Parsing Below the Segment in a Constraint Based Framework

by

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Abstract

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This dissertation proposes a new model of subsegmental phonology within Optimality Theory that differs from standard Autosegmental Phonology both in its limited use of representational distinctions and in the form of the grammar to which the representations submit. The research focuses particularly on phonological units which are invisible to parsing in certain contexts, such as floating features and ghost segments, and demonstrates that the current understanding of segmental representation does not adequately characterize the full range of subsegmental phenomena found cross-linguistically. I propose instead an analysis in the framework of Optimality Theory in which the grammar derives the variety of surface phenomena from a single underlying representation. The typology which results from this analysis correctly classifies the entire range of behavior associated with subminimal phonological units while allowing a unique characterization of the immunity of defective segments from the demands of regular parsing. This dissertation thus both enlarges the empirical foundation on which an adequate theory of segment structure must be based, and in developing such an account sheds new light on classic problems of subsegmental parsing.

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Acknowledgments

All the influences were lined up waiting for me. I was born,
*and there they were to form m*e....(Augie March)

1. The limits of representation

1.1 Introduction

Since the advent of autosegmental phonology, the belief that phonological behavior follows automatically from segmental representation has set the course for a large body of research into segments and subsegments. Yet the cost of maintaining as a guiding principle the primacy of the representation has been an explosion of diacritics which distinguish between many, though not all, of the autosegmental patterns found cross-linguistically but fail to capture the relationships between them. This dissertation focuses particularly on phonological units which are invisible to the syllable in some way, such as floating features and latent segments. Expanding on the growing realization in the field that association conventions (à la Goldsmith 1976) do not reliably generate the wide variety of phenomena found in the areas of segmental and subsegmental phonology (Liberman 1979, Halle and Vergnaud 1982, Haraguchi 1977, Pulleyblank 1986, Hyman and Ngunga 1994, Archangeli and Pulleyblank 1994 among others), I demonstrate that the representational distinctions traditionally advocated between different types of subsegments in conjunction with the so-called universal conventions that govern their behavior result in a false typology, predicting contrasts which do not exist while failing to provide a satisfactory account for well-attested phenomena.

This dissertation will demonstrate that a large part of the burden of explanation for subsegmental behavior must fall on the grammar. It will become clear, however, that although rule based approaches have had some success in providing analyses of specific patterns, a variety of subsegmental phenomena still lack a satisfactory account. My

approach differs from previous accounts in two important ways. First, I argue for a single underlying distinction between full segments and all subsegmental elements. Secondly, I will propose an analysis in the constraint-based framework of Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993). The typology which results from this analysis correctly classifies the entire range of behavior associated with subminimal phonological units while allowing a unique characterization of the immunity of defective segments from the demands of regular parsing.

Optimality Theory has not evolved primarily as a theory of subsegmental phonology. This thesis begins to fill the gap in its coverage by introducing a general approach to subsegmental phonology within the theory. This extension of Optimality Theory to the segmental netherworld reveals previously undetected problems with current approaches to phenomena above the level of the segment as well, for which solutions will likewise be provided.

1.2 Autosegmental phonology

A long-standing conception of phonological elements held that segments (consonants or vowels) constitute the smallest phonolological units. Under this view, segments comprise a number of featural attributes but the features themselves have no existence independent of the segment (see for example Jakobson 1939; later Jakobson Fant, and Halle 1963, Chomsky and Halle 1968). Yet three important observations indicate the potential autonomy of features from segments: (i) a single segment may contain more than one value of a feature; (ii) a single feature can belong to more than one

segment; and (iii) some features exhibit stability; that is, they remain behind even when their host segment deletes. These are shown schematically in (1).

(1)   Independence of features and segments   (from Goldsmith 1976)

Contour segments	**Multiple association**	**Stability**
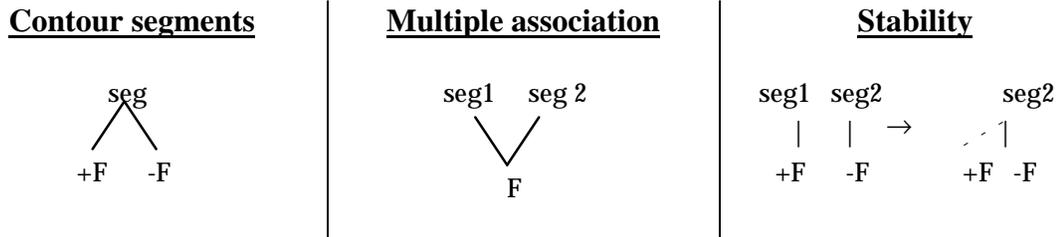
The earliest frameworks to reflect the independence of features from segments were advanced independently in the 1940s by John Firth and Zelig Harris. Firth (1948) outlines a theory of phonology in which a linguistic utterance is composed of *phonematic units* (a kind of skeleton), and *prosodic elements*: that is, features which are independent from the phonematic units.[1] Harris 1944 demonstrates that there is not a strictly one-to-one relation between phonemes and features, but rather that an utterance consists of what he called "simultaneous components," some of which strictly coincide with a single phoneme, but others of which might stretch over a longer portion of the word. (See also Hockett 1947, Bloch 1948).

These theories never caught on, especially in the United States, largely because neither articulated detailed procedures for implementation of their insights. Firth in particular is notoriously difficult to understand and utilize. As the editors of the volume *In Memory of J. R. Firth* (Bazell et. al. 1966: vi) respectfully observe "Firth as a

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[1]Details of the framework have been amply discussed elsewhere. See for example Hill 1966 and other papers in Bazell et.al. 1966, Langendoen 1967, Goldsmith 1992, Ogden and Local 1992 and references therein.

colleague and a teacher was unmatched. . . . He was not, however, it must be admitted, the clearest of writers." Haugen (1958: 502), in a review of a book of Firth's collected papers, notes that the book "makes spicy reading insofar as they reveal an erudite and charmingly crusty personality. . . but has not led to the development of explicit techniques." Anderson (1985: 179) makes this point rather more forcefully: "Even the papers one might most expect to present systematic expositions of his theoretical position. . . are full of obscure and allusive references and completely unclear on essential points." [2]

Yet the necessity of a concept of prosodies or long components in the traditional domain of suprasegmentals, especially tone, slowly gained acceptance (Woo 1969, Leben 1971, Williams 1976). Goldsmith's theory of "Autosegmental Phonology" (Goldsmith 1976, 1979, 1981), extending the insights of Leben 1971, finally provided the explicit formal framework that was necessary to incorporate these so-called "long components" into a phonological system and to extend the approach to features beyond intonation and stress. Autosegmental Phonology improves on the earlier theories both by introducing explicit representations of autosegments as well as spelling out detailed conventions regarding their behavior. [3]

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[2]   Langendoen 1967 devotes himself to explicating Firthian theory in terms comprehensible to a generative linguist and to relating the theory to the transformational phonology of the time. Ironically, Langendoen's presentation completely obscures any possible contribution or insight from Firth's prosodic analysis, and appears to eliminate the motivation for non-phonemic analyses altogether. Langendoen's work serves to "commend those aspects of London linguistics that appear to anticipate current TG attitudes, and to compare the shortcomings that he sees with what he considers the better treatments of linguistic data by linguists of the TG persuasion" (Robins 1969: 109).

[3] Dependency Phonology has developed a different kind of approach addressing similar issues (Anderson and Ewen 1987, Ewen 1995).

The representation of individual features as *autosegments* constitutes one of the most important developments of autosegmental phonology. According to Goldsmith (1992: 54):

> Autosegmental analyses...insist on segmentation of a uniform sort on each tier. Indeed, this is the central idea of autosegmental phonology: that the effects impressionistically called 'suprasegmental' are still just as SEGMENTAL as anything else, in the sense that they consist of linear sequences of more basic units which can be treated analytically.

In (2), for instance, the tone melody is represented as a sequence of tonal autosegments on a tier separate from the segments which it affects. The tones are associated to their host segments by association lines which indicate that the tone is realized simultaneously with the segment to which it is linked.

(2)   Features as "autosegments"   (Goldsmith 1979:23)

àkála

```
            a k a l a
            |   |   /\
tone tier   L   H  LH
```
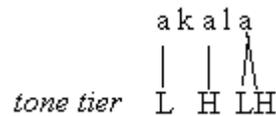
Autosegmental Phonology arose to account for the independence of suprasegmentals such as tone from segmental melodies, but it soon expanded to a full theory of segment structure in which every feature or feature class is represented as a linearly ordered melody on its own tier. (See for example Goldsmith 1976, 1979, Anderson 1976, Clements 1976, 1977) An example utterance with its representative autosegmental tiers is shown in (3). It can be seen that in any given word some features will correspond to only one segment, such as [nasal] here, while others may have a longer span , here such as [labial] and [continuant].

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(3)   Partial representation of *mpa*

	m	*p*	*a*
NASAL	[+nasal]		
LARYNGEAL	[+voice]	[-voice]	[+voice]
PLACE		[lab]	[low]
STRICTURE	[-cont]		[+cont]

Despite the breakdown into subsegments, the notion of a segment persists in Autosegmental Phonology because independent subsegments link to a central node dubbed the *root* (Mohanan 1983). Following Schein and Steriade 1986 and McCarthy 1988, the root node is represented here as the features [consonantal] and [sonorant]. Autosegments linked to the root node are all considered to be part of the same segment (4). The root node then serves as the locus of properties typically associated with segmenthood.[4]

(4)   Root as organizational node

$$
\begin{array}{ccc}
m & p & a \\
\left[\begin{array}{l} \text{consonantal} \\ \text{sonorant} \end{array}\right] &
\left[\begin{array}{l} \text{consonantal} \\ \text{sonorant} \end{array}\right] &
\left[\begin{array}{l} \text{consonantal} \\ \text{sonorant} \end{array}\right]
\end{array}
$$

NASAL	[+nasal]		
LARYNGEAL	[+voice]	[-voice]	[+voice]
PLACE		[lab]	[low]
STRICTURE	[-cont]		[+cont]

Further research (Mohanan 1983, Clements 1985, Sagey 1986, Mester 1986, Schein and Steriade 1986, Steriade 1987, McCarthy 1988; see Clements and Hume 1995

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[4] Steriade's 1992's aperture node serves the organizing function of the root node.

for an overview) has suggested that autosegmenal tiers should be organized hierarchically, with the tree in (5) representing the arrangement which I adopt in this dissertation. Two points merit attention. First, the close association observed between place and stricture features in phonological processes cross-linguistically is reified in the geometry here by treating Place/Stricture as a single class (Selkirk 1988, Padgett 1991)[5].

(5)   **Feature Geometry:**

(Clements 1985, Sagey 1986, McCarthy 1988, Selkirk 1988, Hume 1992, Padgett 1991)
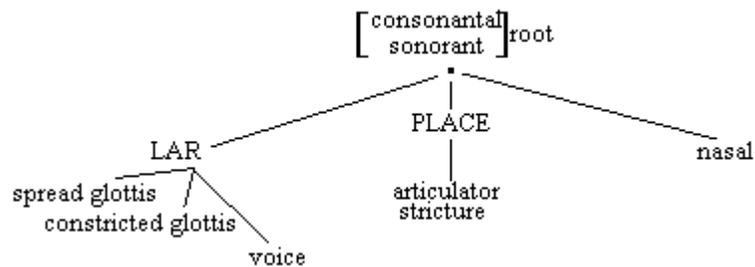
In addition, I will be assuming a separation between consonantal place features and vocalic place features, following Clements 1991, Clements and Hume 1995, and Ní Chiosáin and Padgett 1993. For the purposes of this thesis it does not matter whether this separation is effected through independent place nodes or by using different names for the consonantal and vocalic features (6). Here for clarity of exposition I will use the traditional vowel features {high, low, back, round, ATR, RTR} for vowels and reserve place of articulation names {coronal, dorsal, labial, phar} for consonants.[6]

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[5] Halle 1995 argues for a somewhat different organization than the one adopted here. For the most part this geometry is compatible with the thrust of this dissertation, although its separation of Place and Stricture as well as the independence of the feature lateral from coronal would require some adjustment of some of the inventory claims in Chapter 5.

[6] Because it is convenient I represent the feature classes in the traditional manner using class nodes in the geometry. In fact nothing in this dissertation depends on the presence of class nodes per se, conforming to the conclusion of Padgett 1995 who argues instead for non-representational feature classes.

(6) Close-up of PLACE
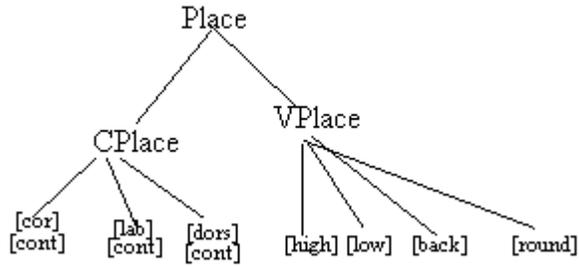
   The explicitness of segmental representation in Autosegmental Phonology engenders three processes in addition to the standard insertion, deletion and reduplication which determine the realization of phonological elements: linking, delinking and spread. This is illustrated schematically in (7) for subsegments. These operations are governed by the universal Well-Formedness Condition in (8), which represents a pared down version of the one originally proposed by Goldsmith 1976 (see Pulleyblank 1986). Research in Autosegmental Phonology consists primarily of determining when, where and how these three processes take place.

(7) Three processes

Link	**Delink**	**Spread**
Root	Root	Root Root
feature	feature	F
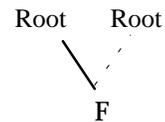
(8)   **Well-Formedness Condition**[7]   (after Goldsmith 1976)

Association lines do not cross

1.3 Ostensible differences between segments and subsegments

Thus autosegmental phonology breaks down the old monolithic segment into its component parts and provides explicit techniques for putting the segment together again. Support for this approach comes from the fact that there exist phonological elements which consist only of a subsegment, also known as *floating features*. In Chaha, for example, the third-person singular object is indicated by labialization on the verb (9-10). The object affix has been analyzed as a floating *[+round]* feature (McCarthy 1983, Rose 1994, Archangeli and Pulleyblank 1994).[8]   Because it lacks a root node the floating feature must dock onto a segment in order to be realized. As shown in (10), here it associates to the rightmost labializable segment, either a labial or a dorsal consonant (10a-c). If there is no such consonant *[round]* has nowhere to dock. Consequently it does not belong to any segment and fails to appear (10d).

(9)   Chaha object labialization morpheme

          [+round]

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[7] Sagey 1988 and Hammond 1988 show how the WFC may be derived from more general principles

[8] Other examples of morphemes which consist of only a floating feature include:

  [lateral] and **[nasal]**: Quileute (Chimakuan) (Frachtenberg 1920); **[continuant]** Tepehua (Mexican) (Willett 1982); **[voice]** Otomi (Oto-Manguean) (Wallis 1948), Japanese Rendaku (Ito and Mester 1986); **[round]** Chaha (Gurage) (McCarthy 1983, Rose 1994, Archangeli and Pulleyblank 1994), Mafa (Chadic) (Barreteau and Le Bleis 1987, Zoll (in prep)); **[constricted glottis]** Salishan languages (Nichols 1971), Tepehua (Watters 1987); **Tone** many including Leben, Goldsmith, Pulleyblank, Hyman etc; **[high]** Aizi (Kru) (Herault 1986), Japanese Mimetics (Mester and Ito 1989, Zoll 1995)....

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(10)   Chaha object labialization   (McCarthy 1983: 179)

		no object	*with object*	
a.	final	dænæg	dænæg^w	*hit*
		nækæb	nækæb^w	*find*
b.	medial	mækær	mæk^{w}ær	*burn*
		s^{y}æfær	s^{y}æf^{w}ær	*cover*
c.	initial	qætær	q^{w}ætær	*kill*
		mæsær	m^{w}æsær	*seem*
d.	none	sædæd	sædæd	*chase*

The presence of the root node remains essential to the surface realization of a subsegment (11)[9]. Association to a root node indicates which segment the floating feature belongs to, a necessary prerequisite to surface realization.[10] The syllable organizes consonants and vowels into larger units, and only elements incoroporated into prosodic structure through syllabification (or licensed extrametricality (Itô 1986, 1989, Goldsmith 1990)) will be pronounced.

(11)   Root node is conduit through which subsegment is realized in a syllable

floating [round] invisible to syllable	*[round] made visible by linking to full segment*
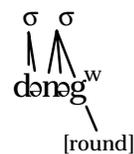
Chaha labialization exhibits the properties typically associated with the classic subsegment or floating feature (12).

(12)   Ostensible differences between segments and subsegments

	subsegment	*segment*
AUTARCHY	no	yes
UNDERLYING ROOT NODE	no	yes
VISIBLE TO SYLLABLE	no	yes
HETEROTROPIC	yes	no

Lacking an underlying root node, *[round]* does not surface independently (e.g., as a round vowel). Rather, its access to the syllable depends on its association with the root node of a full segment in the verb, so an underlying floating feature does not have surface *autarchy*. (In other words, it is not self-sufficient.) In addition, the floating feature is *heterotropic*. That is, it does not have a fixed position with respect to the segmental string (13). The floating *[round]*, unencumbered by its own root node, has a bird's eye view of the entire string of segments which serve as potential hosts, and as such is free to dock wherever it finds a compatible root.

(13)   Floating features are *heterotropic*
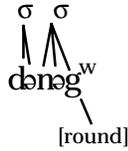
| Host is final | Host is medial | Host is initial |
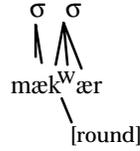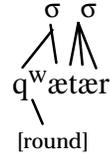
Compare the floating *[round]* above to the *ag-* prefix in Ilokano in (14). The affix

always surfaces as a string of fully independent segments and thus presumably consists

underlyingly of the bisegmental sequence /ag/. That *ag* is not heterotropic is assumed to

follow from this. Restrained in position by the presence of its own root nodes, it does not

have the freedom to move away from the leftmost edge of the verb (15).

(14)   Iloko Prefix *ag-* (Vanoverbergh 1955)

	Root	**-ag-**	PRESENT	
a.	isem	ag-ísem	*(actually) smiles*	132
b.	kagat	ag-kagát	*(actually) bites*	137

(15)   ® = root node
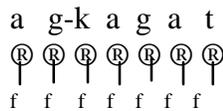
If the properties in (12) are all correlated with presence or absence of underlying

root node as indicated by the differences between Chaha *[round]* and Ilokano *ag*, then

we expect to find only immobile segments and mobile floating features cross-linguistically (16).

(16) The wrong prediction

	Autarchic	Heterotropic	*Example*
A	no	yes	*Chaha labialization*
B	no	no	
C	yes	yes	
D	yes	no	*Iloko ag-prefix*

I show in the next section, however, that this expectation is wrong. The four logically possible types of phenomena are attested (17) and must be accounted for in a general theory of subsegmental phonology.

(17) Every combination attested

	Autarchic	Heterotropic	*Example*
A	no	yes	*Chaha/Inor labialization*
B	no	no	*Inor palatalization*
C	yes	yes	*Iloko metathetic ni- prefix*
D	yes	no	*Iloko ag-prefix*

1.3.1 Independent properties

The problem with the conventional distinction subsegments and full segments is that the dividing line between the two classes of phenomena is not clear cut, and the properties listed in (12) do not always correlate with each other. First, metathesis and infixation involve the movement of undiminished consonants and vowels, so we cannot rely on the root node to keep something in its place. Infixation in Tagalog, for example, involves the movement of an entire affix (18). The prefix *um-* is pronounced at the beginning of vowel initial verbs (18a) but appears after the entire onset in verbs which are consonant initial (18b-c).

(18)   Tagalog *-um-* Infixation   (McCarthy and Prince 1993a: 19)

<u>Root</u>   <u>-um-</u>

a.   aral   um-aral   *teach*

b.   sulat   s-um-ulat   *write*

c.   gradwet   gr-um-adwet   *graduate*

Likewise Iloko (also known as Ilokano) contains affixes whose position is not fixed (Vanoverbergh 1955). The past tense *in-* is pronounced word-initially before vowel initial verbs (19a) but follows the onset in consonant initial ones (19b). This affix has even greater flexibility than the Tagalog *um-*. In words which begin with sonorant coronal consonants metathesis of the affixal segments themselves may take place instead of infixation (19c), yielding *ni-* at the beginning of the word instead.

(19)   Iloko *in-* Infixation and Metathesis (Vanoverbergh 1955)

	Root	-in-		PAST TENSE	
a.	aso	in-áso		*got*	147
b.	dañgaw	d-in-añgaw		*devastated*	147
c.	lukatán	ni-lukatán ≈ l-in-ukatán		*opened*	40

Moreover, it is not always the case that things restricted to a single position will be independently visible to syllabification. For example, Inor (20-21) has heterotropic labialization which patterns like that of Chaha above (Rose 1994). In addition, certain plural verb forms in Inor are marked by a palatalizing autosegment which can only dock at the right edge (21a-b). If the final consonant is not a coronal obstruent then palatalization will fail to surface (21c-d). This subsegmental morpheme is restricted to an edge, but never materializes as its own segment.[11]

(20)   Two floating feature morphemes in Inor

Masculine: *[round]*

Plural: *[-back]*

---

[11] McCarthy 1983 and Archangeli and Pulleyblank 1994 discuss an apparently similar phenomenon in Chaha but see Rose 1993

(21)   Inor Verb Forms (Rose 1995)

Masculine: Labialize <u>rightmost</u> velar or labial

Plural: Palatalize root <u>final</u> consonant if coronal obstruent

		3masc. pl.	3fem.pl.	
a.	√kfd	kəfʷəj-u-m	kəfəj-a-m	'they opened'
b.	√nks	nəkʷəs-u-m	nəkəs-a-m	'they bit'
c.	√drg	dənəgʷ-u-m	dənəg-a-m	'they hit'
d.	√sbr	səpʷə-m	səpər-a-m	'they broke'

The palatalization morpheme associated with Japanese mimetics (22) (Hamano 1986, Mester and Itô 1989, Zoll 1995) exemplifies even more the unreliability of mobility as a diagnostic in determining underlying representation. Here a single feature is both heterotropic and edge bound, depending on the circumstances. In Japanese Mimetic Palatalization palatalization targets the <u>rightmost</u> non-<u>r</u> coronal consonant. If there are none then the palatalizing feature links to the <u>leftmost</u> segment. In (22a), where both consonants are coronal, palatalization targets the medial consonant <u>s</u> while in (22b) the rightmost coronal is initial, so it is palatalized. As shown in (22c-d), however, in the absence of a non-<u>r</u> coronal the floating palatal attaches to the leftmost consonant. Thus in (22c) palatalized <u>poko</u> yields <u>pʸoko</u> 'flip-flop'. In (22d), where the medial segment is <u>r</u>, palatalization also targets the leftmost consonant, yielding <u>kʸoro</u> 'look around indeterminately'.

(22)   Japanese mimetic palatalization: (Mester and Itô 1989)
        a single feature is both mobile and edge bound

Palatalize the rightmost non-*r* coronal

a.   /dosa/   do**š**a-do**š**a   'in large amounts'

b.   /toko/   **č**oko-**č**oko   'childish small steps'

Otherwise palatalize the initial consonant

c.   /poko/   **p**^{y}oko-**p**^{y}oko   *po**k**^{y}o   'flip-flop'

d.   /koro/   **k**^{y}oro-**k**^{y}oro   *kyo**r**^{y}o   'look around indeterminately'

        No generalization with respect to underlying structure and mobility emerges from

this survey of the variety of possible patterns. Heterotropicity, or the lack thereof, cannot

therefore be used as a diagnostic for underlying presence or absence of a root node (23).

Whatever the underlying structure of a melodic element is, its potential mobility must be

determined by its interaction with a particular grammar.

(23)   Ostensible differences II

	subsegment	*segment*
AUTARCHY	no	yes
UNDERLYING ROOT NODE	no	yes
VISIBLE TO SYLLABLE	no	yes
HETEROTROPIC		

1.3.2 One possible approach

Archangeli and Pulleyblank 1994 likewise demonstrate the necessity of language-particular statements, as opposed to universal conventions, to derive the contrast between the edge-bound and heterotropic subsegments. In fact as early as 1983 McCarthy proposed different kinds of rules for the two types, and the rule system of Archangeli and Pulleyblank 1994 simply incorporates these into a more general conception of parametric rules. The rules for the two varieties found in Inor are shown in (24) and (25).[12] The important parameter for these cases is *iteration*. The non-iterative palatalization (24) searches for a target only at the right edge. Failing to find one it does not go on looking for another and will not appear in the output. On the other hand, the iterativity of the labialization rule (25) allows the floating feature to seek a target beginning at the right edge, but if the final segment will not do it can continue looking until a suitable resting place is found.

(24)   Non-Iterative Palatalization

        (adapted from Archangeli and Pulleyblank 1994: 318)

Element: [-back]		
Parameters	Operation	LINK
	Direction	RIGHT-TO-LEFT
	Iteration	NON-ITERATIVE
Other requirements		

---

[12] These rules are vastly simplified versions of the parametric rules in Archangeli and Pulleyblank 1994, containing only the elements necessary to illustrate the differences for the edge-bound and heterotropic subsegmental affixes. For a better appreciation of the intricacies of their system the reader is referred to their book.

(25)   Iterative Labialization

(adapted from Archangeli and Pulleyblank 1994: 316)

Element: [+round]		
Parameters	Operation	LINK
	Direction	RIGHT-TO-LEFT
	Iteration	ITERATIVE
Other requirements		

Archangeli and Pulleyblank's framework is an important step toward a better understanding of subsegmental phonology and demonstrates how apparently ad hoc rule types can form part of a larger system of parametric rules. It does not go far enough, however, either in providing meaningful accounts for more complex phenomena or in limiting the range of patterns to just those found cross-linguistically. First, a strong prediction of the parametric rule theory would be that every process will be characterizable as either Left-to-Right *or* Right-to-Left, and either Iterative *or* Non-Iterative. Cases like the Japanese Mimetic Palatalization in (22) above, however, falsify that prediction. Mimetic palatalization of coronals is a right-to-left iterative process, while palatalization of labials, velars and *r* by the same morpheme is left-to-right and non-iterative (26).

(26)   Two patterns for one subsegment

a.   Palatalize the rightmost non-*r* coronal   (iterative, right-to-left)

b.   Otherwise palatalize the initial consonant   (non-iterative, left-to-right)

As in standard rule based approaches, Archangeli and Pulleyblank handle complex cases such as these with a sequence of ordered rules. For the mimetic

palatalization they adopt the analysis of Mester and Itô 1989 shown in (27-28) in the

adapted parametric rule formalism.

(27)   Iterative coronal palatalization
        (adapted from Archangeli and Pulleyblank 1994: 333)

Element: [-back]		
Parameters	Operation	LINK
	Direction	RIGHT-TO-LEFT
	Iteration	ITERATIVE
Other requirements	*Target*	*CORONAL*

(28)   Non-Iterative Palatalization
        (adapted from Archangeli and Pulleyblank 1994: 332)

Element: [-back]		
Parameters	Operation	LINK
	Direction	RIGHT-TO-LEFT
	Iteration	NON-ITERATIVE
Other requirements		

The iterative palatalization rule precedes the non-iterative palatalization, as shown

by the mini-derivation in (29).

(29)   Derivation of palatalized forms

	dosa	toko	poko
Iterative coronal palatalization	dosa	coko	-
Non-iterative palatalization	-	-	p^{y}oko

While this account does derive the pattern in (22), capturing this generalization

through the application of multiple rules renders it simply an unrelated collocation of

independent patterns, and begs the question of why these two rules have these particular parameters and why they occur together. This constitutes a significant shortcoming in the parametric rule theory because while the rules themselves are now formally constrained, the relationships between rules are not. I will return to this point many times throughout the dissertation and in particular will propose a more organic analysis of the mimetic palatalization and related phenomena in Chapter 4.

1.3.3 Dependent features and independent segments

The major strength of the parametric rule theory—its ability to highlight relationships between seemingly unrelated rules through the breakdown of every rule into a number of independent parameters—also constitutes its second major limitation. While the painstaking decomposition of rules into binary parameters succceeds in capturing some species of generalizations, it completely obscures other obvious relationships, particularly similarities between segmental and subsegmental phenomena. For example, there exists a clear parallel between the subsegmental infixation of the Inor labialization and the segmental Tagalog *um-* infixation. However the parameters derive only insertion, linking and spreading of features, none of which is appropriate for a fully segmental affix.

One could disclaim the existence of any deep parallel between segmental and subsegmental phenomena, but this would be incorrect. Some mobile floating features will under certain circumstances appear as independent segments. A pattern of surface alternation between autarchic segment and dependent feature, also known as stability, is widely attested (Goldsmith 1976) and calls for a unified approach. The suffix induced

glottalization in Yowlumne[13] in (30) is a particularly interesting example of this. Glottalization floats from the suffix into the the verb and surfaces on a post-vocalic sonorant (30a-b). If there is no such target in a triconsonantal root, glottalization will fail to surface (30c). Thus far the glottal looks simply like a well-behaved floating feature. But in a biconsonantal root which contains no glottalizable sonorants, glottalization will emerge as a suffix-initial glottal stop (30d), with subsequent shortening of the vowel in the now closed syllable which preceeds it (Archangeli 1983, 1984, Noske 1984, Newman 1944).

(30)   Glottalization in Yowlumne

        (Archangeli and Pulleyblank 1994)

a.   /caaw   -(ʔ)aa/   caawʔaa   'shout'   *glottalizes R most post vocalic sonorant*

b.   /ʔelk   -(ʔ)aa/   ʔelʔkaa   'sing'

c.   /hogn   -(ʔ)aa/   hognaa   'float'   *fails to surface*

d.   /max   -(ʔ)aa/   maxʔaa   'procure'   *surfaces in biconsonantal root as stop*

---

[13] This is the way native speakers write the name of the language referred to in the literature as Yawelmani. William Weigel (p.c.), who works with Yowlumne speakers in California, writes:

"The spelling is Yowlumne, at least according to members of the tribe. The story is complicated. Kroeber's word list (A.L. Krober. 1963. Yokuts Dialect Survey. Berkeley: UC Press p 227) gives the singular and plural ethnonyms: Yawlamni /Yawelmani (sic stress) Both words bear penultimate stress marks in the text. Leanne Hinton takes Kroeber to mean that 'Yawelmani' should actually have antepenultimate stress. Apparently, however, 'Yawelmani' is a collective plural, meaning a (small) group of Yowlumne. This is the essence of a story in Frank F. Latta. 1977. *Handbook of Yokuts Indians*, 2nd ed.Santa Cruz: Bear State Books, pp280-81, in which a tribe member speculates that someone way back when must have asked 'Who are they' pointing at a bunch of Yowlumne, and the Indian said 'Yawelmani'. I have also been told by a tribe member--they have long been aware, for example, of Newman's grammar--that she remembers being told long ago (by her grandfather?) that 'Yawelmani' was a misnomer."

Another interesting example of this type has been described and analyzed by Elorrieta (1995). The allocutive form of the verb in Zeanuri Basque is marked by a palatalizing prefix (written here as I) which surfaces as the palatal glide *y* [j] on vowel initial forms (31a) and substitutes for an initial *d* (31b-c). For words which begin with *g* (31d), the prefix also appears as *y* but is infixed into the stem following an epenthetic *a*. As shown by the forms in (31e-f), however, this prefix surfaces as mere palatalization on *n* and *l*, changing them to *ɲ* and *ʎ* respectively.[14]

(31)   Consonant Mutation in Zeanuri Basque   (Elorrieta 1995: 78-79)

Allocutive

a.	/a-u-a-n/	[oan]	/I-a-u-a-n/	[**y**oan]	'he brought it'
b.	/d-a-u/	[dau]	/I-d-a-u-k/	[**y**ok]	'he brought it' (pres. perf)
c.	/d-it-u-es/	[ditues]	/I-d-a-u-s-ak/	[**y**osak]	'he brought them'
d.	/g-a-t-u-s/	[gatus]	/I-g-a-u-s-ak/	[g**ay**osak]	'he brought us'
e.	/n-a-u/	[nau]	/I-n-a-u-k/	[ɲok]	'he brought me'
f.	/l-e-u-ke/	[leuke]	/I-l-e-uke-k/	[ʎeukek]	'he would bring it'

This phenomenon betrays two important inadequacies in the parametric rule theory operating on standard representations. First, because there exist elements which are simultaneously segmental and subsegmental, the assertion of complete independence of segmental and subsegmental patterns cannot be maintained. It is not obvious how the

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[14] The Athapaskan perfective suffix (Rice 1995) may be another example of this phenomenon.

theory could be extended to handle the Yowlumne glottalization. Interestingly, although Archangeli and Pulleyblank 1994 do provide an analysis of the distribution of the glottal as a dependent feature, the cases where it surfaces as a glottal stop are written off in a footnote with no explanation, suggesting that the theory as it stands cannot account for its behavior. I will provide an analysis which can in Chapter 5.

Seond, this phenomenon further belies the osensible differences between segments and subsegments outlined above in (12). Since a single phonological element can appear as either a dependent feature or as an autarchic segment, surface manifestation is not (wholly) determined by the presence/absence of an underlying root node. Thus whether or not an element appears as a surface segment or not does not constitute a reliable diagnostic for underlying representation (32).

(32)

	subsegment	*segment*
AUTARCHY		
UNDERLYING ROOT NODE	no	yes
VISIBLE TO SYLLABLE	no	yes
HETEROTROPIC		

Only one structural diagnostic remains: whether or not a phonological element exhibits exceptionality with regard to syllabification (33). The burden of explanation with respect to the manner in which a floating feature manifests itself, including when it may surface as an independent segment, must fall on the grammar. We have seen that existing

rule based accounts can take us only so far in this task. The remainder of the dissertation develops a constraint-based grammar equal to the challenge.

(33)   Subsegments   (floating features) invisible to the syllable

| *floating [round] invisible to syllable* | *[round] made visible by linking to full segment* |
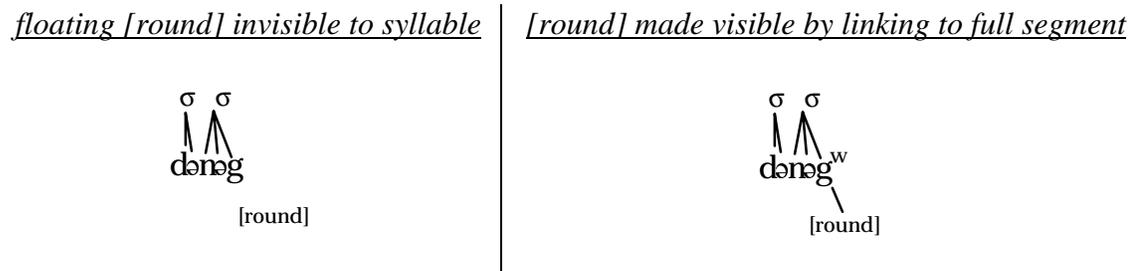
1.4 A unified representation for all subsegments

1.4.1 Latent segments lack a root node

The previous section makes plain that exceptional parsing alone brands an element as underlyingly rootless, since the other conventional diagnostics are not correlated. This result yields an unexpected bounty; namely, it provides a solution to the long-standing problem of how to represent *ghost segments* (aka *latent segments*) in a non-diacritic fashion. Latent segments share properties of both epenthesis and deletion, but cannot be strictly characterized as either (Hyman 1985, Kenstowicz and Rubach 1987, Archangeli 1991, Clements and Keyser 1983, Szpyra 1992). Like epenthetic segments the presence of a ghost segment on the surface is largely predictable from prosodic and cluster conditions in a language, but ghosts are distinct from epenthetic segments in that the quality and/or underlying distribution are idiosyncratic. Therefore ghost segments must be part of the underlying representation of the words in which they occur. On the other hand, ghost deletion cannot be analyzed as simple syncope of segments in a

particular context, since this deletion process is not general. Therefore latent segments

must be distinguished from their more robust peers underlyingly. In (34) I have provided

an example from Polish, illustrating the unpredictable distribution of yers, the Slavic

ghost vowels. The regular vowels in (34a) and (34c) surface consistently as we would

expect, but in the nearly identical (34b) and (34d) the ghost vowel, represented here as *E*,

is silent in the genitive singular forms. Therefore the alternating vowel in (34b) and (34d)

must have some sort of underlying representation which distinguishes it from full vowels.

(Piotrowski 1992, Piotrowski, Roca and Spencer 1992, Szpyra 1992, Bethin 1992,

Rubach and Booij 1990, Czaykowska-Higgins 1988, Rubach 1984, Gussmann 1980 inter

alia.).

(34)   Yers in Polish (data from Szpyra 1992: 279)

    (yers represented by E)

	underlying	nom. sg.	gen. sg.	
a.	/bes/	bies	bies-a	devil
b.	/pEs/	piEs	ps-a	dog
c.	/seter/	seter	seter-a	setter
d.	/swetEr/	swetEr	swetr-a	sweater

Latent consonants in French constitute another well-known example of this

phenomenon (See Tranel 1981 and Tranel 1995b and references therein). Consider the

data in (35). Each of these adjectives ends in a latent consonant which appears only

before a vowel-initial or glide-initial noun. This cannot be simply characterized as

consonant insertion since the choice of consonant {p, t, z, ʁ, or n} in any given word is largely unpredictable. Likewise, it is not consonant deletion, since not every final consnant deletes before a following consonant.[15] For example the adjective *net* 'clean' retains its final consonant in all contexts.

(35)   Latent consonants in French

p	[trop] aimé	'too much loved'	[tro] détesté	'too much hated'
t	[pətit] étang	'small lake'	[pəti] chien	'small dog
	[grǎt] étang	'big lake'	[grǎ] chien	'big dog'
z	[døz] étang	'two lakes'	[dø] chien	'two dogs'
	[groz] étang	'big lake'	[gro] chien	'big dog'
ʁ	[ležɛʁ] incident	'slight incident'	[leze] son	'faint sound'
n	[sɛrtɛn] étang	'certain lake'	[sɛrtɛ̃] chien	'certain dog'

Latent segments, like floating features, are exceptionally invisible to the syllable. However, unlike floating features, they are thought to require root nodes primarily because (i) latent segments are not heterotropic and (ii) latent segments surface as independent segments (36).

(36)   Traditional view

FULL SEGMENT	LATENT SEGMENT
Root	Root
|	|
features	features

This distinction has necessitated the use of diacritics or the largely redundant X-tier to capture the defective parsing properties of the latent segments (to which I will

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[15] I return to these in Chapter 5

return below). The last section demonstrated however that potential mobility and independence of a phonological entity do not correlate either with each other or with the presence or absence of a root node. Therefore these properties cannot be relied upon to motivate a structural distinction between latent segments and floating features. The one criterion remaining in (32)--potential invisibility to the syllable--condignly differentiates between full segments and latent segments. A unified underlying representation for both latent segments and floating features (37) based on their shared invisibility allows a unique characterization of their immunity from the demands of regular parsing.

(37)

SURFACE:	FULL SEGMENTS	LATENT SEGMENTS
	Root	
	|	
UNDERLYING:	features	features

As depicted in (38), like floating features these degenerate segments fail to be interpreted in the absence of a root node (38a). For now I will represent a rootless feature matrix with capital letters. The ghost melody is parsed only in contexts where the phonology supplies an epenthetic root node, as in (38b) where no other vowel is available. The only thing that distinguishes latent segments from floating features in their realization then is that conventional floating features associate to an existing root node while latent segments associate to an epenthetic root node inserted only in certain phonological contexts, some of which will be discussed in Chapter 5.

(38)   Polish: ® = root node

NO ROOT INSERTED: ROOT INSERTED:
floating features invisible to syllable   *floating features realized through linking to*
                                             inserted root node

$$\sigma$$

®	® ®
g	E r a

gra   'game'
(nom. sg)

$$\sigma$$

®	®	®
g	E	*r* `

gier   'game
(gen. pl)
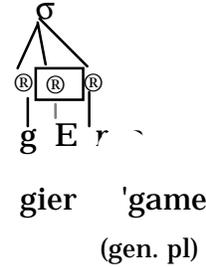
1.4.2 Problems with previous proposals

1.4.2.1 Overview

Traditionally, latent segments have been represented as full melodic segments underlyingly since in prototypical cases like the Polish yer they surface as segments in a fixed postion; but, as we have seen, neither of these constitutes a sure diagnostic of underlying segmenthood. In fact, not only is there no unequivocal evidence that latent segments should be represented as underlying segments, but to classify them as such makes it impossible to explain their exceptional invisibility to the syllable in a non-diacritic fashion.

To illustrate, consider the range of representations which have been proposed to solve this problem in (39) (Clements and Keyser 1983, Noske 1984, Archangeli 1984, Hyman 1985, Kenstowicz & Rubach 1987, Archangeli 1991, Szpyra 1992, Rubach 1993 inter alia). Three types of solutions exist: (i) extrametricality, (ii) lack of a timing slot, and (iii) defective root node or missing features. The next sections, which draw heavily

on Tranel 1995a, demonstrate that none provides a satisfying account of the ghost segment phenomenon.

(39) Proposed Representations for latent segments

a.   Lacking a timing unit
        (Hyman 1985, Kenstowicz and Rubach 1987, Rubach 1993)

```
        X   X
        |   |
        Ⓡ   Ⓡ   Ⓡ
        |   |   |
        p   a   s
```
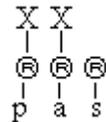
b.   Marked lexically as optionally non-syllabifying
        (Archangeli 1991)

```
  Ⓡ  Ⓡ  (Ⓡ)      Condition: Don't syllabify  (Ⓡ)
  |   |   |                                     |
  p   a  (s)                                   (s)
```
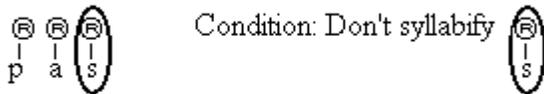
c. Underlyingly extrametrical   d. Has a defective root node
   (Clements and Keyser 1983)   (Szpyra 1992)

```
        σ
        Λ                                [α consonantal]
   Ⓡ  Ⓡ  Ⓡ
   |   |   |
   p   a (s)
```
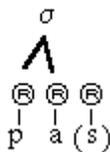
1.4.2.2 Extrametricality

Extrametricality has perhaps the least credence as a non-diacritic solution to the problem of representing ghost segments. As Tranel 1995 demonstrates, the

36

extrametricality required to account for latent segments differs substantially from standard extrametricality (Liberman and Prince 1977, Hayes 1981, Harris 1983, Archangeli 1984, Poser 1984, Franks 1985, 1989, Pulleyblank 1986, Itô 1986, Halle and Vergnaud 1987, Inkelas 1989, and Roca 1992 among others). While both dictate that some element should be undominated by higher prosodic structure, standard extrametricality uses this as a way of licensing material which for some reason is ignored by phonological rules. Crucially these elements *do not delete*. In Estonian for example (40), CVC is considered heavy (and thus stress attracting) in non-final syllables but light finally (Hayes 1995: 56). Extrametricality here allows the stress algorithm to ignore the final consonant but does not block the final consonant from surfacing.[16]

(40)   Estonian   (Hayes 1995: 56)

a.   Nonfinal CVC is heavy   válu**sàt**tele

b.   Final CVC is light   pála**val**   *from*   pála**va<l>**

Likewise Inkelas 1993 demonstrates the role of extrametricality in accounting for voicing alternations in Amele, a member of the Gum family of languages in Papua New Guinea. In Amele, coda labial and velar plosives {p/b, g/k} are voiced everywhere but in word final position (41a-b). The one exception to this is the monosyllable final consonants, which retain their voicing (41c).

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[16] In recent approaches to extrametricality in Optimality Theory final consonant invisibility is rejected even in standard cases in favor of constraints dictating non-finality of stress (Prince and Smolensky 1993, Hung 1994 among others; but see Inkelas 1993 for a different view).

(41)   Amele (Inkelas 1993: 2 from Roberts 1987)

a.   /pa/   [bæ]   'today'
      /apa/   [æbə]   'brother'
      /kiʔ/   [giʔ]   'finger/toe'
      /okol/   [ɔgɔl]   'tree species'
      /tup-d-oʔ/   [tub.doʔ]   'join-3sg-inf'
      /tuk͡p-d-oʔ/   [tug͡b-d-oʔ]   'butcher-3sg-inf'

b.   /kalap/   [gælæp]   'body ornament'
      /polop/   [bɔlɔp]   'trap'
      /pamik/   [bæmik]   'his scrotum'
      /alok/   [ælɔk]   'raven'

c.   /sip/   [sib]   'rubbish'
      /nap/   [næb]   'termite'
      /ʔuk/   [ʔɔg]   'frog'
      /lik/   [lig]   'shrub species'

Inkelas 1993 proposes that final consonants are extrametrical (outside the rule domain) and thus invisible to a rule which inserts [+voice] on plosives (42). Crucially, the final consonant does not delete but surfaces as a voiceless stop. Extrametricality is blocked on monosyllables due to minimality considerations, accounting for the exceptional voice insertion on their final consonants.

(42)   Only non-final C visible for voice insertion

Extrametrical final C invisible to insertion   *Extrametricality blocked in monosyllables*

kalæ p>   pamɨ k>   s i p
      \   \   \
  [+voice]   [+voice]   [+voice]
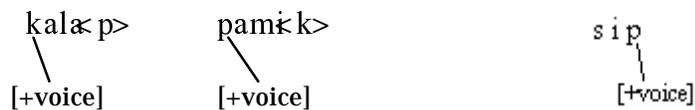
Thus invisibility conferred by extrametricality does not result in deletion of the extrametrical consonant, so this device cannot capture the special behavior of latent segments.   A further problem demonstrated by Tranel 1995b is that normally extrametricality affects strictly peripheral segments (Harris 1983). In contrast, the exceptionality of ghost segments is not dependent on where they fall in the morpheme. Consider the Yokuts data in (43) (Archangeli 1991 and Noske 1984). Normally epenthesis occurs to break up a triconsonantal cluster (43a), but when one of the consonants is latent, the cluster is resolved through deletion of the ghost consonant (43b). Crucially, the consonant which deletes is word-medial, and in the case of *ʔ(h)iy* it is suffix medial as well.

(43)   Yokuts

a.   Vowel epenthesis breaks up illicit triconsonantal cluster for full consonants

        -hin   /ho<u>gn-h</u>in/   ho. g*I*n-hin

b.   Ghost segments delete rather than trigger epenthesis in the same environment

        -(h)nel   /hog<u>on-(h)</u>nel/   ho. gon. -nel

.   cf   /maxa-<u>(h)</u>nel/   ma. xa-**H**. nel

        -ʔ(h)iy   /cexel-ʔ(h)iy/→   cexel-ʔiy   (This form from Noske 1984)

        cf   /cese-ʔ(h)iy/→ce. seʔ. **H**iy

        Latent segments would thus require a kind of extametricality which triggers deletion and is not constrained by the peripherality condition. This is not an extension of the well-motivated concept of extra-metricality. As Archangeli 1991 recognized,   it

functions only as a stipulatory device indicating that ghost segments may be ignored under certain conditions.

1.4.2.3   The X-slot

The representation of ghost segments as lacking a slot on the timing tier (44) appears to be more promising. Within skeletal theory every segment has an inherent X-slot that mediates between segment and syllable (Levin 1985), so an absent X-slot is the most general and obvious way to capture the latent segment's exceptional invisibility. (The moraic solution of Hyman 1985 is equivalent to the skeletal model in this respect since all segments carry an inherent weight unit.)

(44)   Ghost segment lacks a skeletal slot

(Hyman 1985, Kenstowicz and Rubach 1987, Rubach 1993, Sloan 1991)
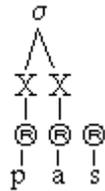
The skeleton has performed the functions listed in (45). However, as phonological theory has evolved, most of the functions of the X-slot have been usurped by the mora and the root node, leaving ghost segments as the only domain in which the skeleton is still claimed to be necessary.

(45)   X-slot mediates between melody and syllable   (from Broselow 1995: 175ff)

Functions of the skeleton   →   **taken over by...**

a.   mark off segments   **[root nodes]**
      Clements and Keyser 1983   Mohanan 1983 via Clements 1985

b.   represent segment weight/length   **[moras]**
      McCarthy 1982   Hyman 1985, It 1986, Hayes 1989,
                                                           Itô 1989

c.   describe template shapes   **[higher prosodic structure]**
      McCarthy 1981, Marantz 1982   McCarthy and Prince 1986

d.   indicate a ghost segment by its absence   **???**

We saw above that as a result of developments in feature geometry (Clements 1985, Sagey 1986, McCarthy 1988 and subsequent work) the root node serves as segmental place-keeper, a role once performed by the X-slot. Next, the mora has proven to better capture the weight encoding function of the skeleton (Hyman 1985, Itô 1986, McCarthy and Prince 1986, Hayes 1989; see Broselow 1995 for an overview)[17]. For example, Hayes 1989 argues that with respect to compensatory lengthening, deletion of an element from the rime may trigger lengthening of a neighboring segment but deletion of an onset does not. While this follows from moraic theory, where only rime elements are dominated by a mora, skeletal theory must stipulate that onset positions will not be filled (46).

---

[17] But see Blevins 1995 for counterarguments based on three way weight distinctions.

(46)   The syllable in skeletal theory and moraic theory

mora	skeleton
•onset deletion leaves no empty weight unit	•onset deletion leaves an empty weight unit
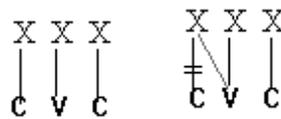
Finally, McCarthy and Prince 1986 argue that the templates in templatic morphology are restricted exclusively to prosodic constitutents, where a prosodic constituent is a syllable, foot, etc. The templates in Yowlumne are a typical example(Newman 1944, Kuroda 1967, Kisseberth 1970, Archangeli 1983, 1984, 1991, Noske 1984). Yowlumne's three morphological templates all correspond to prosodic constituents as shown in (47): iambic foot, heavy syllable, light syllable.[18] Templates in skeletal theory (McCarthy 1979, Marantz 1982, Clements and Keyser 1983, Levin 1985, Lowenstamm and Kaye 1986) are not so constrained. In principle any sequence of consonants and vowels would constitute a well-formed template. The limits of a prosodic theory of templates thus better captures the range of patterns found in prosodic morphology.

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[18] Prince 1990 argues that the so-called light syllable template is the absence of a template.

(47)   Templatic morphology in Yowlumne (Archangeli 1991)

Verb stems are biconsonantal or triconsonantal
Each has a default template

default template				AORIST /-hin/	*gloss*	
iambic foot	CVCVV	a.	lag	**la. gaa**. -hin	*spend night*	
		b.	bint	**bi. ne**t. -hin	*ask*	
heavy syllable	CVV	c.	dull	**doo**. lUl-hun	*climb*	
		d.	hix	**he**x. -hin	*be fat*	
light syllable	CV	e.	hogn	**ho**. gIn. -hin	*float*	
		f.	dub	**du**b. -hun	*lead by hand*	

It appears then that the representation of ghost segments constitutes the only area where the otherwise redundant skeletal tier is still considered indispensable (Tranel 1995). The X-slot has been reduced to a diacritic whose sole purpose is to distinguish the normal parsing of regular segments from the exceptional parsing of latent segments. This compels us to seek another solution.

1.4.2.4 The mora

Since the weight and positional functions of the X-slot have been taken over by the mora and root node respectively, we can ask which of these could be implicated in the exceptional behavior of ghosts. Given the assumption in the literature that the ghosts must have a root node, an obvious alternative is to propose that ghosts lack an underlying mora. The assignment of moras is largely predictable, however, so moraic structure is not generally posited underlyingly except to encode distinctive length (Hayes 1989). Therefore, as Tranel 1995 points out, it is not possible to distinguish non-moraic ghost segments from regular segments in the lexicon. This problem could be avoided by

assigning moras to all regular segments, but then the insights of moraic theory would be lost.

1.4.2.5 Defective root node

Extrametricality, skeletal theory and the mora have failed to yield an adequate representation for latent segments. A defect within the segment itself alone remains as a potential means to characterize the exceptionality of latent segments. Since within moraic theory it is the root node (instead of a skeletal slot) which mediates between segmental features and higher prosodic structure, an absent root node captures this most directly. Thus by process of elimination we are driven to the solution arrived at by looking at other subsegmental phenomena: phonological elements which are exceptionally invisible to the syllable lack an underlying root node.

(48)   Single representational distinction between full segments vs. *all* subsegments

SURFACE:	FULL SEGMENTS	LATENT SEGMENTS AND DEPENDENT FEATURES
	Root | features	
UNDERLYING:	features	features

One important consequence of this proposal for the theory of subsegmental phonology is that it eliminates an embarassing indeterminacy which arises if latent segments and floating features have distinct underlying representations. Consider again the Yowlumne suffix-induced glottalization in (30). Because it both surfaces as an autarchic segment and as a dependent feature (depending on context) there is no obvious

way to choose a unique underlying representation for it. At different times Archangeli proposed both analyses in (49), and given the contemporary understanding of segment structure no criteria could have distinguished the two. With the better understanding of the role of the representation in subsegmental phonology afforded by the discussion in this chapter, the theory unequivocally chooses the floating feature (49a) as the only possible underlying representation. In Chapter 5 I develop the grammar which will derive its variety of surface forms and relate its behavior to the other latent segments in Yowlumne.

(49)   Possible representations of suffix induced glottalization

     a.   Archangeli 1984:   floating glottal <u>feature</u> [+G]

     b.   Archangeli 1991:   extrametrical <u>segment</u>

By representing ghost segments underlyingly as rootless bundles of features we can account for their characteristic properties in (50).

(50)

	Ghosts have...	This follows because...
a.	Unpredictable Quality	*They are present in underlying representation*
b.	Unpredictable Distribution	*They are present in underlying representation*
c.	Immunity from parsing	*Floating features are too small to join directly to a mora or syllable*
d.	Inventory limited in principled ways	*Absence of root node potentially limits the number of possible underlying distinctions*
e.	No Underlying Length	*No root node means underlying mora cannot be supported*

This proposal allows the necessary inclusion of the latent segments in underlying representation, given their unpredictable quality and distribution. Likewise, invisibility to the syllable follows directly from the absence of a root node to which the features can dock. I postpone implications for expected latent segment inventories (50d) to Chapter 5, but note here that all known inventories are expressible underlyingly as a single feature class whose remaining features can be filled in by universal and language specific markedness conventions. Finally, this account correctly predicts that underlyingly long consonants or vowels will never act like latent segments. Since moras necessarily dominate root nodes in moraic theory, underlyingly long segments must always have root nodes (51a).[19] Since ghost segments lack a root node, they cannot support a mora and therefore cannot encode any underlying length distinctions (51b). [20]

(51)   Root nodes support the mora

Regular segments

μ   μ μ
| \ /
Ⓡ   Ⓡ
| |
features   features
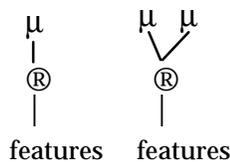
Szpyra 1992 proposes a less drastic alternative (52), suggesting that latent segments have root nodes, but that these nodes lack a value for consonantal and as a

---

[19]This does not entail that long segments never alternate with zero, but only that in those cases the surface length will be predictable from context.

[20] This prediction also follows from an analysis such as that of Hyman (1985) or Kenstowicz & Rubach (1987) where a ghost lacks an underlying skeletal slot.

result are invisible to syllabification.[21] The value for consonantal is filled in contextually when the yer is syllabified. [22]

(52)   [ø consonantal]

There are at least two reasons why this solution does not have the desired result. First, the underspecification solution fails to account for the absence of long latent consonants and vowels. Because root nodes support the mora, it becomes necessary to stipulate that a root node unspecified for consonantal cannot bear underlying length. The proposed solution, where the root node is completely missing, gets this result for free. Second, Szpyra's proposal rests on the assumption that only information from the root node is available to the syllable, but that cannot be true. Take for example a coda condition on place features like the one in Hamer (South Omotic) in (53). In Hamer, only coronal consonants and nasals homo-organic to a following consonant are allowed in the coda (Lydall 1976: 404). One way that potentially illicit codas are avoided is by metathesis. Information about PLACE thus plays an important role in syllabification. Assuming that place features are identified as either consonantal or vocalic, there is no principled way to allow place features to percolate up through the root node while blocking the information about whether it is CPlace or VPlace. In fact Hume and Odden

_____

[21] In a related vein, Spring 1993 (see also Yip 1983, Black 1991) argues that the exceptional deletion of the placeless nasal *N* in Axininca Campa follows from the fact that it is underspecified for PLACE (along the lines of Pulleyblank's 1988 account of *i* deletion in Yoruba). Although most latent segments must be specified for PLACE (see chapter 5) this approach could be generalized in a framework where regular segments are fully specified to say that if a segment is missing anything at all the segment will delete in some contexts where fully specified segments do not. However, in cases like Slovak (Rubach 1993) where *all* short vowels have a latent counterpart such underspecification can not be independently supported.

[22]Szpyra (1992) presents her arguments within the skeletal framework but her arguments translate readily into moraic theory.

1994 argue on grounds such as these against the feature [consonantal] in the root node at all. The only way unspecified consonantality can block syllabification is through stipulation. [23]

(53)   Hamer (South Omotic) Metathesis   Lydall (1976: 408-409)

a.   isin   sorghum   isin**ta**   small amount of sorghum

     rac   Rac   (clan)   ra**tc**a   Rac man

b.   oto   calf   oto**no**   all calves

     isin   sorghum   isin**no**   all sorghum

     rac   Rac   (clan)   ra**nc**o   all Rac

1.5 Summary of the chapter

The absence of universal conventions on subsegmental representations and the problems with previous representations of latent segments and floating features support the unified representation for subsegments in (54).

(54)   Single representational distinction between full segments vs. *all* subsegments

SURFACE:	FULL SEGMENTS	LATENT SEGMENTS AND DEPENDENT FEATURES
	Root |
UNDERLYING:	features	features

---

[23] Representation of vowel/glide alternations poses a third potential problem for Szpyra's 1992 solution. Waksler 1990, for example, represents segments which alternate between surface glide and surface vowel as underlyingly underspecified for [consonantal].Rosenthall 1994 argues, however, that such high vowel underspecification is unnecessary in Optimality Theory given parallel evaluation of alternative parses.

The crosslinguistic assortment of subsegmental behavior and patterns must instead follow from various options encoded in grammars and not from automatic consequences of the representations themselves. The remainder of the dissertation concerns itself with developing such a grammar.

Parsing Below the Segment in a Constraint Based Framework

by

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4. CONFLICTING DIRECTIONALITY

5. LATENT SEGMENTS AND EXFIXATION

2. Optimality: Theory and Practice

Confronted with the absence of conventions, rule based approaches go a long way toward accounting for some of the problems in Chapter 1, but as we have seen a variety of subsegmental phenomena still lack a satisfactory account. This is due both to the excessive rigidity of rules and their interaction with likewise inflexible representations, as well as to the excessive freedom of relationship between rules in a derivation. Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993b), which conceives of the grammar as a hierarchy of *ranked* and *violable* constraints relating input and output, constitutes an important advance over previous theories in this regard. On the one hand, the violability of constraints in Optimality Theory affords the necessary flexibility to deal with cases where the all-or-nothing quality of rules prevents a successful analysis. Yet Optimality Theory is also potentially more constrained than previous rule-based and constraint-based theories in that it creates no intermediate derivational stages. This restriction motivates a fresh look at phonological patterns, leading to new insight. This dissertation demonstrates throughout the fruitfulness of such an approach.

2.1 The Rudiments of Optimality Theory

Constraints are not new in phonology (see for example Kisseberth 1970, Kisseberth 1972, Haiman 1972, Pyle 1972, Hale 1973, Sommerstein 1974; and more recently Paradis 1988, Goldsmith 1990; additional references in Prince and Smolensky 1993), but the significance of Optimality Theory stems from its resolution of the uneasy

relationship between rules and constraints (or "conspiracies") which already existed in contemporary rule-based and mixed rule/constraint theories. The debate in the 1980s surrounding the *Obligatory Contour Principle* (OCP), (1), a constraint against adjacent identical elements first proposed by Leben 1973, serves as a classic illustration of this difficulty.

(1)   **Obligatory Contour Principle**   (McCarthy 1986a: 208)

        At the melodic level, adjacent identical elements are prohibited

McCarthy 1986 demonstrates that the OCP functions not only as a passive morpheme structure constraint, but in addition operates actively in the course of phonological derivation. In particular he claims that the OCP prevents the formation of geminates in Afar (Cushitic) and other languages by blocking vowel syncope between identical consonants. Consider the data in (2). Afar manifests the well-known deletion of vowels in the prototypical double sided open syllable environment (2a and 2c). As expected, deletion is blocked in closed syllables (2b and 2d). In addition, vowel deletion fails to occur between identical consonants, even when the vowel appears in an open syllable (2e). McCarthy 1986 claims that this *antigemination* effect follows from the ability of the OCP to block a rule whose outcome would violate it.

(2)   Afar Syncope (Bliese 1981)

     V→Ø/VC__CV

	underlying stem		
a.	/wag<u>e</u>r/ *reconcile*	wag. r-é *he reconciled*	*V deletes when unnecessary*
b.		wa. ger. -n-é [*wag <r>-n-é] *we reconciled*	*deletion blocked by σ structure*
c.	/al<u>i</u>f/ *close*	al. f-é *he closed*	*V deletes when unnecessary*
d.		a. lif. -t-ee. -ní [*al <f>-t-ee-ní] *you (pl) closed*	*deletion blocked by σ structure*
e.	/ad<u>u</u>d/ *be wet*	ad<u>u</u>d-é [*addé] *he was wet*	*deletion blocked byOCP*

In order to strengthen his claim, McCarthy 1986 maintains that the role of the

OCP in the grammar is exclusively as a rule *blocker*. By denying the potential rule

triggering effects of the OCP, he attempts to establish a general convention on the role of

constraints with respect to rules (McCarthy 1986: 222).   He specifically rejects the

assertion commonly found in the literature on tone that the OCP *triggers* fusion of

adjacent identical elements. The potential of the OCP to both trigger *and* block rules

constitutes a weakness in a primarily rule-based theory because it prevents a uniform

statement about the relationship between constraints and rules.

In fact, no such universal convention is possible. In a direct refutation of

McCarthy's claim, Odden 1988 presents complementary cases where the OCP triggers

syncope exclusively between identical consonants, an effect he dubs *antiantigemination*.

In Maliseet-Passamaquoddy (3), for example the weak vowels *ə* and *a* delete only when

flanked by identical consonants (3a and 3c) in a doubly open syllable. They remain when

the surrounding consonants are different (3b and 3d). Here it seems that the OCP triggers syncope as well as the subsequent fusion of identical adjacent consonants.

(3) Maliseet-Passamaquoddy   (Odden 1988:464 from Sherwood 1983)

	Underlying	*Surface*	*Gloss*
a.	te**p-ăp**i-w	te**pp**o	'he sits inside'
b.	məkwə**t-ăp**i-w	kw'ə**tə**po	''he sits alone'
c.	w-tə**m-əm**-a-w-al	t'ə**mm**al	'he bites in half'
d.	w(t)- ə**l-əm**-a-w-al	t'ə**ləm**al	'he bites him'

The ostensible arbitrariness of the choice of strategies in response to the OCP leads Odden (1988: 474) to conclude that the OCP "is not a formal part of linguistic theory." Yet in an important paper, Yip 1988 presents a convincing case that the presence of the OCP as a filter in the grammar, one that can both trigger and block a variety of rules (4), is desirable, particularly because it allows extensive rule simplification through elimination of complex environment descriptions, thereby capturing an important generalization.

(4)   Some OCP Effects   (Yip 1988)

RULE TRIGGER	*example*	**RULE BLOCKER**	*example*
Epenthesis	*English*	Syncope	*Afar*
Degemination	*Seri*		
Dissimilation	*Cantonese*		
Assimilation	*Berber*		

Thus on the one hand Yip 1988 shows the value of a constraint like the OCP in simplifying rule statements, while on the other we are left with no way to address the concerns of McCarthy 1986 and Odden 1988 with respect to the unconstrained nature of the seemingly arbitrary application of the OCP in both triggering and blocking rules.

Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993) circumvents the uneasy relationship between rules and constraints by completely eliminating rules from the grammar.[1] Instead the grammar consists of a generator (GEN) that associates an input form with a set of possible output analyses, and an evaluation component (EVAL) that consists exclusively of a hierarchy of ranked and violable constraints. EVAL assigns a unique structural description to the output by choosing the best of the candidates offered to it by GEN (5).

---

[1] The Theory of Constraints and Repair Strategies (TCRS) of Paradis 1988 and Myers 1991's Persistent Rule Theory were developed as other possible responses to this problem.

(5)

input $\rightarrow$ | GEN | $\rightarrow$ | EVAL | $\rightarrow$ output

GEN (input$_i$) = {candidate$_1$, candidate$_2$, ...}

EVAL ({candidate$_1$, candidate$_2$, ...})$\rightarrow$ candidate$_k$ (the optimal output)

To illustrate, consider the case of verbs in Samoan (Bloomfield 1933). Samoan does not allow final consonants, so unsuffixed consonant final verbs undergo consonant deletion (6).

(6)   Samoan   (Bloomfield 1933: 219)

	UNDERLYING	WITHOUT SUFFIX		WITH SUFFIX	
a.	/tanis/	tani	'weep'	tanis-ia	'wept'
b.	/inum/	inu	'drink'	inum-ia	'drunk'
c.	/uluf/	ulu	'enter'	uluf-ia	'entered'

Two of the constraints implicated in deletion are shown in (7).[2] The first promotes deletion by banning consonants at the ends of words. MAX(SEG), on the other hand, prohibits deletion.

(7)   Sample constraints

NO FINAL C   No word final consonants   (Bloomfield 1933)

MAX(SEG)   An input segment should appear in the output (MP 1995: 264)

---

[2] Hale 1973 and McCarthy 1981 provide a morphological solution which does not involve deletion in the similar case of Maori. See Blevins 1994 for a more recent account of the Maori case.

GEN, limited only by basic principles of phonological structure, associates an input form, such as *tanis*, with a variety of possible outputs for EVAL to compare. Among them will be the forms in (8).

(8)   Candidates produced by GEN

a.   tanis

b.   tani   (*s* deleted)

c.   ani   (*t, s* deleted)

EVAL examines all of the candidates in parallel. For every candidate ouput each constraint assesses a set of marks (*), where each mark corresponds to a single violation of the constraint. These marks are displayed in a chart known as a *tableau*. The tableau in (9) indicates that candidate (9a) violates **NO FINAL C**, because it has retained the word final consonant. Thus in the tableau it gets one asterisk. Candidates (9b) and (9c) satisfy this constraint but violate MAX. Candidate (9b) violates it once, because the final consonant has been deleted. (9c) is marked for two violations since two consonants have been deleted.

(9)   **/tanis/**

	Candidates	**NO FINAL C**	MAX	
a.	tanis	*		*/s/ is word final*
b.	tani		*	*/s/ deleted in output*
c.	ani		**	*/t/ and /s/ deleted*

Since these constraints are at odds with each other, the actual output will obviously violate one of them. In order to choose a unique output it is necessary to rank the constraints. The establishment of formal conventions for adjudicating the relative importance of competing constraints, entailing that constraints must be potentially violable, constitutes the principle insight of Optimality Theory. In this case, NO FINAL C must dominate MAX since in the optimal output, the actual Samoan form *tani*, the final consonant does not appear (10). It will be more important to satisfy NO FINAL C, even if this is done at the expense of a violation of MAX.

(10)   If /tanis/ → [tani], then

      NO FINAL C » MAX-SEGMENT   (» ≡ '**DOMINATES**')

The now solid line between the constraint columns in (11) indicates that the constraints are ranked with respect to each other. The fact that **NO FINAL C** precedes MAX means that satisfaction of **NO FINAL C** is more important. Candidate (11a) violates this highest ranked constraint, and since there are other candidates that do obey it, (11a) loses and will not succeed as the optimal output. Fatal violations like this are indicated by "*!". Now only candidates (11b) and (11c) remain. Both violate the lower ranked constraint, but (11c) fares worse because two of its consonants have been deleted. Form (11b) is chosen as the best output because it violates the lowest constraint the fewest number of times. The winner is indicated by ☞ in the first column.

(11)   Constraint Tableau: There are two ways to lose

/tanis/

	Candidates	**NO FINAL C**	MAX
a.	tanis	*!		*/s/ is word final*
b. ☞	tani		*	*/s/ deleted in output*
c.	ani		**!	*/t/ and /s/ deleted*

2.2 Faithfulness and Correspondence

Theories of phonology differ on the issue of abstractness of underlying representation, but most agree that differences between input and output should be minimal. This *faithfulness* between output and input is automatic in rule-based theories because no changes to an input occur unless the form undergoes some sort of rule. No follower of Chomsky and Halle 1968, for example, would think to ask why an input such as /kənis/ is not pronounced [ba], since it is hard to imagine what sort of well-motivated rules would be able to create one from the other. All else being equal, the word [ba] will simply be represented underlyingly as /ba/, and the underlying /kənis/ will surface faithful to the input string.

The concept of faithfulness does not follow automatically in Optimality Theory, but is built into the theory by including universal constraints mandating faithfulness as part of EVAL. While GEN can do almost anything, we still do not expect /kənis/ to come out as [ba] since constraints like MAX (7) maintain faithfulness between input and output by penalizing output candidates which deviate from the input form. Faithfulness

55

constraints can be violated under pressure of a higher ranked constraint, such as NO FINAL

C, but this violation is always minimal. For example, in the optimal candidate above only

the consonant necessary to satisfy NO FINAL C was expunged. The non-optimal (11c) lost

due to its gratuitous initial consonant deletion. So just as in rule based theories where

faithfulness is violated only when a rule dictates some sort of change, in Optimality

Theory it is violated only when a higher ranked constraint forces a violation.

Faithfulness in Optimality Theory is instantiated in EVAL as a set of constraints on

corresponding segments (McCarthy and Prince 1995). McCarthy 1995 has offered the

following definition of *Correspondence* (12).

(12)   **Correspondence**   (McCarthy 1995: 4)

> Given two strings S_j and S_0, related to each other by some
> linguistic process, *Correspondence* is a function g from any
> subset of elements of S_1 to S_0. Any element α of S_1 and any
> element β of S_0 are *correspondents* of one another if β is
> the image of α under Correspondence; that is $\beta=g(\alpha)$.

The input/output correspondence relation is like an identity function in that it

maps input structure to its "image" in the output. Correspondents need not be the same in

every particular, however. Consider the Inor masculine verb form $k\partial f^w\partial d$ from Chapter 1

marked by labialization on the medial consonant (13). Here the verb root (S_2) is a string

of segments, the affix (S_1) is a floating feature *[round]*, and the output stem (S_0) consists

of correspondents of both the verb root and the subsegmental affix. The correspondence

relation $g(x)$ matches elements in the input (S_1 and S_2) to their correspondent elements in

the output stem (S_0). Notice that the labialized consonant f^w is different from the plain

consonant to which it corresponds. Common sense tells us that given this input and output the segments returned by $g(x)$ shown in (13) reflect the most reasonable correspondents, although the mechanics of determining exactly what corresponds to what have never been explicitly formulated.

(13) S_2-S_0 correspondents: (S_0 = stem [output] , S_1 = affix, S_2 = root)

   $g(k)=k, g(ə) = ə, g(f) = f^w$, ...

verb root   S2   k ə f ə d

output   S0   k ə f̰̂ʷ ə d

affix   S1   [round]$_{masc}$

McCarthy and Prince 1995: 370 have proposed that "only segments stand in correspondence." This statement is too strong however, as they themselves note, because it remains necessary to monitor the fate of input floating features as well. I submit that a floating feature, or subsegment, corresponds to *the highest melodic element that contains it in S_0*. Therefore, where input subsegments have docked onto a full segment in the output, the correspondence relation returns the output segment which hosts the feature, not the feature itself.[3] For example, (14) shows the correspondence relation between an input floating feature affix and the output stem. Here $g([round]_{masc})=[f^w]$.

---

[3]   This is input/output correspondence. McCarthy and Prince 1995:266 propose alternatively a kind of output/output correspondence for autosegmental linking, shown below. There the relation $g(\alpha)$ is not identity, but rather establishes linking and returns a host for every dependent feature. The input/output correspondence I use is crucial for evaluating faithfulness with respect to floating features, since we want to know whether or not they make it into the output at all. It remains to be seen whether the McCarthy and Prince 1995 extension of correspondence is necessary as well.

   $g([round])=k$ (S_1 = output labial tier, S_0 = output root tier)

(14)   Input *subsegment* corresponds to output *segment* which contains it

S_1-S_0 correspondents: (S_0 = stem [output] , S_1 = affix, S_2 = root)

$g([round]_{masc})=f^w$

verb root   S2   k ǝ f ǝ d

output   S0   k ǝ f̰ᵂ ǝ d

affix   S1 $[round]_{masc}$

If as I have suggested an input floating feature corresponds to the highest melodic element that contains it, then in cases where a subsegment persists as an independent element on the surface its output correspondent will be the subsegment itself. Tonal downstep, for example, is often represented by a floating low tone prececeding a high (following Leben 1978, Hyman 1979)[4] as (15) illustrates.

(15)   Persistence of a floating feature in output: subsegments correspond

á…ꞌá
S0 | |
        H (L) H

S1   H L H

In Aghem, for instance, a Western Grassfields Bantu language spoken in Cameroon, the demonstrative suffix *kín* (class 7) appears with a high tone following some

---

S0   nǝk ǝs
            |
S1   [round]

[4] See Hyman 1993 and Inkelas 1987 for an account of downstep without a floating feature in the surface form.

high tone nouns (16a) but with downstep following some others (16b). As shown in (17), Hyman 1987 posits a free L as part of the tone melody of the downstep-triggering nouns to account for this.

(16)   Downstep in Aghem   (Hyman 1987)

a.   fú + kín   'this rat'

b.   bɛ́ + ˈkín   'this fufu'

(17)   Representation of downstep[5]

                  no downstep: *downstep:*

S_j - f u + k ɨ n   - b ɛ + k ɨ n
                     H_1 H_2 H_1L H_2

S_0 - f u + k ɨ n   - b ɛ + k ɨ n
                     H_1 H_2 H_1L H_2

                       fúkín   bɛ́ ˈkín

     If we represent downstep in this way, the L which triggers the downstep must be included in S_0, but no segment dominates it there. In this case the correspondence relation must return the subsegment itself, since this is the largest melodic element of which L is a part (18).

---

[5] The tone melody of the suffix is actually HL as well, as evidenced by the fact that it likewise triggers downstep on the following morpheme, for example in *fú kín ˈkɔ* 'this rat'   (Hyman 1987: 213).

(18)   Correspondents of tonal subsegments in *bɛ́ ˈkɨ́n*

g(L) = L g(H$_1$) = ɛ́ g(H$_2$) = ɨ́

Correspondence is often notated as shown in (19), with **R** as a shorthand for the relationship which links x and y. In (19c) for example, *f **R**f*ʷ means that *f*ʷ is the value returned by g(f); or in other words *f*ʷ is "the image of" *f* in S$_0$.

(19)   If g(x) = y then x**R**y   'x corresponds to y'

a. g(k)=k   k**R**k

b. g(ə) = ə   ə**R**ə

c. g(f) = fʷ   f **R**fʷ

d. g([round]$_{masc}$)=fʷ   [round]$_{masc}$**R** fʷ

e. g(L) = L   L**R**L

       etc.

Correspondence constraints refer to a phonological element and impose conditions on it and its correspondent(s). The faithfulness constraint MAX(SEG) can now be formally stated as the correspondence constraint in (20).

(20)   **MAX (SEG)**   Every *segment* in S$_j$ has a correspondent in S$_0$
        (McCarthy and Prince 1995)

        ∀x ((Segment(x) ∧ S$_j$(x))→ ∃y(S$_0$(y) ∧ x**R**y))

The tableau in (21) illustrates in detail some violations of MAX(SEG). Corresponding elements here are those dictated by the common sense procedure sketched above, by which segments more or less identical with respect to position and quality

correspond. Candidate (21b) violates MAX(SEG) once because its final consonant has been deleted. Candidate (21c) fares even worse since it has two breaches of the constraint. With respect to this constraint (21a) is optimal, since every segment in the input (S_2 and S_1) does have a correspondent in the output (S_0).

(21)

		Candidates	MAX (SEG)	*Comments*
a. ☞		S2 k ə f ə d S0 k ə f̫ʷ ə d S1 [round]$_{masc}$		
b.		S2 k ə f ə d S0 k ə f̫ʷ ə S1 [round]$_{masc}$	*!	*d* lacks a correspondent in the output (S_0)
c.		S2 k ə f ə d S0 k ə f̫ʷ S1 [round]$_{masc}$	**!	*ə, d* lack correspondents in the output (S_0)

The MAX(SEG) constraint can say nothing about the correspondence between the input floating *[round]* and anything in the output, however, since *[round]* is not associated with an input segment. I offer the correspondence constraint in (22), MAX (SUBSEG), to handle these cases.

(22)   MAX (SUBSEG)   Every *subsegment* in S_j has a correspondent in S_0

$\forall$x (Subsegment (x) $\wedge$ S_j(x))$\rightarrow$ $\exists$y(S_0(y) $\wedge$ x*R*y))

Before illustrating the operation of MAX (SUBSEG) it is necessary to define *subsegment*. (23) provides a working definition. In feature geometric terms, a full segment consists of a root node and the F-elements it dominates, where F-elements include class nodes and features (Archangeli and Pulleyblank 1995). A subsegment, therefore, is an undominated F-element. Some examples are given in (24). Note that F-elements joined in a single hierarchy (such as Place dominating coronal dominating anterior) constitute a single subsegment. Conversely, unrelated F-elements (such as floating PLACE and floating LARYNGEAL nodes) are considered to be independent subsegments.

(23)   **SUBSEGMENT**: an undominated F-element

(i)   Floating Class nodes

(ii)   Floating features

(24)

<u>Segment</u>   <u>Subsegments</u>

Root   Place   **Lar**   [nas]   High Tone
features   [cor]   [spread glotti
                                          [-anterior]
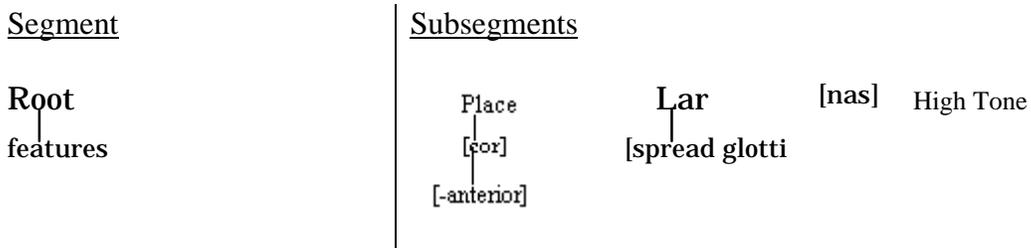
The operation of MAX (SUBSEG) is illustrated by the tableau in (25). Recall that an input subsegment corresponds to the highest melodic element that contains it in S_0, where

a root node constitutes the topmost node of a melodic tree. Candidate (25a) satisfies the constraint because the floating *[round]* is parsed in the output. In other words, input *[round]* does have a corresponding segment in S_0. On the other hand no consonant in (25b) has been rounded, and so the constraint assesses one mark for this form. MAX (SUBSEG) is not violated by candidate (25c) because, although the value of continuant has changed from plus to minus on the final segment, continuant is not an independent element in the input but rather is part of a full segment and is not subject to MAX(SUBSEG).

(25)

		MAX (SUBSEG)	Comments
a.☞	S2 k ə f ə d [-cont] S0 k əf̣ʷə d [-cont] S1 [round]masc		*f ʷ* corresponds to *[round]masc*
b.	S2 k ə f ə d [-cont] S0 k ə f ə d [-cont] S1 [round]masc	*!	*[round]masc has no output correspondent*
c.	S2 k ə f ə d [-cont] S0 k əf̣ʷə z [+∞nt] S1 [round]masc		*feature changing is not a violation of* *MAX (SUBSEG)*

Henceforth to save space I will often show only the output stem, S_0, with the material that corresponds to the affix in larger bold type. The previous tableau in its condensed form is as in (26).

(26)   *from* / kəfəd, [round]/

		MAX (SUBSEG)	Comments
a.	kə**fʷ**əd		*fʷ* corresponds to *[round]$_{masc}$* in output
b.	kəfəd	*!	*[round]$_{masc}$ has no output correspondent*
c.	kə**fʷ**əz		*feature changing (d→z) is not a violation of* MAX(SUBSEG)

Obviously the grammar requires a constraint which will punish the kind of feature changing shown in (26c). McCarthy and Prince 1995 propose IDENT(F) to take care of this problem (27).

(27)   IDENT(F)   (McCarthy and Prince 1995: 370)

Correspondent segments have identical values for the feature F.

If x and y are segments and x is [γF] and x*R*y then y is [γF]

This constraint is violated by (28c) below because *g*(d)=z, but while *d* is [-continuant] *z* has the value [+continuant]. Note that IDENT(F) is not violated by non-parsing of the subsegment *[round]* since *[round]* is not a segment in Sj (28b).[6]

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[6] In principle one could include an Ident constraint for subsegments, but I have not found it to be violated.

(28)   *from* / kəfəd, [round]/

		MAX (SUBSEG)	IDENT(F)
a.☞	kə**fʷ**əd		*
b.	kəfəd	*!	
c.	kə**fʷ**ə<u>z</u>		**!

Finally, I follow the proposal of Orgun 1995 and 1996 in assessing violations of IDENT(F) only in cases of absent or differing specifications, but not when the output correspondent is more specified than the input.[7] Thus f^w is not a violation of IDENT(F) despite its added vocalic off-glide, since its underlying feature specifications remain intact.

Together these three constraints yield a two-part theory of input/output faithfulness (29). MAX and IDENT determine respectively (i) whether all input melodic projections have correspondents in the output and (ii) whether input segments are identical to their output correspondents.[8] The main difference between the original McCarthy and Prince 1995 proposal (and that of Orgun 1995 and 1996) and the one presented here is the addition of a constraint which evaluates faithfulness with respect to floating features, MAX (SUBSEG).

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[7] The constraint in Orgun 1995 and 1996 is called MATCH.

[8] Along the same lines Orgun 1995 and 1996 proposes the constraint CORR in addition to MATCH. CORR does essentially the same work as MAX, dictating that an element in the input must have a correspondent in the output.

(29)   Two-part input/output faithfulness:

a.   Does every input projection have an output correspondent?
        (MAX(SEG), MAX (SUBSEG))

b.   Are input segments and their output correspondents identical?
        (IDENT(FEATURE))

The need for correspondence between features has been demonstrated elsewhere (see for example Orgun 1995, Ringen and Vago 1996, Lombardi 1995), but the proposed constraint in (22), MAX (SUBSEG), is the first to discriminate between floating features and those which are dominated by a segment.[9] This distinction proves extremely useful in resolving potential conflict between the two types. For example, some prefixes in Mixteco consist only of a floating high tone (Tranel 1995: from Pike 1944, 1948). The full range of lexical tone patterns of bare and prefixed words is shown schematically in (30), where it is assumed that mid tone is unspecified.[10] When the H prefix associates it displaces the lexical tone, yielding the pattern in the third column.

(30)   General patterns from association of floating H affix
        (Tranel 1995: 5)

	lexical tone	surface	plus affixal **H**
a.	HH	HH	**H**H
b.	HØ	HM	**H**M
c.	HL	HL	**H**L
d.	ØØ	MM	**H**M
e.	LH	LH	**H**H
f.	LØ	LM	**H**M
g.	ØH	MH	M**H**
h.	ØL	ML	M**H**

---

[9] Carleton and Myers 1994 provide an analysis of tone association which does make use of this distinction.

[10] There is no lexical LL pattern. The whole range of patterns are discussed more fully in Chapter 4.

Pattern (30f) provides the clearest illustration of this displacement. For reasons discussed by Tranel 1995a/b[11] H tone docks onto the first vowel of an LM word such as *kìku* 'to sew'. (Mid-toned vowels are unmarked in the transcription.) By doing so it changes the tone value of the first vowel from low to high (31).

(31)   / kìku, H/   →   kíku   'child'   (Tranel 1995b:7)

root	S1	k ̀i k u
output	S0	k ́i k ʊ
affix	S2	H

MAX(SEG) alone does nothing for us here, since it does not evaluate correspondences between subsegmental units. Yet a general MAX(FEATURE) constraint that evaluates correspondence directly between features (suggested as an alternative by McCarthy and Prince 1994: fn8), cannot make the necessary distinctions between the vowel dominated L and the floating H tones (32).

(32)   **MAX(FEATURE)** 'Every input feature has a correspondent in the output'

$\forall x\ ((Feature\ (x)\ \wedge S_j\ (x)) \rightarrow \exists y(S_0(y) \wedge xRy))$

As shown by the tableau in (33), both candidates violate the constraint once, yielding an indeterminate result.

---

[11] See below, Chapter 4.

(33)   MAX(FEATURE) alone yields an indeterminate result

kíku *from* / kìku, H/

			MAX (FEATURE)	*comments*
a.	LM	kìku	*	*H has no output correspondent*
b.	HM	kíku	*	*L has no output correspondent*

To make a fair comparison we might supplement MAX(F) with IDENT(F), as shown in (34). This fares even worse, however, as it selects the wrong candidate no matter how the constraints are ranked with respect to each other. Since replacement of the lexical L violates both MAX(F) *and* IDENT(F), candidate (34a), which retains its the input specification of the first vowel, will prove optimal.

(34)   MAX(FEATURE) plus IDENT(FEATURE) yields wrong result[12]

kíku *from* / kìku, H/

			MAX (FEATURE)	IDENT(F)	*comments*
a. ♠	LM	*kìku	*		*H has no output correspondent*
b.	HM	kíku	*	*!	*L has no output correspondent* *First vowel not identical to input vowel*

---

[12]An alternative proposal might solve this problem by including constraints which refer explicitly to association lines. This likewise would get the wrong result in this case, as shown by the tableau below.

			MAX (FEATURE)	MAX(LINE)	*comments*
a. ♠	LM	*kìku	*		*H has no output correspondent*
b.	HM	kíku	*	*!	*L has no output correspondent* *Input association line not parsed*

Therefore dominated and undominated input features must be treated independently by the grammar. As the tableau in (31) illustrates, the lack of overlap between the domains of MAX (SUBSEG) and IDENT(FEATURE) make it possible to choose the correct output form.

(35)   kíku *from* / kìku, H/

			MAX (SUBSEG)	IDENT(F)	*comments*
a.	LM	kìku	*!		*H subsegment has no output correspondent*
b. ☞	HM	kíku		*!	*First vowel not identical to input vowel*

An alternative resolution of the conflict in Mixteco would be to break up Max(F) into a constraint family where each feature boasts its own constraint. As shown by the tableau in (36) if MAX(H) dominates MAX(L), for example, replacement of L by H on the first syllable of kìku will be optimal (36b). In this case IDENT(F) is superfluous.

(36)   kíku *from* / kìku, H/

			MAX (H)	MAX (L)	*comments*
a.	LM	kìku	*!		*H has no output correspondent*
b. ☞	HM	kíku		*!	*L has no output correspondent*

The two accounts make different predictions, however. The breakdown of MAX(F) predicts that with the ranking in (36) while a floating H will displace a lexical L a floating L tone will lose out to a lexical H. The MAX (SUBSEG) hypothesis, on the other

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hand, predicts no such feature specific asymmetry. Given the ranking in (35) it predicts a floating feature will knock off a lexical specification regardless of the feature values. Unfortunately Mixteco does not provide the necessary configurations to test this hypothesis. This question awaits further investigation.[13]

2.3 Formal Clarity and Multiple Violation

The last section outlined the structure of Optimality Theory and some basic principles of Faithfulness. In this section I would like to briefly address the formalism of the constraints themselves. One advantage of SPE-style rules is the explicitness of the rule format. Such formal clarity is often absent from constraints in the Optimality Theory literature. In particular, it is sometimes the case that the mode of evaluation (gradient or binary) of a constraint does not follow from the statement of the constraint or the statement of the constraint does not evaluate the structure in the way an author intends.

The means to formal clarity are readily at hand, however, if we avail ourselves of the language of first order logic. Broadly, a constraint expresses a generalization about a string which may or may not be true. For example, NO-CODA (37), a typical binary constraint, consists of a statement, either true or false, about syllables. With respect to NO-CODA, the most harmonic candidate(s) in a set are those for which the statement in (37) is true.

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[13] Another possibility would be to use faithfulness constraints sensitive to morpheme affiliation, e.g. Max(Affix) and Max(Base) (see for example Ringen and Vago 1996, Padgett 1995, Urbanczyk 1995). Here Max(Affix) would outrank Max(Base). The data which will between all three hypotheses has yet to be assembled.

(37)   A Binary constraint: (Prince and Smolensky 1993:85)

NO-CODA   A syllable has no coda

First order logic provides an obvious means for elucidating the operation of a

binary constraint. I propose that all binary constraints be rendered as in (38), where φ

stands for the substance of the constraint itself, the statement to be judged either true or

false.

(38) $\forall x(\varphi)$

NO-CODA, for example, is easily stated in this manner (39). A Tagalog form from

Chapter 1 is shown in (40) with varying degrees of infixation. Candidates (40a-40b) both

violate the constraint since each contains at least one syllable closed by a coda.

(39) **NO-CODA**   'A syllable has no coda'

$\forall x$(Syllable $(x) \rightarrow x$ has no coda)

(40)   NO-CODA   *from* {um, sulat}$_{stem}$ $\rightarrow$ sumulat   'write'

	Candidates	NO-CODA	
a.	u<u>m</u>-sula<u>t</u>	*	*some syllable has a coda*
b.	s-um-ula<u>t</u>	*	*some syllable has a coda*

As it stands NO-CODA cannot differentiate between these two candidates despite

the fact that each carries a different number of closed syllables. In practice, however, one

intends NO-CODA to look at each syllable node in a string and mark each closed syllable

it finds. To make the assessment of multiple violations explicit, then, (38) must be supplemented with a statement dictating that *each falsifying instance of x*, in this case each syllable that ends in a consonant, merits an asterisk. Thus violations do not simply reflect the truth or falsity of the statement of the constraint but indicate *how many* values of the variable in the string will falsify it. For a binary constraint to generate more than one asterisk a two part assertion is necessary, as shown in (41). The first is the familiar true/false statement and the second dictates how to determine the number of marks in the tableau.

(41) (i) $\forall x(\varphi)$

    (ii) Assess one mark for each value of x for which (i) is false

The full NO-CODA constraint is now given in (42).

(42) **NO-CODA** 'A syllable has no coda'

    (i) $\forall x(\text{Syllable }(x) \rightarrow x \text{ has no coda})$

    (ii) Assess one mark for each value of x for which (i) is false

The tableau in (43) reflects that more closed syllables in a string result in a more serious transgression, indicated by one mark for each syllable that renders the constraint false.

(43)   NO-CODA   *from* {um, sulat}$_{stem}$

	Candidates	NO-CODA	
a.	u<u>m</u>-sula<u>t</u>	**!	*The first and last syllables have codas*
b.☞	s-um-ula<u>t</u>	*	*The last syllable has a coda*

The schema in (41) thus allows us to articulate precisely the reckoning of multiple violations, and in doing so clarifies formally the operation of individual constraints. Of course, if all constraints take the form in (41) then the second clause simply constitutes a general strategy for the calculation of multiple violations. Its inclusion in individual constraints serves the practical purpose of enforcing a degree of formal rigor.[14]

2.4 Constraints vs. rules: a demonstration

In this section I analyze the tone patterns of Kukuya (Paulian 1975, Hyman 1987) in order to contrast an Optimality Theory analysis with a typical rule based approach. Many of the issues raised in this section will set the stage for discussion in subsequent chapters.

2.4.1 Kukuya tone melodies

Consider tone association in Kukuya (Paulian 1975, Hyman 1987, Archangeli and Pulleyblank 1995) (44). Kukuya exhibits five different underlying stem melodies (Paulian 1975, Hyman 1987). A simple one-to-one relationship prevails between tones and TBUs

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[14] If categorical (non-multiply violable) binary constraints prove necessary, the addition of the assessment clause may be considered one option in formulating constraints. Sharon Inkelas (p.c.) has pointed out that in a system of cophonologies such as the one proposed by Itô and Mester 1995, different cophonologies might be distinguished by whether particular constraints had the extra assessment clause or not. For example, a cophonology with the plain NO-CODA statement from (42) would ban all codas from that part of the vocabulary, while in another part of the vocabulary the addition of the assessment clause would only

(moras) when the number of tones matches the number of moras. Cases of mismatch, however, require some explanation. First, where the number of tones exceeds the number of tone bearing units (TBUs), contour tones arise on the final syllable. In principle any syllable in the word could claim the contour tone, but in Kukuya contour tones fall only on the last syllable.

(44)   Kukuya tone melodies(Hyman 1987: 313-314)

melody	monomoraic stem	bimoraic stem	trimoraic stem
L	L	LL	LLL
	bà	bàlà	bàlàgà
	'grasshopper killer'	'to build'	'to change route'
H	H	H	HHH
	bá	bágá	bálágá
	'oil palms'	'show knives'	'fence'
HL	HL	HL	HLL
	ka	kárà	káràgà
	'to pick'	'paralytic'	'to be entangled'
LH	LH	LH	LLH
	sa	sàmí	mʷàrəgí
	'weaving knot'	'conversation'	'younger brother'
LHL	LHL	LHL	LHL
	bvî	pàli	kàləgì
	'falls'	'goes out'	'turns around'

Second, where the number of TBUs exceeds the number of vowels, one tone must spread to the otherwise toneless vowels. As Hyman 1987 shows, Kukuya exhibits an interesting asymmetry in this regard (45). In a trimoraic word, the underlying HL pattern seems to associate tones and TBUs consecutively from the left. When the tones run out,

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minimize codas but not ban them outright. Itô and Mester achieve these sorts of differences through

the *final* tone spreads to the end of the word (HLL). In contrast, LH manifests what Yip 1988 describes as "edge-in association." The underlying L tone links to the first syllable as expected, but the H tone leaps directly to the final vowel. Here either spread of the *initial* L tone or the insertion of default L must fill the lacuna in the middle (LLH).

(45)

	"left to right"	*"edge-in"*
/HL/→	HLL	*HHL
	káràgà	*kárágà
/LH/→	*LHH	LLH
	*mʷàrə́gí	mʷàrə̀gí

This wrinkle of tone association is not limited to Kukuya. Mende, for example, exhibits the same kind of asymmetry when a toneless suffix such as the postposition *-ma* attaches to disyllabic nouns (46) (Leben 1978). When the affix follows an HL noun the overall tone pattern of the word is the left-to-right HLL (36a). For most LH nouns, on the other hand we find the edge-in pattern LLH (36b). There are a few words, shown in (46c), where the H spreads, yielding LHH. Leben 1978: 196 bemoans the fact that "unfortunately the [pattern in (b)] comprises the vast majority of LH nouns." In the next section I will propose an analysis which correctly favors (46b) over (46c) in the unmarked case.

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reranking.

(46)   Spreading asymmetries in Mende   (Leben 1978)

a.   HL-Ø→HLL   /ngílà-ma/   ngílàmà   'dog'

b.   LH-Ø→LLH   /fàndé-ma/   fàndèmá   'cotton'

c.   LH-Ø→LHH   /nàvó-ma/   nàvómá   'money'

2.4.2 Rule based account of Kukuya

Hyman and Paulian consider tone melodies to be underlyingly independent of the

segments that bear them since only the surface tone patterns in (44) occur. If each TBU

had an underlying tone associated with it, the number of expected surface patterns would

increase dramatically. Hyman 1987 applies Goldsmith's 1976 association conventions

(47) to derive the patterns in (44).

(47)   Rules of association   (Hyman 1987: 315 from Goldsmith 1976)

        In a left-to-right-fashion,

a.   assign each tone to each TBU in a one-to-one fashion;

b.   If there are more TBUs than tones, extend the association of the last tone onto the

        remaining TBU(s);

c.   If there are more tones than TBUs assign the remaining tone(s) to the rightmost

        TBU

These are efficacious for all but the edge-in pattern from underlying LH, because

they predict, as shown in (48), that LH will become LHH on a trimoraic form.

(48)

| *input:* | karaga | mwarəgɪ |
| | HL | LH |

LINK   karaga   mwarəgɪ
            \ | / |
             H L   L   H

SPREAD karaga   mwarəgɪ
            | |/   /   V
             H L   L   H

| *output:* | káràgà (HLL) | *mʷàrə́gí | (*LHH) |
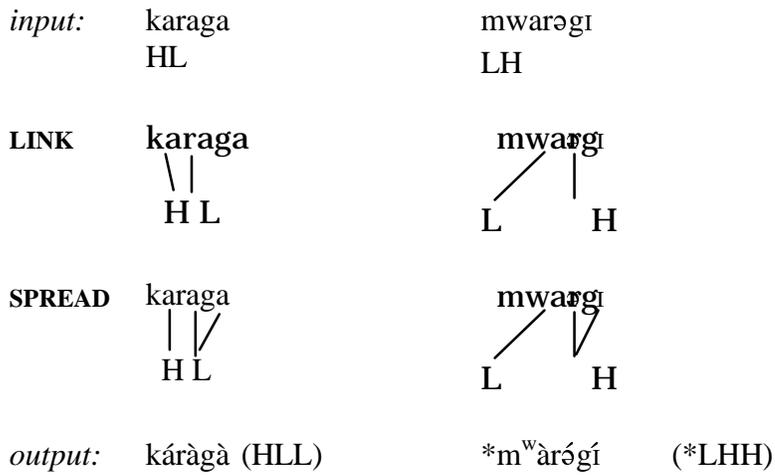
At least two possible remedies exist. The first, adopted by Hyman, is to introduce a clean-up rule, L-spread (49), which turns *LHH into LLH by spreading L to the second TBU with consequent delinking of H. This delinking is an instance of what Hyman and Schuh 1974 call *Tone Absorption*, a process which functions cross-linguistically to simplify contours, particularly word-internally. When applied to the outcome of the association conventions it will derive the correct result, as shown in (50).

(49)   L-spreading rule   (Hyman 1987: 316)

      x x x→ **x x x**   **(x=mo**
        \   V | ⊀/
         L   H   L   H
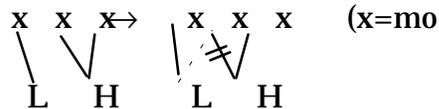
(50)

input:	karaga HL	mwarəgɪ LH

LINK karaga
　　　　\ |
　　　　H L

　　　　mwarəgɪ
　　　　／ │
　　　　L　　H

SPREAD karaga
　　　　　│ |/
　　　　　H L

　　　　　mwarəgɪ
　　　　　／ |/
　　　　　L　　H

L-SPREAD —

　　　　　mwarəgɪ
　　　　　／⫽
　　　　　L　　H

output:　káràgà (HLL)　　mʷàrəgɪ́　(LLH)

　　　This account leaves two crucial questions unanswered however. First, why does the L-spreading rule in (49) entail simplification of the contour tone it creates on the middle vowel? More generally, why is word internal tone absorption so common? That H delinks here suggests that there is more to the restriction of contour tones to final syllables than simply the fact that tones are associating from left to right. Secondly, the L-spreading rule, while effective, is somewhat arbitrary in character. It derives the correct output, but sheds no light on why it is LH rather than HL which exhibits the so-called edge-in pattern. I believe these two questions are not unrelated and will return to them in the next section.

　　　Hyman 1987 derives the unexpected outcome from underlying LH on a trimoraic word through application of the well-formedness conventions *followed* by the clean-up rule in (45). Archangeli and Pulleyblank 1995, adopting the proposal of Leben 1978: 200

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for the similar pattern in Mende, take the other possible route; namely, they pre-empt the association conventions with the H association rule in (51), which I refer to as Final H.[15] This rule applies first and associates a melody final high tone to the final TBU. From underlying HL this rule has the effect shown in (51) for mono-, bi- and tri-moraic roots. It does not apply to the underlying HL melody since the H is not final.

(51)   **Final H**: Associate melody final H to final tone bearing unit

input:	sa	sami	mwarəgɪ	‖ karaga
	LH	LH	LH	HL

Final H	s a	sami	mwaɾgɪ	‖ --
	LH	L H	L H	

Once Final H has applied Goldsmith's association conventions operate to link the remaining tones and TBUs in the normal fashion as shown in (52). In *mʷàrɣ̀gí* , the essentially pre-associated H tone is paralyzed at the edge, so the low tone spreads automatically, deriving LLH. In *káràgà*, both tones are free, and hence the output (HLL) follows directly from the association conventions.

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[15] This is the exact rule given by Archangeli and Pulleyblank 1995:

Kukuya Final H association

		Default	Nondefault
Parameters	Relation	INSERT	
	Type	PATH	
	Direction		RIGHT TO LEFT
	Iteration		NONITERATIVE
Structure Requirements	A-Structure	NONE	
	T-Structure	FREE	
Other Requirements	A-conditions		
	T-Conditions		

(52)   Sample derivations

input: sa   sami   mwarəgɪ   karaga

         LH   LH   LH   HL

Final H   s a   sami   mwarəgɪ
         |
         LH   L   H   L   H

Link   s a   sami   mwarəgɪ   karaga
         /|
         LH   L   H   L   H   H L

Spread   —   —   mwarəgɪ   karaga
                                   L H   H L

output: sa   sàmí   mʷàrəgí   káràgà

Although the Archangeli and Pulleyblank 1995 analysis avoids directly raising the issue of the absence of word-internal contour tones, Final H (51) has the same arbitrary quality as did Hyman 1987's L-spread rule. However, Paulian 1975 proposes a similar association algorithm to account for the spreading asymmetry that does follow from more general properties of the language. In particular, tonal and independent segmental evidence (summarized in Hyman 1987) indicate that the first and last syllables of a stem are "accented". The tones of the LH and HL melodies, therefore, attracted to the accented syllables, link to the first and third TBUs (53). In both cases, the middle syllable receives default L. The fact that the middle vowel of CVCVCV stems often reduces or deletes supports Paulian's contention that the middle syllable is weak compared to those on the

periphery (Larry Hyman, pc). As we will see below, the analysis of Mende by Leben 1978 likewise accounts for the edge-in pattern by attracting H to a strong (accented) syllable.

(53)   Paulian analysis illustrated

input: mwarəgɪ   karaga
                            LH   HL

Tone to Accent   mwarəgɪ   karaga
                            ╱   │   │ │
                            L   H   H   L

Default L   mwarəgɪ   karaga
                            ╱ ┆ │   │ ┆ │
                            L   L H   H L L

output: mʷàrəgɪ́   káràgà

In the following section I propose a unified explanation in Optimality Theory for both the finality of contour tones and for the asymmetric spreading by drawing on Leben and Paulian's proposals with respect to strong and weak positions. In particular, I argue that both patterns follow from a licensing condition that optimizes the association of marked tones (contour tones and H tones as opposed to L) with strong positions. The relationship between these two patterns cannot be directly incorporated into standard rule based analyses like those above, largely because the solution which relates the two relies crucially on constraint violability, and as such provides support for the Optimality Theoretic view of phonology.

2.5 Proposal in Optimality Theory

2.5.1 Basic association

Consider first association in mono-moraic forms where the number of tones exceeds the number of tone bearing units. From the input /sa, LH/, GEN produces a variety of reasonable candidates. The candidates in (54) represent the four possibilities of tone association given one vowel and two underlying tones. In (54a), both tones are linked, in (54b) only H associates to the vowel, in (54c) only L links, and in (54d) the output stem is toneless.

(54) e.g., GEN (sa, LH) =

a. (actual output) LH sa

b. H sa *L not in ouput*

c. L sa *H not in ouput*

d. Ø sa *L, H not in ouput*

The survival of both tones on a single vowel (54a) reflects the importance of the faithfulness constraint MAX (SUBSEG) (55).

(55) 'Every tone has a TBU'

MAX (SUBSEG) Every subsegment of Sj has a correspondent in S_0

(i) $\forall x (S_j (x) \wedge \text{Subsegment} (x) \rightarrow \exists y(S_0(y) \wedge xRy))$

(ii) Assess one mark for each value of x for which (i) is false

As the tableau in (56) shows, a shortage of TBUs forces either deletion of extra underlying tones, violating MAX (SUBSEG) (56b-d) or the association of multiple tones to a single TBU. MAX (SUBSEG) favors the form in (56a) with the contour tone.

(56)   /sa, LH/ → sa

		Candidates	MAX (SUBSEG)	
a. ☞	LH	sa		*LH is complex*
b.	H	sa	*!	*L not in ouput*
c.	L	sa	*!	*H not in ouput*
d.	Ø	sa	**!	*L, H not in ouput*

A second constraint, SPEC(Tone), gives us the second clause of the Goldsmith's 1976 Well-Formedness condition, by dictating that every vowel be specified for tone (57).

(57)   SPEC(Tone)   'Every TBU has a tone'   (after Prince and Smolensky 1993)

   (i)   ∀x(TBU (x)→ x is specified for tone)

   (ii)   Assess one mark for each value of x for which (i) is false

From /sami, LH/, where the number of tones matches the number of vowels, the optimal output distributes the tones to both syllables (58a). These two constraints together yield one-to-one association where the number of tones equal the number of tone bearing units.

(58)   *from* /sami, LH/

		Candidates	MAX (SUBSEG)	SPEC(TONE)	
a. ☞	LH	sàmí			
b.	Ø LH	sami		*!	*1st syllable unspecified*

2.5.2 Contour Licensing

The constraints in the previous section account for both one-to-one association and for the fact that multiple tones may associate to a single TBU in Kukuya. Yet why are contour tones found only on the final syllable? Hyman 1987 takes this as evidence for left to right linking, but the analysis in the previous section does not appeal to directional association. In fact, a superior account of contour placement is available which does not require serial linking from left to right.

Clark 1983 argues that contour placement is not simply an artifact of directional association, but results rather from a special affinity between contour tones and final syllables. Compare two potentially contour forming processes in Ohuhu Igbo (59-60). The first links a floating low tone to the final syllable of the subject in an affirmative statement (59), creating a HL contour at the end of a word, here on *ékwê* (Clark 1983: 47).

(59)   Ohuhu Igbo Affirmative L-linking   (Clark 1983: 47)

ékwé mèchìrì ányá → ékwê mèchìrì ányá
 H (L) L   H   H (L)   L   H
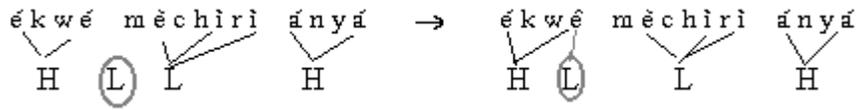
'Ekwe shut his eyes'

Clark contrasts the operation in (60) with three other processes that potentially create contours word-internally. In negative relative constructions, for example, a verb initial H tone spreads one syllable to the right (Clark 1983: 45), delinking the tone it finds there (60). (61) provides some data.

(60)   **Relative Clause H tone spread and contour simplification**

V....V.....V
| |
H   T
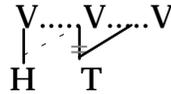
(61)

		Main Clause	Relative Clause	
a.	**H stem verb**	ém'échígí	éméch'ígí	'didn't shut'
b.	**L stem verb**	éwèlàghɪ̀	éwélàghɪ̀	'didn't take home'
c.	**HL stem verb**	át'úbhàghɪ̀	átúbhàghɪ̀	'didn't throw in'

The presence of downstep on the second syllable in (61a) and (61c) indicates the delinking of L which results from contour prevention. (62) illustrates the avoidance of a word-internal contour tone for the L stem. Spreading of a high tone onto a low toned syllable potentially produces a falling tone. Yet while word final syllables tolerate contour

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tones word internal syllables do not. Here delinking of the L tone from the second syllable avoids the potential HL .

(62)   L stem verbs

Main Clause   Relative Clause

L stem   éwèlàghǐ   éwélàghǐ   *éwèlàgh

          H L   H L   L HL
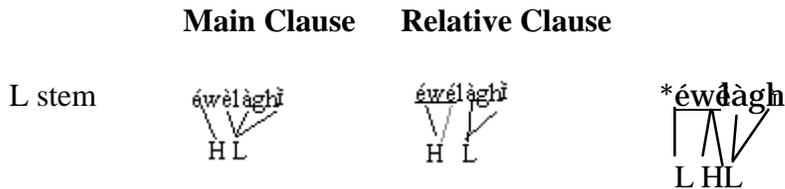
Clark 1983 proposes extrametricality of the final tone to account for the restriction of contour tones to final position (63). The purpose of the extrametricality feature [+ex] (Nanni 1977, Hayes 1982) is to render the final tone invisible to a well-formedness condition, in this case one which dictates one tone per vowel. Since extrametricality has a peripherality condition (Harris 1983) an extra tone can lurk only on the final vowel.

(63)   ékwe

                    ékwe

                    H   L
                        [+ex]
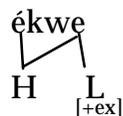
This analysis wrongly predicts, however, that languages which restrict contours to final syllables will possess a surprising gap in surface tone patterns. As shown schematically in (64), with final tone extrametricality an underlying HL melody will always produce surface H HL (not HL) on disyllabic forms. If every vowel must be associated to a tone, non-contour vowels will seem toneless under extrametricality and the penultimate tone should spread to the final vowel.

(64)   Spreading triggered by extrametricality   (*HL→ HHL)

With extrametricality final V appears toneless   *so*   H spreads to confer visible tone on final V

*V⌒...V   →   V⌒...V
 | | ⌐‾‾|
 H   L   H   L
        [+ex]   [+ex]

I propose instead that this restriction on the placement of a contour tone follows from the operation of a licensing condition which licenses syllables with marked tone only word finally.[16] (65) gives a first approximation of this constraint.

(65)   **Licensing condition**: a marked TBU is in the last syllable

A scale such as the one in (66) expresses the relative markedness of simple and contour tones. "TBU/contour tone" indicates the configuration where the TBU dominates a branching tone [or its equivalent], and the configuration "TBU/simple" one where the dominated tone is non-branching. [17]

(66)   **Tone Unmarkedness: Harmony Scale**.   [most marked to least marked]

TBU/contour tone   >   TBU/simple tone

μ   μ   μ   μ
/\   /\ | |
H L L H   H   L

---

[16] See Brasington 1982, Foley 1977, Hooper 1976, Venneman 1972, Itô 1988, Goldsmith 1990, Itô and Mester 1993, Steriade 1995 for discussion of importance of positional restrictions such as these in phonology.

[17] I leave aside here the possibility of *a contour tone units,* e.g., in Chinese, whichYip 1989 argues to be a simple tone. (see Duanmu 1994 for a different take on CTUs).

The harmony scale in (66) is consistent with the standard criteria for determining relative markedness shown in (67). As we have seen, contour tones do not occur freely, but rather may be restricted to a final syllable (67a). Furthermore, contour tones neutralize to simple ones (67b). Not surprisingly neutralization in the opposite direction has not been found in African style tone languages.

(67)   Markedness criteria:

a. **Restricted distribution** of marked structure

b. **Neutralization**: marked neutralizes to unmarked in weak positions

c. **Assimilation**: unmarked is target

d. **Default insertion**: unmarked is inserted

The evidence indicates that there are finer gradations to be made among simple tones as well. Cross-linguistically, in situations where a toneless vowel requires default fill-in, the grammar provides a simple tone, and in particular in a two tone system it will be a *low tone*. In Tiv, for instance, Pulleyblank 1986: 68-69 demonstrates default L tone insertion in the general past form of the verb (68).

(68)   General Past in Tiv   (Pulleyblank 1986: 68)

	H-stem		*L-stem*	
1 syllable	ˈH	ˈvá *came*	L	dzà *went*
2 syllable	ˈHL	ˈúngwà *heard*	LL	vèndè *refused*
3 syllable	ˈHLL	ˈyévèsè *fled*	LLL	ngòhòrò *accepted*

Pulleyblank's analysis is sketched in (69) for a trisyllabic high toned verb. A floating low tone prefix marks the General Past form of the verb. Here the lexical H is associated to the first vowel. L has nowhere to link, and remains floating, creating downstep on the initial syllable. The remaining vowels are assigned low tone by default.

(69)   Tiv
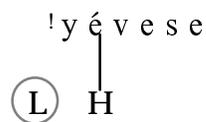
General Past . . .   **plus default L insertion**
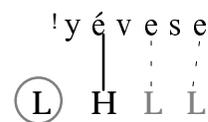
The resulting harmony scale, indicating that L is less marked than H, is given in (70).

(70)   **Tone Unmarkedness: Harmony Scale II**.
        [most marked to least marked]

        TBU/contour tone > TBU/H > TBU/L

This scale forms the basis for the parametrized constraint hierarchy à la Kiparsky 1994 and Smolensky 1995 shown in (71).[18] Because the harmony scale is universal, the

---

[18]These licensing constraints are stated more formally below. This formalism is motivated in Chapter 4. Each constraint asserts that a TBU which dominates a tone *Z* belongs to the final syllable of a word. The specific identity of *Z* constitutes the parameter to be filled in by the values of the universal tone markedness hierarchy in (42).

Licence (Z) $\forall x((TBU/Z(x) \rightarrow$ Coincide (x, final σ))

License (contour) $\forall x((TBU/contour(x) \rightarrow$ Coincide (x, final σ))
License (H) $\forall x((TBU/H(x) \rightarrow$ Coincide(x, final σ))

relative ranking of these constraints is fixed. This captures the generalization that more marked tones will require licensing in contexts where the less marked tones do not.

(71)   License(TBU/contour tone) » License(TBU/H) » License(TBU/L)

Licensing sanctions contours only at the right edge. Returning now to Kukuya, compare the rival forms in the tableau in (72). (72a) is optimal because the marked contour tone is licensed there on the final syllable, whereas it is not licensed in (72b).

(72)   HLH → LHL   e.g.,   pàli   'goes out'   *from* /pali, HLH/

		Candidates	License (TBU/contour)	
a. ☞	LHL	pàli		contour syllable is final
b.	LHL	palì	*!	contour syllable is not final

Finally, the ranking of SPEC(Tone) and MAX (SUBSEG) over the LICENSE family of constraints guarantees one-to-one association whenever possible. In the tableau in (73), the optimal candidate (73a) violates LICENSE(H) but this is more harmonic than the alternatives, all of which leave some vowels devoid of tone.

License (L) $\forall x((TBU/L(x) \rightarrow Coincide(x, final \sigma))$

(73) HL → HL   kárà 'paralytic' *from* /kara, HL/

		Candidates	MAX (SUBSEG)	SPEC(Tone)	LICENSE (H)
a. ☞	HL	kárà			*
b.	LH Ø	kara		*!	
c.	Ø HL	kara		*!	
d.	LL	kàrà	*! (H)		

Thus the licensing contraints, in conjunction with MAX and SPEC, take over the role of directional rules in traditional autosegmental accounts with respect to basic one-to-one tone linkage and and the placement of contour tones.[19] From the partial rankings motivated above (74) we can construct the full hierarchy which governs Kukuya tone association (75). Notice that two clauses of Goldsmith 1976's WELL-FORMEDNESS CONDITION have re-appeared in the hierarchy in the form of MAX and SPEC. Although these constraints are unviolated in Kukuya, they are potentially violable constraints and thus should be able to account for patterns which were problematic for the original WFC (see Pulleyblank 1986, and more recently Hyman and Ngunga 1994).

(74) Partial Rankings

　　a.　LICENSE(contour) » LICENSE(H) » LICENSE(H)　　　　　(42)

　　b.　MAX (SUBSEG) , SPEC (TONE) » LICENSE (H)　　　　　(45)

---

[19] Beckman 1995 has likewise shown the role of licensing in accounting for some ostensibly directional effects in vowel harmony.

(75)   Full ranking

MAX (SUBSEG) , SPEC (TONE), LICENSE(contour) » LICENSE(H) » LICENSE(L)

2.5.3 Spreading asymmetry

The previous section demonstrated one way to replicate directional association in Optimality Theory. However, this constraint based account actually makes different predictions than a blindly directional rule-based analysis with respect to words where the number of TBUs exceeds the number of tones. In this section I show that the different behavior of LH and HL in trimoriac words follows automatically from the constraint hierarchy in (75).

Recall that an underlying LH melody exhibits "edge-in" association in Kukuya. The tableau in (76) illustrates that this result follows directly from the analysis. Because H is more marked than L, its licensing constraint ranks higher, securing H on the final syllable. L must link to satisfy the high ranking MAX, and then one of the two tones must spread to the leftover vowel. Since spread of H triggers a violation of the higher ranking LICENSE(H) constraint (76b), the optimal candidate (76a) surfaces as LLH.

(76)   LH → LLH   e.g.,   mʷàrə̀gí 'younger brother' from /mwarəgɪ, LH/

		Candidates	LICENSE (H)	LICENSE(L)	
a. ☞	LLH	mʷàrə̀gí		**	*gí* is final
b.	L<u>H</u>H	mʷàr<u>ə̀</u>gí	*!	*	*rə́* is not final

The same reasoning derives the strict Left-to-Right effect (HLL) from underlying HL (77). Assuming that association lines cannot cross, since every vowel needs a tone H must associate to the first syllable. Still, there is no incentive to spread H any further since this would increase the number of LICENCE(H) violations. The most harmonic candidate (77b) avoids the extra violations by double linking L.[20]

(77)   HL → HLL   e.g.,   káràgà 'to be entangled'   *from* /karaga, HL/

		Candidates	LICENSE (H)	LICENSE(L)	
a.	HHL	kárágà	**!		*ká, rá* are not final
b. ☞	HLL	káràgà	*	*	*ká* is not final

2.5.4 Summary of Kukuya

By formally incorporating the notion of licensing as a hierarchy of violable constraints this analysis relates the spreading asymmetries to the distribution of contour tones in Kukuya in a way which had heretofore been impossible. I will return again to this issue in Chapter 4.

2.5.5 A Note about Mende

As noted above, in derived words Mende exhibits the same spreading asymmetry as Kukuya. The data is repeated below in (78a-b). However in Mende additional patterns call for an analysis. First, a minority of suffixed disyllabic nouns with underlying LH

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[20] The other potential candidate *kàràgâ   (LLHL) must be ruled out by a constraint against contour tones (*Contour) which ranks above the licensing constraints but below MAX (SUBSEG).

surface as LHH rather than the LLH predicted by the Kukuya analysis (78c). In addition, in monomorphemic trisyllables both LLH and LHH are attested (79).

(78)   Disyllabic noun plus toneless suffix in Mende

a.   HL-Ø→HLL   /ngílà-ma/   ngílàmà   'dog'

b.   LH-Ø→LLH   /fàndé-ma/   fàndèmá   'cotton'   *(major pattern)*

c.   LH-Ø→LHH   /nàvó-ma/   nàvómá   'money'   *(minor pattern)*

(79)   Mende monomorphemic trisyllables (Leben 1978)

a. /LH/   <u>LHH</u>   ndàvúlá   'sling'   <u>LLH</u>   làsìmɔ́   'amulet'

b. /HL/   <u>HLL</u>   félàmà   'junction'   <u>HHL</u>[21] pétíkù   'spectacles'

I argued for Kukuya above that the final syllable of a word is a strong H attracting position. Leben 1978 proposes more generally a kind of lexical pitch accent in Mende where a nonfinal syllable may be accented (shown in (80) with an asterisk) and thus attract the high tone to it. Leben's account adapts straightforwardly to the Optimality Theoretic analysis proposed in the previous section, with the additional twist that a lexical accent must override the inherent strength of the final syllable, just as heavy syllables obscure the inherent prominence of an initial syllable in certain kinds of quantity sensitive unbounded stress systems.[22] In (80a), *nàvómá*, the accented syllable attracts the H tone which then spreads to the final syllable resulting in surface LHH. In unaccented words, on

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[21] There appear to be no native words with this pattern, but quite a few borrowed words exhibit it, including longer forms such as *pláimínísà* 'prime minister' (Will Leben (p.c.)). Leben 1978 analyzes these with penultimate accent.

[22] See Chapter 4

the other hand, the H tone defaults to the final syllable, which is strong, as in *fàndèmá*

(80b). We expect the default pattern in (80b) to occur more frequently and, as Leben

1978 lamented, it does.

(80)

        a. <u>Lexical Accent:</u>   b. <u>Default to final (strong) syllable</u>

          n a v o - m a   f a n d e - m a

              L H   L H
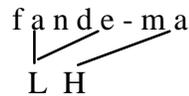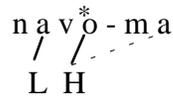
Thus the pattern in Mende provides additional support for the Kukuya analysis

proposed above Although this account does not resolve every issue in the complex

domain of tone association, it does cast fresh light on these topics providing an impetus

for further research.[23]

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[23] Pure Goldsmithian left to right association where there is no evidence of accent (for example as in Arabic *samam* type words (McCarthy 1979 and following)) reflects the domination of License(H) by higher ranking constraints which draw tone to the left. Adapting a McCarthy and Prince 1993a style analysis in light of Chapter 3 of this dissertation this can be accomplished by the constraint below, NO-INTERVENING(T-domain;L) which optimizes tone association toward the left edge by penalizing TBUs that intervene between the edge of the T-domain and the edge of the word. Roughly, a T-domain corresponds to the segmental substring to which a tone is associated. So in candidate (a) here for example the H-domain consists of the last syllable and in (b) it consists of the last two syllables. (SeeCole and Kisseberth for a somewhat different notion of domains.)

	/LH/		NO-INTERVENING(T-domain;L)	License(H)
a.	LLH	σσσ	**!	
b.☞	LHH	σσσ	*	*

Note that this still must be supplemented by the high ranking LICENSE(Contour) constraint or it will place all contour tones on initial syllables when the number of tones exceeds the number of TBUs.

	/LHL/		LICENCE(Contour)	NO-INTERVENING(T-domain;L)
a.☞	L HL	σσ		**
b.	LH L	σσ	*!	*

2.6 Conclusion

This chapter has outlined the basic principles of Optimality Theory, provided initial motivation for the use of Optimality Theory, and illustrated its potential for developing an adequate account of subsegmental phonology by capturing generalizations which previously either eluded observation or were impossible to formalize in traditional rule-based theories. In addition, this chapter introduced a number of formal proposals with respect to the application of Optimality Theory both in general and to subsegmental phonology in particular. Subsequent chapters build upon these fundamentals.

Parsing Below the Segment in a Constraint Based Framework

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5. LATENT SEGMENTS AND EXFIXATION

3. The general approach: simple cases and ALIGN

3.1 Align

As we saw in Chapter 1, both floating features and full segments may surface in a position removed from the edge. (1) presents another example of a fully segmental infix in Iloko. Like Tagalog, Iloko's *um-* affix appears inside the word in verbs that are consonant initial (1b).

(1)   Iloko *-um-* Infixation (Vanoverbergh 1955: 137)

(same phenomenon as Tagalog in McCarthy and Prince 1993a: 19)

	Root	-um-	PRESENT TENSE
a.	isem	um-ísem	*(threatens to) smile*
b.	kagat	k-um-agát	*(threatens to) bite*

Compare the Iloko affix *ag-*, PRESENT, in (2). The *ag-* prefix appears word initially no matter what form the verb takes. On both vowel-initial (2a) and consonant initial roots (2b), the affix always stays at the left edge of the word.

(2)   Compare to Iloko Prefix *ag-* (Vanoverbergh 1955)

	Root	**-ag-**	PRESENT	
a.	isem	ag-ísem	*(actually) smiles*	132
b.	kagat	ag-kagát	*(actually) bites*	137

Prince and Smolensky 1993 and McCarthy and Prince 1993a argue that infixes such as the Tagalog and Iloko *-um-* do not constitute a distinct third class of affixes.

Rather, they differ from fixed affixes only in that prosodic constraints outweigh the infix's own imperative to align with the left (or right) edge of the stem. In this case McCarthy and Prince 1993a propose that it is the interaction of the familiar NO-CODA constraint (3a) with an ALIGN constraint (3b) that determines the position of *um-*.

(3)   Constraints   (McCarthy and Prince 1993a: 20)

a.   **NO-CODA**   ∀x(Syllable (x)→x has no coda)

b.   **ALIGN-*um***   Left-Align (*um*, Stem) i.e., *-um-* is a prefix

c.   Ranking: NO-CODA »Align-*um*

       Rationale: Alignment will be violated to avoid additional coda violations

The complete definition of Generalized Alignment from McCarthy and Prince 1993a is given in (4). . The *Edge*(x) function (5) returns the segment which is initial or final in the string. ALIGN then demands coincidence of edgemost elements.

(4)   **Generalized Alignment**   (McCarthy and Prince 1993a: 2)

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

       ∀Cat1 ∃Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide

(5)   Definition of Edge   (McCarthy and Prince 1995)

       Edge(X,{L, R}) = the element standing at the *Edge* L, R of X.

The alignment constraint from McCarthy and Prince 1993a for *um-* infixation in Tagalog, illustrated here with the similar data in Ilokano, is shown in (6).

(6)   **ALIGN-*um***   Align (*um*,Left, Stem, Left) i.e., *-um-* is a prefix

        $\forall um \exists$stem(Coincide(Left(um), Left(stem))

Infixation arises because NO-CODA dominates ALIGN (7). Thus in a word which begins with one or more consonants, *-um-* follows the first onset (7b), despite the resulting misalignment of the prefix, since breaches of alignment are less serious than those of the more highly esteemed NO-CODA. Candidate (7a) satisfies ALIGN because *u=u*. Candidate (7b) violates the constraint because *u≠k*.

(7)   NO-CODA » ALIGN-*um* , from {*um, kagat*}$_{Stem}$

	Candidates	NO-CODA	ALIGN-*um*
a.	<u>um</u>.kagat	**!	
b. ☞	k-<u>um</u>.-agat	*	* *(u≠k)*

For vowel initial verbs, such as the one in the tableau in (8), *-um-* does surface at the left edge (8b) since perfect alignment here does not entail any additional **NO-CODA** violations.

(8)   um-ísem from {*um, isem*}$_{Stem}$

	Candidates	NO-CODA	ALIGN-*um*
a.	<u>um</u>.isem	*	
b.☞	is-<u>um</u>-em	*	*!

Unlike *-um-*, the prefix *ag-* appears word initially regardless of whether the verb initial segment is a consonant or a vowel. Extending the analysis of McCarthy and Prince 1993, the difference between infixing *-um-* and prefixing *-ag-* follows from the relative ranking of their alignment constraints with regard to NO-CODA. The constraint which governs the placement of *ag-* must dominate the NO-CODA constraint since additional coda violations will be tolerated in order to maintain perfect alignment (9).

(9)   a.   ALIGN-*ag*   ALIGN Left ([*ag*]$_{Af}$,Stem)   i.e., *ag* is a prefix

        b.   Ranking: ALIGN-*ag* » NO-CODA

               Rationale: Additional coda violations tolerated in order to maintain

                              perfect alignment

The tableau in (10) illustrates the effect of this ranking. In a consonant initial verb the optimal candidate (10a) places the affix at the beginning of the word, since in this case the resulting additional violation of the lower ranked NO-CODA is tolerable.

(10)   ALIGN-*ag* » NO-CODA   *from* {ag, kagat}$_{stem}$

	Candidates	ALIGN-*ag*	NO-CODA
a.☞	ag-kagát		**
b.	k-ag-agát	*!	*

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These two examples yield the mini-grammar for Iloko shown in (11). The varied behavior of the two affixes follows directly from the ranking of their respective MCat-PCat Alignment constraints vis-à-vis the purely phonological constraint NO-CODA.

(11)   Iloko: ALIGN-*ag* » NO-CODA » ALIGN -*um*

3.1.1 A problem with ALIGN

The approach I take to account for the differences in mobility of different subsegments in this dissertation closely parallels the account of segmental affixation from McCarthy and Prince 1993 described above. However first it is necessary to be more precise about the formal operation of the the alignment constraint itself vis-à-vis its mode of violation by looking at a wider range of possible candidates. Although it is informally understood that multiple violations of ALIGN reflect the number of elements which intervene between the affix and the designated edge, neither ALIGN (nor its successor ANCHOR) formally states a procedure for assessment that will yield the multiple violations necessary to distinguish different degress of misalignment that are normally attributed to it in the literature. In this section I propose a reformulation of the constraint following Ellison 1995 that promotes the notion of intervening elements to the main constraint statement, yielding a constraint subject to the general assessment strategy proposed in Chapter 2. I will show that the appropriate constraint which explicitly returns multiple violations is different in important ways from the original ALIGN/ANCHOR. In particular, we will see in this chapter and the next that Generalized Alignment wrongly

conflates the ideas of *coincidence* and *precedence*. I will argue that these must be kept

distinct.

3.1.2 Mode of Violation

Consider again the method applied by ALIGN to compare competing forms.

ALIGN-*um* evaluates each candidate as shown in (12), where we consider the optimal

output for underlying /*um, isem*/. A function *Left*(x) (or *Right*(x) if it is a suffix) returns

the leftmost (or rightmost) element of the category in question. Once the substrings which

constitute the affix and stem respectively are identified, comparison of the leftmost

element in each reveals that they are indeed the same segment. In this case no violations

of ALIGN accrue.

(12)

	ALIGN (*um*, left, Stem, left)	$\{um, isem\}_{Stem}$
	Candidate:	$[\textbf{\textit{um}}isem]_{Stem}$
a)	Take the leftmost element of *um*	Left(*um*) = ***u***
b)	Take the leftmost element of the stem	Left(***um****isem*) = ***u***
c)	∀affix∃stem(Coincide(Left(affix), Left(stem)))	TRUE *(**u**=**u**)*

Compare this result to the outcome of evaluation of a form such as *k-**um**-agat*

from /um, kagat/, where ALIGN is violated in the optimal output candidate (13). We take

affix and stem and compare the leftmost element in each. In this case they do not match,

so alignment fails.

(13)

	ALIGN (*um*, left, Stem, left)	{*um, kagat*}_{Stem}
	Candidate:	[***kum****agat*]_{Stem}
a)	Take the leftmost element of *um*	Left(*um*) = ***u***
b)	Take the leftmost element of the stem	Left(***kum****agat*) = ***k***
c)	∀affix∃stem(Coincide(Left(affix), Left(stem)))	FALSE (***u≠k***)

As stated, ALIGN distinguishes clearly between forms which violate it (as in *k-**um**-agat*) and those that don't (***um**-kagat*), but formally it fails to differentiate between candidates which appear to have different degrees of violation. Compare the result for *k**um**agat* with *kag**um**at*, a candidate in which the affix follows the first *three* segments (14). Again we take affix and stem and compare the leftmost element in each. The two segments differ, resulting in the expected violation of ALIGN, but the assessment does not express that further infixation into the stem might lead to a more severe breach of the constraint.

(14)

	ALIGN (*um*, left, Stem, left)	{*um, kagat*}_{Stem}
	Candidate:	[*kag**um**at*]_{Stem}
a)	Take the leftmost element of *um*	Left(*um*) = ***u***
b)	Take the leftmost element of the stem	Left(*kag**um**at*) = ***k***
c)	∀affix∃stem(Coincide(Left(affix), Left(stem)))	FALSE (***u≠k***)

Thus the ALIGN constraint as stated fails to return the multiple violations required to distinguish between competing candidates, all of which violate ALIGN. The more complete tableau in (15), adapted from McCarthy and Prince 1993a:23 illustrates that we do indeed need to be able to assess multiple violation. The form in (16a) satisfies ALIGN

but its extra violation of the higher ranking NoCoda eliminates it from consideration. A comparison of the remaining candidates, all of which fail to satisfy Align, affirms that unless the constraint is restated, Eval can only deliver an indeterminate result.

(15)   NO-CODA » Align-*um* , from {*um, kagat*}_{Stem}

	Candidates	NO-CODA	ALIGN-*um*
a.	**um**-kagat	**!	
b. ?	k-**um-**agat	*	*
c. ?	kag-**um**-at	*	*

Align's mode of violation problem follows from the fact that it has been formulated as a binary constraint on a unique element, here the affix, and thus can only return a single yes or a no violation. Consider again the tableau in (15). The uniqueness of the affix in the stem in conjunction with the categorical nature of the constraint doom this formulation of Align. Align must be redefined to return multiple violations, conferring formal status on what has up to now been an informal understanding on the way the constraint ought to work.

Anchor, the reformulation of Align in Correspondence Theory (McCarthy and Prince 1995) perpetuates the mode of violation problem. The general schema for anchoring is given in (16), restated with the assessment clause in (17). Like alignment, this constraint is satisfied by the coincidence of affix and stem edge.

(16)   **{RIGHT, LEFT}-ANCHOR (S₁,S₂)**   (McCarthy and Prince 1995)

Any element at the designated periphery of S₁ has a correspondent at the designated periphery of S₂.

Let *Edge*(X,{L, R}) = the element standing at the *Edge* L, R of X.

RIGHT-ANCHOR. If x = *Edge*(S₁,R) and y=*Edge*(S₂,R) then xRy.
LEFT-ANCHOR. Likewise, *mutatis mutandis*.

(17)   **{RIGHT, LEFT}-ANCHOR (S₁,S₂)**

$\exists x \exists y((x = Edge(S_1,\{L, R\}) \wedge y= Edge(S_2,\{L, R\})) \rightarrow xRy)$

The constraint for *um-* is given in (18). As with ALIGN the difficulty lies in the impossibility of indicating the extent of displacement of an element. Stated as a binary constraint over a unique structure, ANCHOR, like ALIGN, formally returns only one violation for any degree of infixation. Analysis of the Ilokano infixation again illustrates this point for the Left-Anchor constraint given in (18).

(18)   **LEFT-ANCHOR (affix, stem)**

Any element at the designated periphery of the affix has a correspondent at the designated periphery of the stem

If x = *Edge*(affix,L) and y=*Edge*(stem,L) then xRy.

(19) provides three different structures subject to evaluation by ANCHOR. For the input /*um, isem*/, (I) satisfies ANCHOR since the first element in the affix and the first element in the stem do correspond. On the other hand, for input /*um, kagat*/, (II) and (III) both violate ANCHOR since the affix initial vowel does *not* correspond to the consonant at the leftmost edge of the stem. Since this is the only comparison dictated by the constraint,

however, the evaluation does not reflect further that (II), the actual output, is better than (III), so as with ALIGN the output of EVAL is indeterminate. ANCHOR cannot return the multiple violations necessary to distinguish between (II) and (III).

(19)

	I.	II.	III.
S2 = *stem*	(u) m isem	(k) u m agat	(k) agu mat
S1 = *affix*	(u) m	(u) m	(u) m
ANCHOR	okay	*	*

3.1.3 No-Intervening

Clearly then we are compelled to reformulate the constraint to account for cases where multiple violation is crucial. One way would be to promote the informal understanding of mutliple violation proposed in McCarthy and Prince 1993 to a formal assessment clause as shown in (20). As it stands however, although the assessment clause in (20) makes sense intuitively, there is no obvious formal relationship between the two clauses of the constraint. The admission of such a constraint results in too powerful a theory because it leaves us with no principled way to limit the assessment of multiple violation. If (20) is allowed, it is hard to imagine what might rule out the intuitively less satisfying constraint in (21), for example.

(20)   **ALIGN II**
(i) $\forall$Cat1 $\exists$Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide
(ii)   if (i) is false then assess one mark for each element that intervenes between *Cat1* and the left edge.

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(21)   **ALIGN III**
(i) $\forall$Cat1 $\exists$Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide
(ii)   if (i) is false then assess one mark for each syllable that has a coda

A potentially more constrained solution is to restate the constraint in a way consistent with the use of the general assessment strategy proposed in the previous chapter. A formulation of alignment suggested in Ellison 1995, called NO-INTERVENING (22) fits the bill perfectly.

(22)   **NO-INTERVENING(ρ; E; D)**   Ellison 1995: 2

There is no material intervening between ρ and edge E in domain D

The constraint is restated in (23) with the assessment clause. NO-INTERVENING returns a violation for each segment (x) occurring between the element in question and the edge of the domain.[1] Since for all the cases under consideration the domain is simply the output string, S_0, in general I will not specify D explicitly.

(23)   **NO-INTERVENING(ρ; E)[2]**

(i) $\neg\exists$x(x intervenes between ρ and edge E)
(ii)   Assess one mark for each value of x for which (i) is false

To see how NO-INTERVENING works, consider the again the case of the Ilokano infix *um-*. The specific constraint necessary is given in (24).[3] Note that there is

---

[1] In principle one could designate the domain to draw from any member of the prosodic hierarchy, but for the cases under consideration it will be a segment unless otherwise specified.

[2] Merchant 1994 claims that all PCat/MCat alignment may be stated categorically.

technically no distinct morpheme *um* in the output, so the *um* in the constraint is a

shorthand for "the segments in S_0 which correspond to S_1 (where $S_1=um$)." In the tableau

in (25), (25b) is more harmonic than (25c) because fewer elements intervene between the

edge and the affix.

(24)   **NO-INTERVENING(*um-*; L)**

     (i)   ¬∃x (x intervenes between *um-* and the left edge)
     (ii)   Assess one mark for each value of x for which (i) is false

(25)

	Candidates	NO-INTERVENING	*comment*
a.	[**um**kagat		nothing intervenes between the affix and the left edge of the stem
b.	[k**um**agat	*	*k* intervenes between the affix and the left edge of the stem
c.	[kag**um**at	***	*k,a,g* intervene between the affix and the left edge of the stem

As illustrated by the tableau in (25), intervening elements are those segments in

the string which do not correspond to ρ; in this case they include segments which do not

correspond to the affix *um*. (26) provides a more formal definition of intervening

segments.

---

[3] This is the form of the constraint I will use in the next two chapters, but in Chapter 4 I will discuss cases
of exfixation which will result in slight modification.

(26)   **Intervention**

x right-intervenes between ρ and edge E iff ρ > x > E and x≠ ø

x left-intervenes between ρ and edge E iff E > x > ρ and x≠ ø

Note that this reformulation of ALIGN, which is necessary to achieve multiple violation, reveals the necessity of referring to the edge *E* as independent from the edgemost element in a string. If the edge were simply identified with the edgemost element, as suggested by McCarthy and Prince 1993a, infixation by one would not be penalized. As illustrated in the tableau in (27), neither (27a) nor (27b) has anything intervening between the affix and the leftmost segment in the stem.

(27)

	Candidates	NO-INTERVENING	*comment*
a.	**u**m-kagat		*nothing intervenes between the affix and the leftmost element in the stem*
b.	**k**-um-agat		*nothing intervenes between the affix and the leftmost element in the stem*

NO-INTERVENING then penalizes each segment of the root which precedes *um*-in S_0 (28). Since this constraint ranks below NO-CODA the optimal candidate (28b) violates NO-INTERVENING, but it does so minimally, since only one segment intervenes between the affix and the left edge of the word.

(28) NO-CODA » NO-INTERVENING (*um*; L) , from {*um, kagat*}$_{Stem}$

	Candidates	NO-CODA	NO-INTERVENING	*COMMENTS*
a.	[**um**-kagat	**!		
b.☞	[k-**um-**agat	*	*	*k* intervenes
c.	[kag-**um**-at	*	***!	*k,a,g* intervene

Again, contrast this with the opposite ranking for the prefix *ag-* (29). Here NO-INTERVENING(*ag*; L) outranks the coda constraint, so in the optimal form in the tableau in (29) the affix appears word initially (29a).

(29) NO-INTERVENING(*ag-*; L)

(i) ¬∃x (x intervenes between *ag-* and edge *L*)
(ii) Assess one mark for each value of x for which (i) is false

NO-INTERVENING(*ag-*; L) » NO-CODA, from {*ag, kagat*}$_{Stem}$

	Candidates	NO-INTERVENING(*ag-*; L)	NO-CODA	*COMMENTS*
a. ☞	[**ag**-kagat		**	
b.	[k-**ag-**agat	*!	*	*k* intervenes
c.	[kag-**ag**-at	***!	*	*k,a,g* intervene

Thus NO-INTERVENING works formally where ALIGN and ANCHOR fail. It remains true to the original gradient spirit of ALIGN as first proposed, but goes beyond it in

formulating specifically just how multiple violations ensue in accordance with a general strategy of assessment of multiple violations.

3.2 Inor

In the cases discussed in Prince and Smolensky 1993 and McCarthy and Prince 1993a the crucial interaction leading to infixation is between the alignment of segmental morphemes and the demands of syllable structure constraints, but their account, adapted with NO-INTERVENING, extends easily to floating features.[4] In this section I show that subsegmental behavior can likewise be accounted for as the result of a conflict between morpheme specific edge-orientation and more general constraints in the grammar.

The data to be accounted for are repeated here in (30). In Inor (Western Gurage), the third (past and non-past) and the second (non-past) person plural forms of verbs are marked by palatalization of the final coronal obstruent (Rose 1994). In addition, masculine is indicated by labialization of the rightmost velar or labial. Thus in a single form we find examples of both heterotropic and edge-bound subsegmental morphemes.

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[4]The extension of alignment to features was first implemented by Yip 1993a (cf Yip 1993b) and Kirchener 1993. For a broadly similar approach to the one taken here see Akinlabi 1994.

(30)   Inor Plural Verb Forms (Rose 1994)

Plural (*[+high]*)   Palatalize <u>final</u> consonant if coronal

Masculine (*[+round]*)   Labialize <u>rightmost</u> labial or velar

		3masc. pl.	**3fem.pl.**		
a.	√**kfd**	kəf^{w}əj-u-m	kəfəj-a-m	'they opened'
b.	√**nks**	nək^{w}əs-u-m	nəkəs-a-m	'they bit'
c.	√**drg**	dənəg^w-u-m	dənəg-a-m	'they hit'
d.	√**sbr**	səp^{w}ə-m	səpər-a-m	'they broke'

I show below that the difference between labialization and palatalization follows from the position of their respective precedence constraints with respect to faithfulness, specifically their relative ranking vis-a-vis MAX (SUBSEG).

3.2.1 The analysis

The relevant precedence constraint for labialization is given in (31). Recall that although the constraint shorthand specifies only the subsegmental morpheme *[round]$_{masc}$*, it refers to the segment that corresponds to the morpheme in the output string, S_0. As this example will show, correspondence of an *input subsegment* with the *output segment* which contains it greatly facilitates the assessment of precedence relations in S_0.

(31)   **NO-INTERVENING(*[round]$_{masc}$*; R)**

(i) $\neg\exists$x (x intervenes between *[round]$_{masc}$* and the *R* edge)
(ii)   Assess one mark for each value of x for which (i) is false

In the tableau in (32), the possible labialized candidates include only the ones shown in (32b) and (32c). These necessarily both violate NO-INTERVENING([round]$_{masc}$; R) since the final consonant, *d*, is neither labial nor velar so cannot be labialized. Candidate (32a) has fewer violations of this constraint, since the labialized consonant is followed by only two root segments. Labialization of the initial *k* constitutes a more serious breach of the constraint (32b). In (32c), the subsegmental affix is not realized, so no S$_0$ segment correspnds to the affix. Since there is thus no *x* which stands between a segment which corresponds to the affix and the right edge of the stem NO-INTERVENING(*[round]$_{masc}$*; R) is trivially satisfied.[5]

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[5] The necessary vacuous satisfaction of NO-INTERVENING([round]$_{masc}$; L; stem) in (31c) constitutes a second difference between this constraint and ALIGN. Consider again the alignment of McCarthy and Prince 1993 below. Because of the principle of *containment* (Prince and Smolensky 1993), where the input is contained in the output string, the constraint could not be vacuously satisfied even when the floating feature was unlinked in the ouput. Therefore we expect ALIGN to be false for the structure in (31b) below. Pulleyblank 1994 argues that because an unlinked feature is not inherently ordered with respect to the rest of the melody we might as well consider it to coincide with the final consonant, but the opposite position could just as easily be argued for. This problem does not arise for ANCHOR in Correspondence Theory (McCarthy and Prince 1995), since the unparsed feature does not appear in the ouput string.

  (a)   **ALIGN**
        (i)   ∀Cat1∃Cat2(Edge1 of Cat1 and Edge2 of Cat2 coincide)
        (ii)   Assign * for each Cat1 which for which (c) is false

(b)

<div align="center">w
kəfəd</div>

(32)

		No-Intervening([round]$_{masc}$; R)	Comments
a.	S1 k ə f ə d S0 k ə f^{w}ə d] S2 [round]$_{masc}$	**	ə, d intervene between labialized _f^w_ and right edge
b.	S1 k ə f ə d S0 k^{w}ə f ə d] S2 [round]$_{masc}$	****!	ə, f, ə, d intervene between labialized _k^w_ and right edge
c.	S1 k ə f ə d S0 k ə f ə d] S2 [round]$_{masc}$		[round]$_{masc}$ has no correspondent in S_0 so the constraint is vacuously satisfied

The abbreviated tableau, showing only the output stem, S_0, is in (33). The material

that corresponds to the affix appears in larger bold type.(33)

		No-Intervening([round]$_{masc}$; R)	Comments
a.	kə**f^w**əd]	**	ə, d intervene between labialized _f^w_ and right edge
b.	**k^w**əfəd]	****!	ə, f, ə, d intervene between labialized _k^w_ and right edge
c.	kəfəd]		[round]$_{masc}$ has no correspondent in S_0 so the constraint is vacuously satisfied

To capture the variety of subsegmental behavior in Inor the grammar requires a

second constraint that when ranked in relation to NO-INTERVENING will be able to derive

both kinds of floating affixes. One constraint that can do the job is MAX (SUBSEG) (34).

Recall that this constraint applies only to an input subsegment: a melodic element whose

highest node is not the root node.

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(34) **MAX (SUBSEG)**   Every subsegment in S_j has a correspondent in S_0

(i) $\forall x \exists y(x$ is a subsegment in $S_j \rightarrow (y$ is in $S_0 \wedge x\boldsymbol{R}y))$
(ii)   Assess one mark for each value of x for which (i) is false

The tableau in (35) illustrates again how the constraint functions with the now familiar $k\partial f^w \partial d$. MAX (SUBSEG) penalizes candidate (35b) because the subsegmental affix, *[round]*, has no correspondent in S_0.

(35)

		MAX (SUBSEG)	Comments
a.	S1 k ə f ə d S0 k ə f̰ʷ ə d S2 [round]$_{masc}$		*[round]$_{masc}$* corresponds to f^w in S_0
b.	S1 k ə f ə d S0 k ə f ə d S2 [round]$_{masc}$	*	*[round]$_{masc}$* has no correspondent in S_0

Now we are in a position to account for the potential mobility or lack of mobility of a latent feature in its quest for a target through the relative rankings of MAX (SUBSEG) and NO-INTERVENING (36). Where MAX (SUBSEG) dominates NO-INTERVENING the latent feature can move from the edge in order to find a suitable target if necessary (36a). This is the ranking which governs the masculine labialization in Inor. On the other hand, where NO-INTERVENING dominates MAX (SUBSEG) the floating feature is restricted to a target at

the edge specified by the NO-INTERVENING constraint (36b). This ranking regulates the pattern of Inor palatalization for the plural verb forms under consideration.

(36)   *Factorial Typology*: *Infixation and suffixation*

a.   MAX (SUBSEG) » NO-INTERVENING   heterotropic feature

b.   NO-INTERVENING » MAX (SUBSEG)   edge-bound feature

The constraints governing Inor labialization specifically are repeated in (37). Since the morpheme is a heterotropic feature, MAX (SUBSEG) must dominate the morpheme-specific NO-INTERVENING (38).

(37)   Inor Labialization

a.   **MAX (SUBSEG)**

b.   **NO-INTERVENING(*[round]$_{masc}$*; R)**

(38)   *Ranking*:   MAX (SUBSEG) » NO-INTERVENING(*[round]$_{masc}$*; R)
        Rationale: Labialization not limited to the final consonant

The tableau in (39) shows just S_0, with the element corresponding to the affix in larger bold type. Both labials and velars constitute licit targets for the masculine labialization. Since MAX (SUBSEG) sits atop the hierarchy, the precedence violating (39c) loses out to other candidates that violate only the lower ranked NO-INTERVENING(*[round]$_{masc}$*; R). Of the others, (39a) is more harmonic than (39b) because *kəf^{w}əd* violates the lower ranked constraint fewer times.

(39)   kə**fʷ**əd from / kəfəd, [***round***]**masc**/

	Candidates	MAX (SUBSEG)	NO-INTERVENING(*[round]*$_{masc}$; R)
a.☞	kə**fʷ**əd]		**
b.	**kʷ**əfəd]		****!
c.	kəfəd]	*!	

Palatalization differs from labialization in that it only appears if it can do so on the rightmost consonant . This is achieved by domination of NO-INTERVENING(*[+high]*$_{plural}$; R) by the MAX (SUBSEG) constraint (40-41).

(40)   **NO-INTERVENING(*[+high]*plural; R)**

(i)   ¬∃x (x intervenes between *[+high]*$_{plural}$ and edge *R*)
(ii)   Assess one mark for each value of x for which (i) is false

(41) *Ranking*:   NO-INTERVENING(*[+high]*$_{plural}$; R) » MAX (SUBSEG)
      Rationale: Floating feature fails to surface rather than violate
                  precedence constraint

The tableau in (42) illustrates the implementation of this ranking. Because plural palatalization targets only coronal obstruents the only possible target is the verb initial *d* (42a). Since here MAX (SUBSEG) ranks below the precedence constraint, this candidate, with four violations of NO-INTERVENING(*[+high]*$_{plural}$; R), is less harmonic than (42b), where the affix has no correspondent in S$_0$. Therefore in the absence of a suitable word-final target the feature fails to surface.

(42)   dənəg from / dənəg , *[+high]*_{plural} /

		NO-INTERVENING([+*high*]_{plural}; R)	MAX (SUBSEG)
a.	dənəg		*
b.	**j**ənəg	****!	

The different relationship of NO-INTERVENING to MAX (SUBSEG) accounts for both suffixation and infixation of the subsegmental affixes. Together these rankings yield the hierarchy in (43) for Inor. This analysis has thus transformed the iteration parameter of Archangeli and Pulleyblank 1994 into a hierarchy of potentially violable constraints. The remaining chapters of the dissertation demonstrate how this transformation paves the way to a better understanding of more complex phenomena.

(43)   Inor hierarchy

NO-INTERVENING(*[+high]*_{plural}) » MAX (SUBSEG)» NO-INTERVENING([*round*]masc)

3.2.2 Can representational distinctions alone do the trick?

In the analysis of Inor above, the difference between edge-bound palatalization and heterotropic labialization follows from the relative ranking of the affixation constraints with respect to MAX (SUBSEG). An alternative solution might reject the parametric ranking account in favor of a representational distinction between the two affixes. Such an account would leave the association conventions intact, obviating the need for language specific and ranking and morpheme specific constraints. Rose 1994 presents an account along these lines. She proposes that heterotropic labialization

constitutes a true floating feature while edge-bound palatalization corresponds to an underlying abstract segment (44). The "convention" operating here restricts interaction between segments to adjacent elements.

(44)

HETEROTROPIC LABIALIZATION	EDGE-BOUND PALATALIZATION
	i
	|
[round]	[+high]

To make this work, different conventions must govern the two representations. Following traditional reasoning, an unlinked feature is not positioned with respect to the string of full segments and can look for a host anywhere in the string. By positing an abstract segment dominating the palatalizing feature *[+high]*, on the other hand, Rose claims to derive strictly local interaction from *fusion* (45), a process that involves the complete integration of two segments. Since this process unites entire segments, the reasoning goes, it must be local, because presumably no mechanism exists for skipping over intervening roots [modulo metathesis]. One serious problem with this account, however, is that it is not clear exactly what fusion entails. If fusion is regarded as intercourse between full segments, what happens to the other segmental features which are not implicated in the palatalization? If fusion involves an interaction with a segment specified only for the palatalizing feature *[+high]*, on the other hand, it is difficult to see what substantive difference might separate fusion from run-of-the-mill autosegmental association.

(45)

input:
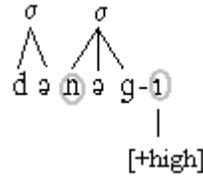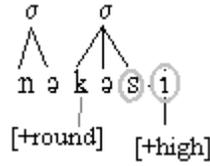
FUSION:

                                              impossible

output   [nəkəš]   [dənəg]

Assuming fusion could be characterized more explicitly, then in principle this solution would have the advantage of eliminating the need for any kind of locality parameter. In addition, it would make a more constrained prediction than the grammar-based account. If locality follows from fusion and fusion entails disappearance of the triggering segment, Rose 1993, 1994 predicts that no necessarily local process will have an overt segmental trigger (46).

(46)   Segments and Locality I

	TRIGGER	PROCESS	
LOCAL	segment	fusion	*segment disappears*
NON-LOCAL	floating feature	autosegmental linking/spreading	

This prediction is incorrect however, since locality does not necessarily correlate with the disappearance of the triggering segment. Widespread local palatalization of an onset by its nucleus in the Slavic languages (for example in Polish (Rubach 1984) and Slovak (Rubach 1993)) and elsewhere constitutes the most devastating counter example this claim. Odden 1994 provides an impressive inventory of other kinds of cases where interaction between overt segments remains strictly local, two of which are given in (47).

(47)   Local effects from overt segmental triggers

a.   Nasal spreading in Chukchi   (Odden 1994: 301)

        [+nasal] spreads only to root adjacent stop

pəne-k   'to grind'   ɣe-mne-lin   'it ground'

rəpən   'flesh side of hide'   rəmn-ət   'flesh sides of hides'

pəŋəl   'news'   ɣa-mŋət-len   'having news'

təm-ək   'to kill'   ɣa-nmə-len   'he killed'

b.   Sanskrit coronal assimilation (Odden 1994:317)

        coronal takes on place features of adjacent following C^6

i.   /indras/   'Indra'   surah   'hero'   indras surah   'hero Indra'

ii.   /tat/   'that'   caksuh   'eye'   tac caksuh   'that eye'

      c.f.   tadayati   'he beats'   tejate   'it is sharp'

---

6 Subscript + (C)corresponds to subscript period in the IPA.

The persistence of the triggering segments in (47), then, belies the claim that segmental fusion eliminates the need for a locality parameter. A possible modification, however, might restrict both fusion and autosegmental spreading of a linked feature to root adjacent segments, as in (48), assuming the two operations could be distinguished.

(48)   Segments and Locality II

	TRIGGER	PROCESS	
LOCAL	segment	fusion	*segment disappears*
	segment	linking	*segment remains*
NON-LOCAL	floating feature	linking	

This modified convention falls short as well. Many cases of assimilation from overt segments have no adjacency restriction (see Odden 1977 and Odden 1994 for a broad inventory). For example, a number of languages with vowel harmony have transparent vowels through which features may spread to a non-local target. Examples from Hungarian and Wolof are shown in (49).

(49)   Transparent vowels in harmony

a.   Wolof: high vowels are transparent   (Pulleyblank 1994:23 from Ka 1988)

		+ATR		-ATR	
i.	/-lEEn/	tox<u>i</u>-leen	'go and smoke'	sɔpp<u>iwu</u>-lɛɛn	'you have not changed'
		tərij<u>i</u>-leen	'go sleep'	tɛkk<u>i</u>-lɛɛn	'untie!'
ii.	/-wOOn/	seen<u>u</u>-woon	'tried to spot'	tɛɛr<u>u</u>-wɔɔn	'welcomed'
		tər<u>i</u>-woon	'went and slept'	xɔll<u>i</u>-wɔɔn	'peeled'

b.   Hungarian: *i* is transparent   (Ringen and Vago 1995: 2)

       -nEk 'dative'

a.   bokor   bokor-nak   'bush'

b.   öröm   öröm-nek   'joy'

c.   büró   büró-nak   'bureau'

d.   soför   soför-nek   'chauffeur'

e.   radir   rad<u>i</u>r-nak   (*radir-nek)   'eraser'

       Quileute manifests a lesser known example of non-local spreading, here from one

consonant to another (50). "When speaking of [mythical] SNAIL or of a cross-eyed and

one-eyed person", reports Frachtenberg 1920: 297, L- is prefixed to every word, and all

sibilants in the word become lateral. No adjacency condition restricts the spread of

laterality (50d-e).

(50)   SNAIL's speech in Quileute   (Frachtenberg 1920)

		NORMAL	SNAIL	
a.	s→ɬ	<u>s</u>iˈyali	L- <u>ɬ</u>iˈyali	'I see it'
b.	c→ɬ	<u>c</u>iquli	L- <u>ɬ</u>iquli	'I pull it'
c.	ts!→L!	<u>ts</u>!i'qati	L-<u>L</u>!i'qati	'world'
d.	ts→L	i<u>ts</u>ēɬli	L- i<u>L</u>ēɬli	'I intend to do it'
e.	s→ɬ tc→L	axa<u>stc</u>a'a	L- axa<u>ɬL</u>a'a	'where is it?'

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Finally, non-local spreading from vowel to consonant is also attested. In Harari, for example, the second person singular suffix *-i* triggers palatalization of coronals long-distance while remaining overt (Sharon Rose, personal communication). Odden (1977 and 1994) reports that s-palatalization in Karok may skip an intervening consonant (51).

(51)   *s*-palatalization in Karok   (Odden 1977: 185 from Jensen 1974: 685)

s→s/i(C)____

a.   mu-spuk   'his money'   ispuk   'money'

b.   ʔárip   -sur   ʔáripsur   'to cut a strip off'

Thus the abstract representational solution proposed by Rose both relies on on the ill-defined operation of fusion and in doing so unnecessarily excludes from the resulting typology a number of well-attested phenomena. Unless we are willing to develop additional representational diacritics to make distinctions between local and non-local processes, it remains necessary to utilize the flexible resources of a grammar to derive the wide variey of segmental and subsegmental patterns which have been observed.

3.3 Summary

Chapter 1 made the case that the potential mobility of individual subsegments (floating features) and full segments cannot follow from universal conventions on representations, but rather that locality is specifically determined by grammars. Refining the infixation model of Prince and Smolensky 1993 and McCarthy and Prince 1993a this chapter has provided a general account of variation in both segmental and subsegmental

affixation in Optimality Theory. The next two chapters consider more complex cases of subsegmental association and demonstrate the superiority of this proposal to parametric rule based accounts.

Parsing Below the Segment in a Constraint Based Framework

by

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4. CONFLICTING DIRECTIONALITY

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4. Conflicting directionality

4.1 Introduction

The last chapters clarified the general approach to infixation in Optimality Theory proposed by McCarthy and Prince 1993a and extended this result to subsegmental affixation. It was shown that infixation occurs when a phonological constraint (such as NO-CODA or MAX) outranks a morphological precedence constraint (NO-INTERVENING). As is typical in infixation, each of the affixes evinced only minimal displacement from the designated edge. This chapter examines a pattern of infixation of morphological and prosodic constituents which lacks the gradient character of the more typical sort. In cases of what I will call *conflicting directionality*[1], the dominating constraints actually force the element in question to leap directly to the end of the word opposite to the primary edge. I argue that this pattern requires a theory which includes coincidence-based licensing constraints on the model of ALIGN (Itô and Mester 1994, Lombardi 1995) and demonstrate that conflicting directionality results from antagonism between licensing and the more general constraints on the placement of phonological and morphological elements discussed in Chapter 3.

4.2 Conflicting directionality

Certain kinds of complex phenomena serve as testing and proving grounds in phonology as theories develop and change. Cases of what I will call *conflicting directionality*, constitute one such phenomenon. In Japanese Mimetic Palatalization

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[1] Thanks to Larry Hyman for suggesting this term.

(Mester and Itô 1989, Hamano 1986), for example (1), palatalization targets the *rightmost* non-*r* coronal consonant. If there are none then the palatalizing feature links to the *leftmost* segment. In (1a), where both consonants are coronal, palatalization targets the medial consonant *s* while in (1b) the rightmost coronal is peripheral, so it is palatalized. As shown in (1c-d), however, in the absence of a non-*r* coronal the floating palatal attaches to the leftmost consonant. Thus in (1c) palatalized *poko* yields *pʸoko* 'flip-flop'. In (1d), where the medial segment is *r*, palatalization also targets the leftmost consonant, yielding *kʸoro* 'look around indeterminately'.

(1)   Japanese Mimetic Palatalization (Data from Mester and Itô 1989)

        Rightmost

a.   /dosa/   do**š**a-do**š**a   'in large amounts'

b.   /toko/   **č**oko-**č**oko   'childish small steps'

        Leftmost

c.   /poko/   **pʸ**oko-**pʸ**oko   *po**kʸ**o   'flip-flop'

d.   /koro/   **kʸ**oro-**kʸ**oro   'look around indeterminately'

A typical case of conflicting directionality involving stress is exemplified by the pattern in Eastern Cheremis in (2). These data, introduced into the generative literature by Kiparsky 1973 from Itkonen 1955, have been important building blocks in all major theories of stress (Hayes 1981, 1991, Prince 1983, and Halle and Vergnaud 1987 among others). Descriptively, in Eastern Cheremis the *rightmost* heavy (CVV) syllable receives the stress (2a-d), but if there are no heavy syllables, it is the *leftmost* syllable which is stressed (2e). The term conflicting directionality describes this elsewhere relationship

between the right and left edges of a word. No theory of stress is complete if it cannot account for this pattern.[2]

(2)   Stress in Eastern Cheremis   (Data from Hayes 1981: 57)

a.   šiin**çáam**   *I sit*

b.   šlaa**páa**ʒəm   *his hat (acc)*

c.   **püü**gəlmə   *cone*

d.   **kíi**dəštəʒa   *in his hand*

e.   **t**ələzən   *moon's*

I argue in this chapter that positional restrictions on marked structure play an important role in complex directionality effects. This analysis reveals the relationship between Japanese Mimetic palatalization and the parallel stress patterns in languages like Eastern Cheremis and their connection to other phenomena governed by general principles of licensing and establishes a model for handling such effects in a declarative framework such as Optimality Theory. Unlike previous rule-based analyses the proposed account will correctly limit the predicted patterns of association to just those attested.

4.3 Analysis

In most previous analyses of conflicting directionality in stress, one basic generalization stands out; namely, one of the directionality statements in the algorithm mentions a peripheral constituent, usually one that is word-initial. This element is

---

[2] Other languages with this pattern include Classical Arabic, Kuuku-Yaʔu, Juasateco, Chuvash (Hayes

specially designated to serve as the head of a foot or to receive an extra projection on the grid (Hayes 1991, Halle and Vergnaud 1987, Prince (1983), Kiparsky (1973); see Kenstowicz 1994 for a different sort of proposal within OT). The unified solution to conflicting directionality proposed for both the melodic and prosodic cases draws on this insight of inherent peripheral "prominence" from the stress analysis. We turn first to the mimetic palatalization, and examine the range of well-formed outputs of the process (3). The palatalized consonants which are restricted to the leftmost position, that is word-initial position, are those which are complex segments with a palatal off-glide. Significantly this set includes the labials, the velars and *r*. These contrast with the other coronals, which all remain simple segments, even when they are palatalized (Mester and Itô 1989: 287).

(3)

| t → | c | z → | z (j) | Compare: b^y, k^y, r^y etc. |

| d → | j | n → | ñ |

| s → | s |

This observation now provides a motivation for exclusive palatalization of initial consonants in the absence of a non-*r* coronal elsewhere in the word. I propose that this is actually a licensing condition (Itô 1988, Goldsmith 1990, Itô and Mester 1993, Steriade 1995) which allows complex segments only peripherally (following Brasington 1982, Foley 1977, Hooper 1976, Venneman 1972), in this case only at the beginning of a word. Before formalizing licensing below I want to demonstrate its importance in accounting

(1991: 254)).

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for conflicting directionality. (4) provides a rough version of the appropriate licensing constraint.

(4)   **Licensing**   'A complex segment is initial'

   (i)   ∀x(x is a complex segment→x is word-initial)
   (ii)   Assess one mark for each value of x for which (i) is false

As shown in (5), in the case of the Mimetic Palatalization a complex segment is one which has a dual place specification.[3]

(5)

Simple Place: | Complex Place:

          ǰ | p   r

        Place | Place   Place
          | | /   \   /   \
         cor | lab   Vplace   cor   Vplace
        /   \ | | |
    +ant   -ant | high   high
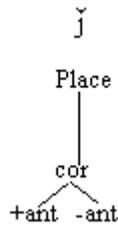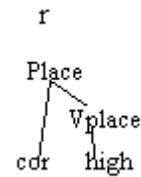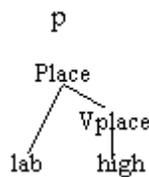
The analysis proposed here relates the Japanese Mimetic pattern to well-attested examples of licensing cross-linguistically. I have provided a few examples in (6). The most striking of these is !Xõõ (Traill 1985, Spaelti ms), where 116 segments, primarily different kinds of clicks, are licensed in prosodic word initial position, while only six can appear intervocalically and only two word finally. Similar statements characterize

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[3] In Steriade 1992 terms the difference between the two types of segments is characterizable with respect to the the aperture sequence of each. An affricate (c, j) consists of closure followed by release, but the segments with vocalic offglides arguably contain two release nodes (preceded by closure in in the labial and velar stops). More research into related cases should yield a more grounded conception of complexity. The papers in Dyck (1993) directly address this issue.

languages as diverse as Efik (Hyman 1990), Kukuya (Paulian 1985, Hyman 1987), and Ancient Greek (Steriade 1995). More contrast, thus more complexity, is licensed in constituent initial positions. Beckman 1995 reaches similar conclusions with respect to indirect licensing of marked vowels.

(6)   Licensing of marked segments in word-initial position

a.   Efik: (Hyman 1990: 180)
        Only C_1 in foot licenses voice and manner contrasts

```
C₁=         t           k    kp  │ C₂=  B     D     G
       b    d                    │      m     n     ŋ
       f    s    y           w    │
       m    n    ...         ŋʷ   │
```

b.   Licensing in !Xóõ -   (Traill 1985, Spaelti 1992)
        Only C_1 in a foot/stem can be complex

position: #C   VCV   C#
number of licensed segments: 116   6   2

c.   Licensing in Kukuya: (Paulian 1975: 85; Hyman 1987)

        Only boxed segments allowed in non-initial position

p	pf	t		ts	k
b	bv	d		dz	
w	f	s	y		h
mp	mf	nt		ns	nk
mb	mv	nd		nz	ng
m	n−	n	l	−	−

d.   Licensing in Greek -
        Aspirated vowels are licensed only word-initially (Steriade 1995)

The LICENSING constraint in (4) optimizes complex segments in initial position. However, mimetic palatalization has a general orientation toward the right edge of the word. The restriction of a marked segment to the left edge conflicts with a more general suffixing constraint, NO-INTERVENING (*[pal]*; R), shown in (7). Recall that *[pal]* is shorthand for the element in S_0 that corresponds to the palatalizing morpheme. It is this opposition that gives rise to the phenomenon of conflicting directionality.

(7)   NO-INTERVENING(*[pal]*; R)

        (i)   ¬∃x (x intervenes between *[pal]* and the right edge)
        (ii)   Assign * for every x which falsifies (i)

The ranking of the two constraints is given in (8). The licensing condition must outrank the morphological NO-INTERVENING constraint here since precedence will be sacrificed to avoid violation of LICENSE.

(8)   LICENSE » NO-INTERVENING(*[pal]*; R)

The effect of this ranking is illustrated by the tableau in (9) for a word whose only coronal is initial. The candidate in (9a) best satisfies NO-INTERVENING(*[pal]*; R), but is not optimal since it violates the more highly ranked LICENSE constraint for complex segments. Therefore the form in (9b), where the initial coronal is palatalized, is the winner.

(9)   /toko,*mimetic*/

		LICENSE	NO-INTERVENING (pal;R)
a.	to**k**^{y}o]	*!	*
b. ☞	**č**oko]		***

The NO-INTERVENING(*[pal]*; R) constraint exerts its muscle in (10) where the base has two coronal consonants. Since both coronals yield palatalized segments with simple PLACE (although complex in manner) there is no pressure against palatalizing the rightmost consonant in (10a). The tableaux in (9-10) thus illustrate the optimality of the "rightmost coronal" pattern.[4]

(10)   Palatalization targets rightmost coronal   *from*   /dosa, *mimetic*/

		LICENSE	NO-INTERVENING (pal;R)
a. ☞	do**š**a]		*
b.	**ǰ**osa]		***!

(11) illustrates the targeting of the leftmost consonant in the absence of a non-*r* coronal. In *poko*, both consonants would have complex palatalized counterparts. Because the LICENSE constraint on complex segments is high, the violation caused by the medial

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[4] Multiple linking of the palatalizing feature, as in *josa* is presumably ruled out by a general constraint against spreading such as *SPREAD.

complex segment in (11a) is fatal. The form in (11b) where the leftmost non-coronal is targeted, is optimal. Thus arises the leftmost non-coronal pattern.

(11)   Palatalization targets leftmost of the two non-coronals *from* /poko, *mimetic*/

		LICENSE	NO-INTERVENING(pal:R)
a.	po**kʸ**o]	*!	*
b. ☞	**pʸ**oko]		***

The coronal *r* patterns with the non-coronals then because, like palatalized velars and labials, the palatalized *rʸ* has a vocalic off-glide and is thus considered complex. As shown in the tableau in (12) the candidate (12a) is ruled out because the *rʸ* in non-initial position violates the high ranking licensing constraint.

(12)   *r* patterns with non-coronals because rʸ is complex, *from* /koro, *mimetic*/

		LICENSE	NO-INTERVENING(pal;R)
a.	ko**rʸ**o]	*!	
b.☞	**kʸ**oro]		***

4.4 *Implication for underspecification*

Conflicting directionality in Japanese mimetics emerges thus from antagonism between two constraints pushing toward opposite edges. An important consequence of this proposal is that it undermines what has been considered to be a strong argument for contrastive underspecification. Mester and Itô 1989 argued that the behavior of *r* in

mimetic palatalization constitutes an argument *against* radical underspecification (Archangeli 1988, Pulleyblank 1988, Archangeli and Pulleyblank 1989), but *for* a theory of contrastive underspecification (Clements 1987, Steriade 1987). Their account is sketched below in (13). In a right to left scan, the palatalizing feature targets the first non-*r* coronal it encounters. This yields palatalization of the medial segment in a word like *dosa* 'in large amounts', but the peripheral segment if the rightmost consonant is not a coronal. In the absence of non-*r* coronals, then, the feature docks by default to the left edge. Under that analysis, the reason that *r* patterns with the non-coronals is that it lacks an underlying coronal specification, since the place of *r* is not contrastive in the Japanese consonant inventory (cf Steriade 1995). The lack of an underlying coronal specification removes *r* from the class of coronal segments underlyingly, and thus from the set of eligible coronals in the right to left scan. The special behavior of this *r* has become a standard argument for contrastive underspecification.

(13)   Japanese   (Mester and Itô 1989)

i. Associate palatalizing feature to the first non-*r* coronal encountered moving right to left

ii. DEFAULT DOCKING:
If none is encountered then link the feature to the edge where the scan ends (that is, peripherally)

doša   **čoko**   **pʸoko**   **kʸoro**

dosa   to ko   poko   koro
| | | •   •   •   •   •
[cor][cor]   [cor]   \   \
                                 •   •
       \   \
       [-ant]   [-ant]   [-ant]   [-ant]
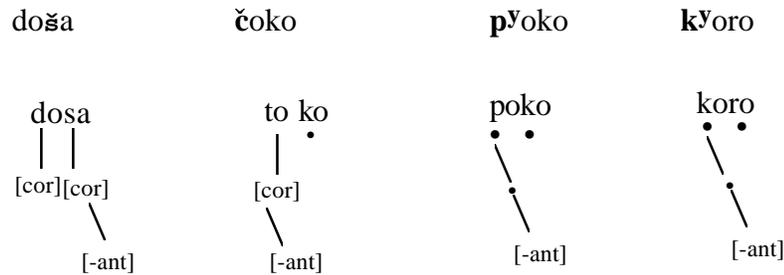
The current proposal instead relates the seeming transparency of *r* to its surface form, attributing its exceptional patterning with the non-coronals as a consequence of the complexity of its palatalized counterpart, a solution corroborated by the well known resistance of *r* to palatalization cross-linguistically (Bhat 1974: 66), which appears to be independent of inventory considerations. Thus the behavior of *r* does not provide an argument for underspecification, a result which is in accord with much recent work arguing against both contrastive and radical underspecification, including that of Mohanan (1991), McCarthy and Taub (1992), Smolensky (1993), Steriade (1993), Inkelas (1994), and Itô, Mester & Padgett (1995) .

4.5 Formal statement of licensing:

4.5.1 Licensing as ALIGN

To sum up so far, this analysis accounts for conflicting directionality in Japanese mimetic palatalization as the optimal resolution of the push/pull relationship between word-peripheral licensing of marked segments and the suffixal nature of mimetic palatalization. How is this licensing to be formalized? Steriade 1995, Brasington 1982, Foley 1977, Hooper 1976, Venneman 1972 have made important contributions to the understanding of licensing through their discoveries of asymmetries between positions which allow complexity (strong positions) and those that do not (weak positions), but none of these proposes a formal licensing condition. While Itô 1986, Goldsmith 1990 and Lombardi 1991 have developed licensing conditions for subconstitutents of the syllable, such as the coda, no formal statement of licensing which might include the licensing of complex segments in Japanese has emerged because a peripheral consonant, whether in a word, foot, or accented syllable, does not correspond to any constituent in current

representations.[5]   However, as Itô and Mester 1994 and Lombardi 1995 quickly recognized, the *Edge*(D) function in McCarthy and Prince 1993a's theory of Generalized Alignment does provide a potentially constrained way to designate a segment which coincides with the edge of any constituent. Following their model, a constraint for the mimetic palatalization would be the one in (14). This states that every complex segment must coincide with the initial segment in the prosodic word: that is, complex segments are initial.

(14)   Licensing effects from ALIGNMENT:

ALIGN LEFT (Complex Segment, PWd)   'complex segments are initial'
$\forall$Cat1$\exists$Cat2(Coincide (Left(complex segment),Left(word))

Recall that the function *Left*(D) returns the leftmost element in domain D, exemplified in (15) for the non-existent $p^y or^y o$. When D is a single segment it necessarily constitutes the leftmost element in the domain. Thus *Left*(complex segment) will return the segment itself.

(15)   *Left*(D) = the leftmost element in domain D

Left(word):   Left $(p^y or^y o) = p^y$

Left(complex segment):   Left$(p^y) = p^y$

Left(complex segment):   Left$(r^y) = r^y$

---

[5] The constraint could be stated informally in previous theories, as I have done in (4), but as such it is too powerful since nothing limits what appears on the left and right sides of the arrow.

The tableau illustrates the operation of the licensing qua alignment constraint for *p^{y}oko* 'flip-flop'. Here candidate (16b) is optimal with respect to the licensing constraint because the complex segment *p^y* is also the first segment in the word.

(16) /poko, *mimetic*/

		ALIGN LEFT	
a.	po**k^y**o]	*!	*k^y* does not coincide with the first consonant
b.☞	**p^y**oko]		*p^y* does coincide with the first consonant

4.5.2 A problem with licensing as alignment

In chapter 3 I argued that precedence constraints better fulfill the mission of Generalized Alignment (McCarthy and Prince 1993a) with respect to the characterization of infixation. However, there are two properties of licensing which distinguish it from the cases of affixation discussed there. First, licensing of marked structure never involves an injunction to be as close to a strong position as possible. Rather, licensing *always* constitutes an all-or-nothing proposition whereby marked structures are licit in licensed positions but ill-formed everywhere else. Additional data from Japanese mimetic palatalization provide an important illustration of this (17). The initial consonant in these words is not an eligible target for palatalization due to a co-occurence restriction against palatalized onsets to *e* (18). If licensing could be gradiently satisfied the medial consonant would be palatalized in these cases, but it is not. A complex segment either appears initially or not at all.

(17)   Data from Mester and Itô 1989: 284

		*violates *C^y e*	*violates licensing*
keba-keba	'gaudy'	*k^yeba-k^yeba	*keb^ya-keb^ya
neba-neba	'sticky'	*n^yeba-n^yeba	*neb^ya-neb^ya
gebo-gebo	'gurgling'	*g^yebo-g^yebo	*geb^yo-geb^yo
teka-teka	'shining'	*ceka-teka	*cek^ya-tek^ya

(18)   ***C^y e**   (Mester and Itô 1989: 283)

'*e* cannot be preceded by a palatalized consonant'

(i) $\forall x(x = e \rightarrow x$ is not preceded by a palatalized C)
(ii)   Assess one mark for each value of x for which (i) is false

The second important difference is that licensing does not strictly involve either coincidence of edges or distance from an edge, but is concerned rather with membership in a constituent which may be peripheral. In Guugu Yimidhirr (Kager 1995), for example, long vowel syllables are restricted to the first two syllables of a word (19). Either the first, the second or both of these syllables may contain long vowels, but no long vowels are licensed outside this two syllable window. Kager analyzes the first two syllables as a kind of foot, allowing an informal licensing statement like the one shown in (20). This provides another illustration of the all-or-nothing quality of licensing as well. It is not enough to be as close to the first foot as possible. A heavy syllable can fall anywhere withing the foot, but it must belong to the first foot.

(19) Vowel length distribution in Guugu Yimidhirr

1st syllable heavy		2nd syllable heavy		1st & 2nd	
miil	*eye*	da*waar*	*star*	*buuraay*	*water*
*waa*Da	*crow*	gam*buu*gu	*head*	*muuluu*mul	*dove*
*guu*Rumugu	*meat hawk*	bu*duu*nbina	*thunder*		

(20)   **Licensing**:   Heavy syllables (CVV) belong to the first foot (Φ)

As it stands neither the alignment theory of licensing nor the precedence constraints in Chapter 3 can account for positional restrictions such as this which do not restrict marked structure to a single edge. Because a heavy syllable is licensed at both edges of the foot, Guugu Yimidhirr requires two constraints in either theory. (21) provides the requisite ALIGN constraints. In *muuluumul*, for example (22), each heavy syllable satisfies one alignment constraint while violating the other.

(21)   **Align-Left**(Heavy syllable, First foot)
          'a heavy syllable coincides with the leftmost syllable in the first foot'

          Align-Right(Heavy syllable, First foot)
          'a heavy syllable coincides with the rightmost syllable in the first foot'

(22)   /*muuluu*mul/ → [muuluumul]

	Candidates	ALIGN Left	ALIGN Right
a.	[*muuluu*]mul	* (luu)	* (muu)

Because each syllable violates one of the alignment constraints, a constraint against shortening must outrank them both. Urbanczyk 1995:512 proposes a correspondence constraint requiring identity of moraic analyis for correspondent segments which has the desired effect (23).

(23)   **IDENT(μ)**[6]   'input length is preserved in the output'

If α (an integer) weight bearing units dominate a segment in S1 then α weight bearing units dominate its correspondent in S2.

(24)   **IDENT(μ)** » **ALIGN LEFT;ALIGN RIGHT**

Rationale: alignment violations do not trigger shortening

A more complete tableau is given in (25). The optimal candidate (25a) retains the input long vowels because to shorten either would result in the violation of the higher ranked **IDENT(μ)**.

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[6] Urbanczyk calls the constraint TRANSFER. (Urbanczyk 1995: 512)

(25) *muuluu*mul   from /muuluumul/

	Candidates	IDENT(μ)	ALIGN Left	ALIGN Right
a.	[*muuluu*]mul		* (luu)	* (muu)
b.	[*muulu*]mul	*!		
c.	[*muluu*]mul	*!		

With both these constraints it is impossible to limit the heavy syllables exclusively to the foot domain, however. Consider a hypothetical input with a heavy syllable in the third position (26). The ill-formed candidate which surfaces with the long vowel (26a) triggers the same constraint violations as the well formed word in (25) above, and cannot be ruled out by this hierarchy. In the wrongly optimal output (26b), vowel length is preserved due to the high ranking IDENT(μ).

(26) Hypothetical /mulubuulu/→ *mulubuulu

	Candidates	IDENT(μ)	ALIGN Left	ALIGN Right
a. ♠	*[mulu]*buu*lu		*	*
b.	[mulu]*bu*lu	*!		

The precedence constraints (27) fail for the same reason. In (28a), the heavy syllable *buu* violates NO-INTERVENING(σ_H;L;Φ_1) twice because two syllables intervene between it and the left edge of the first foot (marked by a left bracket). Since violations of

the precedence constraint must be allowed for foot internal heavy syllables, we cannot

force the vowel in the third syllable here to shorten.

(27)   **NO-INTERVENING(σ_H;R;Φ_1)**
       'nothing intervenes between a heavy syllable and the right edge of the first foot'

       NO-INTERVENING(σ_H;L;Φ_1)
       'nothing intervenes between a heavy syllable and the left edge of the first foot'

(28)   /mulubuulu/$\rightarrow$ *mulu*buu*lu

	Candidates	IDENT(μ)	NO-INTERVENING (σ_H;L;Φ_1)	NO-INTERVENING (σ_H;R;Φ_1)
a. ♠	[mulu]*buu*lu		**	
b.	[mulu]***bu***lu	*!		

Thus neither ALIGN as it stands nor NO-INTERVENING yields an adequate theory of

licensing. Both ALIGN and NO-INTERVENING are constraints about edges. ALIGN requires

coincidence of edgemost elements, while NO-INTERVENING measures distance from a

designated edge. Yet we saw in Guugu Yimidhirr that heavy syllables simply want to

belong to the first foot. The edge of the foot at which they stand is irrelevant. In the next

section I will show that we do need ALIGN's notion of coincidence for licensing, but

modify earlier proposals by formalizing a constraint on coincidence of *constituents*, one

possibility of which includes coincidence of edge-most elements.

4.5.3 A proposal

On the one hand, McCarthy and Prince 1993a's *Edge*(x) function for the first time provides a way to formally designate the leftmost element in a string, opening the door to a more general formulation of licensing. On the other hand, because ALIGN refers exclusively to the coincidence of edges it fails to account for licensing of elements not found strictly at an edge such as the heavy syllables of Guugu Yimidhirr. Licensing requires a more general constraint on coincidence of constituents. (29) shows the general form of the constraint necessary to capture this formally which I propose.[7]

(29) **COINCIDE** (marked structure, strong constituent)   (*generally*)

(i) $\forall x$ (x is marked $\rightarrow \exists y$(y=strong constituent $\land$ Coincide (x,y))
(ii)   Assess one mark for each value of x for which (i) is false

Coincide (x,y) will be true if (i) y=x, as in the case of the peripheral consonant in Japanese Mimetics (30a); (ii) y dominates x, as in the case of the heavy syllables in Guugu Yimidhirr (30b); or (iii) x dominates y, as in the moraic licensing proposed by Zec 1988 (30c).

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[7] The hierarchy I develop here conforms to the restrictions imposed in Kiparsky 1994, who proposed that a parametrizable constraint has a general version (such as Coincide (segment, X)) and a version that refers specifically to marked feature values (such as Coincide (marked segment, X). Under this conception no constraint refers specifically to unmarked features. See also Smolensky 1994.

(30)   Coincidence

		Example:	
b.	$y = x$	$\#C^yVC$	C^y *coincides with the first consonant*
a.	y dominates x $$\begin{array}{c} y \\ \diagup\diagdown \\ x \quad z \end{array}$$	$$\begin{array}{c} \text{Foot} \\ \diagup\diagdown \\ \sigma_H \quad \sigma_L \end{array}$$	σ_H *coincides with the foot* σ_L *coincides with the foot*
c.	x dominates y $$\begin{array}{c} x \\ | \\ y \end{array}$$	$$\begin{array}{c} \mu \\ | \\ \text{vowel} \end{array}$$	μ *coincides with the vowel*
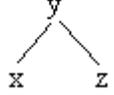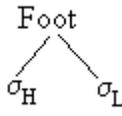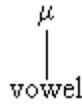
The proposed licensing constraint in (29), like ALIGN, dictates the coincidence of the marked structure in question with a strong constituent. Some structures, such as accented syllables and long vowels, may be considered strong independently of their location, but others gain prominence only by dint of their peripheral position. To pick out these peripheral constituents we can build on Itô and Mester 1994's and Lombardi 1995's use of the function *Edge*(x) for this purpose. The function *{L,R}-most*(P, Q,) in (31) extends this notion to designate any prosodic constituent (from the prosodic hierarchy) at a designated edge. (32) shows the constituents returned by the *Leftmost*(P,Q) function for the cases discussed above.[8]

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[8] We will see instances of *Rightmost*(P,Q) below.

(31)   Let *{L,R}-most*(P,Q) = the {L,R}-most P in Q, where P,Q are
        prosodic constituents

        Then: *Rightmost*(P,Q) = the rightmost P in Q

                Leftmost(P,Q) = the leftmost P in Q

(32)   ***STRONG CONSTITUENT***   ***LANGUAGE***

        Leftmost(foot, word)= first foot   *Guugu Yimidhirr*

        Leftmost(segment, word)= first segment   *Japanese (Mimetics)*

        COINCIDE is a parametrizable constraint in the sense of Smolensky 1995 and
Kiparsky 1994. In Guugu Yimidhirr, for example, licensing should entail that a heavy
syllable belong to the first foot, but be indifferent to the position of the syllable with
respect to either foot edge.(33) shows the specific constraints for Guugu Yimidhirr. It
states that a heavy syllable coincides with the first foot, exactly the restriction required.

(33)   Guugu Yimidhirr:

        COINCIDE(heavy syllable, *Leftmost*(Foot, word))
        'a heavy syllable belongs to the first foot'

        (i) $\forall x$(x is a heavy syllable $\rightarrow \exists y$ (y= *Leftmost*(Foot, word) $\land$ Coincide (x,y))
        (ii)   Assess one mark for each value of x for which (i) is false

        The tableau in (34) illustrates how licensing works in Guugu Yimidhirr. COINCIDE
is violated by a heavy syllable that falls outside the foot. The constraint correctly selects
(34b) as the optimal candidate, since the heavy syllable in (34a) does not coincide with
the leftmost foot. In this account IDENT(μ) must rank below the licensing constraint since

COINCIDE violation will forse the shortening of an input long vowel which appears outside of the first foot.

(34)   Hypothetical   /mulubuulu/ → [mulubulu]

	Candidates	COINCIDE (σ_H, L(Foot, word))	IDENT(μ)	
a.	₍foot₎[mulu]*buu*lu	*!		*buu* does not coincide with initial foot
b.☞	₍foot₎[mulu]***bu***lu		*	input *buu* shortened in output

COINCIDE does allow either syllable in the foot to be heavy (35). Unlike ALIGN and NO-INTERVENING, however, no violations accrue for a syllable which is not at a particular edge of the foot, either left or right. Therefore a heavy syllable in either of the first two syllables will not force a violation of the lower ranked constraint which preserves input vowel length.

(35)   *muuluu*mul

	Candidates	COINCIDE (σ_H, L(Foot, word))	IDENT(μ)	
a. ☞	₍foot₎[muuluu]mul			
b.	₍foot₎[muluu]mul		*!	input *muu* shortened in output
c.	₍foot₎[muulu]mul		*!	input *luu* shortened in output

COINCIDE yields the right result for the mimetic palatalization as well. The licensing constraint is given in (36).

(36)   Mimetics   **COINCIDE**(complex consonant, *Leftmost*(segment, word))
'A complex consonant is the first segment in the word'

(i) $\forall x$ (x is a complex segment $\rightarrow \exists y$ (y= *Leftmost*(Segment, word) $\wedge$ Coincide (x,y))
(ii)   Assess one mark for each value of x for which (i) is false

As the tableau in (37) shows, in cases where palatalization is blocked on the first syllable by the high ranking co-occurence restriction the optimal candidate contains no complex segments.

(37)   /keba, mimetic/

		*C^{Y}E	**COINCIDE**(complex, *L* (segment, word))
a.	k^{y}eba	*!	
b.	keb^{y}a		*!
c.☞	keba		

It should be obvious by now that precedence and coincidence are independent concepts. Chapter 3 demonstrated the necessity of precedence constraints in the case of infixation. In this chapter I showed conversely that precedence cannot account for licensing effects which require marked structure to belong to a strong constituent but are indifferent to its position within that constituent. Thus coincidence and precedence, originally conflated in Generalized Alignment, are both formally and empirically distinct and have to be distinguished in the grammar.

An account of licensing founded on COINCIDE yields the universal theory of licensing of marked structure which previously eluded precise formulation.[9] It shares with ALIGN the advantage of being able to pick out an element at an edge, but it is also more general because it encompasses cases that are not strictly about edges. The next section uses the resources of COINCIDE to develop a parallel account for conflicting directionality in stress. The proposed solution bridges the gap between the prosodic and melodic manifestations of conflicting directionality, and thus establishes a general model for analyzing conflicting directionality within Optimality Theory.

4.6 Licensing of Prosodic Structure in Eastern Cheremis

A typical case of conflicting directionality involving stress is exemplified by the stress pattern in Eastern Cheremis. The data are repeated here in (38). Recall that the *rightmost* heavy (CVV) syllable receives the stress, but if there are no heavy syllables, it is the *leftmost* syllable which is stressed.

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[9] There are two other kinds of effects dubbed licensing in the literature in which coincidence plays no role. One is the sort of licensing discussed by Goldsmith 1990 and Yip 1991 where a constituent admits only one instance of a feature.The other is licensing through government or adjacency (e.g., Kaye 1990).

(38)   Stress in Eastern Cheremis   (Data from Hayes 1981: 57)

a.   šiin**çáam**   *I sit*

b.   šlaa**páa**ʒəm   *his hat (acc)*

c.   **pǘü**gəlmə   *cone*

d.   **kíi**dəštəʒa   *in his hand*

e.   **tə**ləzən   *moon's*

Following the model established for Japanese, the general precedence constraint in (39), which optimally stresses the rightmost syllable in the word, must be in opposition to a licensing constraint which aligns marked prosodic structure to the left edge (40). I propose that the marked structure in this case is a *light stress-bearing syllable*. The existence of languages which lengthen stressed short vowels, such as those presented in Hayes 1985 and Buckley 1996, provides strong support for the contention that light syllables with stress are indeed marked. (40) spells out the COINCIDE constraint which has the effect of licensing stressed light syllables only word initially.

(39)   General Placement of stressed syllables

NO-INTERVENING(σ ; R)   'A stressed syllable is final'

(i)   ¬∃x(Syllable(x) ∧ x intervenes between σ and the right end of the word)

(ii)   Assess one mark for each value of x for which (i) is false

(40) Constraint licensing light stressed syllable:

COINCIDE(σ_μ, *Leftmost*(σ, word))   'A stressed light syllable is word initial'

(i) $\forall$x (x is a stressed light syllable $\rightarrow$ $\exists$y (y= *Leftmost*(σ, word) $\wedge$ Coincide (x,y))
 (ii) Assess one mark for each value of x for which (i) is false

As in Japanese, the licensing constraint must rank above the more general NO-INTERVENING constraint, since NO-INTERVENING will be violated to preserve licensing. The tableaux in (41) and (42) show how this generates the correct pattern for Eastern Cheremis. The form in (41) contains two heavy syllables. In (41a) the rightmost syllable is light, and by stressing it we violate the high ranking COINCIDE constraint. Since the other syllables are both heavy they vacuously pass the coincidence constraint. In the optimal form in (41b) the rightmost heavy syllable bears the stress, since this causes the fewest violations of NO-INTERVENING.

(41)   **COINCIDE**(σ_μ, *Leftmost*(σ, word) » **NO-INTERVENING**(σ ; R)

from /šlaapaaʒəm/

	Candidates	**COINCIDE**(σ_μ; L)	**NO-INTERVENING**(σ ; R)
a.	šlaapaaʒə́m	*!	
b.☞	šlaa**páa**ʒəm		*
c.	**šláa**paaʒəm		**!

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In the form in (40) on the other hand where all syllables are light, the highly ranked **COINCIDE**(σ_μ; L) constraint renders the word initial stress optimal (40c). This analysis thus derives the rightmost heavy/leftmost light pattern using the same general constraints that were used to account for Japanese Mimetic Palatalization.

(42)   tələzən

	Candidates	**COINCIDE**(σ_μ; L)	**NO-INTERVENING**(σ ; R)
a.	tələzən	*!	
b.	tələzən	*!	*
c.⇨	tələzən		**

4.7   Typology

The proposed analysis for the first time relates conflicting directionality in the prosodic and melodic domains. In this section I will show that this account surpasses previous analyses further by correctly making more constrained predictions about the variety of patterns expected cross-linguistically. In particular it predicts that we will not find a language where it is the *unmarked* structure that has defective distribution (43). In such a language, for example, palatalization would target a rightmost velar, but if there were none, an initial coronal would be palatalized. Likewise stress would be attracted to the rightmost light syllable, or failing that, the leftmost heavy. No matter how we

manipulate the constraints it is impossible to derive this pattern. While one may never have expected to find such a language, standard rules of association predict it to exist.

(43)   Prediction: No language where *unmarked structure* has defective distribution

	Palatalization	Stress
target the rightmost marked:	ko**kʸ**	ta.<u>tá</u>
	kʸot	<u>tá</u>. taa
otherwise leftmost unmarked:	**š**od	<u>táa</u>.taa

Manipulation of these constraints will fail to generate the pattern in (43). As summarized in (44), the typology comprises only four possible patterns.[10] When a constraint which is not specific to marked structure outranks a licensing constraint (44a-b) the effects of the lower constraint will not be felt. In these patterns licensing plays no active role. Only when the licensing constraint is dominant and specifies the opposite edge from the general constraint will it have an impact on the output. Where licensing favors the left edge (44c), the Japanese mimetic palatalization pattern will be found. Where it favors the right edge (44d) we expect the mirror image.

(44)

a.	*leftmost*	No-Intervening(ø;L)	»	Coincide(marked, R/L)
b.	*rightmost*	No-Intervening(ø;R)	»	Coincide(marked, R/L)
c.	*leftmost simple else rightmost complex*	Coincide(marked, R)	»	No-Intervening(ø;L)
d.	*rightmost simple else leftmost complex*	Coincide(marked, L)	»	No-Intervening(ø;R)

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[10] Walker 1995a extends this typology to cases where these constraints interact with nonfinality.

First, ranking of a general right edge oriented precedence constraint over a phonological licensing constraint for either edge will produce a uniform "rightmost consonant" or "rightmost syllable" pattern. Hyman 1977, for instance, lists 97 languages with predominant final stress. The same ranking accounts for subsegmental suffixes, including tonal ones. In Bini, for example, the Associative high tone docks on the final syllable of the head noun in a noun-noun collocation (45). Alternations in bisyllabic low toned nouns illustrate the pattern (Akinlabi (in press)).[11]

(45)   **Bini Associative Construction**

	L			LH	
a.	òwɛ̀	ɔ̀sà	→	òwɛ́ ɔ̀sà	
	leg	chimpanzee		'a chimpanzee's leg'	
b.	ɛ̀vbɔ̀	òzó	→	ɛ̀vbɔ́ òzó	
	town	Ozo		'Ozo's town'	

.

The relevant part of Akinlabi's analysis, adapted to the present framework, is shown in (46). A right-edge oriented morpheme specific No-INTERVENING ([High]associative; R) constraint dominates the H licensing constraint, COINCIDE. Because

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[11] In longer forms the high tone spreads through the head noun to the peninitial syllable. For example:

L			LHH	
àkòbè	úyǐ	→	à**kóbɛ́** úyǐ	
iron trap	Uyi		Uyi's iron trap	

Spreading results from whatever constraints induce harmony (Cole and Kisseberth, Beckman, Walker, etc.) Akinlabi follows Kirchner 1993 in proposing that leftward spreading is induced by an ALIGN-Left constraint. See Akinlabi (in press) for details.

the precedence constraint is more general, any effect of licensing will be masked, and

licensing violations will never be decisive.

(46)   NO-INTERVENING ([High] $_{\text{associative}}$; R) » COINCIDE ([High]; R or L)

ὲvbó *from*   /ɛvbo, L, H$_{\text{associative}}$/

			NO-INTERVENING ([High] $_{\text{associative}}$; R)	COINCIDE ([High]; R or L)
a.	HL	ɛ́vbò	*!	
b. ☞	LH	ɛ̀vbó		

The reversal of the directional parameter of a high ranking general precedence

constraint yields a pattern where the *leftmost* potential element will be the target,

regardless of markedness. [12] Representing this case, at least 144 languages have been

shown to exhibit syllable peripheral stress (Hyman 1977). Subsegmental examples

include Zoque palatalization (Akinlabi 1994, Wonderly 1951), voicing in Otomi (Wallis

1948) and Japanese Rendaku (Itô and Mester 1986), and H tone association in Mixteco

(Tranel 1995). The continuative morpheme in Mixteco, for instance, consists only of a

floating high tone prefix (Tranel 1995). The full range of lexical tone patterns is shown

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[12] Even where licensing is ranked low its effects may be felt depending on other constraints. For example,
the complex tone pattern in the N. Karanga verb (Hewitt and Prince 1989; see also Goldsmith 1987)
arguably follows from the ranking OCP » Coincide (Tone, Left) » Coincide (H, Right). This is somewhat
complicated by what appears to be initial syllable extrametricality, however, and merits closer examination.

schematically in (47)[13], where it is assumed that mid tone is unspecified. When the prefixal H associates it yields the patterns in the third column.

(47)   General patterns from association of floating H prefix   (Tranel 1995: 5)

	lexical tone	surface	plus prefix **H**
a.	HH	HH	**H**H
b.	HØ	HM	**H**M
c.	HL	HL	**H**L
d.	ØØ	MM	**H**M
e.	LH	LH	**H**H
f.	LØ	LM	**H**M
g.	ØH	MH	M**H**
h.	ØL	ML	M**H**

Patterns (47a) through (47f) substantiate the assertion that the continuative H morpheme is in fact a prefix. Tranel captures this with a constraint he calls TONE-LEFT (Tranel 1995b:10).[14] This translates readily into the left-edge oriented NO-INTERVENING constraint in (48).This constraint eclipses the lower ranked licensing constraint, whose edge-orientation is again irrelevant.

(48)   NO-INTERVENING ([High] $_{continuative}$; L) » COINCIDE ([High]; R or L)

/HM *from* MM, H $_{continuative}$ /

		NO-INTERVENING ([High] $_{continuative}$; L)	COINCIDE ([High]; R or L)
a. ☞	**HM**		*
b.	M**H**	*!	

To complete the account, in ML and MH words the peripheral mid tone is transparent, and the prefixal H actually surfaces on the second syllable. The NO-

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[14]The NO-INTERVENING constraint in (48) is a somewhat oversimplified version of Tranel's TONE-LEFT, which is actually an alignment constraint on the laryngeal tier. This is necessary to handle cases where the host word contains a tone-perturbing glottal stop. See Tranel 1995a, 1995b for details.

INTERVENING(Left) constraint is thus violable under pressure from some higher ranking constraint. Tranel proposes a constraint he calls TPFaith to explain these cases (49). TPFaith blocks the prefixal H tone from associating to a lexically toneless syllable whenever possible (50). In short, since M is toneless, this constraint forces the prefixal H onto the second syllable from underlying ØL (ML) and (ØH). H settles on the first syllable when confronted with MM (underlying /ØØ/) only because the neither syllable has a lexical tone associated with it so nothing compels violation of NO-INTERVENING.

(49)   **TPFaith**   'Preserve tonal prominence profile'
       (Tranel 1995a: 19)

(50)   **TPFaith**   »   **NO-INTERVENING** ([High] $_{continuative}$; L)

/MH *from* ØL, H $_{continuative}$ /

		TPFaith	NO-INTERVENING ([High] $_{continuative}$; L)
a.	**HL**	*!	
b. ☞	**MH**		*

Finally, the only possibility remaining in this system is to keep licensing high, but with the *right* edge as the strong edge, in conflict with a more general *left* edge-oriented constraint. If complexity is licensed at the right edge of a word, but the precedence constraint favors the the left edge, a conflicting directionality opposite to Japanese Mimetic palatalization and Eastern Cheremis stress results. There have been no examples

of this pattern for subsegmental association[15], indicating a licensing assymetry between prosodic and melodic domains. The stress pattern in Kwakwala constitutes an example of this. As described by Zec 1994 (drawing on Boas 1947) in Kwakwala the leftmost heavy syllable is stressed. In the absence of a heavy syllable it is the final syllable which receives the stress. I have shown this schematically in the tableaux in (51).

(51)　**COINCIDE**(σ_μ, L) » **NO-INTERVENING**(σ ; R)

Leftmost heavy

		COINCIDE(σ_μ, R)	**NO-INTERVENING**(σ ; L)
a.	CVV CVV		*!
b. ☞	CVV CVV		

Rightmost light

		COINCIDE(σ_μ, R)	**NO-INTERVENING**(σ ; L)
a. ☞	CV CV		*
b.	CV CV	*!	

4.8 *The other unbounded stress pattern*

The proposed analysis succeeds in correctly limiting conflicting directionality to those cases where only the marked structure is subject to positional restrictions. In addition, the factorial typology derives the unbounded stress pattern where the target is

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[15] Although we expect to find this kind of conflicting directionality for tone.

the leftmost or rightmost unit in a domain regardless of syllable weight. There is one other pattern of so-called "unbounded stress" which must be accounted for, exemplified by the languages in (52) (Hayes 1981 via Prince 1983: 77). In this pattern the stress targets the leftmost heavy syllable if there is one. Otherwise the initial syllable is stressed (52a). The mirror image of this pattern, where the rightmost heavy syllable or else the rightmost syllable is stressed also exists (52b).

(52)   Two other unbounded patterns

a.   First heavy or first syllable: Fore, Khalka Mongolian, Yana

b.   Last heavy or last syllable: Aguacatec, Golin

        I illustrate this with data from Aguacatec (Mayan) (McArthur and McArthur 1956). Here stress occurs on the rightmost long vowel or on the final short vowel if no long vowels are present. In (53a) the stress is found on the final syllable since this syllable is heavy. In (53b), however, the first syllable attracts stress since it has a long vowel. Examples (53c) and (53d) provide a near minimal pair to illustrate stress assignment. In (53d), stress appears on the initial syllable since it contains the only long vowel in the word. In (53c), on the other hand, where both syllables are light, stress defaults to the final syllable. This example shows further that syllable weight is not a consequence of stress, since the stressed vowel does not lengthen.

(53)   Aguacatec (Mayan)   (McArthur and McArthur 1956)

a.   ʔacu:ʔc   'your milk'

b.   ʔa:c'um   'salt'

c.   ʔak'ac   'your hip'

d.   ʔa:k'ah   'new'

e.   ŋqe:rac   'that isn't it'

f.   tpiltáʔ   'courthouse'

To account for these languages it is only necessary to enrich the proposed hierarchy with the well-motivated WEIGHT-TO-STRESS PRINCIPLE (Prince 1990), as shown in (54).[16] Because stress occurs on the rightmost syllable in the absence of any heavy syllable, the constraint which governs stress assignment, NO-INTERVENING(σ;R), must prefer the right edge. NO-INTERVENING(σ;R) must rank below the WSP, however, since the precedence constraint may be violated to allow stress on a heavy syllable,

(54)   a.   **WEIGHT-TO-STRESS (WSP)**   'If heavy then stressed'

(i)   ∀x (Heavy Syllable(x) → Stressed(x))
(ii)   Assess one mark for each value of x for which (i) is false

b.   **NO-INTERVENING(ó;R)**   'stress the rightmost syllable'

c.   **WSP** »   **NO-INTERVENING(ó;R)**

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[16] The WSP constitutes one member of the family of Peak-Prominence constraints utilized by Prince and Smolensky 1993 and Kenstowicz 1994.

The tableaux in (55-56) show that this ranking indeed produces the desired outcome. In (55) only the first syllable of the input is heavy. The optimal output candidate (55b) places stress on the initial syllable, thereby violating NO-INTERVENING but satisfying the higher ranked WSP.

(55)   ʔa:c'um *from*   /ʔa:c'um/   'salt'

/ʔa:c'um /		WSP	NO-INTERVENING(ó;R)	
a.	ʔa:**c'úm**	*!		a heavy σ is unstressed
b. ☞	ʔ**á:**c'um		*	σ intervenes between σ and edge

Compare this form to one where the input is a word where all syllables are light (56). Here stress occurs on the final syllable in the optimal output form (56a), since there is no motivation to place it to the left.[17]

(56)   ʔak'ač *from*   /ʔak'ac /   'your hip'

/ʔak'ac /		WSP	NO-INTERVENING(ó;R)
a. ☞	ʔa**k'ác**		
b.	ʔ**a**k'ac		*!

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[17] A high ranking constraint presumably dictates only a single primary stress per word.

Thus this ranking derives the pattern described as rightmost heavy otherwise rightmost syllable. By changing the precedence constraint to favor the left edge the hierarchy would yield the leftmost heavy otherwise leftmost syllable pattern. Notice that unlike conflicting directionality, this pattern does not depend on licensing. Here No-INTERVENING is violated in order to arrive at a less marked stressed syllable, regardless of its position in the word. In fact, this cannot be made to follow from licensing. An analysis parallel to that of conflicting directionality would contain the constraints in (57). Here the direction of COINCIDE and NO-INTERVENING are the same.

(57) **COINCIDE(σ'_μ, R)** » **NO-INTERVENING ($\acute{\sigma}$;R)**

The tableau in (58) provides the crucial case. Where marked structure is licensed at the same edge favored by NO-INTERVENING there is no way to choose a less marked structure which is misaligned. There would be no reason to pass over a stressed light syllable in final position, since it would violate neither of the alignment constraints. These constraints alone would produce simply a "rightmost syllable" pattern.

(58)

/ʔa:c'um /		COINCIDE(σ_μ, R)	NO-INTERVENING (σ;R)
a.♠	ʔa:**c'úm**		
b.	ʔ**á:**c'um		*!

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Conversely, conflicting directionality crucially involves the licensing of marked structure, rather than an explicit preference for unmarked structure.[18] Unless the analysis specifically refers to the position in which complex structure is permitted there is no way to achieve its hallmark asymmetrical distribution. A potentially promising bid to avoid implicating licensing would be to involve the WSP with two general precedence contraints, as shown in (59). However, there is no ranking of these constraints which will achieve conflicting directionality.

(59) a. **WEIGHT-TO-STRESS (WSP)**: If heavy then stressed

       b. **NO-INTERVENING(σ́;R)** Stress the rightmost syllable

       c. **NO-INTERVENING(σ́;L)** Stress the leftmost syllable

The six possible rankings of these three constraints yield only two patterns. First of all, directionality will be completely determined by the higher ranking precedence constraint. Therefore the mere presence of mirror image NO-INTERVENING constraints cannot result in conflicting directionality. Furthermore the relative ranking of the WSP with respect to the dominant constraint will not give us the contest between edges we seek. It has already been shown that when the WSP outranks NO-INTERVENING we get the "Xmost heavy otherwise Xmost" pattern (60a). The opposite ranking, where NO-INTERVENING ranks highest, will yield the quantity insensitive statement "stress the Xmost syllable" (60b).

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[18] See Hewitt and Crowhurst 1995 for an account using alignment and local conjunction to achieve conflicting directionality without reference to licensing.

(60)   a.   WSP   »   **NO-INTERVENING(ó;X)**

   Stress the Xmost heavy otherwise the Xmost syllable

   b.   **NO-INTERVENING(ó;X)**   »   WSP

   Stress the Xmost syllable

Therefore licensing is crucial in cases of conflicting directionality, but plays no role in phenomena where a single edge is dominant. This result may help to explain an asymmetry between the two types of cases in the literature. In the majority of cases of conflicting directionality the marked structure is found in initial position. The relative rarity of the mirror image conflicting directionality then follows from the fact that word final position is not as strong a licenser in general. In cases where licensing plays no role, however, we expect to find robust effects both at the left and right edges. While left edge orientation is somewhat more common in non-conflicting cases, there is no shortage of languages which stress final syllables irrespective of quality or associate a floating feature to the right edge. Hyman (1977), for example, lists 144 languages with predominantly peripheral stress, and 97 languages with predominantly final stress.

4.9 Conclusion

In this chapter I elaborated a theory of licensing within Optimality Theory and argued that conflicting directionality arises from the antagonism between the licensing of marked structures and the demands of more general precedence constraints. The account

reveals the link between the segmental and prosodic cases of conflicting directionality and relates them to well-attested cases of licensing cross-linguistically.

5.   Latent Segments and Exfixation

5.1 Introduction

Chapter 1 demonstrated that invisibility to the syllable constitutes the only automatic consequence of representing a phonological element as a floating feature. Traditionally the realm of floating features embraces exclusively phenomena like those discussed in Chapters 2, 3 and 4, where the features are realized only by docking onto some existing segment. However latent segments also behave exceptionally with respect to parsing, and as argued in Chapter 1, should likewise be represented as floating features. For all floating features the grammar dictates their optimal target. Latent segments differ from prototypical floating features only in that their target is an inserted root node rather than a consonant or vowel present elsewhere in the string.

(1)   Exceptional parsing⇒ No root node

SURFACE:	FULL SEGMENTS	LATENT SEGMENTS AND FLOATING FEATURES
	Root |	
UNDERLYING:	features	features

In this chapter I do a case study of the realization of three kinds of latent segments in Yowlumne.[1] The language is most interesting in this regard because its floating glottalization may either target an existing segment or dock onto an inserted root node, depending on the context. Yowlumne has in addition two other types of latent segments. In this chapter I will show how the behavior of all three types follows from an analysis

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[1] The native spelling of the language usually referred to as Yawelmani in the linguistic literature (William Weigel, p.c.). See Chapter 1, fn 13

parallel to the one developed for the Inor floating features in Chapter 3, and motivate the use of *STRUC(σ), a constraint against excess structure, by demonstrating its role in accounting for asymmetries in the behavior of Yowlumne's latent consonants and latent vowels. This chapter further illustrates the generality of the approach to subsegments introduced in the earlier chapters.

Yowlumne also provides an opportunity to introduce a third class of affixes into the typology, one not previously analyzed in Optimality Theory. Up until now we have seen edge-bound affixes (2a), and infixes (2b), both segmental and subsegmental. Under the analysis in previous chapters, the differences between the two types of affixes follows from the relative ranking of their precedence constraints with respect to other constraints in the grammar. Yowlumne provides evidence of a third class of affix called an *exfix* (2c).[2] Unlike full infixes, these suffixes are discontinuous in the output because only a portion of the suffix works its way into the base. I show that this behavior likewise follows from the same sort of NO-INTERVENING constraint which governs the edge-bound and fully infixing affixes. No such general account is available under the McCarthy and Prince 1993 coincidence-based conception of affix placement.

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[2] The term for this kind of affixation comes from McCarthy and Prince 1995b:320 , although in that context they dispute the existence of exfixation

(2)

		SUBSEGMENTAL	**SEGMENTAL**
a.	*edge-bound affixes*	Inor palatalization	Ilokano *ag-* prefix
b.	*full infixation*	Inor labialization Japanese mimetic palatalization	Ilokano um- infix
c.	*exfixation*	Yowlumne glottalizing suffixes	Hamer -ta suffix

5.2 Latent glottals in Yowlumne

5.2.1 How do you identify a subsegment in Yowlumne?

The Yowlumne glottalization process (Newman 1944, Kuroda 1967, Kisseberth 1970, Archangeli 1983, 1984, 1991, Noske 1984, Archangeli and Pulleyblank 1994) is an example of a subsegment difficult to classify as either ghost segment or floating feature. Depending on context it either moves to find a suitable docking site in the base or projects its own root node. (3) provides some examples. Suffix induced glottalization targets the rightmost post-vocalic sonorant in the base (3a). Otherwise, in a biconsonantal root it will manifest itself as a suffix initial glottal stop (3b). Note that in (3a) vowel shortening is unnecessary since [constricted glottis] can dock as a secondary feature on the preceding sonorant, whereas in (3b), a biconsonantal stem with no glottalizable sonorant, vowel length is sacrificed to the parsing of the full glottal.[3] In the triconsonantal root in (3c) there is no way to parse the feature since there is no post-vocalic sonorant, nor

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[3] The vowel length comes from the morphological templates, presented in Chapter 1. See references above for discussion.

is there space for a full glottal stop without epenthesizing a vowel, so the glottalization is

not expressed. Other glottalizing suffixes are shown in (4).[4]

(3)   Glottalization in Yowlumne

      ^(ʔ)aa   *durative*:   ^(ʔ) = [constricted glottis]

                              ([+G] of Archangeli 1983)

a.   glottalize <u>rightmost post-vocalic sonorant</u>

      /caaw-^(ʔ)**aa**/   caa**w**ˀ **aa**-   *shout*

      /ʔiilk-^(ʔ)**aa**/   ʔe**l**ˀk**aa**-   *sing*

b.   otherwise full glottal root finally if room

      /maax- ^(ʔ)**aa**/   max**ˀaa**-   *procure*

c.   otherwise fail to surface   ⁽*CCC⁾

      /hogn- ^(ʔ)**aa**/   hognaa-   *float*

(4)   Suffixes which induce glottalization (Archangeli 1983: 379)

(ʔ)iixoo   *consequent auxiliary*   (ʔ)aas   *habitual genitive*

(ʔ)aa   *continuative*   (ʔ)inˀay   *contemporaneous gerundial*

(ʔ)ic   *agentive*   (ʔ)anaa   *desiderative agentive*

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[4] Steriade 1995 argues that sonorant glottalization and obstruent glottalization are different features, hence the restriction here to sonorants. See also Archangeli and Pulleyblank 1994 for grounding conditions.

The absence of epenethesis to rescue the glottal in (3c) sets this potential glottal stop apart from regular segments. As shown in (5), a full segment in the same triconsonantal context does trigger vowel insertion to save itself.

(5)

a.   Full segment: Epenthesis into CCC cluster

/woʔ**y-h**in/   *woy. hin   wo. ʔ**uy**. hin   *sleep (PASSIVE AORIST)*

b.   Compare subsegmental glottal: no epenthesis

/ho**gn-** (ʔ)aa-/   hog. naa-   *ho. g**in**. ʔaa- *gloss*

5.2.2 How should the glottal be represented?

Chapter 1 demonstrated that irregularity of parsing constitutes the single reliable diagnostic of underlying structure. Therefore I follow Archangeli 1984 in representing the glottal as a floating [constricted glottis] feature (6).

(6)   Exceptional parsing⇒ No root node

	FULL SEGMENTS	LATENT GLOTTAL
	Root	
	|	
UNDERLYING:	features	[constricted glottis]

5.2.3 *STRUC(σ):

The first task is to account for the fact that full segments trigger epenthesis to facilitate parsing while the latent glottal does not. The parsing constraints that make the

necessary distinctions between floating features and full segments have already been

motivated in Chapter 2 (7-8).

(7)   **MAX (SEG)**   Every *segment* in S_j has a correspondent in S_0

  (i) $\forall x\ ((\text{Segment}(x) \wedge S_j(x)) \rightarrow \exists y(S_0(y) \wedge xRy))$
  (ii)   Assess one mark for each value of x for which (i) is false

(8)   **MAX (SUBSEG)**   Every *subsegment* in S_j has a correspondent in S_0

  (i) $\forall x\ (\text{Subsegment}\ (x)\ \wedge S_j(x)) \rightarrow \exists y(S_0(y) \wedge xRy))$
  (ii)   Assess one mark for each value of x for which (i) is false

Because only potentially unparseable full segments trigger vowel insertion, some

constraint against epenthesis must come between the two parsing constraints. Zoll 1993a

proposes *STRUC(σ), a constraint which functions to minimize the total number of

syllables in a word (9). This is an OT implementation of Selkirk (1981)'s Syllable

Minimization Principle. (See also Broselow (1995 fn 19), and Noske (1984)).

(9)   ***STRUC(σ)**:   'No syllables'   (Zoll 1993a)

  (i) $\neg \exists x \text{Syllable}(x)$
  (ii)   Assess one mark for each value of x for which (i) is false

MAX(SEG) must outrank *STRUC(σ) in Yowlumne, because a vowel will be

inserted to facilitate parsing of an input segment. In the tableau in (10), (10a) is optimal

because it best satisfies MAX(SEG). It outdoes (10b) despite the greater number of

*STRUC(σ) violations because *STRUC(σ) sits below MAX(SEG) in the hierarchy.

(10)   /wo**ʔy-h**in/ → wo. ʔ**u**y. hin   *sleep (PASSIVE AORIST)*

	Candidates	MAX(SEG)	*STRUC(σ)	COMMENTS
a.☞	wo. ʔuy. hin		***	*u is epenthetic*
b.	woy. hin	*	**	*ʔ deleted*

By the same reasoning, *STRUC(σ) must outrank MAX (SUBSEG) since a floating feature deletes rather than trigger epenthesis (11).

(11)   Ranking: *STRUC(σ) » MAX (SUBSEG)

Rationale: No vowel epenthesis to make room for latent feature as segment

For /hogn-ʔaa/, in the tableau in (12), for example, no sonorants in the base attract the glottalization since none are post-vocalic.[5]   Yet unlike the example in (10), the floating [constricted glottis] also fails to materialize as its own segment. This is because the CVX maximal syllable limit in Yowlumne keeps [c.g.] from turning up as a full glottal stop without vowel epenthesis, but epenthesis would lead to a fatal violation of *STRUC(σ) (12a). The most harmonic candidate fails to parse [constricted glottis], thereby avoiding the more serious *STRUC(σ) violations which would otherwise ensue.

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[5] A high ranking constraint on contiguity in the affix must keep the glottal from surfacing suffix internally.

(12)   Segment Structure, *STRUC(σ) » MAX (SUBSEG) from /hogn, ˀaa/

	Candidates	*STRUC(σ)	MAX (SUBSEG)
a.	ho. g*I*n. ˀ**aa**	***!	
b.☞	hog. n**aa**	**	*

This results in the hierarchy in (13). The domination of *STRUC(σ) by MAX(SEG)

accounts for the fact that potentially stray consonants can trigger epenthesis. The low

ranking of MAX (SUBSEG) captures the fact that floating features will delete rather than

prompt life-saving insertion of an additional vowel.

(13)   MAX(SEG) » *STRUC(σ) » MAX (SUBSEG)

There are of course a number of other possible ways to keep a floating feature

from manifesting itself as a full segment. A FILL (McCarthy and Prince 1993) or DEP

(McCarthy and Prince 1995) constraint (termed No New Root in Zoll 1993a) could

proscribe insertion of a new root node , or we could count additional segments rather than

syllables as extra structure violations. However only *STRUC(σ) correctly predicts an

asymmetry that exists between the behavior of floating consonantal and vocalic features

(14).[6] Namely, since extra consonants can be an onset or coda to an already existing

syllable, they will not necessarily violate the constraint when they surface as independent

segments. In a language without diphthongs however, an inserted vowel inevitably adds a

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[6] The FILL(Nuc) constraint (Prince and Smolensky 1993) makes the same prediction, but requires reference to a nucleus constituent which is otherwise unmotivated with respect to epenthesis.

new syllable and thus violates *STRUC(σ). It follows from this that latent consonants will surface more readily than latent vowels. This prediction is confirmed below in Yowlumne.

(14)   Prediction of *STRUC(σ):

   Asymmetry between consonant and vowel epenthesis

   (® = inserted root node)

   a. inserted V violates *STRUC(σ):   b. inserted C needn't
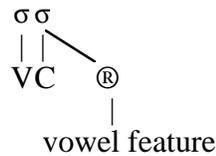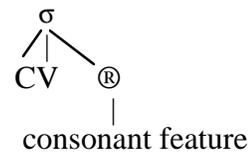
5.2.4 Affix placement

5.2.4.1 Exfixation

   Candidate evaluation with NO-INTERVENING is straightforward when the affix exists as a contiguous substring within the stem, but cases such as the glottalizing affixes in Yowlumne, where affix integrity may be compromised, require a more articulated statement of NO-INTERVENING. In *ʔelʔkaa* (15), for example, nothing intervenes between the right edge of the affix and the right edge of the word, but the non-affixal *k* does follow the glottalized *l^ʔ* (which corresponds to the suffix). The surface discontinuity of the suffix

constitutes an example of *exfixation*.[7] Clearly the constraint requires modification to allow it to handle cases where the affix does not behave as a block.

(15)   ʔelʔkaa   *from* /ʔelk, ʔaa/

	Candidates	**NO-INTERVENING**	*comment*
a.	ʔel^ʔkaa]	??	nothing intervenes between the right edge of the affix and the edge base *k* intervenes between the glottalized *l*ʔ and the edge

Exfixation is not restricted to affixes with a subsegmental component. The data in (16) from Hamer (South Omotic) illustrate a case involving only full segments. Here the initial consonants in the two suffixes *-ta* and *-no* undergo metathesis, resulting in the intermingling of segments belonging to base and suffix.

(16)   Hamer (South Omotic) Metathesis   Lydall (1976: 408-409)

a.   isin   sorghum   isin**ta**   small amount of sorghum

      rac   Rac   (clan)   ra**tc**a   Rac man

b.   oto   calf   oto**no**   all calves

      isin   sorghum   isin**no**   all sorghum

      rac   Rac   (clan)   ra**nc**o   all Rac

---

[7] These data falsify the hypothesis of McCarthy and Prince 1995b: 322 that exfixation with fixed segmentalism does not occur.

5.2.4.2 No-Intervening II:

In order to handle cases like these, the NO-INTERVENING constraint must be modified to refer to individual segments in the affix, rather than treat the affix as a single block. The constraint in (17) does this by having both variables range over separate consonants and vowels. Here Base(x) is a shorthand for elements in S_0 that correspond to the base and Affix(y) refers to elements in S_0 that correspond to the affix. Thus the individual segments that correspond to the affix count as possible values of the second variable, *y*. This constraint penalizes segments which correspond to the base which intervene between any part of the affix and the right edge of S_0.

(17)   **No-Intervening** II:

(i) $\forall x \neg \exists y$ (Base(x) $\wedge$ Affix(y) $\rightarrow$ x intervenes between y and edge E)
(ii)   Assess one mark for every x which falsifies (i)

To illlustrate, consider the evaluation of candidates in Hamer. The precedence constraint for the suffix *-ta* is given in (18).

(18)   **NO-INTERVENING(*ta*;R)**
        'nothing intervenes between any part of *ta* and the right edge of the word'

(i) $\forall x \neg \exists y$ (Base(x) $\wedge$ *ta*(y)$\rightarrow$ x intervenes between y and edge R)
(ii)   Assess one mark for every x which falsifies (i)

In Hamer, only coronal consonants and nasals homo-organic to a following consonant are allowed in the coda (Lydall 1976: 404), forcing exfixation. A descriptively accurate coda condition is given in (19). It sanctions non-coronals only in positions which

open up into a vowel.[8] This allows codas consisting of the first half of any geminate, a

nasal which shares place with the following onset consonant, or any coronal segment.

(19)   **Coda condition**   'Noncoronal place must open into a vowel'

Following now standard reasoning, the CODA-CONDITION must outrank the affix

constraint, since NO-INTERVENING will be violated in order to contrive well-formed

syllables in the output. As shown by the tableau in (20), this ranking selects (20b) as the

optimal candidate since it satisfies the coda condition while only minimally violating NO-

INTERVENING.

(20)   ra**tc̲a̲** *from* /rac, ta/

	Candidates	CODA-CONDITION	NO-INTERVENING(*ta)*	
a.	rac**ta**]	*!		
b.☞	ra**tca**]		*	*c* intervenes between *t* and right edge
c.	**t**rac**a**]		***!	*r, a, c* intervene between *t* and right edge

This modified NO-INTERVENING constraint likewise handles the affixation cases

discussed in previous chapters. Where there is only one segment which corresponds to the

affix, as in Inor or in the Japanese Mimetic palatalization, the two versions of the

constraint are obviously the same. Interestingly, this constraint handles cases of full

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[8] See Padgett (to appear), Lombardi 1991

infixation of longer affixes as well. Compare Hamer's exfixation with the total infixation

of *um-* in Ilokano. (21) shows the constraint that applies.

(21)   **NO-INTERVENING(*um-*; L)**

   (i) $\forall x \neg \exists y$ (Base(x) $\land$ *um*(y)$\rightarrow$ x intervenes between y and edge L)
   (ii)   Assess one mark for every x which falsifies (i)

The candidates in the tableau now include those with both full (22a) and partial

(22b) infixation, both of which minimally violate NO-INTERVENING.   The difference

between Ilokano and Hamer follows from the nature of the dominating constraint and the

shape of the affix. The only way to satisfy NO-CODA here is by infixation of the entire

affix. (22a) is more harmonic than (22b) and (22c) because it contains the fewest closed

syllables.

(22)   NO-CODA » NO-INTERVENING (*um*; L) , from {*um, kagat*}$_\text{Stem}$

	Candidates	NO-CODA	NO-INTERVENING	*COMMENTS*
a. ☞	[k**um**agat	*	*	*full infixation*
b.	[**u**k**m**agat	**!	*	*exfixation*
c.	[**um**kagat	**!		*no infixation*

5.2.4.3 Exfixation in Yowlumne

Exfixation in Yowlumne yields to the same sort of account developed for Hamer. The Yowlumne precedence constraint in (23) governs the behavior of all its suffixes so I have not specified the morpheme to which it applies in each example.

(23)   **NO-INTERVENING(*affix*; R)**

(i) $\forall x \neg \exists y$ (Base(x) $\wedge$ affix(y)$\rightarrow$ x intervenes between y and edge R)
(ii)   Assess one mark for every x which falsifies (i)

Because glottalization appears base internally when necessary it must be the case that NO-INTERVENING is outranked by a constraint which will force it to be violated (24). This case is completely parallel to Inor where the dominant constraint is MAX (SUBSEG).

(24)   *Ranking*:   **MAX (SUBSEG)**   »   **NO-INTERVENING** (affix;R)

        Rationale: Precedence constraint violated by floating glottalization

This is illustrated by the tableau in (25).The glottal cannot surface as an onset to the suffix since this would create an ill-formed trisyllabic cluster. The root final *k* is not a licit target for glottalization, but the floating [constricted glottis] can dock to the root internal post-vocalic *l*, as in (25b). This candidate is more harmonic than (25a) where [constricted glottis] is unparsed, because although nonparsing of the floating feature vacuously satisfies NO-INTERVENING, it results in a breach of the higher ranked MAX (SUBSEG).

(25)   MAX-FEATURE » NO-INTERVENING from *{ ʔelk, [c.g.]aa }*

	Candidates	MAX (SUBSEG)	**NO-INTERVENING**	
-----	-----------	--------------	--------------------	
a.	ʔelk**aa**]	*!		*[c.g.]*not parsed
b.☞	ʔel^ʔk**aa**]		*	*k* intervenes between *l′* and right edge

The lack of a sanctioned mooring at the edge of the root thus sends a latent feature sailing inside to look for one, since its need to be parsed exceeds the importance of perfect alignment. But what sets the Yowlumne glottalization apart from prototypical examples of floating features is that under certain circumstances it does show up as an autonomous segment . Where there is no glottalizable sonorant, it will emerge as a full segment if, in the process, it neither displaces a full consonant nor requires vowel epenthesis.

This is illustrated by the tableau in (26). There is no glottalizable (post-vocalic) sonorant in *maax* so secondary glottalization is impossible. The only way MAX (SUBSEG) can be satisfied then is by the insertion of a full glottal stop (26b), despite the resulting shortening of the template's long vowel. The need to parse the feature outweighs any cost incurred by shortening.[9] Note that the precedence constraint operates here to make sure that the resulting glottal stop surfaces as the onset to the suffix. Therefore the logically possible candidate in (26c), where the suffixal glottal precedes a segment which correponds to the base, will never be optimal in Yowlumne because it results in more

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[9] For discussion of the function of template preservation in Yowlumne see Zoll 1993b and Broselow 1993 and 1995.

violations of the precedence constraint. NO-INTERVENING thus subsumes the place-holding role usually attributed to the root node.

(26)   MAX (SUBSEG) » IDENT(μ) , NO-INTERVENING(affix, R)   from /maax, ˀaa/

	Candidates	MAX (SUBSEG)	IDENT(μ)	**NO-INTERVENING**	COMMENTS
a.	maa.x**aa**]	*!			*[c.g]* unparsed
b.☞	max**ˀaa**]		*		
c.	ma**ˀ**x**aa**]		*	*!	*x* intervenes between suffixal *ˀ* and right edge

The mixed behavior of the Yowlumne glottal thus follows from the interaction of a hierarchy of general constraints with the latent (rootless) glottal feature (27). The ranking of the constraints is given in (27). The domination of NO-INTERVENING by MAX (SUBSEG) allows mobility of affixal material. High-ranking *STRUC(σ) favors deletion over epenthesis as the resolution of potentially triconsonantal clusters where one of the consonants is a latent segment. Finally the effect of the low-ranking precedence constraint is to keep the glottalization as close to the beginning of the affix as possible, subsuming what has been considered the place-keeping function of the root node. In the next two sections I will show how this hierarchy also accounts for the diverse behavior of Yowlumne's other latent consonants and vowels.

(27)   Yowlumne Hierarchy:

MAX(SEG) » *STRUC(σ) » MAX (SUBSEG) » NO-INTERVENING(ROOT,AFFIX), IDENT(μ)

5.3 Other latent segments

5.3.1 The data

The dual behavior of the glottal contrasts with that of other latent segments in Yowlumne. A list of the suffixes containing other latent consonants, shown in parentheses, is provided in (28).

(28)   Yowlumne suffixes with latent features   (Archangeli 1984)

   (h)nel   *passive adjunctive*

   (m)aam   *decedent*

   (l)saa   *causative repetitive*

   (n)iit   *decedent*

Like the floating glottal these latent segments are distinguished from regular consonants in that they delete rather than trigger epenthesis to avoid forming an illicit cluster. The data in (29) illustrate this constrast. The suffix-initial *h* in *hin* is a full segment. In (29a) suffixation results in a triconsonantal *gnh* cluster which must be resolved, since the maximal syllable in Yowlumne is CVX. Because all three are full segments they must all be parsed, and therefore a vowel is epenthesized.[10] In (29b) suffixation of *(h)nel* likewise has the potential to produce a triconsonantal cluster, but since here *h* is a latent segment, like the glottal above, it fails to appear rather than force

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[10]See Broselow (1995), Zoll (1993b), Noske (1984), and Archangeli (1991) for choice of epenthesis site in a cluster.

epenthesis. It is the hallmark property of these latent segments as well as the glottal stop

that they never trigger epenthesis of a vowel to save themselves, although as we can see

again in (29c) vowel length will be sacrificed to spare a latent segment. What

distinguishes these latent consonants from the glottal, however, is that they never

manifest themselves by docking onto an existing segment as secondary articulations.

(29)   (Data from Archangeli 1991)

a.   -hin   /ho<u>gn-h</u>in/   ho. g***I***n-hin

b.   -(h)nel   /hogo<u>n-(h)n</u>el/   ho. gon. -•nel   *ho. g^hon. -nel

c.   cf   /maxaa-<u>(h)</u>nel/   ma. xa-h. nel

Yet a third kind of behavior is exhibited by latent vowels, exemplified in (30).

Latent vowels, like the latent consonants, sometimes fail to surface. Unlike the

consonants however these vowels are parsed only when necessary. In (30a) the final

vowel is required to facilitate syllabification of the suffixal ***m*** . In (30b), on the other

hand, this ***m*** becomes the coda of the preceding open syllable. There is room for the

vowel, but as it is not necessary for any other reason it does not materialize.

(30)   Vowel/ø alternation: Latent vowels surface only when they are necessary

        -m(i) *precative*   (Data from Newman 1944: 135)

a.   /amic-m(i)/   amic-mi   *amic-m•   *having approached*

b.   /panaa-m(i)/   panam•   *panaa-mi   *having arrived*

This is not simply a vowel deletion rule, since it is not the case that all expendable final vowels are deleted (Noske 1984). As shown in (31), for example, the indirect object suffix *ni* holds on to its final vowel even suffixed to a vowel final root.

(31)   Not Final Vowel Deletion: (Noske 1984)

Compare *ni*   ' indirect object '   (Newman, p.201)

a.   /talaap-ni/   talapni   *bow-IO*

b.   /xataa-ni/   xataani   *xatan•   *food-IO*

Superficially it appears then that there are three different kinds of latent segments in Yowlumne: (i) glottals which show up wherever they can either as full segments or secondary features (ii) other latent consonants which only come to light as full segments when there is room for them and (iii) latent vowels which turn up only when they are absolutely necessary, these latter two always as independent segments. All three of these contrast with full segments which are always parsed even if it requires epenthesis.

The absence of an underlying root node for all three types of irregularly parsed segments in Yowlumne would account for their immunity from normal parsing. Once we have made this distinction between full segments (which have a root node) and latent features (which lack a root node) the diversified behavior of the different latent features follows from the Yowlumne hierarchy developed in the previous section.

5.3.2 Analysis of Latent Consonants

We saw in the previous section that this constraint hierarchy interacts with a latent feature such that it will dock on an existing segment where it can, will minimally disrupt the template and emerge as a full segment if it must, but in the face of impending epenthesis it will fail to be parsed. The only thing that sets the behavior of the other latent consonants apart from the glottal is that they never dock secondarily on an existing segment. I have repeated the list of suffixes with proposed underlying representations in (32).[11]

(32)   Yowlumne suffixes with latent C

	UNDERLYING REPRESENTATION
a. *passive adjunctive* (h)nel	
b. *causative repetitive* (l)saa	
c. *decedent* (m)aam	

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[11]See chapter 1 for motivation.

d. *decedent* (n)iit	(n) i i t
	PLACE coronal

Since glottalized segments are among the possible segment types in Yowlumne (33) it is no surprise that a floating glottal feature will associate to an existing plain segment. Glottalization constitutes the only secondary articulation in Yowlumne, however, so other floating features are precluded from docking onto existing segments by segment structure constraints that prohibit the creation of things like phonologically aspirated consonants or doubly articulated stops. The floating featues in (32) therefore can only be realized as the primary articulation on an inserted root node; that is they will act like latent segments. The difference between the glottal and the other latent segments need not reflect distinct underlying configurations but depends instead on the nature of the features involved. Their surface patterns follow directly from the Yowlumne segment inventory.

(33)   Yowlumne Inventory (Archangeli 1984:60 from Newman 1944)
           b p pˀ   d t tˀ   d̪ t̪ t̪ˀ   x g k kˀ
                                ʒ c cˀ   ʒ c̪ c̪ˀ
                                s s
           m mˀ   n nˀ

           w wˀ   y yˀ   h ʔ
                                l lˀ

NO-INTERVENING, and constraints on contiguity (McCarthy and Prince 1995, Hume 1996) insure that when there is room for the epenthetic root node it will be inserted suffix initially, so we need not depend on underlying root nodes to keep latent features in place. The ranking of *STRUC (σ) above MAX (SUBSEG) entails that when there is no available spot in an existing syllable, the features will fail to appear. This is illustrated by the tableaux in (34-35). For the tri-consonantal root *hogon-* in (34), the only way for the suffix's latent *(h)* to surface would be through vowel epenthesis. The consequent addition of an additional syllable produces a fatal violation of *STRUC(σ), so instead the best choice (34b) is to let the feature go.[12]

(34)   hogonnel   from /hogon, (h)nel/

	Candidates	*STRUC(σ)	MAX (SUBSEG)	NO-INTERVENING
a.	ho. gon. **h_l_. nel**	****!		
b. ☞	ho. gon. **nel**	***	*	

Compare that result to the biconsonantal root *maxaa*. Here with vowel shortening in (35a) the optimal candidate has room for the latent feature to surface as an independent segment. This candidate beats (35b) where the feature is left unparsed. Note again that a candidate like (35c), which differs from the winner only in that the inserted root appears further to the left, loses on the grounds that it violates NO-INTERVENING.

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[12] An unviolated *CONTIGUITY* constraint (McCarthy and Prince 1995) rules out the possible candidate *hoghonnel.* See footnote 5.

(35)   maxahnel   from /maxaa, (h)nel/

	Candidates	*STRUC(σ)	MAX (SUBSEG)	**NO-INTERVENING**
b. ☞	ma. xa**h. nel**	***		
a.	ma. xaa. **nel**	***	*!	
c.	ma**h**. xaa. **nel**	***		***!

What differentiates the so-called floating glottal from the other latent consonants then is that the only secondary articulation possible in Yowlumne is glottalization. Other potentially floating features can only turn up as independent segments. NO-INTERVENING functions to keep the latent consonant at the beginning of the suffix. Thus the behavior of the latent consonants does not entail that they have an underlying root node, since their form and position are completely predictable from the grammar.

5.3.3 Analysis of Latent Vowels

Finally we return to the latent vowels. The relevant data is shown again in (36). Their behavior differs from that of the latent consonants, including the glottal, in that they do not materialize every time there is room for them. Rather they appear only when called upon to rescue an otherwise unparseable consonant, as in (36a).

(36)   Vowel/ø alternation: Latent vowels surface only when they are necessary

        -m(i) *precative*   (Data from Newman 1944: 135)

a.   /amic-m(i)/   amic-mi   *amic-m•   *having approached*

b.   /panaa-m(i)/   panam•   *panaa-mi   *having arrived*

The behavior of the latent vowels, analyzed as floating V-place features, also follows from the constraint hierarchy already established. It is the *STRUC(σ) constraint, which militates against superfluous syllable building, that distinguishes the behavior of the latent vowels from the latent consonants. This constraint has no impact on the consonants themselves, since they emerge by simply slipping into existing syllable structure. The constraint functions there only to exclude an epenthetic vowel whose only purpose is to rescue an otherwise doomed latent feature. *STRUC(σ) will limit the realization of latent vowels themselves, on the other hand, because a vowel always heads its own syllable in this language. Every time a vowel comes on the scene, it triggers a violation of *STRUC(σ), so latent vowels only show up when violation of *STRUC(σ) is forced by some higher constraint, in this case MAX(SEG) as argued above. Since the language has no secondary vocalic articulations, segment structure constraints will prevent them from otherwise docking on existing full segments. This state of affairs is illustrated by the tableaux in (37-38). The winner in (37a) succeeds in parsing all the full segments into only two syllables so violates *STRUC(σ) only twice, while parsing the latent vowel in the non-optimal (37b) requires three syllables.

(37) panam from /panaa-m [hi]/

		MAX(SEG)	*STRUC(σ)	MAX (SUBSEG)	**NO-INTERVENING**
a. ☞	pa. na. **m**		**	*	
b.	pa. naa. **mi**		***!		

In the tableau in (38), on the other hand, the latent vowel is needed to rescue the otherwise unparseable *m* . This causes an additional *STRUC(σ) violation but is necessary in order to avoid deleting a full segment. Therefore (38b) is optimal.[13]

(38) amicmi from /amic-m [hi]/

		MAX-SEG	*STRUC(σ)	COMMENTS
a.	a. mic	*!	**	*m* deleted
b. ☞	a. mic. **mI**		***	latent *I* saves *m*

Thus in Yowlumne there is no need to distinguish the variety of latent segments configurationally, since both their movement and/or possible segmenthood is predictable from the interaction of segment structure restrictions with the constraints ranked as in (39) embedded in the larger templatic grammar of the language.

(39)   MAX(SEG) » *STRUC » MAX (SUBSEG) » NO-INTERVENING

5.4 Inventory and the single node

It has been demonstrated that neither immobility nor the ability of an underlying set of features to manifest itself as an independent segment can be used as a diagnostic for the presence or absence of an underlying root node. Rather, a hierarchy of ranked and violable constraints such as NO-INTERVENING, MAX (SUBSEG) and *STRUC(σ) governs

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[13]The potential candidate amic-Im is ruled out independently by other constraints on word shape. See Zoll 1993a.

where and how latent features manifest themselves on the surface. Since this grammar can determine surface position and segmentality of underlying floating features, it obviates the need for an underlying representational distinction between even prototypical cases of latent segments and floating features. Thus there is no evidence that we ever need to distinguish latent segments from floating features. The following section provides further confirmation. A consideration of cross-linguistic inventories of traditional floating features and latent segments reveals that all are characterizable in the same way, that is by identifying each element with a single floating feature class.

5.4.1 The Single Node Generalization

A major impetus for the geometric organization of features is to characterize features which link, delink, or spread together as dominated by a single node of a feature hierarchy (Clements 1985, 1986, Sagey 1986, 1987, McCarthy 1988 and subsequent work on feature geometry; see Clements and Hume 1995 and references therein). I will refer to this as the **Single Node Generalization** following Pulleyblank 1988. The Single Node Generalization sets a standard for simplicity in analyses of phenomena involving floating features (Pulleyblank 1988). Ideally, any process of feature insertion, deletion, assimilation or dissimilation should refer to either a full segment or to a single class of features. Any additional features manipulated should be predictable through language specific defaults or universal markedness principles alone (see Rice 1989's review of Lieber 1987).

The speech of Raven's Wife in Quileute (Frachtenberg 1920) illustrates the conventional division of labor between floating features and default fill-ins which ensue

(40). When speaking in a myth the Raven's Wife prefixes *ts* - to each word and then nasalizes voiced obstruent stops, changing *d* and *l* to *n* (40a-b) and *b* to *m*. (40c).

(40)   Quileute   Frachtenberg (1920: 297)

   Regular   **Raven's wife**

a.   L!oxwaˀ**d**as   ts-L!oxwaˀ**n**as   'old man'

b.   heˀtku**l**i   ts-heˀtku**n**i   'I am sick'

c.   **b**oˀyukwā̄ˀts!oˀ   ts-**m**oˀyukwā̄ˀts!oˀ   'something'

        The differences between the input and output in (40) clearly involve more than a single featural node. In every case [nasal] has been added, but in addition (40b) requires [-cont], (40a,c) demand [+sonorant] etc. In a case like this, however, it is unnecessary to posit multiple floating nodes. The floating element consists only of unpredictable feature information while default rules or markedness constraints supply the rest (41).

(41)

hē'tku**l**$_i$ [nas] $\rightarrow$ [+son]
       /
     [nas]   [nas] $\rightarrow$ [-cont]

        If, as I have argued, latent segments and floating features have the same underlying representation, it would not be surprising to find that latent segments in an inventory can be distinguished from each other by a single node as well. This would

entail that the latent segment be the unmarked members of their respective classes, since

their remaining features would have to be filled in by default rules or constraints.

5.4.2 Yowlumne inventory

The inventory of latent consonants in   Yowlumne provides an excellent

illustration of this point. The consonant inventory is repeated here in (42). The

consonants which occur as latent segments in some contexts are underlined.

(42)   Yowlumne Inventory (Archangeli 1984:60 from Newman 1944)

$$
\begin{array}{llll}
\text{b p p}^ʔ & \text{d t t}^ʔ & \text{ḍ t t}^ʔ & \text{x g k k}^ʔ \\
& \text{ʒ c c}^ʔ & \text{ʒ c̣ c}^ʔ & \\
& \text{s s} & & \\
\underline{\text{m}}\ \text{m}^ʔ & \underline{\text{n}}\ \text{n}^ʔ & & \\
\underline{\text{w}}\ \text{w}^ʔ & \text{y y}^ʔ & & \underline{\text{h}}\ ʔ \\
& \underline{\text{l}}\ \text{l}^ʔ & &
\end{array}
$$

It is completely straightforward to describe this limited inventory in terms of

single nodes. First of all, although glottalized segments abound in Yowlumne there are

no pairs of latent consonants which contrast solely with regard to the presence or absence

of glottalization. The absence of this contrast makes it unnecessary to posit both PLACE

and LARYNGEAL features underlying for a single latent segment (43).

(43)   m   *m^ʔ

PLACE   LAR

PLACE

labial   constricted
glottis

labial

In fact, in Yowlumne all of the latent consonants can be distinguished from each other on the basis of either laryngeal features or place/stricture features alone (44). I will show below that the missing values are the unmarked ones.

(44)   Representation of Latent segments

m	**l**	**w**	**n**	**ʔ**	**h**
CPLACE	CPLACE	CPLACE	NAS	LAR	LAR
labial	coronal	dorsal		constricted	spread
	lateral			glottis	glottis

Under this proposal the underlyingly unspecified features are optimally filled in on the surface as the result of language specific defaults and universal markedness conventions (45-46), in the tradition of underspecification and following more recently Prince and Smolensky 1993 and Smolensky 1994 (see also the Grounding Conditions of Archangeli and Pulleyblank 1994). The necessary universal markedness statements are given in (45) with their corresponding constraints.

(45)   Universal markedness statements

MARKEDNESS RULES	CONSTRAINTS
[+sonorant] → [+voice]	* +sonorant | -voice
[CPLACE] → [+consonantal]	* -consonantal | CPlace
[constricted glottis] →[+consonantal]	* -consonantal | constricted glottis
[+spread glottis]→ [+consonantal]	* -consonantal | spread glottis

[nasal] →[+consonantal]	* -consonantal | nasal	
[øCPLACE] → [coronal]	*CPL | Labial	*CPL | Dorsal

Note further that the Yowlumne latent consonants are all [+sonorant]. Under this analysis this asymmetric inventory is not surprising. A single constraint can provide the language specific default (46). Since this is not a statement of markedness, we expect to find the opposite value in some other language. This will be the case in French where all of the latent consonants except the nasal surface as obstruents.

(46)

LANGUAGE PARTICULAR DEFAULT	CONSTRAINT
Ø → [+sonorant]	$*\begin{bmatrix} +cons \\ -son \end{bmatrix}$

As an example, the tableau in (47) illustrates how these constraints produce the desired optimal [n] output for an underlying floating NAS. Note that none of these constraints can be ranked with respect to each other here since the output violates none of them.

(47)   [nasal] →   n

		*+cons -son	*+son -voice	*-cons nasal	*CPL Labial	*CPL Dorsal
☞	n					
	ŋ					*!
	m				*!	
	i			*!		
	n		*!			
	ⁿt	*!				

Given that default specification involves minimal feature addition, it follows then that the plain sonorants rather than their glottalized counterparts serve as the latent segments. Although it is logically possible to assign [+constricted glottis] by default to every segment underlyingly unspecified for that feature, no theory of universal markedness or language specific defaults that I know of would posit such a rule. If on the other hand the latent segments were not melodically defective, the absence of glottalized latent consonants and other contrasts would not follow from the representation. These sorts of asymmetries, which conform to the Single Node Generalization as well as any case of conventional floating features might, are merely accidental in other theories of latent segments which maintain a configurational distinction between the latent segments and floating features, all of which leave the segment itself intact.

The Single Node Generalization characterizes latent vowel inventories equally well. Since vowels are primarily distinguished by PLACE, and since their place features constitute a single node in most conceptions of feature geometry, every plain (short) vowel can conceivably have a latent counterpart without contravening the hypothesis.

This is the case in Slovak, for example, whose vowel inventory is shown in (48). All of these vowels do function as latent vowels in some words (Rubach 1993).[14]

(48)   Slovak Vowels   (Rubach 1993: 631)

       i   u
       e   o
       ä   a

In fact all documented cases of latent segments conform to the expectations of the Single Node Generalization. It is striking that the languages in my sample have only one or two latent consonants, and these are never complex (49). Furthermore, in every language the latent segments either are (i) at different places of articulation (e.g., Korean), (ii) differ in stricture at the same place of articulation (e.g., Tiwi), or can be distinguished with nasal or laryngeal features alone (e.g., Armenian, Dakota). There appear to be no cases, for example, with both an alternating *k* and alternating *g*, since such a case would require both place and laryngeal features to make the right distinctions underlyingly.

(49)

    a.   Armenian: k, n   (field notes)

    b.   Axininca Campa: ŋ   (see MP 1993b)

    c.   Dakota: k, ʔ   (Shaw 1989)

    e.   Swahili: l   (Moxley 1993)

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[14] Rubach (1993:633) claims that on the contrary "such a prediction is not made by the featural [rootless] account, because multiplying the number of yers would lead to complicating the inventory, as many new underlying contrasts in terms of phonological features would have to be introduced....We would probably

f.	Wolof:	k	(Ka 1994)
g.	Korean:	n, l , k	(Namkung, p.c.)
h.	French	t, z, ʁ,n	(see below)
j.	Tiwi	p,ʈ,t,l,r,y	(Archangeli 1988)
h.	Polish:	e	(Szpyra 1992)
i.	Slovak:	o,u,e,a,ä,i	(Rubach 1993)

5.4.3   French

If latent segments consist of rootless melodic material underlyingly, then it is not surprising to find that the ghost segments in many languages can be distinguished from each other with features from a single class, {PLACE/STRICTURE, LARYNGEAL, *or* NASAL}. The latent consonant inventory in Yowlumne, discussed above, provided a remarkable illustration of this observation. The unified treatment of latent segments and floating features yields a better understanding of the limited inventory of phonologically alternating final consonants in French as well.

Consider the data in (50). Each of these adjectives ends in a latent consonant which appears only before a following vowel or glide initial noun. The inventory of possible latent consonants is limited to one of the five consonants {p, t, z, ʁ, n} (Tranel 1987: 174).[15] As noted by Schane 1973, and still true today, this constitutes a very small

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run out of phonological features." Without more detail about his assumptions regarding feature organization it is impossible to evaluate this claim.

[15] There is only one word with a velar, "longue" (Tranel 1987: 174). An archaic (before 1930 according to Morin 1992) pronounciation of this has /k/ rather than /g/ here (Morin 1992 blames the orthography), and some people do not link at all with this word. I leave this aside here.

subset of the full inventory of French consonants, whose limits no previous account has been able to rationalize.

(50)   Latent consonants in French

p   [trop] aimé   'too much loved'   [tro] détesté   'too much hated'

t   [pətit] étang   'small lake'   [pəti] chien   'small dog

     [grɑ̃t] étang   'big lake'   [grɑ̃] chien   'big dog'

z   [døz] étang   'two lakes'   [dø] chien   'two dogs'

     [groz] étang   'big lake'   [gro] chien   'big dog'

ʁ   [ležɛʁ] incident   'slight incident'   [leze] son   'faint sound'

n   [sɛrtɛn] étang   'certain lake'   [sɛrtɛ̃] chien   'certain dog'

(51) illustrates the proposed representions for the latent liaison consonants as single class nodes underlyingly.

(51)   representations

p		**t**		**z**		**ʁ**		**n**
CPLACE		CPLACE		CPLACE		CPLACE		NAS
labial		coronal		coronal		dorsal		
-continuant		-continuant		+continuant		+continuant		

As in Yowlumne, the remaining features can be filled in predictably following segmental markedness constraints, resulting always in the least marked member of the class of segments designated by the underlying feature class specification. The crucial universal markedness constraints are shown in (52).

(52)   Universal markedness statements

MARKEDNESS RULES	CONSTRAINTS	
[øCPLACE] → [coronal]	*CPL | Labial	*CPL | Dorsal
[+sonorant] → [+voice]	* +sonorant | -voice	
[+continuant] →[+voice]	*+continuant -voice	
[-continuant] →[-voice]	*-continuant +voice	
[CPLACE] → [+consonantal]	* -consonantal | CPlace	
[nasal] →[+consonantal]	* -consonantal | nasal	
[nasal] →[+sonorant]	*-sonorant | nasal	

Voicing defaults for obstruents depend on stricture. It appears from the consonant inventories in Maddieson 1984 that voiced fricatives are less marked than their voiceless counterparts, and conversely voiceless stops are less marked than voiced ones. Only the sonorant nasal stop prefers [+voice]. This provides an argument for the presumably universal ranking in (53), which causes [nasal] to surface with [+voice] in the unmarked case.

(53)   *[+sonorant, -voice] » *[-continuant, +voice] *from* [nas] → *n*

		*[+sonorant, -voice]	*[-continuant, +voice]
☞	n		*
	n	*!	

The language specific default for sonorant is the opposite to that in Yowlumne (54). Since no universally unmarked context-independent value for [sonorant] exists, it is not surprising that the default varies cross-linguistically.

(54)   Language particular default

LANGUAGE PARTICULAR DEFAULT	CONSTRAINT
Ø → [-sonorant]	$*\begin{bmatrix} +\text{cons} \\ +\text{son} \end{bmatrix}$

Finally, because the unmarked nasal stop will be sonorant, it must be the case that the constraint against nasal obstruents outranks the more general [-sonorant] default (55).

(55)   *[nasal, -son] » *[+cons, +son] *from* [nas] → *n*

		*[nasal, -son]	*[+cons, +son]
☞	n		*
	ⁿt	*!	

The tableau in (56), illustrates how these constraints together produce the desired optimal [n] output for an underlying floating NAS. Likewise, these constraints yield the unmarked members of the underlying feature class on the surface for each latent segment.

(56)   [nas] → *n*

		*-cons nasal	*-son nasal	*CPL Labial	*CPL Dorsal	*+son -voice	*-cont +voice	*+cons +son
☞	n						*	*
	n					*!		
	ŋ				*!			
	m			*!				
	ⁿt		*!					
	i	*!						

Representing the French latent consonants underlyingly with single class nodes thus provides a rational synchronic characterization of the limited inventory of the latent consonants. Furthermore it helps to explain the fact that the *phonologically non-alternating* feminine final consonants, shown in (57), are not likewise restricted. Like full segments, the feminine final consonants always appear (in feminine contexts) regardless of the following word, and thus we do not expect to find any particular limitations on the number of different contrasts. Thirteen different feminine final consonants are available

{t, d, k, g, n, ñ, v, s, z, s, r, l, j} (Tranel 1981: 252), compared to the five possibilities in

liaison.

(57) Tranel 1981: 252

		masculine	**feminine**	
t	petit	pəti-t	pətit	'small'
d	grand	grã -t	grã:d	'tall'
s	gros	gro-z	gro:s	'big'
z	heureux	ørø-z	ørøz	'happy'
r	entier	ãtje-r	ãtjɛr	'entire'
n	plein	plɛ̃ -n	plɛn	'full'
g	long	lɔ̃-g	lɔ̃:g	'long'
v	loup	lu	luv	'wolf'
l	soul	su	sul	'drunk'
j	gentil	žãti	žãtij	'nice'
š	blanc	blã	blãš	'white'
ñ	bénin	benɛ̃	beniñ[1]	'not serious'

   If the phonologically alternating (masculine) segments are characterized

underlying as single nodes, then the marked feminine forms whose final consonants

differ from the masculine ones will be listed separately in the lexicon with their full final

consonants, independently of their unmarked masculine counterparts This does not result

in any substantial loss of generality, however, because relatively few forms show this split (Tranel 1981).

This analysis is superior to accounts which derive all masculine and feminine forms from a single base by way of neutralization rules that refer to unparsed segments, a device which Itô 1986 demonstrates to be overly powerful. The so-called voice neutralization among the coronal obstruents in the masculine liaison forms (58) has proven to be the most tantalizing yet most intractable generalization to capture in this regard.

(58)   Differences in voicing

			masculine	**feminine**	
a.	**t**	petit	pəti-t	pətit	'small'
b.	**d**	grand	grã̃ -t	grã:d	'tall'
c.	**s**	gros	gro-z	gro:s	'big'
d.	**z**	heureux	ørø-z	ørøz	'happy'

Since the only difference between the masculine and feminine consonants in (58) is their voicing, it makes sense to try to analyze it as a rule-governed alternation. Levin 1987 develops one of the few explicit accounts of this process. As shown in (59), she posits a voice-changing rule that applies to consonants that fail to be parsed in the first round of syllabification, i.e., the masculine liaison consonants. While this does derive the correct form of the consonant, the small number of forms which exhibit this alternation

do not warrant such a powerful addition to the inventory of possible rule types (Itô

1989).[16]

(59)   De/voicing rule   (Levin 1987)

(X' is an unsyllabified segment)

$$[\text{-son}, \alpha \text{ cont}] \quad \Rightarrow \quad [\alpha \text{ voice}]/\underset{\underset{\rule{1.2em}{0.4pt}}{|}}{\overset{X'}{}}$$

5.5   Summary

Chapter 1 provided several arguments against the traditional dichotomy between

latent segments and floating features. It was shown that the traditional roles associated

with the root node—immobility and autarchy—do not correlate with the presence or

absence of a root node underlyingly, and in subsequent chapters a grammar based on a

hierarchy of violable constraints was developed to account for the independent

manifestations of these two functions. By positing a unified underlying representation for

all instances of ghosts and floating features, this analysis utilizes the generalizations

which govern the mixed behavior of some floating features to generate a cross-linguistic

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[16] In current terms, this rule corresponds to a *conjoined* constraint (Smolensky 1995) which shuns "the worst of the worst", in this case segments which both remain (lexically) unsyllabified and contain a marked value for [voice]. Although some constraint conjunctions may turn out to be necessary, in this case the conjunction of any constraint with MAX(SEG) is subject to the same criticism levelled by Itô 1986 against the rule based approach.

Conjunction:
a.   Constraint I: MAX(SEG)
        Constraint II: *[-continuant, +voice]
        Conjoined constraint: **MAX(SEG) & *[-continuant, +voice]**
        i.e. unparsed stops should not be [+voice]
b.   Constraint I: MAX(SEG)
        Constraint II: *[+continuant, -voice]
        Conjoined constraint: **MAX(SEG) & *[+continuant, -voice]**
        i.e. unparsed continuants should not be [-voice]

typology of the entire range of behavior associated with subminimal phonological units, while allowing a unique characterization of both the limited inventories of latent segments and floating features and their immunity from the demands of regular parsing. While this chapter has not discussed every argument ever proposed to motivate the representational distinction between latent segments and floating features (see for example Rubach 1993), it does provide a strong basis for the re-evaluation of these claims in light of the evidence presented here supporting a unified representation.

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