

Capturing Segmental Strength in Non-Linear Phonology¹⁾

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Foreword

The identification of the linguistically significant notion of “primitive” has been a leitmotif in the scientific study of language, among others, in several strands of research in Generative Phonology, and the study of the non-linear aspects found in phonological primitives has provided new ways of analyses into phonological processes, including various types of assimilation and those of segmental insertion and deletion. On the one hand, versions of Autosegmental Phonology successfully make explicit the advantage of the theory of Feature Geometry over the traditional, linear theory of phonological features advocated by Chomsky and Halle (1968). One of the driving motivations of the former is the notion of the “natural class of phonological features,” which Clements (1985) brought into a new light. But on the other hand, the study of generative phonology as a whole has substantially neglected the importance of the strength, or the sonority, of phonological segments. It should be remarkable that Kiparsky’s (1979) metrical analysis of the so-called “low-level phonetic alternations” re-emphasized the role that the segmental strength plays in universal phonology: the segmental strength is supposed to be attributed to the phonological segment in question, and it is essentially unanalyzable and based crucially on the traditional notion “phoneme.” The purpose of the present paper is to integrate the notion of segmental strength into the overall framework of Autosegmental Phonology, specifically into the system of Feature Geometry, assuming that the phonological primitives are features that are hierarchically organized and are temporarily interwoven into each other in linguistically adequate ways.

The study of phonology conducted within the framework of Natural Phonology, which was pioneered by Stampe (1973), should be taken to be a harbinger of our investigation.²⁾ Stampe (1973) presents a framework of phonology in which the phonology of an individual language is a constellation of linguistic processes of “fortition” (also called “strengthening”) and “lenition” (also called “weakening”) that is “largely the residue of an innate system of phonological processes, revised in certain ways by linguistic experience.” This is what we may call “mutually repulsive” attributes in language. But it should be apparent

1) The term “strength” comes from terminology of Hooper (1976) and Nathan (1983). We may reword it as “sonority,” but the use of the word will not essentially alter the argumentation of the present paper.

I would like to thank Douglas Huff, who suggested stylistic improvements.

2) For fuller explanation of the theory of Natural Phonology, readers are referred to Stampe (1973), Donegan (1978), and Goman (1981).

that the phonological fields in which fortition processes are operative are delimited deliberately to certain ranges that do not overlap the fields where lenition processes are evoked.

The upshot of our investigation of phonological segmental strength would be that the autosegmental operation of featural spreading is governed by the relative strength relationships among segments: the target of postlexical operations of featural spreading is phonologically weaker than the trigger of the operation. Let us cite a typical example of featural operation from English phonology: partial devoicing of the sonorants in the onsets found in *smile* [s^hmail] and *slight* [s^hlaɪt]. The rightward spreading operation of [-voiced] of /s/ onto the two sonorants is borne out by the assumptions (i) that the nasal /m/ and the lateral /l/ are weaker than the voiceless fricative /s/ and (ii) that the specification of [+voiced] of /l/ and /m/ is not present crucially at the level where the autosegmental operation is applied. Therefore it is unnecessary to stipulate that the rightward spreading operation of [-voiced] be limited to the sonorants. To make a rather general deduction from what is observed in the example just examined, the phonology of an individual language may be free of any stipulation on autosegmental spreading operations.

The present paper will proceed as follows. Section 1 will deal with main motivations for the theory of Feature Geometry, referring crucially to the proposals presented in Halle (1995). In Section 2 an algorithm will be postulated to derive the segmental strength which scans the internal structures of segments and calculates out the strength of the segments. I would like to present a tentative analysis of epenthetical processes found in Old English, and then to go on to argue for a general constraint on featural spreading. Section 3 will refer to the basic dichotomy realized in the phonology of English and stipulate the domain in which the general constraint will operate. Section 4 will extend the general constraint of autosegmental spreading to accommodate the so called low-level phonetic alternations and seemingly intricate processes of glottalization of English.

1 Feature Geometry

One of the strongest motivations to be noted for theoretical inventions in phonology has been “descriptive simplicity,” which has been offered by Halle (1964) as a basic tenet in Generative Phonology. Based on the assumption, the standard theory of Generative Phonology rejected the Structuralist assumption that the notion of phoneme is the ultimate and elementary unit in the description of phonology, and it opted for the notion “phonological features.”³⁾ The crucial evidence for phonological features was that the naturalness of phonological description may directly be translated into its formal simplicity: the simpler the representation is, the more natural is the phonological description. For example, in the phonemic analysis, the set of sounds {e, p, r} is as complex as that of {p,

3) As for related discussion, readers are referred to Halle (1964), Chomsky (1964), and Chomsky and Halle (1968).

t, k}. Contrastively, in the feature approach, the former set may be much more complex than the latter. Therefore the feature analysis succeeds in capturing the notion of the “natural class of segments.”

The similar argument is applicable to the methodological comparison of the classical feature analysis with the Feature Geometry analysis. Assuming the general validity of the Autosegmental Phonology, Clements (1985) foregrounded the concept of the “natural class of features”: thus, in English phonology place of articulation features behave as a group and are spread leftward. In order to capture the functional generalization, Clements (1985) introduced hierarchical relationships among features: a given non-terminal node α may dominate β and χ if β and χ share structural description(s) of phonological rule(s). Sagey (1986) elaborated the theory of Feature Geometry and adequately verified the hypothesis that the phonological representations of language are three-dimensional: i.e., the sounds of language are linearly ordered along / with respect to the temporal dimension, and furthermore they internalize hierarchical structures that are temporarily independent. Thus, if α dominates β and χ , the order of the dominated elements β and χ is not governed by temporal relationships, and the dominator α and the dominees β and χ share the same tim(ing): in other words, they are contemporary. Articulatorily, the terminal nodes in the hierarchy of the Feature Geometry are contemporaneous instructions to the organs of speech.

The second motivation for the theory of Feature Geometry is the anatomical basis by which sets, or groups, of phonological features are phonetically implemented. Halle (1995) points to the underdeveloped state of phonetic theory and delineates the phonetic condition on the actualization of the phonological features: “The phonetic actualization of a feature is an action performed by an articulator” (Halle (1995: 2)). The components of the vocal tract that are capable of “changing the geometry of the cavity or determining the manner in which it is excited” are, Halle argues, (i) the lips, (ii) the soft palate, (iii) larynx, (iv) the tongue root, (v) the tongue body, and (vi) the tongue blade, which are encoded in the hierarchy of Feature Geometry as non-terminal nodes, Labial, Soft Palate, Larynx, Tongue Root, Dorsal, and Coronal, respectively. There are two sorts of “articulator-free” features, which may by definition be executed by several different articulators: (i) root features, i.e., [sonorant] and [consonantal], which are spread autosegmentally only if there is total assimilation and (ii) features that are direct dependents of the root node, i.e., [suction], [continuant], [strident], and [lateral], which can be spread singly. There are groups of “articulator-bound” features, which are by definition executed by a given dedicated articulator: [anterior], [distributed], [round], [high], [back], [low], and so on (see Halle (1995: 2) for details). I would like to adopt Halle’s (1995) term “the designated articulator” to denote the articulator that executes an articulator-free feature:

- (1) designated articulator of six classes of [-consonantal](i.e., articulator-free) phonemes
- | | |
|------------------------|----------|
| designated articulator | phonemes |
| Larynx | [h?] |

Tongue Root	pharyngeals
Soft Palate	nasal glides
Dorsal	vowels
Labial	[w]
Coronal	[y]

Based on these assumptions, Halle presents two constraints on Feature Geometry:

- (2) a. The designated articulator for [+consonantal] phonemes must be one of the three Place articulators, Labial, Dorsal, or Coronal.
 b. Articulator-free features other than [consonantal] are applicable only to [+consonantal] phonemes.

The notable upshot of Halle's (1995) anatomy-based system is that operations of autosegmental featural spreading are governed by the following convention:

- (3) The linking lines that are spread from one segment to another by an assimilation rule are those of terminal nodes in the tree, with the restriction that terminal nodes spread in a given rule are all and only those dominated by a single nonterminal node.

To rephrase Halle's contention on autosegmental spreading, phonological processes are in general performed on individual terminal features, and spreading of nonterminal nodes are restricted to cases of total assimilation.

2 Relative Strength of Phonological Segments

In this section, I would like to argue for a generalized constraint on the autosegmental operation that crucially refers to the segment-internal feature specifications. The intrusion of stops recurs in natural languages both synchronically and diachronically.⁴⁾ Therefore it is natural to assume that explanatorily adequate theory of phonology of any sort has to capture some general properties of the phenomenon. In the following paragraphs, a tentative reanalysis will be presented concerning the phenomena that are observed in Old and Present-Day English.

As a first approximation, the general tendency of the intrusion of stops will be summarized as follows:

- (4) a. stops are inserted into the position either to the left or to the right of the neighboring sonorants

4) See Nakao (1985: 429) for details of diachronic process of intrusion of stops in Old English.

- b. intrusive stops are voiceless unless either side of the segments is voiced
- c. the point of articulation of intrusive stops is the same as that of either side of the neighboring segments

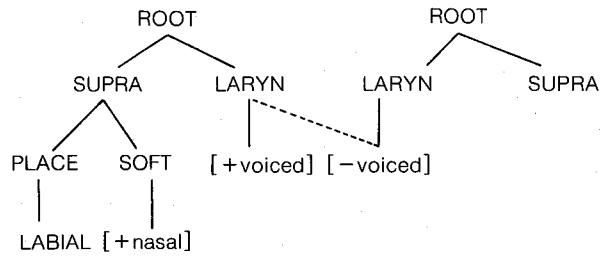
It is interesting to observe that the process of the intrusion of stops may somehow interact with that of the assimilation of the points of articulation: e.g., *strength* may be pronounced either as [stren^hθ] or as [streŋ^hθ].⁵⁾ The interaction of processes at the level of surface phonetic behavior may arguably be translated into that of two (i.e., rightward and leftward) autosegmental operations.

The derivational aspect of the intrusive stops, i.e., the delimitation of the phonological level at which the intrusive stops may be derived, may invoke serious theoretical issues concerning the principles of Lexical Phonology. The representation of the intrusive stops, irrespective of whether we adopt some sort of linear alignment of phonological segments or the three-dimensional representation of phonological features, will be underspecified underlyingly because the realization of the stops may be predictable. Therefore on the one hand the stops are allophonic variants in traditional terms, and their lexical derivation should be prohibited if we intend to adopt Kiparsky's (1984, 1985, 1993) notion of Structure Preservation. On the other hand, there is evidence suggesting that the derivation has to be performed at the lexical level(s). We may cite Stampe's (1979: 4-6) remarks on the psychological property: "An example involving a class of sound *sequences*: a sequence of nasal plus spirant, e.g. [ns], is difficult to articulate because it requires the release of the oral closure of the nasal to coincide precisely with the closure of the velum. . . . There are two processes responding to this difficulty of timing. One inserts an oral stop: [nts]. The other substitutes for the nasal stop a nasal lacking oral closure: . . . they are not merely motor slips for an intended [ns], but represent distinct phonetic targets supplied by mental substitution. This is confirmed by the difficulty, for speakers whose idioms require these substitutions, of pronouncing [ns] even in silent mental speech." I have to leave open the question concerning the identification of the derivational level. But I will assume tentatively that the level is postlexical and present an analysis of epenthetical stops in Old and Present-Day English.

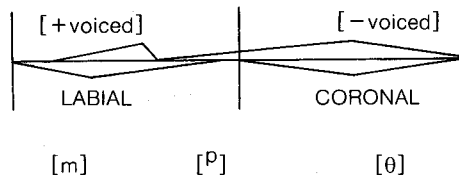
As I have argued elsewhere (see Takahashi (1995)), the intrusion of stops of the Present-Day English can be accounted for as an autosegmental leftward spreading operation of a phonological feature [voiced]:⁶⁾

5) It may be worth quoting Wells' (1990) observation that the former type of pronunciation realizes systematically in British English.

6) Only for purpose of typographical brevity, I will use the term "voiced" instead of "stiff vocal folds" or "slack vocal folds."

(5) the case of *warmth*a. the geometry of features in [m^pθ]

b. temporal relationships



(5b) is a representation that underscores temporal relationships among articulatory features.

Old English seems to exhibit not only the rightward spreading of [voiced], but also its leftward spreading to produce the intrusive stops. The linguistic data exemplified in (6) are instances of the leftward spreading of [voiced]:

- (6) a. $\emptyset \rightarrow [b]$
 hamor > hamber "hammer"
 chimly > chimbly "chimney"
- b. $\emptyset \rightarrow [p]$
 æmtig > æmptig "empty"
 nemnan > nempnen "name"

Apparently, the intrusive [p] in *nempnen* might pose some problems, because (4b) may produce an output *nembnen*, which is counterfactual. But it seems to be a plausible move to assume that the hypothetical output *nembnen* may somehow be filtered out by the following temporality-free constraint:

(7) *Universal Coda Constraint*

In the coda, default rules cannot apply if the ROOT node comes to dominate two feature specifications of the same value

By the Elsewhere Condition, the default rule "[+nasal] > [+voiced]" cannot apply prior

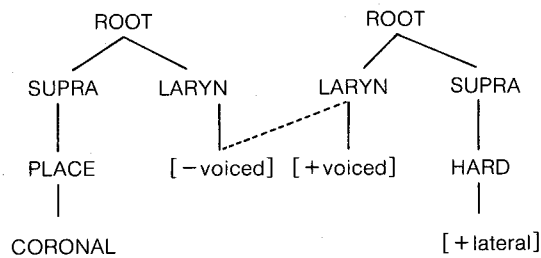
to the leftward spreading operation exemplified in (5), and if it supplies [+voiced] to /m/ in the hypothetical form *nemnen*, the derivation will be abolished by (7).⁷⁾

There are two cases in Old English that seem to involve a rightward spreading of [voiced]:⁸⁾

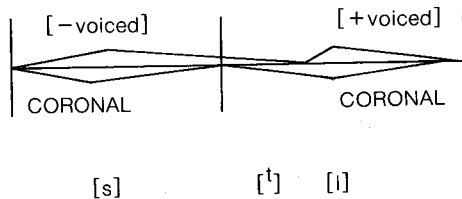
- (8) $\emptyset \rightarrow [t]$
 mæsling > mæstling “brass”
 mislic > mistlic “various”

The representation of the intrusive stop [t] in (8) may be (9):

- (9) a. the geometry of features in [s^tl]



- b. temporal relationships



It should be noted that the direction of the spreading operation depends on the phonological property of the triggering unit: when [voiced] features appear in the neighboring environment, one of the ROOT nodes is identified as the target of the autosegmental operation.

The inspection of the phenomena from fortis-lenis perspective would suggest that the weaker the segment is, the more liable is the segment to become the target of phonological featural spreading, which I would like to formalize as follows:

- (10) *Strength Constraint on the Target of Featural Spreading* (preliminary version):

7) As for the definition of the Elsewhere Condition, see Kiparsky (1982, 1984, 1985).

8) The following instances of intrusive stops are problematic to our analysis:

smēgende > scmēgende “meditating”
 snīcende > scnīcende “sneaking”

A given featural specification of a terminal node dominated by a ROOT X may optionally be spread onto a ROOT Z if and only if X is stronger than Z phonologically.

The phonological strength is determined by the following algorithms:

(11) *Phonological Strength*

a. [underspecification]⁹⁾

Underspecification of feature values contributes to the segmental relative weakness.

b. [scale]

If two root nodes X and Z may dominate mutually distinct specifications, the root X is stronger if X dominates features that include:

- i. [+stiff v.c.]
- ii. [+spread glottis]
- iii. [-continuant]
- iv. [+nasal]
- v. [+round]
- vi. [-anterior]
- vii. [+high]
- viii. [-low]

As one instance of this generalization, we may cite partial devoicing assimilation of sonorants in English, e.g., in *snow* [snoʊ]: because /n/ is weaker than /s/ the former is identified as the target of the spreading operation. Incidentally, because /n/ is specified as [+nasal] and /ou/ is not, the specification [+nasal] will be spread onto the diphthong in *snow*, which is a process of *Nasalization*. Couched from our perspectives on segmental strength, in the phonologies of intrusive stops in Old and Present-Day English, the relative (i.e., lenis vs. fortis) attributes of the neighboring segments trigger the rightward or leftward autosegmental operations.

3 Lexical vs. Postlexical Operations on Consonants

One of the most significant empirical consequences of the principles stated in (10) and (11) is that essentially phonetic processes of language may be reducible into a unified, language universal operation of spreading of a terminal phonological feature and that such lexically governed alternations as *Velar Softening* and *Spirantization* are specific to phonologies of individual languages. In order for a given rule of autosegmental spreading to appropriate-

9) Spring (1994) tacitly relies on the notion "phonological strength" in the analysis of the phonology of Axininca Campa and assumes that underspecified segments are "weak."

ly operate, (i) the trigger and target of the rule is properly specified and (ii) the domain of application of the rule is assigned. I would like to adopt Kiparsky's (1984) Strong Domain Hypothesis (hereafter, SDH) and assume as a working hypothesis that the rule of the phonological component is constituted of only a universal rule "spread any terminal feature," whose domain of application is governed by the interaction of the SDH and a constraint on feeding relationships in lexical phonology.¹⁰ The specification of the trigger and target of a rule is generally assumed in the present paper to be governed by (10) and (11), which I would like to call "principles of phonological strength." Morphologically governed alternations such as *Velar Softening* of Present-Day English does not seem to be subject to principles of phonological strength and principles of domain assignment: in [[elektrik]_A +iti]_N, the segment /k/ is replaced by /s/ in the morphological environment "____ +iti_A".

The generalized approach to phonological processes that I have here proposed is applicable to (i) assimilation of various sorts of point and manner of articulation, (ii) sonorant syllabification and (iii) consonantal epenthesis. Let us examine some concrete examples in turn. In *horse shoe*, the word-final fricative realizes optionally as [ʃ], which may be specified as [-anterior] lexically: by principles of phonological strength, the featural specification will be spread leftward. If we examine the sonorant syllabification in *open* [oupm], it may arguably be shown that the process is a complex of two phonological processes: (i) a rightward spreading of LABIAL and (ii) a leftward spreading of [+nasal], as is predicted by principles of phonological strength.

4 Syllable Related Strength of Segments

In this section I would like to extend the principles of segmental strength to other types of phonological processes that apparently do not conform to the generalization in (10).

4.1 Strength Constraint on Phonetic Processing and Three "Low-Level" Phonetic Alternations

The so called "low-level" phonetic alternations, which include *Flapping*, *Aspiration*, and *Glottalization* in English, have hitherto escaped explanations that aim to capture generalizations on types of allophonic, phonetic alternations in language. Thus on the one hand, the theory of Autosegmental Phonology succeeded in formalizing multi-dimensional properties of various sorts of assimilatory processes of languages, but on the other hand, it was not able to abstract away from any autosegmental properties of the phonetic processes that I have just mentioned. In the present section, I would like to submit that the principles of segmental strength may readily be extended to present a more generalized account of the robust phonetic processes.

10) The constraint may be formalized as follows: in the lexicon, default rules cannot feed unmarked phonological rules.

As a first approximation I would like to revise (10) into (12):

(12) *Strength Constraint on Phonetic Processing*

A given featural specification X may optionally be introduced by (i) or (ii) into a terminal node dominated by a ROOT Y,

- i. if and only if the neighboring ROOT Z is weaker than Y, prosodically prototypical rules apply to fill in feature specifications
- ii. otherwise, the specification X may be spread autosegmentally onto Y from Z

The newly introduced type of rules, "prosodically prototypical rules," belongs to the system of default rules, which are by definition cost-free. It should at least be clear that three phonological processes recur in languages, which I will formalize as (13):¹¹⁾

(13) Prosodically Prototypical Rules¹²⁾

a. Flapping

$[\alpha, +\text{constricted glottis}] \rightarrow [+ \text{sonorant}] / [\dots [+ \text{sonorant}] ___ V \dots]_{PD}$

b. Aspiration

$[-\text{continuant}] \rightarrow [+ \text{spread glottis}] / [___ \dots]_{PD}$

c. Glottalization

$[-\text{continuant}] \rightarrow [+ \text{constricted glottis}] / [\dots [+ \text{sonorant}] ___]_{PD}$

To cite but a few examples of these processes, flapped consonants can be observed in American and British English (Jones (1960: 195)), Auca (Kenstowicz (1994: 505), Spanish (Kenstowicz (1994: 35), and Hausa (Laver (1994: 222)).¹³⁾ Aspirated and glottalized consonants are also ubiquitous: see Kenstowicz (1994: 61) for data of aspirated consonants from Mandarin Chinese and Hindi, and Nespor and Vogel (1986: 77) and Laver (1994: 332) for

11) PD is a variable that stands for a certain prosodic category.

12) The phonological feature [constricted glottis] interacts with [spread glottis] to describe tripartite glottal width:

open	-constricted glottis	+spread glottis	"aspirated"
l	-constricted glottis	-spread glottis	"plain"
closed	+constricted glottis	-spread glottis	"glottalized"

13) Laver (1994: 224) notes that flapped consonants belong to phonemic inventories of several languages.

14) Jensen (1993) raises pieces of evidence for the postlexical application of *Aspiration*, *Glottalization*, and *Flapping*. I would like to cite them below for purpose of explanation:

i. Flapping

$[+ \text{coronal}, -\text{strident}, -\text{continuant}, -\text{tense}] \rightarrow [f]$
 $/ [\dots [-\text{consonantal}] ______ V \dots]_U$

ii. Aspiration

$[-\text{continuant}, -\text{voice}] \rightarrow [+ \text{spread glottis}] / [F ______ \dots]$

iii. Glottalization

$[-\text{continuant}, -\text{voice}] \rightarrow [+ \text{constricted glottis}] / [\dots [+ \text{sonorant}] ______]_\sigma$

The symbol "U" stands for "utterance," "F" for "foot," and "σ" for "syllable."

data of glottalized consonants from British and American English.

The rules that are assumed to account for the phonetic processes of American English, e.g., by Kiparsky (1979), Nespors and Vogel (1986), and Jensen (1993), are now translated and reduced into specifications of the domain of the prosodically motivated rules:¹⁴⁾

- (14) Specifications of Domain of Application (American English)
- a. Flapping: Utterance, α = alveolar stops
 - b. Aspiration: Phonological Foot
 - c. Glottalization: Syllable

Let us examine some relevant cases. In the words *matter*, *target*, and *atlas*, the tokens of the alveolar stop /t/ are all stronger than the neighboring segments: they are specified as [+stiff vocal folds].

4.2 On the Interaction of Glottalization and Place Assimilation

It may be appropriate here to note that types of assimilation of place of articulation in English exhibit asymmetrical behaviors. As noted by Nathan (1983), nasal consonants are regularly subject to assimilation of point of articulation, governed by his "Strength Hierarchy":

- (15) a. /n/ + Labial: *hand-ball* [hæmbɔ:l]
 /n/ + Velar: *man kind* [mæŋkaind]
 b. /m/ + Velar: *some day* * [sʌndei]
 /m/ + Alveolar: *crumb cake* * [krʌŋkeik]
 c. /ʊ/ + Labial: *hang down* [hændaun]
 /ʊ/ + Velar: *song bird* [sɔmbəd]

In the phonological sequence "voiced obstruent stop + voiced obstruent stop," we find regular pattern of backward assimilation of point of articulation. The type of phonological sequence of two consecutive voiceless obstruent stops shows a rather exceptional behavior. Firstly, the point of articulation of syllable-final voiceless stops is assimilated to that of syllable-initial stops but the former accompanies glottal closure:¹⁵⁾

- (16) hot plate [hɒp^ʔpleit]
 active [æ^ʔtiv]

Nathan (1984: 311)

Second, in the sequence C_1C_2 , C_1 realizes as a glottal stop, (i) if C_1 is a voiceless alveolar stop /t/ or (ii) if the sequence is constituted of two homorganic voiceless stops.

15) The superscripted [ʔ], as in [tʔ], indicates that the segment [t] has a color of glottalization.

- (17) a. Catford [kæʔfəd]
hot shot [hɔʔʃɒt] Nathan (1984: 313)
great wonder [greit'wʌndə] → [greiʔwʌndə] Jensen (1994: 126)
- b. hip boots [hiʔbu:ts]
cattails [kæʔteilz]
back-ground [bæʔgraund] Nathan (1984: 313)

Nathan (1983) takes this as evidence for independent, autosegmental tiers (tiers of place and manner of articulation) and a generalized operation of deletion of specifications at the place tier: "Under some circumstances a voiceless stop loses its point of articulation, keeping only its essential 'stoppedness.'"

The behavior of the sequence constituted of two, consecutive voiced consonants will be accounted for within our framework as follows. The types of assimilation of point of articulation exemplified in (15) and those in which voiced obstruents are affected by voiced obstruents are straightforwardly accounted for by (11) and (12): in the segmental sequence C_1C_2 , C_2 is stronger than C_1 . In the cases in (15), C_1 is weaker than C_2 , because the former is [-stiff vocal folds, +nasal]. In the cases of two consecutive voiced obstruents, C_1 is assimilated to C_2 , if C_1 is weaker than C_2 : e.g., *Cadbury's* [kæbbɹiz], *Big Bird* [bibbəd], and *crab-cakes* *[krægkeiks].

What may somewhat be problematic and noticeable are the cases of (i) cases of assimilation accompanied by glottalization (e.g., [hɒp'pleit]) and (ii) segmental substitution into glottal stops (e.g., [hiʔbu:ts]), either of which involve voiceless stops. Within our framework, the variety of phonetic implementation that I just referred to seems to be attributable to the interaction of (12) with some sort of system that governs temporal alignment of articulators, specifically among laryngeal and supralaryngeal articulators:¹⁶⁾ the latter may in certain stylistic environments stipulate that the two processes referred to in (12) are conjunctive, i.e., both are executed in certain environments. If these are conjunctive, the phonology of English would produce representations as exemplified in (16), and if disjunctive, it would derive syllable-final glottal stops as in (17a).

It should be noted in this connection that the realization of simple glottal stop [ʔ] is severely restricted to two sorts of environments. Within our analysis, the restriction to the two seemingly unrelated environments may be attributed to two independently motivated principles of phonology: (i) Underspecification of feature specification in Lexical Phonology and (ii) the Obligatory Contour Principle (hereafter, OCP).¹⁷⁾ If the Coronal node is absent from underlying representation in English and is introduced by a default rule, as suggested by Avery and Rice (1989), and if /t/ is unspecified with respect to the feature

16) The system will stipulate that the subconditions in (12) are mutually conjunctive if C_1C_2 are both [+stiff vocal folds] and [-continuant].

17) The OCP is defined in Yip (1988) as follows:

At the melodic level, adjacent identical elements are prohibited.

I would like to adopt his interpretation on OCP, seeing it as "a kind of omnipresent well-formedness filter, with obvious parallels in the filters of syntactic theory."

[stiff vocal folds], then (12i) is not satisfied and instead (13c) will apply to derive a glottal consonant. The internal structure of the case of the phonological sequence of two identical voiceless stops will be simplified by the OCP, which I assume triggers deletion of the specification of the place features of the stop consonant on the left: in this case too, (12i) will not be met and our system will derive a glottal stop in the syllable-final position.

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