etc. Hock (1999) claims final position is a monolithically weakening environment. This position is considered weak in the sense that the speaker intends to spend less “articulatory effort” in this position. The study conducted by Keating, Wright and Zhang (1999) show that the consonants in phrase final position in English display linguopalatal contact equal to that of comparable word initial consonants in the same phrasal position thereby contradicting to the view of phrase final articulatory weakness. However, Steriade (1997) maintains that many contrasts are neutralized in final position as stemming from a lack of robust cues to consonant identity in that identity. In addition to these final positions are characterized by a number of other phonetic patterns the effect of which lie in decreasing the perceptual robustness of domain final material. These phonetic patterns include drops in pitch and intensity correlated with subglottal pressure, devoicing, non model phonation such as brethiness or creak, and even potentially licensing. Lack of CV transitions and release bursts distort cues responsible for consonant place and laryngeal specifications. Steriade (1997) argues that regardless of degree of linguopalatal contact or strengthening of any supralaryngeal articulations, the perceptual difficulties pertaining to final segments would lead towards neutralization of laryngeal features (voicing, aspiration etc), neutralization of place features, or ultimately debuccalization and loss. Hock's (1999) weakening theory is about phrase final voicelessness. Dauer (1980) and Gordon (1998) claim that final vowel devoicing can be
correlated with the steep drop in subglottal pressure along with final lowering of F0. This
decrease in subglottal pressure can result in the elimination of the pressure drop across the
glottis required for voicing to be maintained which can be treated as passive voicing (as
discussed in e.g., Ladefoged and Maddieson 1996: 49). Gordon (1998) presents a cross
glottalization and laryngealization. It is evident from the studies
gle surveyed in vowel devoicing in both internal and final positions and made some
generalizations. In nearly all instances the presence of word internal vowel devoicing in a
language implies the presence of final vowel devoicing, though the opposite is not true. In the
same way the devoicing of word final vowels in a language implies the devoicing of phrase
final vowels, while the reverse is not true. Another common salient feature of final syllables
crosslinguistically is glottalization or laryngealization. It is evident from the studies
conducted by Henton and Bladon (1988), Kavitskaya (2001), Ladefoged and Maddieson
(1996:75) etc. Another crosslinguistic tendency associated with final position is vowel
nasalization Hock (1999) attributes the tendency of the prepausal vowels in Vedic Sanskrit to
be nasalized to the phenomenon of velic closure at the end of a phrase, where the articulatory
organs return to the rest position. The fact that the phrase final position is generally correlated
with weakening of the velic closure gesture from experimental evidence as manifested in the
studies of Karkow, Bell-Berti and Wang (1991) although there are ample counter evidences
to this pattern. In the same fashion both neutralizing and non neutralizing vowel lowering is
attested in final position in a variety of languages. Some examples of final lowering
languages include Bare (Northern Arawak- Aikhenvald 1996), Dasenech (Cushiti- Sasse
1976), Castillian dialects (Penny 1986). Behind the emergence of such patterns Cho’s(2001)
sonority enhancement principle can be cited which requires lowering of the final vowels. The
fact that many languages avoid shorter vowels in final position can be assigned to potential
extra length through lowering. Under this interpretation final lowering can be viewed as
Positional augmentation, which Smith (2002) shows as a characteristic of certain otherwise
phonologically strong positions. The phenomenon of final weakening can also be justified on
the basis of laxing or reduction of word or phrase final vowels that happens to be a
commonly encountered pattern crosslinguistically. As, for instance, in Kawaiisu (Zigmond,
Booth and Munro, 1990: 13) word final short vowels are often dropped, especially when there
are utterance final, which appears to be quite contradictory to the view of final open syllables
as environments for vowel lengthening and strengthening. However word final devoicing
leading to deletion is so common crosslinguistically that it does not need any exemplification.
Examples of final vowel reduction include Highland East Cushitic (Hudson 1976:250), Kullo
(Omotic- Allan 1976), Iban (Sea Dayak- Omar 1981), Brok-Skad (Dardic-Sharma1998),
Maithili (Indo Iranian- Jha 2001), Kandahari Pashto (Indo-Iranian- Elfenbein 1997), Muinane (Witotoam- Walton and Walton 1967), Goaiiro (Arawakan- Mansen 1967), Lunda (Bantu-Lary Hyma, personal communication), Nanai (Tungsic- Avrorin 1959; Li 1996). The phonetic implications hidden behind the pattern of final reduction encompass a tendency to total or partial devoicing, a drastic amplitude drop and certain instantiations of non-modal phonation types.

Hence, from the above illustration it is evident that final syllables can not be considered from a crosslinguistic perspective either monolithically strong or monolithically weak in terms of their potential to license vowel contrasts thereby challenging the theories of positional neutralization that assumes that phonological strength or weakness of structural positions is specified in Universal Grammar. The structural strength or weakness pertaining to weak position is language specific. This fact of final syllables raises one question as whether it is possible for UG to predetermine strength or weakness in any other position either.

This issue of strength relations in phonology has been addressed in the framework of headship and melodic strength thereby holding the argument that prosodic informations have bearings upon the melodic strength inherent in a segment. This is discussed below in an elaborate way in the module of Element theory.

2.4 Element theory: a correlation between prosodic and melodic strength

This approach on phonology tries to emphasize on the notion that prosody does not only provide the organizational aspect but also the contents of melody. The realization of a sound can be sensitive to its prosodic position (Fougeron and Keating 1997; Cho and Keating 2001). This proposition is assigned phonetic implications on the premise that it involves small, gradient changes in articulation. As, for instance, Keating et al. (2003) propose an analysis of domain initial strengthening on the basis of slight increases in duration and VOT. However, Backley and Nasukawa (2009), claim that the asymmetries in melodic strength are linguistically significant, as they bear important linguistic information for the listeners and that they should be incorporated into the phonological domain. This approach implies that the components of prosodic structure are indicated by the presence of strong prosodic positions; in other words, the positions which are generally considered to be strong are the ones that carry the responsibility for demarcating the edges of prosodic domain. In literature it has been attested crosslinguistically that it is the left edge of a domain which is marked out and such
preference has been given psycholinguistic justification (Marslen-Wilson and Tyler 1980). Such observation paves the way for a claim such as word initial position is expected to be prosodically stronger than word final position, for example, and syllable initial position (i.e. onset) stronger than syllable-final (i.e. coda). Prosodic strength lies at the boundaries of prosodic domains (i.e. strong positions) and those which are domain internal (i.e. weak positions). The primary function of prosodic structure is not only organizational but also interpretative. The role of prosody lies in conveying information about the relations holding between sounds and to identify higher structural units which may be crucial for the suprasegmental aspects of speech. It is prosodic structure which influences the way melodic structure is interpreted; it is not normally subject to direct phonetic interpretations. Kuniya and Backly (2009) claim that the correlation existing between prosodic and melodic strength can be better represented in the framework of Element theory approach to melodic representation (Harris and Lindsay 1995; Backly and Nasukawa 2006). Headship distinction intends to reflect on differences in prosodic strength: strong prosodic positions signified by the acoustic cues contain segments represented by headed melodic expressions whereas weak positions contain segments represented by non-headed expression. Headship in Element theory tries to claim that melodic headship is one of the strategies that languages adopt to indicate prosodic strength. In Element theory segments are represented by means of certain limited features or elements /A I U H N ?/. Elements are unary and stand for a universal property which is instrumental in displaying active phonological behaviour that is mapped on to an information bearing pattern in the speech signal. In this set of six members the first three members /A I U/ constitute the resonating groups which are mostly involved in the description of vowel contrasts. The other members /H N ?/ constitute the laryngeal source and describe the laryngeal and manner properties of consonants. An unequal combination creates a head dependent relation between the elements concerned and in this regard it bears close affinity with that of Dependency phonology and Particle phonology. It is the head dependence asymmetry which plays a pivotal role in the formation of melodic strength. The headship in melodic theory performs two functions: it increases the number of possible melodic expressions and the number of contrasts and secondly it allows a situation in which one element (the head) dominates all others (the dependents), thereby displaying greater acoustic cues pertaining to the dominant element and thus predominate in the interpretation of the resulting melodic expression. For convenience, consider the laryngeal contrasts in English:
Aspirated voiced context examples

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[pʰ]</td>
<td>yes</td>
<td>no</td>
<td>foot initial</td>
<td>pass, appear</td>
</tr>
<tr>
<td>[p]</td>
<td>no</td>
<td>no</td>
<td>foot internal</td>
<td>wrapper, spy</td>
</tr>
<tr>
<td>[b]</td>
<td>no</td>
<td>no</td>
<td>foot internal</td>
<td>best, about</td>
</tr>
<tr>
<td>[b]</td>
<td>no</td>
<td>yes</td>
<td>foot internal</td>
<td>ruby, cupboard</td>
</tr>
</tbody>
</table>

In the above representation of the data set, the fortis stop [pʰ] is aspirated in the archetypal strong position, that is foot initial position, but loses its aspiration in the weaker environment, such as foot internal position as typified by the above examples. In the Element theory framework laryngeal categories in English can be represented in the following fashion:

(2/13)

<table>
<thead>
<tr>
<th>Category</th>
<th>laryngeal property</th>
<th>representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [pʰ] (aspirated)</td>
<td>long voicing lag</td>
<td>/H/ prominent /H/</td>
</tr>
<tr>
<td>b. [p] (unaspirated)</td>
<td>short/no voicing lag</td>
<td>/H/ present /H/</td>
</tr>
<tr>
<td>c. [b] (neutral)</td>
<td>short/no voicing lag</td>
<td>/H/ present /H/</td>
</tr>
<tr>
<td>d. [b] (voiced)</td>
<td>spontaneous voicing</td>
<td>laryngeally inactive /\</td>
</tr>
</tbody>
</table>

Here in the above representation the voicing lag associated with /H/ is more salient in terms of perception in aspirated rather than unaspirated stops and this heightened salience implies that aspirated stops contain the element /H/ in its stronger guise represented by a headed /H/. It is also clear from the notation that the acoustic properties of a head are stronger than when same element is a dependent. In this representation of aspirated stops, the features of voicing lag is reinforced through melodic headship. In case the prosodic requirement is not met, the result is a weaker or lenited interpretation of the same structure. Lenition process attested in prosodically weak positions would likely to target or remove the headed status of an expression as seen in the laryngeal properties of unaspirated and neutral stops in English stops where the headed /H/ is absent.
2.5 Conclusion:

From the above literature review a resolution can be drawn that the notion of phonological strength is instrumental in the phonological patterning of segmental asymmetry in addition to the hierarchical representation of phonological features. In this chapter an attempt has been made to perceive the issue of phonological strength from various perspectives such as metrical phonology, feature geometry, dependency and government phonology, positional faithfulness and positional augmentation approach, licensing by cue model, pure prominence model and Element theory etc. In addition this chapter bears ample testimony to the fact that phonetics can not be dissociated from phonological patterning of segments in prosodic positions as in this chapter I have discussed as how the notion of strength can be addressed from phonetic perspective too, especially in relation to acoustic parameters, prominent amongst which are pitch, duration and intensity etc. This argument bears consonance with Integrated models of phonetics and phonology. However, positional asymmetry coupled with phonetic implications is instrumental in the designing of segments in terms of strength relations. However, a lot of research has to be conducted in order to establish explicitly what phonological strength is and how can it be correlated to prosodic properties and phonetic factors.