CONSTRAINTS ON PATTERNS OF PRIMARY AND SECONDARY STRESS

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This dissertation examines the interaction of various phonological phenomena

with stress assignment. In some languages primary and secondary stresses behave

identically or symmetrically with respect to a particular process. However, in other

languages, only primary stress undergoes the process while secondary stress does not. In

these languages, stress assignment is said to be asymmetrical.

The goals of this study are two-fold. The first is empirical in nature. A cross-

linguistic comparison reveals a typology of languages that exhibit symmetrical and

asymmetrical stress patterns. Special emphasis is placed on those languages that

demonstrate asymmetries in the behavior of primary and secondary stresses with respect

to a wide variety of different phonological phenomena.

The second goal is theoretical, analyzing these languages within the constraint-

based framework of Optimality Theory (Prince & Smolensky 1993/2002). It is shown

that asymmetrical stress patterns can be accounted for by referring to constraints that are

specific to primary stress. A crucial assumption of this proposal is that constraints may

not refer exclusively to secondary stress. Ranking a primary-stress-specific constraint in a

stringency relation above a general stress constraint, with an antagonistic constraint

ranked intermediately between them, yields an asymmetrical pattern. Due to the nature of

the stringency relation – in which violation of the specific constraint implies violation of

the general constraint, but not vice versa – there is no ranking of these constraints that

will yield a pattern in which a phonological process applies only in secondary stressed

syllables. This is a desirable consequence, since, with respect to certain phonological processes – including nonfinality effects, stressed syllable lengthening, and stress-driven sonority – such patterns are unattested. However, with respect to other phonological processes – e.g., quantity-sensitivity and sonority-driven stress – this type of asymmetrical pattern is attested. It is proposed that the difference between those processes that can apply only in secondary stressed syllables and those that cannot rests in whether stress assignment is process-driven or whether the process is stress-driven. This fundamental dichotomy predicts when such an asymmetrical pattern will be attested and when it will not.

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CHAPTER 1:

INTRODUCTION AND BACKGROUND

1.1   Introduction

It has long been observed that phonological phenomena can influence the assignment of stress and vice versa. For example, in Mohawk (Michelson 1983:67), stress falls on the penultimate underlying vowel, e.g., [te.ka.ti.rút.haʔ] 'I stretch it'. When the stressed syllable is open, the vowel bearing stress is lengthened, e.g., [tʌ.ka.ti.rúː.tʌʔ] 'I shall stretch it'. It could be said that in Mohawk, the process of vowel lengthening is influenced or driven by stress assignment; that is, the vowel lengthens because it is stressed. This interaction between stress and weight can work in the other direction as well. In Aguacatec Mayan (McArthur & McArthur 1956), the default pattern is for stress to fall on the final syllable. This is most evident in words with all light syllables (where CV and CVC are light, CVː is heavy), e.g., [wuqán] 'my foot'. However, if there is a long vowel in the word, it receives stress, even if it is not in the final syllable, e.g., [míːtuʔ] 'cat'. In this language, stress assignment is influenced or driven by weight; stress shifts away from a light syllable in its default position to fall on a heavy syllable elsewhere in the word.

In both Mohawk and Aguacatec, there is only one stress per word. The syllable bearing stress is the most prominent or most salient syllable in the word. However, in other languages, words may have more than one stress. In such cases, the most prominent stress is the *primary stress* (indicated with an acute accent, e.g., ó), while any other stresses are subsidiary or *secondary stresses* (indicated with a grave accent, e.g., ò).[1]

As with single-stress systems, phonological processes can interact with stress assignment in languages with multiple stresses as well. Often, primary and secondary stressed syllables behave identically or *symmetrically* with respect a particular process. The stress literature is rife with examples of languages with symmetrical stress patterns. For example, in Chimalapa Zoque (Knudson 1975), primary stress falls on the penultimate syllable and secondary stress falls on the initial syllable, e.g., [mìn.suk.kéʔt.pa] 'they are coming again'. When a stressed syllable is open, it undergoes vowel lengthening, regardless of whether it bears primary stress or secondary stress, e.g., [ʔòː.toŋ.ɲíː.piʔtʰ] 'if he had spoken'. That is, primary and secondary stresses behave symmetrically with respect to vowel lengthening. We can also find symmetrical stress patterns in languages with weight-driven stress assignment. In Khalkha Mongolian (Walker 1997), primary stress is influenced by weight, falling on the rightmost heavy syllable in the word (where CV and CVC are light; CVV and CVː are heavy), e.g., [ɢalúː] 'goose'.[2] As it turns out, secondary stress assignment is also driven by weight. In words with more than one heavy syllable, secondary stress falls on all heavy syllables not bearing primary stress, e.g., [ulàːnbàːtríːnxan] 'the residents of Ulaanbaatar'.[3] Again, as

in Chimalapa Zoque, primary and secondary stress assignment behave symmetrically with respect to weight-sensitivity.

Languages with a single stress per word or with symmetrical patterns of primary and secondary stress assignment have received the most attention in the stress literature. However, there are languages in which primary and secondary stresses behave differently or *asymmetrically* with respect to a particular phonological process. For example, in Wargamay (Dixon 1981), only primary stressed syllables undergo vowel lengthening while secondary stressed syllables do not. Similarly, in Huariapano (Parker 1994, 1998), while weight influences primary stress assignment, it does not influence secondary stress assignment. Descriptions of languages such as these, with asymmetrical patterns of primary and secondary stress assignment, are harder to find in the stress literature. In fact, many descriptions of languages with stress asymmetries focus only on the primary stress pattern, ignoring secondary stress altogether.

What this brief survey of languages is intended to show is that primary and secondary stress assignment can interact with various phonological phenomena in such a way as to produce a broad typology of different stress patterns. Not all of these patterns have received equal attention in the literature. Furthermore, there are some stress patterns that, while logically possible, are unattested. For example, there is no language with the converse or complementary pattern of Wargamay in which vowel lengthening occurs in secondary stressed syllables to the exclusion of primary stressed syllables. Thus, while some asymmetrical stress patterns are attested, others are not. This fact demands an explanation. Whatever explanation is proposed, it must be reconciled with the fact that there are some languages that *do* exhibit complementary patterns of stress asymmetries.

For instance, because Wargamay lacks an attested counterpart with a complementary stress pattern, we might expect, along similar lines, that there will be no language with the complementary pattern of Huariapano, in which secondary stress is weight-sensitive while primary stress is not. Interestingly, such languages are attested (e.g., Finnish, Koya).

The existence of such languages seems to foil any attempts at making predictions about the types of stress asymmetries that would be expected to occur and not to occur in the world's languages. However, I argue in this thesis that it is possible to predict when an asymmetrical pattern will be attested and when it will not based on whether stress assignment is process-driven, or whether the phonological process is stress-driven.

1.1.1 Goals

The purpose of this thesis is two-fold. The first is empirical in nature. By bringing together often disparate and varied information on primary and secondary stress patterns, I provide a typology of different languages that exhibit both symmetrical and asymmetrical stress patterns. Special emphasis is placed on those languages that demonstrate asymmetries in the behavior of primary and secondary stresses with respect to a wide variety of different phonological phenomena.

The second is theoretical in nature. While many of the analyses in the source material on the stress patterns described in this work are set within earlier derivational or rule-based theories, I analyze these languages within the constraint-based framework of Optimality Theory (henceforth OT – McCarthy & Prince 1993b, 1995; Prince & Smolensky 1993/2002). In OT, there are no rules or serial derivations. Instead, output forms are determined by the interaction of universal, violable constraints. Because the set

of constraints in OT is universal, languages can only differ in terms of their constraint rankings. Every ranking permutation is, in principle, predicted to be a possible language. This inherently typological characteristic of OT makes it an ideal framework for analyzing various patterns of stress. By appealing to OT in this way, it is possible to make predictions about the kinds of stress patterns that are expected to be attested in the world's languages.

1.1.2   The proposal

In this thesis, I propose that accounts of asymmetrical stress patterns require constraints that are relativized to primary stress. Primary-stress-specific constraints stand in a special relationship with constraints that refer to stress in general, such that violation of the specific constraint implies necessarily violation of its general counterpart, but not vice versa. This type of relationship is referred to as *stringency* (McCarthy 2002; Prince 1997a, b). When specific and general stress constraints are ranked in a stringency relation with an antagonistic constraint ranked intermediately between them, it results in a pattern of asymmetry. A crucial assumption of this proposal is that while constraints may refer specifically to primary stress, they may not refer exclusively to secondary stress. This is in keeping with claims made in recent theories (e.g., Beckman 1998; Smith 2002) that positional constraints (both faithfulness and markedness) may only refer to phonologically prominent or 'strong' positions, and never to phonologically 'weak' positions. It is this asymmetry in the formulation of the stress constraints that allows for the asymmetrical patterns of primary and secondary stress assignment.

By ranking the stress constraints in a stringency relation, it makes certain predictions about the types of stress patterns that would be predicted to occur and not to occur. It will be shown that, due to the nature of stringency, there is no ranking of a primary-stress-specific constraint, its general counterpart, and an interacting antagonistic constraint that will yield a pattern in which a phonological process applies only in secondary stressed syllables to the exclusion of primary stressed syllables. This is a desirable consequence since, with respect to certain phonological processes, asymmetrical patterns in which only secondary stressed syllables are affected by the process are unattested. However, with respect to other phonological processes, this type of asymmetrical pattern, in which only secondary stressed syllables are targeted, is attested.

I argue that the difference between those processes that can apply only in secondary stressed syllables vs. those that cannot rests in whether stress assignment is process-driven or whether the process is stress-driven. (I use the term 'process' here theory-independently to refer to any rule, constraint, phonological property or phenomenon that can interact with stress assignment.) Based on this distinction, it is possible to predict when such an asymmetrical pattern will be attested and when it will not.

When a phonological process is stress-driven (e.g., stressed vowel lengthening), it will potentially yield only one type of asymmetrical pattern, in which the process applies only in primary stressed syllables but not in secondary stressed syllables. On the other hand, when stress assignment is process-driven (e.g., weight-sensitivity), it will potentially yield both of the asymmetrical patterns, in which the process interacts exclusively with primary stress or with secondary stress.

The reason why process-driven stress systems can yield the (otherwise) unexpected pattern of asymmetry is due to competing pressures being placed on primary stress: 1) the pressure for primary stress to mark edge-prominence, and 2) the pressure for primary stress to fall on a prominent syllable. It is when the pressure for primary stress to be edge-prominent is given priority over the competing demand that primary stress fall on a syllable with inherent prominence that asymmetrical patterns, in which a process only applies in secondary stressed syllables, can arise.

1.1.3   Outline of the chapter

In the remainder of this chapter, I provide a background on stress phenomena in both derivational and optimality theoretic frameworks. First, in §1.2, I discuss how earlier, rule-based theories account for patterns of symmetry and asymmetry in stress assignment. I compare the more traditional bottom-up approach (§1.2.1) with other top-down approaches to stress assignment (§1.2.2), concluding that top-down theories are better able to characterize the wide variety of attested stress patterns, particularly those that exhibit stress asymmetries. In §1.2.3, I provide a table listing just some of the different kinds of stress asymmetries that are observed in the world's languages.

In §1.3, I provide a brief overview of Optimality Theory, paying special attention to the kinds of constraints that are most often used in analyses of stress (§1.3.2). In §1.3.3, I demonstrate the principle of *factorial typology*, one of the central tenets of OT that gives the theory its inherently typological character. Using stressed vowel lengthening as an example, I show how reranking the same set of constraints yields a range of different stress patterns. Another principle of OT called *stringency*, which plays

a crucial role in accounting for asymmetrical stress patterns and is instrumental in predicting the types of patterns that are expected to be unattested, is discussed in §1.3.3.3.

In §1.4, I discuss the premise behind positing constraints that are specific to primary stress. It is shown that constraints may make reference to phonologically privileged or 'strong' positions, but not to positions that are phonologically 'weak'. While it has been recognized that stressed syllables are among those positions that are considered to be phonologically strong, I argue that primary stressed syllables, being 'strongest of the strong', make a logical focus for positional constraints. Secondary stressed syllables, which are phonologically weak, do not. Theories of positional faithfulness and positional markedness constraints are discussed and it is shown that the types of phenomena presented here, in which phonological processes apply in stressed syllables, cannot be accounted for using positional faithfulness constraints.

In the final section of this chapter (§1.5), I lay out the organization of the remainder of the thesis.

1.2   Rule-based approaches to stress assignment

Stress has been widely studied and well documented in the phonological literature. While earlier work viewed stress as a multi-valued feature, similar to voicing or backness (e.g., Chomsky & Halle 1968), subsequent work has viewed stress as being based on the notion of rhythm (most notably, Halle & Vergnaud 1987; Hayes 1985, 1995; Liberman 1975; Liberman & Prince 1977; Prince 1983). Within this view, these more recent theories of metrical phonology have represented stress as a hierarchically organized rhythmic structure by using the *metrical grid*. The grid is a two-dimensional

array that groups rhythmic beats into a hierarchy of different-sized prosodic constituents. Rows in the grid represent different levels of prosodic structure, while columns represent the relative prominence of syllables and feet. Furthermore, because stress is often predictable, it can be assigned by applying phonological rules that build on the grid.

Within rule-based theories, two different approaches to stress assignment can be identified: bottom-up vs. top-down constructionism. In this section, I briefly describe these two derivational approaches. I conclude that the view of stress espoused in top-down theories is better able to characterize the wide variety of stress patterns found in the world's languages, particularly those that exhibit asymmetrical patterns of primary and secondary stress.

1.2.1 Bottom-up stress assignment

Traditional approaches to metrical stress theory (e.g., Halle & Vergnaud 1987; Hayes 1985, 1995) assign stress from the *bottom up*. Using the metrical grid, every constituent that is eligible to bear stress receives a grid mark. A subset of these constituents is selected to receive stress according to the rules and parameters of the language. Finally, the left- or rightmost of these stressed syllables receives the main or primary stress.

For example, in Maranungku (Tryon 1970), primary stress falls on the initial syllable and secondary stresses fall on every other syllable thereafter. In a metrical account of this language, a foot construction rule builds syllabic trochees from left to right. A later word layer construction rule called End Rule Left (see Hayes 1995; Prince 1983) creates a new metrical constituent atop the existing structure, making the leftmost or initial trochaic foot the head of the word, which is realized with primary stress.

(1) Maranungku

```
     x      x      x                         a. Foot construction:  build syllabic trochees
    (x  .)(x  .)(x  .)                                              from left to right
     σ σ σ σ σ
    welepenemanta

     x                                       b. Word Layer construction: End Rule Left
    (x      x      x  )
    (x  .)(x  .)(x  .)
     σ σ σ σ σ
    wélepènemànta          'kind of duck'
```

In Maranungku, primary stress is assigned to one of the syllables to which (secondary) stress had been assigned by a prior rule. In essence, primary stress is simply a secondary stress that has been given special status or has been promoted in the prosodic hierarchy; otherwise, they are identical.

This kind of bottom-up constructionism is even argued to be necessary in some languages that have only one (primary) stress per word. For example, in Cairene Arabic (McCarthy 1979b), to determine the location of primary stress, feet must first be built iteratively from left to right throughout the word. The rightmost foot is then designated as the head of the word. Finally, secondary stresses are deleted.

This bottom-up characteristic of stress assignment in metrical stress theory is also reflected in the Continuous Column Constraint. Defined below in (2), this constraint says that if a syllable is represented as having a rhythmic beat on a given layer, it must also have a rhythmic beat on all lower layers.

(2)   Continuous Column Constraint (Prince 1983:33)

A grid containing a column with a mark on layer $n + 1$ and no mark on layer n is

ill-formed. Phonological rules are blocked when they would create such a

configuration.

This constraint, which, according to Hayes (1995:34), is inviolable, is meant to capture the tendency for languages to exaggerate pre-existing contrasts by 'making the strong stronger' (as well as by making the weak weaker). It guarantees that a higher mark in the grid may only be assigned to a syllable that already bears stress. Hayes states that the kind of bottom-up stressing described above for Maranungku could be argued to be the only plausible analysis for stress assignment because it obeys the 'strong gets stronger' notion of the Continuous Column Constraint: the foot construction rule selects some subset of the syllables of the word to bear stress and the End Rule selects the left- or rightmost of these stressed syllables to bear the primary stress. Assigning primary stress directly without first going through basic foot construction would lead to extremely complex rules in some languages (Hayes 1995:36).

Within bottom-up theories, the distinction between primary and secondary stress is due to the distinction between prominence relations among feet. Because primary stress is simply a secondary stress that has been promoted in the prosodic hierarchy, the general implication is that they will behave similarly, particularly with respect to footing processes. When they do not, separate rules for assigning (what will become) the primary and secondary stress feet must be specified. For example, in a language in which the primary stress foot is assigned at one edge and secondary stress feet are assigned from the opposite edge, two rules of foot construction must apply: one builds a single foot at an edge non-iteratively, the other builds iterative feet from the opposite edge, and then one

of those feet will be designated as the primary stress foot. As discussed in the next section, separate algorithms for assigning primary and secondary stress are the norm in top-down theories.

1.2.2   Top-down stress assignment

Some researchers (e.g., van der Hulst 1984, 1996, 1999; Hurch 1996; Roca 1986) have challenged the basic bottom-up constructionism of traditional metrical stress theory. They claim that primary and secondary stresses are assigned independently of one another in separate algorithms with primary stress being assigned first in a *top-down* fashion. For example, van der Hulst (1984, 1996, 1999) proposes a theory he calls 'Primary Accent First', where a rule assigning primary accent (or stress) applies before any secondary or rhythmic stresses are assigned. For instance, in most bounded systems, primary stress can be assigned by a peripheral foot at the right or left edge without the need to refer to prior exhaustive footing.

For most languages, particularly when primary stress is assigned at the same edge at which footing begins, bottom-up and top-down stress assignment do not make different predictions about the stress pattern. For instance, to assign stress in Maranungku in a top-down fashion, a primary stress foot would first be assigned at the left edge of the word, and then the remainder of the word would be parsed into feet bearing secondary stresses, yielding the same stress pattern as seen above in (1). While Hayes (1995:116-117) allows for this type of top-down stress assignment, he claims that it is a marked option and that in cases of ambiguity such as this one, bottom-up parsing prevails.

However, there are languages in which bottom-up and top-down parsing would result in different predictions. In these languages, the assignment of secondary stresses seems to rely crucially on the prior assignment of primary stress.

An example of a top-down language discussed in Hayes (1995:133ff) is Cahuilla, an Uto-Aztecan language of Southern California (Seiler 1977). In Cahuilla, primary stress falls on the initial syllable of the root and secondary stress assignment follows a binary alternating count of moras. Thus, if all syllables in the word are light, stress falls on every odd-numbered syllable. However, if the initial syllable of the root is heavy (containing a long vowel or a coda glottal stop), the immediately following syllable is also stressed, and the alternating mora count continues thereafter. Hayes analyzes the stress pattern of this language as first assigning an End Rule Left which places primary stress on the first syllable, followed by a foot construction rule that builds moraic trochees from left to right. Thus, in Cahuilla, secondary stress assignment crucially relies upon the prior assignment of primary stress.

(3)　　Cahuilla

(x　　　)	(x　　)	(x　　)	a. *Word Layer Construction:*
◡ ◡ ◡ ◡	− ◡ ◡	◡ − ◡	End Rule Left
takaličem	qa:nkičem	suka?ti	

(x　　)	(x　　)	(x　　)	b. *Foot Construction:* build
(x .)(x .)	(x) (x .)	(x)(x)(x)	moraic trochees from left
◡ ◡ ◡ ◡	− ◡ ◡	◡ − ◡	to right
tákaľìčem	qá:nkìčem	súkà?ì	
'one-eyed ones'	'palo verde.PL'	'the deer.OBJ'	

The crucial form demonstrating that stress must be assigned top-down is [súkà?ì]. The initial primary stress forces a degenerate foot to be constructed on the

initial syllable. This runs contrary to the Priority Clause (Hayes 1995:95), which states, "If at any stage in foot parsing the portion of the string being scanned would yield a degenerate foot, the parse scans further along the string to construct a proper foot where possible." In other words, if stress assignment proceeded from the bottom up in accordance with the Priority Clause, foot parsing would skip over the light initial syllable – as parsing it would create a degenerate foot – placing stress on the heavy second syllable instead (e.g., *[su(ká?)(ì)]).

Van der Hulst (1996, 1999) also cites as support for his Primary Accent First theory languages which have been analyzed within Lexical Phonology (Kiparsky 1982, 1983, 1985) as having a lexical rule of primary stress assignment and a postlexical rule of secondary stress assignment. He points out that secondary stress location often has properties that are characteristic of postlexical rules, such as optionality and a lack of exceptions, while primary stress assignment is not optional and often has exceptions and subregularities which are characteristic of lexical rules (van der Hulst 1999:72). He gives as examples languages like Spanish, Italian, and Chamorro, where primary stress falls on one of the last three syllables of the word in an unpredictable fashion (as such, they must be lexically marked), and secondary stress alternates predictably on every other preceding syllable. Similar arguments are provided by Hurch (1996) and Roca (1986) for other languages as well.

Apart from languages in which primary stress assignment must precede secondary stress assignment, top-down theorists have observed that in many languages, primary and secondary stresses behave quite independently of one another. Van der Hulst (1996) gives as examples bidirectional languages in which primary and secondary stresses are

oriented towards opposite word edges. Independent of whether stress assignment proceeds from the bottom up or from the top down, separate rules for primary and secondary stress are necessary. Other examples include languages in which primary and secondary stresses obey different projection principles, i.e., where one type of stress is quantity sensitive and the other is not (e.g., Finnish), or they are both quantity sensitive but in different ways (e.g., Tiberian Hebrew).

Finally, there are various observations about primary and secondary stress that suggest their independent nature, regardless of what theory is adopted. For instance, primary stressed syllables are suitable locations for intonational pitch contours, but secondary stressed syllables typically are not. Second, disagreement among speakers on the location of primary stress in a word is not typical. However, opinions sometimes do differ between speakers with respect to the location of secondary stresses. Finally, primary stress is very often (if not always) stable, but in many languages, the secondary stress pattern may vary and have optional realizations (van der Hulst 1999).

1.2.3 Asymmetries of primary and secondary stress

Close inspection of the stress literature yields numerous examples of languages whose primary and secondary stresses behave quite differently and quite independently of one another, both in terms of how they are assigned as well as how they interact with particular phonological phenomena. I list in (4) illustrative examples of languages that display such primary and secondary stress asymmetries.

(4)   Some patterns of primary and secondary stress asymmetries

Language[a]	Primary stress	Secondary stress
a. Paumari, Khalkha, Buriat, Sindhi, Guahibo, Banawá, Delaware	cannot be final[b]	can be final
b. Wargamay, Nyawaygi, Icelandic, Cebuano, Greek, Kuuku-Yaʔu[c]	must be heavy	can be light
c. Chamorro[d], Asheninca, Nganasan, Kara	sonority sensitive	sonority insensitive
d. Armenian, Azerbaijani, Alyawarra	sonority insensitive	sonority sensitive
e. Alyawarra, Niuafo'ou[e], Madimadi[f], Western Aranda	onset sensitive	not sensitive
f. Guugu-Yimidhirr, Nez Perce[g]	can have long or short vowel	must have short vowel
g. Hixkaryana, Boumaa Fijian	must have short vowel	can have long or short vowel
h. Sentani	trochaic stress foot	iambic stress foot
i. Huariapano, Inga, Seneca, Maung, Djabugay, Yukulta, Surinam Carib	quantity sensitive	quantity insensitive
j. Finnish, Koya, Cahuilla, Waalubal, Apalai, Cambodian, Cayapa, Estonian, Irish Gaelic, Gidabal, Tubatulabal, W. Shoshoni, Margany/Gunya, Alabama, Veps, Votic	quantity insensitive	quantity sensitive
k. Chugach[h] (Pacific Yupik), Norton Sound (Central Alaskan Yupik)	quantity sensitive (CVV, CVC)	quantity sensitive (CVV)

[a] References and genetic affiliation for the languages included here are listed in the appendix.
[b] In words with more than one stress.
[c] Primary stressed syllables are made heavy via consonant gemination. All of the other languages in this row do so via vowel lengthening.
[d] While derived secondary stresses are sonority-sensitive, rhythmic secondary stresses are only variably sensitive to sonority.
[e] In Alyawarra and Niuafo'ou, primary stress cannot have a glide onset while secondary stress can.
[f] Primary stress is attracted to syllables with a coronal onset while secondary stress is not.
[g] This is true of predictable stresses. Lexical stresses (whether primary or secondary) can be long or short.
[h] Stresses in these languages are often described as having equal prominence. The pattern described in the primary stress column is true of the leftmost stress.

Language	Primary stress	Secondary stress
l. Tiberian Hebrew	quantity sensitive (superheavy, CVC)	quantity sensitive (CVV)
m. Garawa, Biangai, Gugu-Yalanji, Lower Sorbian, Mingrelian, Watjarri, Walmatjarri, Kara	left-aligned	right-aligned
n. Piro, Armenian, Anyula, Awtuw, Georgian, Lenakel verbs, Maithili, Murut, Polish, Romanian, Sanuma, Sibutu Sama, Tauya[i], Udihe, Chimalapa Zoque	right-aligned	left-aligned
o. Chamorro, Italian, Spanish, Catalan	lexical	predictable
p. Icelandic, Fijian, Huariapano	predictable	lexical[j]
q. Lenakel	same pattern for nouns and verbs	different pattern for nouns and verbs
r. Romanian, Misantla Totonac	different pattern for nouns and verbs	same pattern for nouns and verbs

The 79 different languages listed in (4) are intended to illustrate just some of the possible primary and secondary stress asymmetries observed in the world's languages. This is by no means an exhaustive list.

Because the languages in (4) cover such a wide range of patterns, I am unable to give each of them equal attention in this thesis. In fact, some of these patterns will not be discussed at all. For instance, I do not discuss languages that have differing patterns for nouns and verbs (4q,r). While interesting empirically, they can be handled within OT by having different constraint rankings for the noun and verb phonologies. Similarly, any asymmetries regarding primary and secondary stress in systems with lexical accent (4o,p) can be dealt with rather straightforwardly by appealing to faithfulness constraints in

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[i] Secondary stress is initial (left-aligned), and alternates in front of final primary stress from right to left.
[j] For Icelandic and Fijian, lexical secondary stress is evident in the loanword phonology.

addition to the markedness constraints responsible for assigning stress, since lexical accent is present in the underlying representation or input (see §5.2.3, however, for a discussion of other aspects of the Huariapano stress pattern in (4p)). However, for some of the languages in (4o), primary stress is largely predictable, though there are lexical exceptions. As such, if they exhibit another asymmetry, they are treated as if they have predictable primary stress (e.g., Chamorro (4c), discussed in §4.2.1).

Bidirectional languages (4m,n) that align primary and secondary stress at opposite word edges are discussed only briefly (§1.3.2), as they, too, pose little challenge for either derivational or constraint-based theories. Furthermore, a few of these patterns have been described previously in the OT literature (e.g., Guugu-Yimidhirr (4f) in Kager (1996); Chugach (4k) in Rosenthall & van der Hulst (1999)) and therefore are given only a cursory mention when it is relevant to the discussion at hand (see §6.1.4 for Guugu-Yimidhirr, §3.3.2.4 for Chugach).

Some of the languages listed in (4) have only *apparent* asymmetries of primary and secondary stress (e.g., Hixkaryana (4g), Sentani (4h)). That is, the different behavior of the two types of stresses is due not to the nature of the stress that appears to be affected (i.e., primary stress); rather, it results from external demands or constraints whose domain of application happens to coincide with the domain of primary stress, thereby creating an apparent asymmetry. (For a discussion of the Hixkaryana pattern, see §3.4.1.)

Of the remaining asymmetries, almost all are discussed, to varying degrees, throughout the remainder of this thesis. Particularly, the languages in (4a) form the basis for the discussion in chapter 2 on nonfinality effects. Chapter 3 examines the languages in (4b), which display asymmetries of lengthening or quantity adjustment. Chapter 4

focuses on the sonority sensitivity patterns exhibited by the languages in (4c). Asymmetries involving quantity sensitivity (4i, j) are analyzed in chapter 5, as is the sonority pattern in (4d). Finally, chapter 6 concludes with a brief mention of the onset-sensitivity pattern in (4e) as well as a few additional primary and secondary stress asymmetries that are not represented in this table.

All of the patterns examined in this thesis are analyzed within the framework of Optimality Theory (McCarthy & Prince 1993b, 1995; Prince & Smolensky 1993/2002). Because OT is a constraint-based framework, it has no rules and thus, no serial rule ordering. There is no mechanism for ensuring that any one type of stress is assigned before another since all evaluation in OT is done in parallel. Instead, I argue that the different behavior of primary and secondary stress in languages with stress asymmetries can be captured by appealing to constraints referring specifically to primary stress that stand in a *stringency relation* (McCarthy 2002; Prince 1997a, b) with constraints referring to stress in general. In the next section, I lay out a brief overview of OT (§1.3.1) with special attention paid to the kinds of constraints that are used in analyses of stress (§1.3.2). In §1.3.3, I demonstrate one of the central tenets of OT, factorial typology, using examples of languages with different patterns of stressed vowel lengthening. I conclude the section (§1.3.3.3) with a discussion of stringency.

1.3 Stress in Optimality Theory

1.3.1 Overview

In this thesis, I examine patterns of primary and secondary stress within the framework of Optimality Theory (henceforth OT, McCarthy & Prince 1993b, 1995; Prince & Smolensky 1993/2002). Unlike rule-based derivational theories, OT is constraint-based; that is, there are no phonological rules or serial derivations to determine the correct surface or output form of a phonological input. Instead, optimal output forms are determined by the interaction of universal, violable constraints. While I am assuming the reader has a general familiarity with OT, I will provide a very brief overview here. For more comprehensive overviews, see Archangeli & Langendoen (1997), Kager (1999), and McCarthy (2002c).

The OT grammar consists of three components: GEN, EVAL, and CON. The function GEN generates a universal set of potential output forms, or *candidates*, for a given input, and specifies a relation between those output forms and the input. Which among these candidates is selected as the optimal form is determined by how well they satisfy the constraints in CON. CON is the universal set of violable *constraints* which are present in the grammars of all languages. There are two basic types of constraints: *faithfulness* constraints and *markedness* constraints. Faithfulness constraints demand identity between two strings (such as an input and an output), while markedness constraints, which are strictly output-oriented, favor structurally unmarked forms at the expense of modifying the input. While the constraints are universal, their ranking is language-specific. The final OT component EVAL evaluates in parallel the set of output candidates with respect to the language-particular hierarchy and determines which output form is optimal. EVAL orders output candidates according to how well they satisfy the constraint hierarchy. The optimal or actually occurring output form can violate lower-ranked constraints if such violation secures satisfaction of higher-ranked constraints

which its competitors violate. The winning candidate, then, is the most harmonic form that best satisfies the high-ranked constraints.

1.3.2 Stress constraints

Because the languages I consider in this thesis have (for the most part) predictable stress patterns, stress and the structure that sometimes accompanies it are not present in the input. As such, competing parses of output forms must be evaluated by the output-oriented markedness constraints. In this section, I introduce the core set of constraints that are relevant in OT analyses of stress phenomena.

The fundamental requirement that feet be binary is captured by the constraint FTBIN (McCarthy & Prince 1986; Prince 1980; Prince & Smolensky 1993/2002).

(5)   FTBIN: Feet are binary at some level of analysis (μ, σ).

This constraint demands either that a foot contains two moras, as in monosyllabic (H) and disyllabic (LL), or two syllables ($\sigma\sigma$), regardless of their weight. What is ruled out by this constraint is a degenerate foot consisting only of a light syllable (L), as well as a foot with more than two syllables.

While FBIN demands rhythmic binarity, it does not, by itself, generate an alternating pattern of stresses. Rhythmic alternation also requires an appeal to PARSE-σ (Halle & Vergnaud 1987; Hayes 1985; Prince & Smolensky 1993/2002).

(6)   PARSE-σ: Syllables are parsed by feet.

This constraint assigns one violation for each syllable not parsed by a foot. As shown in the following tableau, when this constraint is ranked above FTBIN, the effect is for footing to be exhaustive

(7)   Exhaustive footing, degenerate feet allowed

/$\sigma\sigma\sigma$/	PARSE-σ	FTBIN
a. ($\sigma\sigma$)σ	*!	
b. ☞ ($\sigma\sigma$)(σ)		*

By failing to parse all of the syllables into feet, candidate (a) is eliminated in favor of candidate (b) with exhaustive footing, even though a degenerate foot is formed.

When the ranking of these two constraints is the reverse, degenerate feet are banned and footing is nonexhaustive.

(8)   Nonexhaustive footing, degenerate feet disallowed

/$\sigma\sigma\sigma$/	FTBIN	PARSE-σ
a. ☞ ($\sigma\sigma$)σ		*
b. ($\sigma\sigma$)(σ)	*!	

With the ranking of it FTBIN >> PARSE-σ it becomes more important to have well-formed binary feet than it is to have exhaustive footing. As a result, candidate (b) with the degenerate foot is eliminated in favor of candidate (a) with nonexhaustive footing.

While these two constraints evaluate candidates with respect to foot parsing, they do not determine the distribution of feet within a word. This requires an appeal to *alignment* constraints. An alignment constraint is a kind of markedness constraint that demands that constituent edges coincide. All alignment constraints are formulated using the Generalized Alignment constraint schema of McCarthy & Prince (1993a), defined formally below.

(9)   Generalized Alignment (McCarthy & Prince 1993a)

Align(Cat$_1$, Edge$_1$, Cat$_2$, Edge$_2$) =$_{def}$

$\forall$Cat$_1$ $\exists$Cat$_2$ such that Edge$_1$ of Cat$_1$ and Edge$_2$ of Cat$_2$ coincide.

Where

Cat$_1$, Cat$_2$ $\in$ PCat, GCat

Edge$_1$, Edge$_2$ $\in$ {Right, Left}

"The element standing at Edge$_1$ of any Cat$_1$ also stands at Edge$_2$ of any Cat$_2$ (where Cat$_1$ and Cat$_2$ are grammatical or prosodic constituents and Edge$_1$ and Edge$_2$ are left or right)."

To paraphrase, Generalized Alignment (or GA) demands that the right/left edge of each prosodic or grammatical constituent of type Cat$_1$ must coincide with the right/left edge of some other prosodic or grammatical constituent Cat$_2$. The types of constituents that can be aligned include, for example, the prosodic categories mora (μ), syllable (σ), foot, and prosodic word and the grammatical categories affix, root, stem, and word. It is important to note that the two categories involved in an alignment constraint do not have a symmetrical relationship. That is, the order in which the two categories are mentioned is not random. The first category is marked with a universal quantifier '$\forall$' (e.g. 'each, every'), while the second category is marked with an existential quantifier '$\exists$' (e.g. 'some'). Thus, a constraint involving the same two categories as another constraint but in the opposite order will have a different interpretation.

An analysis of stress using GA primarily involves the alignment of the prosodic categories foot (Ft) and prosodic word (PrWd). For example, one constraint framed within GA demands that every foot be aligned with a particular edge of some prosodic word.

(10)   ALIGNFT-L: Align (Ft, L, PrWd, L)

Align the left edge of every foot with the left edge of some PrWd.

This constraint demands that every foot must stand at the left edge of the PrWd. It is only fully satisfied when a single foot stands at the absolute left edge of the word; any other foot will necessarily incur a violation of this constraint since more than one foot cannot stand at the left edge. This has the effect of either iterative or non-iterative footing, depending upon its ranking with respect to PARSE-σ. If ALIGNFT-L is ranked above PARSE-σ, footing is non-iterative.

(11)   Non-iterative footing: ALIGNFT-L >> PARSE-σ

/$\sigma\sigma\sigma\sigma$/	ALIGNFT-L	PARSE-σ
a. ☞ ($\sigma\sigma$)$\sigma\sigma$		**
b. ($\sigma\sigma$)($\sigma\sigma$)	*!*	

As seen for candidate (b), violation of ALIGNFT-L is marked gradiently, with one violation mark being incurred for each syllable that separates the left edge of the foot from the left edge of the PrWd. Thus, while the initial foot is perfectly aligned with the left edge of the word, the second foot is two syllables away from the left edge and incurs two violation marks. Because it is more important to satisfy ALIGNFT-L than it is to parse all of the syllables into feet, any word will only have one foot and therefore, only one stress. The reverse ranking of these two constraints yields a pattern of iterative footing.

(12)   Iterative footing: PARSE-σ >> ALIGNFT-L

/$\sigma\sigma\sigma\sigma$/	PARSE-σ	ALIGNFT-L
a. ($\sigma\sigma$)$\sigma\sigma$	*!*	
b. ☞ ($\sigma\sigma$)($\sigma\sigma$)		**

Candidate (b), which has multiple feet and, thus, multiple stresses, is more harmonic than candidate (a), with only one foot, because it leaves no syllables left unparsed. Although candidate (a) fully satisfies ALIGNFT-L by having its only foot perfectly aligned with the left edge of the word, this constraint is low ranked.

Other alignment constraints used in OT analyses of stress systems include ALIGNWD-L and ALIGNWD-R. As opposed to the ALIGNFT-L/R constraints, which make a requirement about feet in terms of word edges, ALIGNWD-L/R constraints make a requirement about words in terms of feet (Kager 1999:169).

(13)   ALIGNWD-L: Align (PrWd, L, Ft, L)
       Align the left edge of every PrWd with the left edge of some foot.

This constraint contains the same categories as ALIGNFT-L, but in the opposite order; it demands that every word begins with a foot and is violated when there is no foot at the left edge.

All of the alignment constraints introduced so far evaluate stress feet in general, regardless of whether they contain primary or secondary stresses. There are, however, alignment constraints that are specific to primary stress. The ALIGNHD-L/R constraints are responsible for the alignment of the most prominent foot of the word bearing primary stress.

(14)   ALIGNHD-L: Align (PrWd, L, Hd(PrWd), L)
       Align the left edge of the PrWd with the left edge of the head foot of the PrWd.

This constraint demands that the left edge of every PrWd must coincide with the head foot of the prosodic word. The ALIGNHD-L/R constraints are similar to Hayes' (1995) End Rule (Left/Right) and Prince & Smolensky's (1993/2002) EDGEMOST constraints, which assign primary stress to the leftmost or rightmost foot in the word.

The ALIGNHD-L/R constraints are crucial in accounting for *bidirectional* stress systems. In bidirectional systems, primary and secondary stress are oriented towards opposite word edges, instead of towards a single edge. For example, in the Australian language Garawa (Furby 1974; McCarthy & Prince 1993a), primary stress falls on the initial syllable, secondary stress falls on the penult, and tertiary stress falls on every other syllable preceding the penult. (I do not distinguish between different degrees of subsidiary stress here.)

(15)   Garawa
       a. (σ́σ)σ   pún.ja.ɭa   'white'
       b. (σ́σ)(ὸσ)   wát.jim.pà.ŋu   'armpit'
       c. (σ́σ)σ(ὸσ)   ká.ma.ɭa.ɽì.ɲi   'wrist'
       d. (σ́σ)(ὸσ)(ὸσ)   yá.ka.là.ka.làm.pa   'loose'
       e. (σ́σ)σ(ὸσ)(ὸσ)   ŋán.ki.ɽi.ɫì.rim.pà.yi 'fought with boomerangs'

While in general the stress feet are aligned with the right edge of the word, it is more important for the primary stress foot to be aligned with the left edge of the word. Thus ALIGNHD-L must dominate ALIGNFT-R, the constraint aligning general stress feet with the right edge of the word. Because there is one unparsed syllable in words with an odd number of syllables (e.g., (15)a, c, e), footing is nonexhaustive, which means FTBIN >> PARSE-σ. Finally, PARSE-σ must outrank ALIGNFT-R, to account for the fact that there are multiple stresses in a word. Together, these constraints yield the bidirectional pattern.

(16)   Bidirectional stress pattern

/σσσσσσ/	FᴛBɪɴ	AʟɪɢɴHᴅ-L	Pᴀʀsᴇ-σ	AʟɪɢɴFᴛ-R
a. ☞ (όσ)σ(ὸσ)(ὸσ)			*	**¸*****
b. (όσ)(ὸσ)(ὸσ)σ			*	*¸***¸****!¸*
c. (όσ)σσσσσ			**!***	*****
d. σ(όσ)(ὸσ)(ὸσ)		*!	*	**¸****
e. (όσ)(ὸσ)(ὸσ)(ὸ)	*!			*¸***¸*****

Because it has a degenerate foot, candidate (e) is ruled out by FᴛBɪɴ. Candidate (d) is eliminated by AʟɪɢɴHᴅ-L since the primary stress foot is not perfectly aligned with the left edge of the word. Candidate(c) incurs gratuitous violations of Pᴀʀsᴇ-σ by failing to have iterative footing. Of the remaining two candidates, candidate (a) better satisfies AʟɪɢɴFᴛ-R, since the two secondary stress feet are aligned with the right edge of the word, and is thus selected as the optimal form.

1.3.3   Factorial typology

As discussed in the previous section, because the set of constraints and inputs in OT are universal, languages can only differ in terms of their constraint rankings. This idea of a *factorial typology* is one of the central tenets of OT; every ranking permutation is, in principle, predicted to be a possible language. That is, given the set of constraints Cᴏɴ with *x* number of constraints, factorial typology will yield *x*! possible rankings of those constraints. However, not every ranking permutation will yield a truly distinct language. Furthermore, if no permutation produces a language with a particular pattern, then such languages are predicted not to exist.

1.3.3.1 Stressed vowel lengthening

In this section, I will demonstrate these principles of OT with an example of stressed vowel lengthening that will be discussed in more detail in chapter 3. Consider the following data from Mohawk (Michelson 1983:67).

(17)   Mohawk

a. /atirut/   t-ʌ-k-atirúːt-ʌʔ   *DUAL+FUT+1p+pull+PUNC*   'I shall stretch it'
         cf.   te-k-atirút-haʔ   *DUAL+1p+pull+SERIAL*   'I stretch it'

b. /hnek/   ʌ-k-hnek-íːr-ʌʔ   *FUT+1p+liquid+fill in+PUNC*   'I will drink'
         cf.   k-hnek-ír-haʔ   *1p+liquid+fill in+SERIAL*   'I drink'

c. /kwit/   wak-kwíːt-u   *1p.OBJ+move+PERF*   'I moved it'
         cf.   k-kwít-haʔ   *1p+move+SERIAL*   'I move it'

In Mohawk, stress always falls on the penultimate (underlying) vowel.[4] While there is no phonemic vowel length distinction in Mohawk, when the stressed vowel is in an open syllable, it is lengthened.[5] This is demonstrated in the alternating forms in (17).

This pattern can be accounted for within OT by ranking a markedness constraint requiring stressed syllables to be heavy above a faithfulness constraint banning mora-insertion (i.e., vowel lengthening). These constraints and their ranking are given in (18).

(18)   Constraints
a. Sᴛʀᴇss-ᴛᴏ-Wᴇɪɢʜᴛ Pʀɪɴᴄɪᴘʟᴇ (S-to-W): Stressed syllables must be heavy.
b. Dᴇᴘ-μ: A mora in the output must have a correspondent in the input. ('No mora insertion.')
Ranking: S-to-W >> Dᴇᴘ-μ

The markedness constraint S-to-W is from Prince (1990) and is discussed in more detail in chapter 3. As shown in the following tableau, this ranking of S-to-W >> Dᴇᴘ-μ will yield the pattern of stressed vowel lengthening in open syllables.[6]

(19)   Stressed vowel lengthening in Mohawk

/wak-kwit-u/	S-to-W	DEP-μ
a. ☞ wak.kwíː.tu		*
b. wak.kwí.tu	*!	

Candidate (b) violates S-to-W, since the stressed syllable is light. It is thus eliminated in favor of candidate (a), which lengthens the stressed vowel at the expense of violating low-ranked faithfulness.

Ranking these two constraints in the reverse order, with faithfulness above markedness, would yield a different grammar in which stressed vowels do not undergo lengthening in any syllables. A tableau evaluating a hypothetical example from such a language is given in (20).

(20)   No stressed vowel lengthening

/paka/	DEP-μ	S-to-W
a. páː.ka	*!	
b. ☞ pá.ka		*

As it turns out, however, these are not the only attested patterns of stressed vowel lengthening. There are languages in which syllables bearing primary stress undergo vowel lengthening while those bearing secondary stress do not. The Australian language Wargamay (Dixon 1981) is one such example. I give a portion of the Wargamay stress data below. For a complete discussion, see §3.3.1.

(21)   Wargamay

a.   mú·ŋan   'mountain-ABS'

      gí·ɹawùlu   'freshwater jewfish'

b.   muŋá·nda   'mountain-LOC'

      ɹuɽá·gay-mìri 'Niagara-Vale-FROM'

Primary stress falls on the initial syllable in even-parity words, as in (a), and on the second syllable in odd-parity words, as in (b). Secondary stresses alternate after the primary stress, but may not fall on the final syllable. What should be noted, however, is that while primary stressed vowels lengthen (indicated by Dixon with '·'), secondary stressed syllables do not.

To account for the fact that primary stressed syllables behave differently than secondary stressed syllables with respect to vowel lengthening, it is necessary to explode the markedness constraint S-to-W into a more specific version of the constraint that demands that only primary stressed syllables be heavy.

(22) S_1-to-W: Primary stressed syllables must be heavy.

The asymmetrical behavior of primary and secondary stressed syllables with respect to vowel lengthening can be captured by ranking the faithfulness constraint DEP-μ intermediately between the specific S_1-to-W and the general S-to-W. The ranking of DEP-μ above S-to-W ensures that vowel lengthening is, in general, prohibited. However, ranking the primary stress specific S_1-to-W constraint above the faithfulness constraint allows vowel lengthening in a restricted set of contexts, namely, in all primary stressed syllables.

(23) Vowel lengthening in primary stressed syllables only

/ɟuʈagay-miri/	S$_1$-to-W	Dep-μ	S-to-W
a. ɟuʈágay-mùri	*!		**
b. ☞ ɟuʈáˑgay-mùri		*	*
c. ɟuʈáˑgay-mùˑri		**!	

Candidate (a) is eliminated due to its failure to lengthen the vowel in the primary stressed syllable. While candidates (b) and (c) both lengthen the primary stressed vowel, candidate (c) is eliminated since it also lengthens the secondary stressed vowel, thereby incurring one extra violation of Dep-μ.

1.3.3.2 Typological patterns of stressed vowel lengthening

With this modest constraint set of S$_1$-to-W, S-to-W, and Dep-μ, the inherently typological nature of OT makes it possible to compute the typology of different patterns of stressed vowel lengthening that is predicted by factorial ranking permutation. With these three constraints, factorial typology yields 3! = 6 different rankings. These rankings are given in (24).

(24) Factorial typology of {Dep-μ, S$_1$-to-W, S-to-W}

I. a. Dep-μ >> S$_1$-to-W >> S-to-W
    b. Dep-μ >> S-to-W >> S$_1$-to-W

II. c. S$_1$-to-W >> S-to-W >> Dep-μ
    d. S-to-W >> S$_1$-to-W >> Dep-μ
    e. S-to-W >> Dep-μ >> S$_1$-to-W

III. f. S$_1$-to-W >> Dep-μ >> S-to-W

While there are six different constraint rankings (a-f), they yield only three distinct patterns of stressed vowel lengthening: I) no vowel lengthening in any stressed syllables, II) vowel lengthening in all stressed syllables (both primary and secondary), and III) vowel lengthening in primary stressed syllables only (but not in secondary stressed syllables). I will consider each of these rankings in turn.

When the faithfulness constraint is high ranking, as in (24a,b), the respective ranking of the two markedness constraints below it is irrelevant. In other words, when dominated by faithfulness, the markedness constraints are inactive and their ranking cannot be determined; either ranking will yield a language in which stressed vowels are faithful to their input weight, i.e., in which stressed vowel lengthening does not occur.

(25) No stressed vowel lengthening

/cvcvcvcv/	Dep-μ	S$_1$-to-W	S-to-W
a. cv́ːcvcv̀ːcv	*!*		
b. ☞ cv́cvcv̀cv		*	**
c. cv́ːcvcv̀cv	*!		*
d. cv́cvcv̀ːcv	*!	*	*

Examples of languages with no stressed vowel lengthening include Anguthimri (Crowley 1981) and Badimaya (Dunn 1988), which are discussed in chapter 3.

The next three rankings in (24) all yield a grammar in which vowel lengthening occurs in all stressed syllables. When faithfulness is ranked below both of the markedness constraints, as in the following two tableaux, it is more important for stressed vowels to lengthen than to preserve input vowel weight.

(26)   Vowel lengthening in primary and secondary stressed syllables

/cvcvcvcv/	S₁-to-W	S-to-W	Dᴇᴘ-μ
a. ☞ cv́:cvcv̀:cv			**
b. cv́cvcv̀cv	*!	**	
c. cv́:cvcv̀cv		*!	*
d. cv́cvcv̀:cv	*!	*	*

/cvcvcvcv/	S-to-W	S₁-to-W	Dᴇᴘ-μ
a. ☞ cv́:cvcv̀:cv			**
b. cv́cvcv̀cv	*!*	*	
c. cv́:cvcv̀cv	*!		*
d. cv́cvcv̀:cv	*!	*	*

Both of these rankings yield candidate (a), with lengthening in both primary and secondary stressed syllables, as the optimal form, regardless of whether the specific markedness constraint outranks the general constraint, or vice versa. Because faithfulness is low-ranking, stressed vowel lengthening will always result.

This is true even when the primary-stress-specific markedness constraint is ranked below faithfulness.

(27)   Vowel lengthening in primary and secondary stressed syllables

/cvcvcvcv/	S-to-W	Dᴇᴘ-μ	S₁-to-W
a. ☞ cv́:cvcv̀:cv		**	
b. cv́cvcv̀cv	*!*		*
c. cv́:cvcv̀cv	*!	*	
d. cv́cvcv̀:cv	*!	*	*

Because the general S-to-W constraint refers to all stressed syllables, whether they bear primary or secondary stress, if it dominates Dᴇᴘ-μ, vowel lengthening will occur in every stressed syllable as in (a). The ranking of S₁-to-W is irrelevant. It is this ranking of general S-to-W >> Dᴇᴘ-μ that is common to all three of the rankings in (24c-e) and that is responsible for the pattern of lengthening in all stressed syllables.

The last ranking permutation in (24) yields the third attested pattern of vowel lengthening. When faithfulness is ranked below S₁-to-W but above S-to-W, it produces an asymmetrical pattern whereby primary stressed syllables undergo vowel lengthening but secondary stressed syllables do not. This pattern, demonstrated in (23) above for Wargamay, is repeated again in (28).

(28)   Vowel lengthening in primary stressed syllables only

/cvcvcvcv/	S₁-to-W	Dᴇᴘ-μ	S-to-W
a. cv́:cvcv̀:cv		**!	
b. cv́cvcv̀cv	*!		**
c. ☞ cv́:cvcv̀cv		*	*
d. cv́cvcv̀:cv	*!	*	*

This ranking ensures that while vowel lengthening is, in general, prohibited (i.e., Dᴇᴘ-μ >> S-to-W), it is allowed in a restricted set of contexts, namely, in primary stressed syllables (i.e., S₁-to-W >> Dᴇᴘ-μ).

In sum, the six ranking permutations listed in (24) yield only three distinct patterns of stressed vowel lengthening. When the specific and general versions of the S-to-W markedness constraint are both ranked above or below faithfulness, it has the same effect as if S-to-W were unexploded. The same is true when the general S-to-W

constraint dominates faithfulness which in turn dominates S_1-to-W. It is only when the primary-stress-specific markedness constraint is ranked high above faithfulness with the general S-to-W constraint ranked low that the asymmetrical pattern is observed. The rankings responsible for the three possible stressed vowel lengthening patterns are summarized in the following table. Examples of languages illustrating each of these patterns are discussed in chapter 3.

(29)   Three attested patterns of stressed vowel lengthening

Ranking	Pattern	Example
a. DEP-μ >> S_1-to-W, S-to-W	cv́cvcv̀cv	Anguthimri, Badimaya (§3.2.3)
b. S_1-to-W, S-to-W >> DEP-μ	cv́ːcvcv̀ːcv	Chimalapa Zoque (§3.2.2)
c. S_1-to-W >> DEP-μ >> S-to-W	cv́ːcvcv̀cv	Wargamay (§3.3.1)

This exercise is intended to demonstrate the predictive character of Optimality Theory. On the one hand, every ranking permutation of a constraint set resulting from factorial typology is, in principle, predicted to be a possible language; however, as demonstrated here, not every ranking permutation will yield a distinct language. On the other hand, OT makes a further prediction: if there is *no* ranking permutation that will produce a language with a particular pattern, then such a language is predicted not to exist. This, too, is illustrated in this typological demonstration.

There is no ranking of these constraints that will yield a fourth, logically possible pattern, in which vowel lengthening occurs in secondary stressed syllables but not in primary stressed syllables. In other words, there is an implicational pattern: if secondary stressed syllables undergo vowel lengthening, primary stressed syllables will exhibit vowel lengthening as well. However, the reverse does not hold true. This kind of implicational universal can be accounted for within OT by appealing to *stringency* (McCarthy 2002c; Prince 1997a, 1997b).

1.3.3.3 Implicational universals and stringency

Two constraints stand in a stringency relation if the violations of one of the constraints (C1) are always a proper subset of the violations of the other constraint (C2), as shown in (30). The term *stringency* refers to the fact that C1 imposes a less stringent test on the candidate set than C2 (i.e., it lets more candidates pass).

(30)   Constraints in a stringency relation

	C1	C2
Cand$_a$		*
Cand$_b$	*	*

The constraints in (30) generate a harmonic ordering on the two candidates such that Cand$_a$ ≻ Cand$_b$ (where '≻' reads 'is more harmonic than'). This ordering holds true regardless of how the two constraints are ranked with respect to one another. There is no ranking of these two constraints that will ever yield a harmonic ordering in which Cand$_b$ ≻ Cand$_a$. Typical examples of stringency involve a context-sensitive constraint as C1 and its context-free counterpart as C2 (e.g., the positional faithfulness constraint IDENT-ONSET[voice] vs. IDENT[voice], or the positional markedness constraint *VOICEDOBSCODA vs. *VOICEDOBS).

To illustrate this with the constraints from the vowel lengthening examples, the markedness constraint referring to primary stress (S_1-to-W) is more specific (i.e., less stringent) than the constraint referring to any stressed syllable (S-to-W). That is, they are in a stringency relation.

(31)   Stringent S-to-W constraints

	S$_1$-to-W	S-to-W
a. cv́:cvcv̀cv		*
b. cv́cvcv̀:cv	*	*

As was the case in (30) above, violations of the more specific S$_1$-to-W are a proper subset of the violations of general S-to-W; that is, a violation of S$_1$-to-W necessarily implies a violation of S-to-W, but not vice versa. There is no ranking of these constraints that will evaluate candidate (b), with vowel lengthening in secondary stressed syllables only, as more harmonic than candidate (a), with lengthening only in the primary stressed syllable.

Another approach to implicational universals that has been used in the OT literature involves constraints in a fixed hierarchy. In such cases, the relevant constraints are not freely permutable but are in a fixed ranking in CON, with one constraint being universally ranked above the other. Consider the following tableau with the fixed constraint ranking C1 >> C2.

(32)   Constraints in a fixed universal hierarchy

	C1	C2
Cand$_a$		*
Cand$_b$	*	

As in the tableau in (30) with the stringent constraints, this tableau yields a harmonic ordering of Cand$_a$ ≻ Cand$_b$. Because the ranking of these constraints is fixed, it cannot yield a harmonic ordering of Cand$_b$ ≻ Cand$_a$. Only an (improper) ranking of C2 >> C1 would yield this ordering. Thus, stringent analyses and fixed ranking analyses can account for the same types of implicational universals. Typical uses of fixed constraint

hierarchies include those based on prominence scales, which evaluate linguistic objects according to some scale of relative prominence. For example, the fact that a liquid makes a better onset than a vowel does falls out from the fixed ranking [… >> *ONSET/vowel >> *ONSET/liquid >> …], which evaluates segments according to a scale of relative sonority. In other words, because liquids are less sonorous than vowels, and because less sonorous onsets are more harmonic than more sonorous ones, liquids are preferred as onsets over vowels. (For further discussion of constraint hierarchies based on prominence scales, see chapter 4.)

It is commonly assumed that because they can account for the same types of universals, fixed hierarchies and stringent analyses are equivalent. However, there are differences between these two types of analyses. The main difference lies in the formulation of the relevant constraints. In a stringent analysis, violation of C1 implies violation of C2. Thus, C1 is a specific instance of C2. In a fixed ranking analysis, the constraints are in a complementary relationship, not a special/general relationship. To use the example from stressed vowel lengthening, the relevant constraints in a fixed hierarchy would be S$_1$-to-W, which is specific to primary stress, and S$_2$-to-W which is relativized to the complement of primary stressed syllables, namely, secondary stressed syllables. These two constraints would be universally ranked S$_1$-to-W >> S$_2$-to-W.

There are several reasons to prefer a stringent analysis over one involving fixed rankings. First of all, free ranking permutability is a desirable characteristic of OT as it places no restrictions on CON or on the principle of factorial typology. Furthermore, some analyses have proposed rankings for languages in which a constraint that is generally

defined must outrank its specific counterpart (e.g., de Lacy 2002a; Lombardi 1999). A theory involving fixed constraints would not be able to account for such languages.

There is another reason to prefer constraints in a stringency relation over complementary constraints, which is related to the issue of the type of linguistic objects constraints may specifically refer to. In a stringent analysis of stressed vowel lengthening, one constraint refers specifically to primary stress (S_1-to-W), while the other refers to stress in general (S-to-W). In a fixed ranking analysis, there are two specific constraints: one referring to primary stress and another to secondary stress.

Following the proposals put forth in recent theories, it will be argued that constraints may refer specifically to elements or positions that are phonologically prominent or strong, such as primary stressed syllables, but not to those that are phonologically weak, such as secondary stressed syllables. I take up this issue in the next section.

1.4   Stressed syllables as strong positions

1.4.1   *Positional faithfulness and positional markedness*

As many researchers have observed, languages can exhibit asymmetries with respect to the contexts or positions in which certain contrasts can be realized. One example of this is unstressed vowel reduction. In many languages (e.g., Catalan), the full inventory of vowels can occur in stressed syllables while the inventory of vowels in unstressed syllables is reduced to a subset of the full inventory that is less marked (either on the articulatory or acoustic dimension). That is, vowels in unstressed syllables often will undergo processes in which (some of) the underlying contrasts are neutralized (for

numerous examples and discussion, see Crosswhite 1999). This type of phenomenon is referred to as *positional neutralization*.

In typical cases of positional neutralization, a distinction is made between phonologically privileged or 'strong' positions, and positions that are phonologically 'weak'. In strong positions, contrast is preserved and typologically marked structures are tolerated; in weak positions, contrast is neutralized in favor of the unmarked (Alderete 1998, 1999; Beckman 1998; Casali 1996, 1997; Lombardi 1999; McCarthy & Prince 1995; Smith 2002; Steriade 1995; Trubetzkoy 1939; Zoll 1997, 1998). Examples of strong positions that have been discussed in the literature include onsets (Goldsmith 1990; Itô 1986; Lombardi 1999; Steriade 1982), long vowels (Cole & Kisseberth 1995; Steriade 1995), morphological roots (Alderete 1998, 2001; McCarthy & Prince 1995), and initial syllables (Beckman 1997; Steriade 1993). A particular position may qualify as strong either because it has special phonetic salience or prominence (e.g., onsets, long vowels) or because they play a special role in psycholinguistic processing (e.g., roots, initial syllables).

Another example of a strong position that has been documented in the literature is stressed syllables (Beckman 1998; Trubetzkoy 1939). As discussed in Beckman (1998), stressed syllables are considered to be privileged or strong positions because they are phonetically prominent, acting as the loci for perceptually salient cues such as increased duration and amplitude, and pitch extrema. While this provides a functional motivation behind their privileged status, she also provides phonological evidence in support of this claim. As noted above, stressed syllables preserve vowel contrasts by resisting

neutralization processes. They also frequently act as triggers and blockers of phonological processes such as vowel harmony.

Beckman (1998) accounts for the fact that stressed syllables (and other strong positions such as onsets, long vowels, initial-syllables, roots) are resistant to neutralization by appealing to *positional faithfulness* (see also Casali 1996, 1997). Positional faithfulness constraints are context-sensitive faithfulness constraints that are relativized to strong positions (e.g., IDENT-σ́[F], IDENT-ONSET[F], IDENT-σ₁[F], etc.). For example, to account for the fact that the nasal/oral contrast for vowels is neutralized in unstressed syllables in Guaraní, Beckman (1998:ch. 3) proposes the following ranking: IDENT-σ́[nasal] >> *V$_{nasal}$ >> IDENT[nasal]. The ranking of the markedness constraint *V$_{nasal}$ above context-free IDENT[nasal] ensures that nasal vowels are, in general, prohibited. However, the ranking of the positionally restricted faithfulness constraint IDENT-σ́[nasal] above *V$_{nasal}$ allows the nasal/oral contrast only in stressed syllables. In more general terms, by ranking a positional faithfulness constraint above an alternation-favoring constraint, which in turn is ranked above a general faithfulness constraint, patterns of positionally-restricted neutralization are accounted for.[7]

While positional faithfulness constraints account well for these kinds of positional neutralization phenomena, they cannot account for all kinds of positional effects. In some languages, neutralization occurs *only* in a strong position and fails to apply in weak positions. In such cases, the inventory of segments allowed in strong positions is a subset of that which may occur in weak positions (de Lacy 2000, 2001; Parker 1998; Smith 2002; Zoll 1998). For example, in the South Slavic dialect Zabiče Slovene (Crosswhite 1999), all seven of the (monomoraic) vowels [i, ɨ, u, e, ə, o, a] may occur in unstressed

syllables; however, only the non-high vowels [e, ə, o, a] may occur in stressed syllables. When stress falls on a high vowel, the vowel undergoes neutralization to become mid.

Positional faithfulness constraints cannot account for this type of pattern. There is no ranking of a context-sensitive faithfulness constraint (e.g., IDENT-σ́[high]), a context-free faithfulness constraint (IDENT[high]), and any antagonistic markedness constraint that would neutralize the contrast in strong positions but not in weak positions. Yet, this is precisely what is required in Zabiče Slovene.

De Lacy (2001) claims that this kind of phenomenon is due to the pressure to reduce prosodic markedness in prominent or strong positions. Prosodic markedness primarily refers to segmental sonority and prosodic structure (e.g., onsets), as well as other prosodic elements such as tone. This is achieved within OT by invoking *positional markedness* constraints that refer specifically to prominent or strong positions. In Zabiče Slovene, it is prosodically more marked to have a low-sonority nucleus (i.e., a high vowel) in a stressed syllable. By appealing to a positional markedness constraint banning such a structure in a prominent position (i.e., *Peak$_{σ́}$/highV) and ranking this above a general faithfulness constraint calling for preservation of vowel height (IDENT[high]), high vowels are neutralized in favor of the less prosodically marked, higher sonority mid vowels.

Smith (2002) also proposes a theory of positional markedness, which she calls *positional augmentation*. Like de Lacy's constraints, Smith's positional augmentation constraints are markedness constraints that are relativized to strong positions. However, she argues that the only kinds of markedness constraints that can refer specifically to strong positions are prominence-enhancing or augmentation constraints; in other words,

they require the presence of perceptually prominent properties (such as syllable weight, high-sonority nuclei, high tone, low-sonority onsets, etc.). She argues for the same type of constraint as de Lacy (e.g., *Peak$_\sigma$/highV, which bans high vowels from occurring in stressed syllables) to account for a language like Zabiče Slovene; the only difference is that, for Smith, the neutralization process of lowering is motivated not by the pressure to reduce prosodic markedness but to increase phonetic prominence.

Just as positional faithfulness constraints cannot subsume positional markedness constraints, since they cannot account for positional augmentation effects that require neutralization in strong positions, neither can positional augmentation constraints subsume positional faithfulness constraints (e.g., Smith 2002; Zoll 1998). Positional augmentation constraints require that certain properties hold for strong positions; they do not make any demands of weak positions. Furthermore, since they are antagonistic to faithfulness in strong positions (in that (nonvacuous) satisfaction of a positional augmentation constraint entails a violation of faithfulness), they cannot account for the loss of contrast in weak positions or the preservation of contrast in strong positions. Both kinds of constraints are necessary to account for the full range of positional effects.

1.4.2 Strong positions vs. weak positions in constraint formulation

One of the crucial assumptions made by Smith (2002) is that positional augmentation constraints can only refer specifically to phonologically strong positions and not phonologically weak positions. One of the main reasons she cites for this is that a weak position is not always an independently identifiable class; in some cases, it is only weak relative to some strong position. For example, the first syllable of a word is a strong position. Consequently, all remaining syllables are weak positions. In order for a

constraint to refer only to the weak position of a non-initial syllable, it must identify 'any syllable that is not the initial syllable'; thus, the grammar must still make reference to the strong position 'initial syllable' to conclude that its complement – any non-initial syllable – is weak. For this reason, Smith proposes that positional constraints may only make reference to strong positions.

Furthermore, as mentioned above, some researchers have proposed accounts of languages that crucially require a general constraint to outrank the specific constraint referring to a strong position. Lombardi (1999) proposes this to account for the fact that both progressive and regressive assimilation to [-voice] occurs in Swedish consonant clusters. The markedness constraint demanding assimilation, Agree, dominates faithfulness. Because constraints in a stringent, special/general relationship can be freely ranked, the general faithfulness constraint preserving input voicing specifications, IDLar, can be ranked above the faithfulness constraint specific to the strong position onset, IDOnsLar. When the markedness constraint banning voiced obstruents, *Lar, is ranked intermediately between the two faithfulness constraints, the Swedish pattern is captured (e.g, /stek+de/ → [stekte]). An analysis that uses fixed complementary constraints referring to both strong and weak positions (i.e., IDOnsLar >> IDCodaLar) would not be able to account for this pattern.

1.4.3 Primary stress as strongest of the strong

In each of the theories discussed here, stressed syllables are considered to be privileged or strong positions. Both positional faithfulness and positional markedness constraints can refer to stressed syllables to account for languages in which phonological processes interact with stress assignment to yield patterns of positional neutralization.

However, what few, if any, of these accounts have examined is the interaction of secondary stress with these processes.[8] In a vast majority of the cases analyzed, either the language in question has only one stress per word, or only the primary stress pattern is discussed. That is, while each of these theories calls upon constraints specific to stressed syllables to account for phenomena that interact with stress assignment, little or no evidence is given to demonstrate whether the constraints are defined in terms of stress in general, or only in terms of primary stress.

If stressed syllables are considered to be prominent or strong positions, I argue that primary stressed syllables can be considered the 'strongest of the strong'. Some languages do not make this distinction, treating all stressed syllables in the same way, as being equally strong in contrast to unstressed syllables. Other languages, however, treat primary stressed syllables as being stronger than either secondary stressed or unstressed syllables. It is in these languages that asymmetrical patterns of stress emerge.

In this thesis I examine symmetrical and asymmetrical patterns of primary and secondary stress involving nonfinality effects, stressed syllable lengthening, sonority-sensitivity, and quantity-sensitivity. These phenomena can be accounted for in a unified way by appealing to constraints that are specific to primary stress, in addition to the constraints proposed in the positional markedness literature that refer to stressed syllables in general. By ranking the primary-stress-specific (S1) and general stress (S) constraints in a stringency relation with an antagonistic constraint (C) ranked between them, it is possible to account for the different primary and secondary stress asymmetries discussed in this chapter.

(33)   Schema for asymmetrical pattern of primary and secondary stress
        Primary-stress-specific >> *Antagonistic Constraint* >> *General stress constraint*
              S1   >>   C   >>   S

However, as I demonstrate in the following chapters, not all languages with multiple stresses in a word exhibit asymmetrical stress patterns. In some languages, both primary and secondary stressed syllables behave in the same way with respect to a particular phonological phenomenon; either they are both targeted for or both remain unaffected by the process in question. In languages such as these with symmetrical patterns of primary and secondary stress assignment, the S1 and S constraints are unranked with respect to one another (or rather, remain as the unexploded general stress constraint S).

(34)   Schemata for symmetrical patterns of primary and secondary stress
        a. Both primary and secondary stress are affected: S1, S >> C
        b. Neither primary nor secondary stress is affected: C >> S1, S

By allowing markedness constraints to refer specifically to primary stress, it is predicted that a variety of different phonological processes may target primary stressed syllables, to the exclusion of all other positions, for interaction. In the following chapters, I demonstrate that this is exactly what is observed in many of the world's languages.

1.5   Outline of the thesis

This thesis is divided into six chapters. In chapters 2, 3, and 4, I present three different phonological phenomena that interact with stress assignment in such a way as to produce three out of the four logically possible stress patterns: two symmetrical patterns in which both primary and secondary stresses are similarly affected or unaffected by the

phenomenon in question, and one asymmetrical pattern in which only primary stress undergoes the process.

Chapter 2 focuses on patterns of nonfinality. Because final position is often considered to be phonologically weak, some languages shift stress that would otherwise fall on a final syllable onto a nonfinal syllable, which has the effect of augmenting or increasing the prominence of the stressed syllable. Within OT, this is due to a high-ranking NONFINALITY constraint, which bans stress from falling on a final syllable. It will be shown that some languages ban both primary and secondary stresses from final position while other languages have no such restriction. Still other languages are shown to exhibit asymmetrical patterns of nonfinality, in which primary stresses are banned from final position, but secondary stresses are not. A primary-stress-specific version of the nonfinality constraint (NONFINALITYHEAD) is proposed to account for such patterns.

Chapter 3 looks at the process of stressed syllable lengthening, introduced above, in more detail. While stressed syllable lengthening in iambic languages can be attributed to constraints on foot structure that are motivated by the Iambic/Trochaic Law, the same is not true for trochaic languages or languages with unbounded stress systems which are often assumed to lack foot structure. It is argued that stressed syllable lengthening in these languages, which may either involve lengthening of the stressed vowel or gemination of the onset consonant of the following syllable, occurs as a means of enhancing the phonetic prominence of those syllables. As such, a positional markedness constraint relativized to primary stress, S_1-to-W, is proposed to account for the asymmetrical pattern observed in both trochaic and unbounded languages in which primary stressed syllables lengthen to the exclusion of secondary stressed syllables

Chapter 4 is devoted to languages that exhibit sensitivity to the sonority of stressed syllable nuclei. Languages with sonority-sensitivity prefer stressed syllables with high sonority nuclei. To achieve this goal, languages may either increase the sonority of the vowel in the stressed syllable to make it more sonorous (in which case, sonority is said to be stress-driven), or they may shift stress off of a low-sonority vowel in its default position to fall on a more sonorous vowel elsewhere (in which case, stress is sonority-driven). Stress-driven sonority is shown to pattern like nonfinality and stressed syllable lengthening in that it interacts with stress assignment to yield languages with symmetrical patterns, in which primary and secondary stress are both either sensitive or insensitive to sonority, as well as languages with an asymmetrical pattern of sonority-sensitive primary stress but sonority-insensitive secondary stress.

With respect to each of these three phenomena – nonfinality, stressed syllable lengthening, and stress-driven sonority – it is predicted that the fourth logically possible pattern, in which secondary stressed syllables are affected by the process in question while primary stressed syllables are not, will be unattested. In each case, this is shown to be due to the nature of the stringency relation of the primary-stress-specific constraint and the general version of that constraint. Apparent counterexamples (in chapters 2 and 3), in which only secondary stressed syllables appear to undergo the process, are discussed and are shown not to represent true cases of asymmetry.

Also examined in chapter 4 are languages with sonority-driven stress, in which the placement of stress on a particular syllable is dependent upon whether it has a high-sonority nucleus. It is demonstrated that sonority-driven stress not only generates the three expected patterns of stress-sonority interactions, but also the fourth (otherwise)

unexpected pattern in which only secondary stress assignment is driven by sonority considerations but not primary stress. While this pattern is expected to be unattested based on the predictions of stringency, languages with this pattern are attested. The explanation for the occurrence of such languages is given in chapter 5.

In chapter 5, it is shown that quantity-sensitivity behaves like sonority-driven stress in that it yields all four of the logically possible stress patterns, including the two different patterns of asymmetry in which: a) only primary stress is quantity-sensitive, and b) only secondary stress is quantity-sensitive. I argue that the difference between those processes, such as quantity-sensitivity and sonority-driven stress, that do induce this second asymmetrical pattern and those, such as stressed syllable lengthening and stress-driven sonority, that do not rests in a fundamental dichotomy: whether stress assignment is process-driven or whether the process is stress-driven. Based on this distinction, it is possible to predict when the second asymmetrical pattern, in which only secondary stressed syllables are targeted for a particular phonological process, will be attested and when it will not.

Chapter 6 concludes the thesis. This chapter discusses some residual issues involving additional phonological phenomena that can interact with stress assignment, reviews the major points to emerge from this study, and suggests avenues for future research.

Notes

[1] I do not distinguish between degrees of subsidiary stress. The term 'secondary stress' is used throughout this thesis to refer to any subsidiary stress that is not primary.

[2] More specifically, primary stress falls on the rightmost nonfinal heavy syllable, unless the only heavy syllable in the word is final, in which case it is assigned primary stress. For a discussion on the nonfinality effects in Khalkha, see §2.3.2.

[3] Walker (1997:24) also mentions a possible secondary stress on initial (light) syllables, though she notes that there is some disagreement on the matter.

[4] In Mohawk, an epenthetic vowel inserted into the final or penultimate syllable is ignored for the purposes of stress assignment. In such cases, stress surfaces on the antepenultimate syllable (Michelson 1983:64).

[5] An open syllable in Mohawk is any syllable that ends in a vowel and is followed by a consonant or glottal stop, but not by *h*. That is, intervocalic *h* closes a preceding syllable and blocks vowel lengthening (Michelson 1983:66).

[6] It is assumed that lengthening is blocked in closed syllables due to high-ranking WEIGHT-BY-POSITION (Hayes 1989), which says that coda consonants are moraic, and *TRIMORAIC which prohibits trimoraic syllables. Further, since a stressed closed syllable vacuously satisfies S-to-W, vowel lengthening is not motivated.

[7] Although Beckman (1998) assumes that a positional faithfulness constraint is in a fixed ranking above the context-free version of the constraint, this assumption is not necessary, as a strong-position-specific constraint and its general counterpart are in a stringency

relation. Even if the general constraint is ranked above the specific constraint, it will still yield an attested pattern, as demonstrated in §1.3.3.2.

[8] Smith (2002:§1.3.1) does suggest that secondary stressed syllables might also be included in the set of strong positions, though she leaves this as a topic for future research.

CHAPTER 2:

NONFINALITY

2.1   Introduction

Many languages avoid stressing the final syllable of a word. In trochaic languages, this often simply follows from the fact that feet are left-headed. In a (syllabic) trochaic language with right-to-left footing, the final syllable will never get stressed. In a language with left-to-right trochaic footing, a final stressed syllable can be avoided by a ban on degenerate feet (i.e., by nonexhaustive footing). On the other hand, in iambic languages, where the feet are right-headed, a final stressed syllable might be expected. As it turns out, however, many iambic languages also avoid stressing a final syllable.

Hyman (1977) provides an explanation as to why languages might avoid stressing a final syllable. He argues that while stress serves a demarcative function by signaling a word boundary, it is best realized in terms of a falling pitch contour (HL). Since final position is phonologically weak (i.e., it is subject to various historical changes and/or loss, final consonants and vowels have a tendency to devoice or be deleted, etc.), a falling pitch on a final syllable is not as prominent as one realized over two syllables. Further, stress is better perceived by contrast with what follows it than by what precedes it (Hyman 1977:46). Thus, placing stress in nonfinal position enhances 1) the perception of

the falling pitch contour, and 2) the perceived prominence of the penultimate syllable by virtue of the fact that a stressless syllable follows it.

Within derivational theory, avoidance of final stress is often achieved by a rule of extrametricality (Hayes 1985, 1995). An extrametricality rule designates a particular prosodic constituent, such as a segment, syllable, foot, or prosodic word, as metrically invisible or inert for the purposes of rule application. Employing extrametricality is what makes it possible to 1) account for languages in which CVC syllables are heavy nonfinally but exceptionally light in final position, 2) place stress three syllables away from the word edge in a theory with only binary feet, 3) prevent stress from falling on a final syllable, and 4) place primary stress on a nonperipheral foot. As this chapter is not concerned with the theory of extrametricality as a whole but with final stresslessness effects, I will only address the last two of these patterns. Moreover, I examine these patterns within the framework of Optimality Theory.

Extrametricality effects are typically accounted for within OT by appealing to the constraint NONFINALITY (Prince & Smolensky 1993/2002).[1] However, NONFINALITY is not an OT equivalent of extrametricality since it "focuses on the well-formedness of the stress peak, not on the parsability of the final syllable" (Prince & Smolensky 1993/2002:42). NONFINALITY demands that no head of the prosodic word can be final in the prosodic word. This constraint, then, is a primary-stress-specific constraint. It is to be interpreted as banning a word-final primary stressed syllable or a final primary stress foot, whether trochaic or iambic. Prince & Smolensky demonstrate that both versions of the constraint are needed to account for the stress patterns of Classical and Pre-Classical Latin. Other researchers have argued that it is necessary to generalize this constraint to prohibit final stress of any kind, whether primary or secondary (Elenbaas 1999; Jacobs 1999; 2000).

In this chapter, I show that both the primary-stress-specific and the general versions of the NONFINALITY constraint are crucially necessary to account for certain patterns of final stresslessness. In §2.2, I discuss Southern Paiute, a language that disallows final stresses of all types, whether primary or secondary. I show that such a language can be accounted for in OT by ranking both the primary-stress-specific and the general versions of NONFINALITY high above the constraints responsible for stress placement. In §2.3, I discuss several languages that treat primary and secondary stresses asymmetrically with respect to final stress. Paumari and Khalkha Mongolian ban a final primary stress, but allow secondary stresses to be realized in final position. I propose that this pattern can be accounted for in OT by appealing to a primary-stress-specific NONFINALITY constraint that stands in a stringency relation with a general NONFINALITY constraint. When the stress placement constraint responsible for aligning primary stress at the right edge is ranked intermediately between the two, the asymmetrical pattern emerges. I contrast this analysis with one from Everett (2002) that makes reference to the superfoot to assign primary stress and argue that an account with NONFINALITY is preferable. In §2.4, I describe the pattern of stress that is predicted not to occur due to the nature of the stringency relation of the NONFINALITY constraints, namely a language that bans only final secondary stress but allows final primary stress. I conclude the chapter in §2.5 with a summary.

2.2 General nonfinality effects

Patterns of final stress/stresslessness differ somewhat for trochaic and iambic languages, a fact that largely follows from the headedness of the feet. Because of this, they show slightly different nonfinality effects. In this section, I examine cases of both types of languages, discussing each in turn. First, I look at trochaic languages.

2.2.1 Avoidance of final stress in trochaic languages

Some trochaic languages never stress a final syllable. However, this is not always due to an external pressure banning final stresses outright. For example, consider the schematic pattern of stress displayed in (1).

(1)   Right-to-left trochaic language with no final stress

     a. (σ́ σ)

     b. σ (σ́ σ)

     c. (σ̀ σ)(σ́ σ)

     d. σ (σ̀ σ)(σ́ σ)

None of the words in (1) has a final stress. This pattern is achieved, within derivational theory, by building syllabic trochees iteratively from right-to-left. If the language also has a disyllabic minimal word requirement, no words will ever exhibit final stress. An example of a language with this pattern is Cavineña (Hayes 1995:202).

The only time a word-final stress can show up in a right-to-left syllabic trochaic language is if there is no minimal word requirement, allowing stress to fall on a monosyllabic foot. Examples of syllabic trochaic languages that allow a final stress only in monosyllabic words include Malakmalak, Nengone, and Warao (Hayes 1995:203).

However, the pattern of final stresslessness in these languages is due to the left-headed nature of the feet, rather than to any rule or constraint banning final stresses *per se*. As such, these languages are not informative when considering the role NONFINALITY plays in banning a stress on a final syllable and will not be considered further in the remainder of this chapter.[2]

In addition to trochaic languages with right-to-left footing, some trochaic languages with left-to-right footing also lack final stresses.

(2)   Left-to-right trochaic language with no final stresses

     a. (σ́ σ)

     b. (σ́ σ) σ

     c. (σ́ σ)(σ̀ σ)

     d. (σ́ σ)(σ̀ σ) σ

In languages with this pattern, stress never shows up on a final syllable, regardless of whether the word contains an even or an odd number of syllables. The absence of final stress in even-syllable words simply follows from the fact that feet are left-headed. However, this does not, on its own, account for the lack of final stress in odd-syllable words. This pattern can be accounted for within derivational theory by building syllabic trochaic feet from left-to-right nonexhaustively. In such languages, monosyllabic degenerate feet are prohibited in weak position (i.e., when they do not bear primary stress). Thus, in odd-parity words, the final syllable will always be left unparsed and unstressed. Examples of such languages given by Hayes (1995:100) include Pintupi, Anguthimri, Badimaya, Diyari, and Karelian. Actually, Hayes argues that all left-to-right syllabic trochaic languages have this pattern of nonfinal stress, even in odd-syllable words. He claims that the final syllable prominence sometimes reported for left-to-right

syllabic trochaic languages should not be attributed to a final metrical stress, but rather to final phonetic lengthening which is perceived as stress. This allows him to appeal to a theory in which degenerate feet are banned absolutely in weak position.

As with right-to-left trochaic systems, lack of final stress in left-to-right trochaic systems does not necessarily follow from an active rule or constraint banning final stresses; the pattern emerges as a result of having left-headed feet and nonexhaustive footing. As such, an OT analysis of left-to-right trochaic languages with final stresslessness would not necessarily require NONFINALITY to be high-ranking and active. Instead, the interaction of just three constraints, defined in (3) below, is able to capture the pattern.

(3)   Constraints
        FTBIN: Feet must be binary at some level of analysis (σ, μ).
        PARSE-σ: All syllables must be parsed by feet.
        ALIGNFT-L: The left edge of every foot must stand at the left edge of the
                        prosodic word.

Because multiple stresses are allowed in words of three or more syllables, footing must be iterative. To achieve this pattern, PARSE-σ is ranked above an alignment constraint demanding that all feet must be aligned with a particular word edge, ALIGNFT-L.

(4)   Iterative footing: PARSE-σ >> ALIGNFT-L

/σ σ σ σ/	PARSE-σ	ALIGNFT-L
a. ☞ (ǵ σ)(ὃ σ)		**
b. (ǵ σ) σ σ	*!*	

Candidate (a), which contains two stressed feet, leaves no unparsed syllables, while candidate (b), which contains only one stress foot, has two unparsed syllables. Although candidate (b) fully satisfies ALIGNFT-L by having its only foot perfectly aligned with the left edge of the word, its violations of PARSE-σ eliminate it from the competition. Candidate (a) violates ALIGNFT-L twice, since the second foot is two syllables away from the left edge of the word, but it fully satisfies higher ranked PARSE-σ. Thus, it is selected as the winning candidate.

The pattern of nonexhaustive footing is achieved through the interaction of FTBIN and PARSE-σ. When FTBIN is ranked above PARSE-σ, it becomes more important to have well-formed binary feet than it is to parse all syllables into feet. This has the effect of banning degenerate feet. This ranking is demonstrated in the tableau in (5).

(5)   Nonexhaustive footing: FTBIN >> PARSE-σ

/σσσσσ/	FTBIN	PARSE-σ
a. (ǵ σ)(ὃ σ)(ὃ)	*!	
b. ☞ (ǵ σ)(ὃ σ) σ		*

Candidate (a), which stresses the final syllable by parsing it into a degenerate foot, is eliminated because it violates high-ranking FTBIN. This allows candidate (b), which leaves the final syllable unparsed and thus unstressed, to be selected as the optimal candidate.

As with the right-to-left trochaic languages discussed above, NONFINALITY is not crucial to the analysis. It could be high-ranked, because it is never violated; stress is never final. However, since the pattern of nonfinal stresses can be achieved by a ranking of FTBIN >> PARSE-σ >> ALIGNFT-L, it could just as easily be low-ranked and inactive.

It becomes clear, then, that examining trochaic languages for final stresslessness effects will not be insightful. Instead, we must look to the iambic languages to see potential nonfinality effects. I take this up in the following section.

2.2.2 Final stress in iambic languages: Araucanian

Because iambic feet are right-headed, there is the potential for interactions with NONFINALITY. For instance, iambic languages with left-to-right footing may have final stress in words with an even number of (light) syllables. Examples of left-to-right iambic languages that exhibit this pattern include Araucanian, Eastern Ojibwa, Passamaquoddy, Macushi, Maidu, Winnebago, and Delaware. Consider the following data from Araucanian (Echeverría & Contreras 1965), a language spoken in Chile and parts of Argentina.

(6)   Araucanian

    a. (σ σ́)   wulé   'tomorrow'

    b. (σ σ́) σ   ṭipánto   'year'

    c. (σ σ́)(σ σ̀)   elúmuyù   'give us'

    d. (σ σ́)(σ σ̀) σ   elúaènew   'he will give me'

    e. (σ σ́)(σ σ̀)(σ σ̀) kimúbalùwulày   'he pretended not to know'

In this language, primary stress falls on the second syllable and secondary stresses fall on every other syllable thereafter. This pattern is derived from left-to-right iambic footing. As there is no weight distinction in this language, the final syllable will always be stressed in words with an even number of syllables, since these words can be exhaustively parsed into well-formed binary iambic feet. As a result, the presence of

words with this pattern illustrate that there is no prohibition against final stress in this language.[3]

An OT analysis of Araucanian is fairly straightforward. As I demonstrated above for trochaic languages in (4) and (5), the ranking of FTBIN >> PARSE-σ >> ALIGNFT-L achieves a pattern of iterative, nonexhaustive footing. The only difference for Araucanian is that the stress feet are iambic. To capture this, undominated FTFORM=IAMB ('Feet must be iambic') is assumed.

(7)   Araucanian: FTBIN >> PARSE-σ >> ALIGNFT-L

/eluaenew/	FTBIN	PARSE-σ	ALIGNFT-L
a. ☞ (e.lú.)(a.è.)new		*	**
b. (e.lú.)(a.è.)(nèw)	*!		**, ****
c. (e.lú.)a.e.new		**!*	

Candidate (a), with two well-formed binary feet, is the optimal candidate, even though it leaves the final syllable left unparsed. Candidate (b), with a final degenerate foot, is eliminated by its violation of FTBIN. Candidate (c), which has one perfectly left-aligned binary foot, is eliminated by PARSE-σ because it has noniterative footing.

Because final syllables can receive stress in even-parity words, NONFINALITY is violated and therefore must be low ranking. Consider the following tableau of a four-syllable word.

(8)   Low-ranked NONFINALITY

/elumuyu/	IAMB	FTBIN	PARSE-σ	ALIGNFT-L	NONFIN
a. ☞ (elú)(muyù)				**	*
b. (elú)muyu			*!*		
c. (elú)(mù)yu		*!	*	**	
d. (elú)(mùyu)	*!			**	

This tableau demonstrates that NONFINALITY must be ranked below PARSE-σ. This is because candidate (b), with a single stress foot, violates PARSE-σ twice but satisfies all of the other constraints, including NONFINALITY. The optimal candidate in (a) violates NONFINALITY and therefore can only be chosen as the winner if PARSE-σ is ranked higher. Candidate (c) avoids stressing a final syllable by failing to parse it. However, this causes egregious violations of FTBIN and PARSE-σ which eliminate it from the competition. Candidate (d) avoids stressing the final syllable by parsing the final two syllables into a trochaic foot, but this causes it to fatally violate undominated IAMB.

It is worth noting that final stresses are allowed regardless of type. That is, final secondary stresses are allowed – as can be seen in even-parity words of four or more syllables – as are final primary stresses, which occur in all disyllabic words. This pattern results from the ranking of the stress placement constraints above the general NONFINALITY constraint responsible for banning all types of final stress.

2.2.3 *Avoidance of final stress in iambic languages: Southern Paiute*

While Araucanian is an iambic language that allows final stresses, other iambic languages strictly prohibit them. One such language is Southern Paiute, an Uto-Aztecan language spoken in Utah and Arizona. The source for the data presented here is Sapir (1930). Other discussions and analyses of this language within derivational and optimality theoretic frameworks include Hayes (1995), Hung (1994b), McCarthy & Prince (1993b), Prince & Smolensky (1993/2002), and Wheeler (1979). Consider the Southern Paiute data given in (9) below.

(9)   Southern Paiute
  a. Odd-numbered syllables

(σσ́)σ	piyíppi̥	'heart'[4]
	nu̥ˣqʷˀinti̥	'stream'
(σσ́)(σσ̀)σ	pɔrúqqu̥pìɣḁ	'several started out'
	tɔtɔ́xxqʷiɣ̀ini̥	'I run repeatedly'

  b. Even-numbered syllables

(σσ́)(σ̀σ)	qanívàŋᵐi̥	'in the house'
	ʃináŋʷàɸi̥	'coyote'
(σσ́)(σσ̀)(σ̀σ)	uɣúmmaŋʷìttùxxᵐḁ	'away from it'
	pumpúŋqu̥ŋʷɨ̀ràŋᵐḁ	'our (incl.) horses owned severally'

In each of the words shown here, primary stress falls on the second syllable. In words containing an odd number of syllables, secondary stress falls on every other syllable following the main stress.[5] This suggests that footing is iambic, assigned from left-to-right. The head foot is assigned by an End Rule Left, which assigns primary stress to the initial foot. However, the secondary stress pattern is complicated in words with an even number of syllables. Because footing is iambic, an even-parity word would be expected to have secondary stress on a final syllable. Instead, the last stress in the word always falls on the penult, even if this creates a stress clash with the preceding syllable. This is due to the fact that Southern Paiute prohibits final stress. The strategy that this language employs to avoid a final stress is to change the final iamb in an even-syllable word into a trochee.

It is not just secondary stresses that are banned from final syllables. Primary stress is also prohibited from being realized on a final syllable. Consider the disyllabic words in (10).

(10) Disyllabic words (σ́σ)

    a. áma̜   'with it'

    b. qáni̜   'house'

    c. wára̜   'edible seeds'

Even though Southern Paiute primarily exhibits an iambic pattern, each of the disyllabic words in (10) has primary stress on the first syllable rather than on the second/final syllable as would be expected in an iambic language. Again, the pressure to avoid final stress causes the stress foot to switch from an iamb to a trochee, thereby placing primary stress on the initial syllable.

Hayes (1995:266) accounts for such a pattern by claiming that Southern Paiute has final syllable extrametricality. This causes the formation of a degenerate foot on the penultimate syllable in even-parity words. Because degenerate feet in weak position are disallowed in Hayes' theory, the foot is repaired by incorporating the final extrametrical syllable, creating a well-formed trochee.

(11) Incorporation of extrametrical material

    (. x)(. x)(x)   (. x)(. x)(x .)

    σ σ σ σ σ⟨σ⟩   →   σ σ σ σ σ σ

As discussed for Araucanian in (7), the basic left-to-right pattern of iterative, nonexhaustive iambic footing in OT results from the ranking of FtBin >> Parse-σ >> AlignFt-L. A tableau demonstrating this ranking for Southern Paiute is given in (12). I assume for the moment that Iamb, the constraint demanding that all feet be iambic, is high ranking and leave it out of the tableau at this time.

(12)   Southern Paiute: FtBin >> Parse-σ >> AlignFt-L

/pɔruqupiɣa/[6]	FtBin	Parse-σ	AlignFt-L
a. ☞ (pɔrúq)(qu̜pɪ̀)ɣa̜		*	**
b. (pɔrúq)(qu̜pɪ̀)(ɣà)	*!		**, ****
c. (pɔrúq)qu̜piɣa̜		**!*	

Because FtBin outranks Parse-σ, candidate (a), which leaves the final odd syllable unparsed, wins out over candidate (b), which parses the final syllable into a degenerate foot. The ranking of Parse-σ above AlignFt-L ensures that candidate (a) will be selected as the optimal candidate over candidate (c), because it parses the word into two stress feet, at the expense of violating alignment, as opposed to forming one perfectly left-aligned binary foot.

The main difference between the Araucanian and Southern Paiute constraint hierarchies, however, is in the respective ranking of NonFinality. In Araucanian, NonFinality is ranked relatively low, below Parse-σ, because final stress is allowed in even-parity words. In Southern Paiute, however, final stress, whether primary or secondary, is never allowed. In fact, it is more important to avoid stress on a final syllable than it is to have an iambic foot. Thus, NonFinality dominates Iamb, causing the final foot to be trochaic. Because such a pattern results in a clash in four-syllable words, both of these constraints must dominate a constraint militating against adjacent stressed syllables (*Clash). This is shown in the tableau in (13).

(13)   NONFINALITY >> IAMB >> *CLASH

/tuɣʷapiɣa/	NONFINALITY	IAMB	*CLASH
a. ☞ (tuɣʷá)(pɨ̀ɣḁ)		*	*
b. (túɣʷa)(pɨ̀ɣḁ)		**!	
c. (tuɣʷá)(pɨɣḁ̀)	*!		

It is clear that NONFINALITY must dominate IAMB or else candidate (c) with two

iambic feet and stress on the final syllable would be the optimal candidate. IAMB in turn

must dominate *CLASH or else the candidate with two trochaic feet in (b) would

incorrectly be selected as the optimal output form. This ranking allows candidate (a),

with one iambic foot and one trochaic foot, to be selected as optimal.

The following tableau demonstrates that PARSE-σ must be ranked above IAMB and

*CLASH as well, or else a four-syllable word with an incomplete parse will win over the

optimal form with a final trochee and stress clash.

(14)   PARSE-σ >> IAMB >> *CLASH

/tuɣʷapiɣa/	PARSE-σ	IAMB	*CLASH
a. ☞ (tuɣʷá)(pɨ̀ɣḁ)		*	*
b. (tuɣʷá)pɨɣḁ	*!*		
c. tu(ɣʷapí)ɣḁ	*!*		
d. tuɣʷa(píɣḁ)	*!*	*	

Candidates (b), (c), and (d) all fare better than the winner with respect to *CLASH

by having only one stress foot in the word. Furthermore, candidates (b) and (c) also better

satisfy the foot form constraint because they contain only iambs. For the winner in (a) to

be chosen as optimal, PARSE-σ must be ranked above IAMB.

A final tableau with all of the constraints for Southern Paiute is given in (15).

(15)   Final ranking for Southern Paiute

/tuɣʷapiɣa/	FTBIN	NONFIN	PARSE	ALIGNL	IAMB	*CLASH
a. ☞ (tuɣʷá)(pɨ̀ɣḁ)				**	*	*
b. (túɣʷa)(pɨ̀ɣḁ)				**	**!	
c. (tuɣʷá)piɣḁ			*!*			
d. tuɣʷa(píɣḁ)			*!*	**	*	
e. (tuɣʷá)(pɨɣḁ̀)		*!		**		
f. (tuɣʷá)(pɨ̀)ɣḁ	*!		*	**		*

This tableau demonstrates that the best way to avoid having stress fall on a final

syllable (e) in an even-parity word is by reversing the final iambic foot to a trochee (a),

even if this results in a clash, rather than by failing to fully parse the word (c, d, f) or by

having all stress feet be trochaic (b).

The final ranking for Southern Paiute is given in (16). Note that NONFINALITY

can be placed in either the topmost or the second highest stratum in the hierarchy as long

as it dominates IAMB.

(16)   Final ranking for Southern Paiute
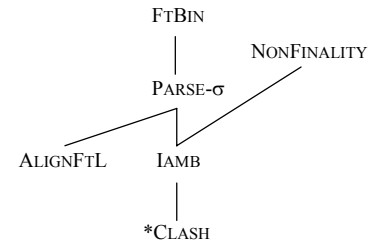
This pattern of final stress avoidance through final iambic foot reversal is not unique to Southern Paiute. Other languages with both primary and secondary stress feet that demonstrate this pattern include Asheninca Campa (McCarthy & Prince 1993b) and Aguaruna (Hung 1994). Examples of iambic languages that have been described as having only primary stress and thus one stress foot which becomes trochaic in disyllables, include Hopi and Ulwa (Prince & Smolensky 1993/2002), and Aljutor (Kenstowicz 1994).[7]

2.3 Asymmetrical nonfinality effects

While the languages discussed so far show symmetrical nonfinality effects, either allowing or disallowing final stress regardless of type, there are some languages that treat primary and secondary stresses asymmetrically with respect to the ban on final stress. However, of those languages that do, it is always primary stress that is prohibited from occurring in a final syllable while final secondary stresses are allowed. I will show that this asymmetrical behavior can be accounted for by appealing to a primary-stress-specific NONFINALITY constraint that stands in a stringency relation with a general NONFINALITY constraint banning all stresses from the final syllable.

2.3.1 Paumari

Paumari is an Arawan language spoken in Brazil. According to Everett (2002; 2003), Paumari is an example of a quantity insensitive language with right-to-left iambic feet. These two stress characteristics alone make Paumari an interesting language to investigate from a theoretical standpoint. I will touch upon them briefly here before discussing the unique nonfinality effects that this language also displays.

The fact that quantity is nondistinctive in this language is unusual considering it is an iambic language; there are no long vowels and diphthongs can occur in either the weak or the strong syllable of a foot, suggesting that they are monomoraic. According to Hayes (1995), a language such as Paumari violates the Iambic/Trochaic Law, defined below.

(17)   Iambic/Trochaic Law (Hayes 1995:80)
   a. Elements contrasting in intensity naturally form groupings with initial prominence.
   b. Elements contrasting in duration naturally form groupings with final prominence.

The claim is that trochaic feet should consist of units equal in duration. That is, in a quantity insensitive language, trochaic feet will consist of two syllables with nondistinctive weight. In a quantity sensitive language, trochaic feet will either consist of two light syllables or a single heavy syllable (made up of two moras). Any other combination of heavy and light syllables would violate the law by having unequal duration among the syllables of the foot. For iambic systems, the claim is that the feet should always have a durational contrast, i.e., they should consist of a light syllable followed by a heavy. This is a canonical iamb. An iambic foot consisting of two light syllables violates the Iambic/Trochaic Law by having syllables of equal duration but final prominence. Languages with such feet often convert them into canonical iambs through processes that make the second syllable heavy, e.g., through vowel lengthening or gemination of the onset of the following syllable (see chapter 3 for a more detailed discussion of such processes). No such process operates in Paumari, which contains only

light-light (LL) iambic feet, also known as even iambs. According to Hayes (1995:268), very few languages seem to require analyses involving even iambs, and those that do can be shown to undergo various processes to conform to the Iambic/Trochaic Law in at least some respects.

A second point of interest in this language is that iambic feet are exhaustively built from right-to-left. This is evident from the fact that stress always falls on the final syllable, while at the left edge of the word, stress will either fall on the initial or the peninitial syllable, depending on whether the word has an odd or an even number of syllables. It has long been noted that right-to-left iambic systems are at the very least typologically rare, if not completely unattested (Alber 2001, 2002; Hayes 1995; Kager 2001; McCarthy & Prince 1993b). For example, Weri, like Paumari, has traditionally been described as having right-to-left iambs constructed exhaustively, since primary stress always falls on the final syllable, and secondary stresses iterate before the primary on alternating syllables. However, as discussed by Hayes (1995) citing Kager's (1989) analysis of Tübatulabal, Weri can be reanalyzed (in derivational terms) as having top-down stress assignment, whereby primary stress is assigned to the final syllable via an End Rule Right. A degenerate foot is then formed underneath it in satisfaction of the Continuous Column Constraint; it is licensed because it is in strong position bearing main stress. Secondary stresses are assigned by building syllabic trochees nonexhaustively from right to left, respecting the location of the primary stress foot. Within OT, this pattern would emerge from a ranking of ALIGNHEAD-R, FTFORM=TROCHEE >> FTBIN, PARSE-σ (Alber 2001). As right-to-left trochaic systems are not considered to be

typologically unusual, unlike right-to-left iambic systems, a trochaic analysis of such languages is considered to be superior.

However, Everett (2002) rejects a trochaic analysis for Paumari because of how primary stress is assigned in this language. Primary stress is only ever perfectly right-aligned, i.e., assigned to a final syllable, in monopodal words. In longer words with two or more feet, primary stress falls on the antepenultimate syllable and secondary stress falls on the final. Because of this pattern, primary stress cannot be assigned by an End Rule Right or, in optimality theoretic terms, by a high-ranking ALIGNHD-R constraint. Therefore, Everett concludes that Paumari must be analyzed as a right-aligned iambic system that violates the Iambic/Trochaic Law by having syllables of even duration within the foot.

It is this unique pattern of primary stress assignment, and its interaction with secondary stress, that is the focus of this section. First I will briefly discuss and illustrate the basic Paumari stress pattern. Then I will summarize Everett's (2002) OT account of the stress facts and contrast it with my own analysis, which incorporates a primary-stress-specific NONFINALITY constraint to account for the pattern. Finally, I will demonstrate that an analysis involving primary-stress-specific NONFINALITY is preferable, as it is able to account for a similar pattern of nonfinality effects in a prominence-based system, something that Everett's analysis cannot accomplish.

2.3.1.1 The data

The basic Paumari stress pattern is described by Everett (2002) as being right-to-left iambic, with exhaustive footing. The following data illustrate this pattern.

(18) Paumari

    a. (σσ́)   pahá   'water'

    b. (σ́)(σσ̀)   bóvirì   'star'

    c. (σσ́)(σσ̀)   kabáhakì   'to get rained on'

    d. (σ̀)(σσ́)(σσ̀)   àhakábarà   'dew'

    e. (σσ̀)(σσ́)(σσ̀)   sohìribánakì   'complete, well-formed circle'

    f. (σ̀)(σσ̀)(σσ́)(σσ̀) bikànathàrarávinì   'to cave in, to fall apart quickly'

Stress falls on the final syllable in every word, as well as on every other syllable before the final stress. That footing is iambic is evident in even-parity words, which have stress on even-numbered syllables. That feet are assigned from right-to-left is evident in odd-parity words. Finally, the fact that stress falls on the initial syllable in odd-parity words indicates that footing is exhaustive.

This language exhibits a unique pattern of primary stress placement. As seen in the disyllabic word in (18), primary stress falls on the final syllable. In a right-to-left iambic system, this is to be expected, as primary stress is most often aligned with the edge of the word where footing begins. However, in words with more than one foot, primary stress falls on the antepenultimate syllable, with secondary stress falling on the final syllable. In other words, if there is only one foot in the word, it bears primary stress. If there is more than one foot in the word, the penultimate foot carries the main stress.

2.3.1.2 Foot extrametricality

Hayes (1995) accounts for languages in which the primary stress falls in a nonperipheral foot by employing final foot extrametricality. For example, Delaware, an Algonquian language, has a vowel inventory consisting of long /iː, eː, oː, aː/ and short /ə, a/. All long vowels are stressed as well as alternating even-numbered short vowels in a string of light syllables. This pattern results from a rule that exhaustively builds iambic feet from left-to-right. Primary stress falls on the rightmost nonfinal stressed vowel in the word, except in disyllables, in which case primary stress is final.

To assign primary stress to the penultimate foot, Hayes (1995:211ff) proposes a rule of final foot extrametricality: when a foot is in absolute word-final position, it is marked as extrametrical and End Rule Right assigns main stress to the stressed syllable in the penultimate foot. The rules of Delaware stress assignment are given in (19). Examples from the Unami and Munsee dialects of Delaware are given in (20a,b), respectively.

(19) Rules

    a. Foot construction: Form iambs from left to right. Degenerate feet are allowed.

    b. Foot extrametricality: Foot → ⟨Foot⟩ / ____]$_{word}$

    c. Word layer construction: End Rule Right

(20) a. 'I am weak'   b. 'he is well'

    (x)   (x)

    (. x)⟨(. x)⟩   (. x)(. x)⟨(x)⟩

    n ə š a w ə s iː → [nšáwsi]   w ə l a ma l ə s ə w → [wəlamalə́səw]

A process variably reduces or deletes an unstressed vowel in the weak position of a foot. Hayes (1995:211) notes that because the alternating vowels that lack primary stress resist the reduction process, it is possible that they bear secondary stress, though he does not mark secondary stress. However, other analyses of the Delaware pattern do mark secondary stress, even in final position (e.g., Buckley 1998). If there are secondary stresses in this language, the Delaware pattern closely resembles the pattern described above for Paumari.

Other languages analyzed by Hayes (1995) as having foot extrametricality but that are not marked as having final secondary stress in the extrametrical foot include Negev Bedouin Arabic and Cayuga. Languages not discussed in Hayes (1995) but that exhibit nonfinal primary stress with reported final secondary stress include Banawá (Buller, Buller & Everett 1993; Everett 1996), a relative of Paumari, and Guahibo (Kondo 2001).

The issue of secondary stress placement in these languages is not a trivial one. McCarthy cites languages like these in his (2002a) paper in which he proposes replacing gradient constraint violation, particularly with respect to the alignment constraints, with categorical violation. In the OT analyses discussed in this thesis, violations of the foot-alignment constraints are marked gradiently, once for each syllable that stands between a foot edge and the word edge. This has been used to achieve directional foot parsing effects (ALIGN(Ft, PrWd, L/R)) and placement of the primary stress foot near an edge (ALIGN(Hd, PrWd, L/R)). McCarthy proposes an alternative to gradience in which quantized or categorical alignment constraints are distinguished by extent of violation. Instead of gradient ALIGN(Ft, PrWd, L/R), for example, there is a family of quantized alignment constraints, one for each type of constituent that can stand between a foot edge and a word edge.

(21)   Quantized ALIGN(Ft, PrWd, L)
    a. ALIGN-BY-σ (Ft, PrWd, L)
        No syllable stands between the left edge of the foot and the left edge of the word.
    b. ALIGN-BY-FT (Ft, PrWd, L)
        No foot stands between the left edge of the foot and the left edge of the word.

As these constraints mark violations categorically, candidates such as [σ(σσ)σσσ], [σσ(σσ)σσ], and [σσσ(σσ)σ] would all violate ALIGN-BY-σ(Ft, PWd, L) once, since they all have some syllable (whether one or more is irrelevant) standing between the left foot edge and the left word edge. Thus, they are not distinguished by the categorical alignment constraint, though they would be by a gradient alignment constraint.

While McCarthy (2002a) makes convincing arguments in favor of adopting categorical alignment, he admits that languages such as those discussed here with nonfinal primary stress but final secondary stress pose a problem for his analysis. The problem is that the categorical alignment constraint responsible for placement of primary stress, ALIGN-BY-FT(Hd, PrWd, R) evaluates the two candidates [(σσ̀)(σσ́)(σσ̀)] and *[(σσ́)(σσ̀)(σσ̀)] identically. In both candidates, the primary stress foot is separated from the right word edge by some foot; whether it is one or two feet that intervenes is not distinguished by the categorical alignment constraint. The tie would then be decided by low-ranking counterpart ALIGN-BY-FT(Hd, PrWd, L), which would wrongly select the incorrect form with primary stress in the initial foot. Thus, categorical alignment cannot produce the proper result.

McCarthy suggests, as a means of saving his proposal, that the actual winning candidate in languages that are described as having this pattern is [(σσ̀)(σσ́)σσ], in which the final two syllables are unfooted and there is no final secondary stress. Such a candidate would fully satisfy ALIGN-BY-FT(Hd, PrWd, R), as there is no longer a foot between the primary stress foot and the word edge. He maintains that there are no solid examples of languages with final foot extrametricality in which primary stress is assigned

to a penultimate foot, especially in preference to another foot further to the left, but that if such evidence were to come to light, it would seriously challenge the theory.

The Paumari data would seem to be such evidence. Everett supports his claim that secondary stress is realized on a final syllable in words with more than one foot with acoustic evidence. I refer the reader to Everett (2002) for spectrograms and a discussion on this matter. Assuming, then, that there is a final secondary stress in this language, and having shown that categorical alignment cannot account for this pattern, I will continue to appeal to gradient stress alignment constraints throughout this chapter and throughout the thesis.

2.3.1.3 An OT account: Everett (2002)

To account for the basic iambic pattern within an OT framework, Everett (2002) appeals to FTBIN and an alignment constraint that places the head syllable of the foot at the right edge of the foot, ALIGNR(Ft, Hd). While this constraint is couched formally in an alignment schema, it is essentially identical to the IAMB constraint referred to throughout this chapter. Therefore, I will continue to use the foot form constraint name for the sake of clarity.

Everett assumes high ranked PARSE-σ, which must dominate FTBIN, to account for the occurrence of degenerate feet as a result of exhaustive footing. The right-to-left pattern of parsing is due to the ALIGNFT-L constraint, which will place the degenerate foot at the left edge of the word (an observation first pointed out by Crowhurst & Hewitt (1995)). A tableau demonstrating this ranking for a three-syllable word is given in (22).

(22)   Exhaustive iambic footing

/boviri/	IAMB	PARSE-σ	FTBIN	ALIGNFT-L
a. ☞ (bó)(virí)			*	*
b. (boví)(rí)			*	**!
c. bo(virí)		*!		*
d. (bóvi)(rí)	*!		*	**

Candidate (d), with a trochaic foot, and candidate (c), with nonexhaustive footing, are eliminated by the highest ranked constraints, IAMB and PARSE-σ, respectively. The two remaining candidates, which each have one binary foot and one degenerate foot, tie with respect to FTBIN. The decision is passed down to the lower-ranked constraint. ALIGNFT-L then selects candidate (a), with the degenerate foot at the left edge, as the optimal form since the second foot is only one syllable away from the left edge.

To account for the pattern of antepenultimate primary stress in words with more than one foot, Everett builds a noniterating, trochaic superfoot (also known as a colon) over the final two iambs; if there is only one iamb in the word, the superfoot itself is degenerate. The constraints responsible for this pattern are given below.

(23)   ALIGNL(SFt, Hd):   The head of the superfoot is on the left margin of the foot.
ALIGNR(PrWd, SFt): The superfoot goes on the right margin of the word.

Everett also assumes a constraint, which he calls LAYERING that is ranked above the constraints in (23). This constraint demands that the head of a foot at level *n* must be built on the head of a foot at level *n-1*. This ensures the head of the superfoot will be built on the head of the foot beneath it, in accordance with the Strict Layer Hypothesis (Selkirk 1984).

A tableau demonstrating how these constraints account for the primary stress pattern is given in (24). Superfoot boundaries are represented by square brackets, and the head of the superfoot is the foot bearing primary stress.

(24)   A right-aligned trochaic superfoot assigns primary stress

/bikanathararavini/	ALIGNL(SFt, Hd)	ALIGNR(PrWd, SFt)
a. ☞ (bikà)(nathà)[(rará)(vinì)]		
b. [(biká)(nathà)](rarà)(vinì)		*!
c. (bikà)(nathà)[(rarà)(viní)]	*!	
d. [(bikà)(nathá)](rarà)(vinì)	*!	*

Candidate (a) is the winner because it fully satisfies both constraints by having a trochaic superfoot aligned at the right edge of the word; this places primary stress in the penultimate foot. The candidate in (b) also has a trochaic superfoot, thereby satisfying ALIGNL(SFt, Hd), but is eliminated because the superfoot is aligned at the left edge of the word. Candidates (c) and (d) each have an iambic superfoot, which is enough to eliminate them from the competition, regardless of whether the superfoot is left- or right-aligned.

While Everett's (2002) analysis accounts for the Paumari stress facts, in the next section, I suggest a different analysis that employs a primary-stress-specific NONFINALITY constraint. I argue an analysis using this constraint is to be preferred as it is better able to capture cross-linguistic patterns of final primary stress avoidance in prominence-based languages.

2.3.1.4 An alternative OT account using NONFINALITY

In this section I present an analysis of Paumari that does not refer to the level of the superfoot. Instead, I argue that NONFINALITY plays a role in the placement of primary stress. However, the nonfinality effect seen in Paumari differs from that of Southern

Paiute, discussed in §2.2.3. Recall that in Southern Paiute, stress never shows up on a final syllable, whether it is primary or secondary. This is due to high ranking NONFINALITY. The strategy used by the language to avoid final stress is to switch the headedness of a final foot from an iamb to a trochee, demonstrating that NONFINALITY must outrank IAMB.

In Paumari, however, stress feet are always iambic, never trochaic. This is most evident in disyllabic words which have final stress and are composed of a single iambic foot. Therefore, the ranking of these two constraints is the reverse of that for Southern Paiute. PARSE-σ must also outrank NONFINALITY to rule out a candidate with a degenerate foot.

(25)   Final primary stress in disyllables: IAMB, PARSE-σ >> NONFINALITY

/paha/	IAMB	PARSE-σ	NONFINALITY
a. ☞ (pahá)			*
b. (páha)	*!		
c. (pá)ha		*!	

Candidate (a) is selected as the optimal candidate, even though it has a final stress, because it is parsed into a well-formed iambic foot. Candidates (b) and (c) both satisfy NONFINALITY by failing to stress the final syllable, but are eliminated by high ranking IAMB and PARSE-σ, respectively.

Because some kind of stress always falls on the final syllable in this language, it may seem that NONFINALITY plays no significant role; it is always violated, so it must be low ranking. However, there is a nonfinality effect evident in this language – one that targets only primary stress. As such, it is necessary to appeal to a more specific version of

the NonFinality constraint that refers specifically to primary stress. This constraint is defined in (26).

(26) NonFinalityHd: Primary stress (i.e., the head syllable of the prosodic word) must not be final in the prosodic word.

This constraint stands in a stringency relation with the general version of the constraint which bans any stress, whether primary or secondary, from being final in the prosodic word. The need for both of these constraints is most evident when some constraint is ranked intermediately between them.

The constraint that is ranked in between the two NonFinality constraints is one that demands that the head foot of the word bearing primary stress must be right-aligned in the prosodic word. In most stress systems, one foot in the word is stronger or more prominent than the others; it is the head of the prosodic word and bears the main stress. Typically, the head foot is either the initial or the final foot in the word. In derivational theory, the head foot is assigned by an End Rule (Left/Right). Within optimality theory, Prince & Smolensky (1993/2002) use Edgemost to assign primary stress; this constraint aligns the head foot with the left or right edge of the prosodic word. In McCarthy & Prince (1993a), Edgemost is subsumed under their theory of Generalized Alignment. Using their alignment schema, I formulate the relevant constraint for Paumari as follows:

(27) AlignHd-R

Align(PrWd, R, HdFt, R): The right edge of every PWd must coincide with the right edge of some head foot of the PWd.

This constraint demands that the head foot of the word be rightmost in the word. McCarthy & Prince (1993a) mark violations of AlignHd constraints absolutely; that is, any candidate that does not have the head foot aligned perfectly with the designated edge of the word incurs one violation of AlignHd, no matter how far the foot may be from that edge. Prince & Smolensky (1993/2002), on the other hand, mark violations of Edgemost constraints gradiently, with one violation mark incurred for each constituent (i.e., syllable, foot, etc.) standing between the head foot and the designated edge of the word. For most languages, the primary stress foot is peripheral, so it is not crucial how violations of head foot alignment are marked; either method will do. However, in Paumari, the head foot is not always peripheral. It moves away from the word edge to avoid having primary stress fall on a final syllable; but, it does so minimally, otherwise staying as close to the right edge as possible. It is crucial, then, that violations of this constraint are marked gradiently, once for each syllable standing between the head foot and right edge of the word. The following tableau demonstrates how the ranking of NonFinalityHd above AlignHd-R accounts for the placement of primary stress. Because the general NonFinality constraint is violated by every word in the language, it is ranked low in the hierarchy.

(28) NonFinalityHd >> AlignHd-R >> NonFinality

/bikanathararavini/	NonFinalityHd	AlignHd-R	NonFinality
a. (bikà)(nathà)(rarà)(viní)	*!		*
b. ☞ (bikà)(nathà)(rará)(vinì)		**	*
c. (bikà)(nathá)(rarà)(vinì)		***!*	*
d. (biká)(nathà)(rarà)(vinì)		***!***	*

By ranking NonFinalityHd above AlignHd-R, this will ensure that primary stress will fall as close to the right edge as possible without falling on the final syllable. Candidate (a), with primary stress on the final syllable, best satisfies AlignHd-R; however, it does so at the expense of violating NonFinalityHd and so is eliminated. The

remaining candidates all satisfy NONFINALITYHD by placing primary stress in one of the other nonfinal stress feet. Candidate (b), with the head foot as close to the right edge as possible without being final, i.e., in the penultimate foot, is selected as optimal.

NONFINALITYHD is not undominated, however. In disyllabic words, primary stress falls on the final syllable, in violation of NONFINALITYHD. This is due to the general pressure in the language to parse syllable into feet and for feet to be iambic. That NONFINALITYHD must be dominated by the foot structure and general stress placement constraints is demonstrated in the following tableau.

(29)   Final primary stress in disyllables: PARSE-σ, IAMB >> NONFINALITYHD

/paha/	PARSE-σ	IAMB	NONFINALITYHD
a. ☞ (pahá)			*
b. (páha)		*!	
c. (pá)ha	*!		

Candidate (a) violates NONFINALITYHD by having a final primary stress. However, this violation is less severe than those incurred by candidates (b) and (c), which are eliminated by virtue of containing a trochee and a degenerate foot, respectively. As a result, candidate (a) is chosen as optimal.

The final constraint ranking for Paumari is given in (30).

(30)   Final Paumari ranking
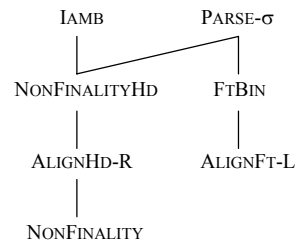
Both the analysis presented here and Everett's (2002) analysis can account for the Paumari pattern of nonperipheral primary stress placement. In the next section, I demonstrate the superiority of the NONFINALITY account, as Everett's analysis cannot account for the same pattern of nonperipheral primary stress in a prominence-based stress system.

2.3.2   Khalkha Mongolian

The languages discussed so far have all had patterns of stress assignment based on binary foot structure; they exhibited patterns of alternating stress, regardless of syllable type. In other languages, however, stress is not foot-based but prominence-based. In these languages, stress falls on a particular syllable not based on its position in the word, but because of its relative prominence.[8] The relative prominence of a syllable for the purposes of stress assignment typically involves factors that contribute to increased salience, such as weight, sonority, tone, peripherality, and nonfinality (Prince 1983, 1990; Prince & Smolensky 1993/2002; Walker 1997).

Walker (1997) discusses Khalkha, the standard dialect of Mongolian. Stress in Khalkha is prominence-driven, based on syllable weight; syllables containing long vowels and diphthongs are considered to be heavy for the purposes of stress assignment. The primary stress pattern of Khalkha is described and illustrated in (31).

(31) Primary stress pattern

    a. In words with one heavy syllable, stress falls on the heavy syllable, even if it is final.

        L H́   [daláe]   'sea'

        L H́   [galúː]   'goose'

    b. In words with more than one heavy syllable, stress falls on the rightmost nonfinal heavy syllable.

        L H́ H   [morióːroː]   'by means of his own horse'

        L H H́ H   [dalaegáːraː] 'by one's own sea'

    c. In words with all light syllables, stress falls on the initial syllable.

        Ĺ L   [xáda]   'mountain'

        Ĺ L L   [únʃisan]   'having read'

Khalkha Mongolian exemplifies what is known as a default-to-opposite stress system. When there are heavy syllables in the word, stress falls towards the right edge of the word (i.e., on the last syllable if it is the only heavy syllable, otherwise on the rightmost nonfinal heavy syllable). When there are no heavy syllables in the word, default stress falls towards the opposite edge, i.e., on the initial syllable.

Within OT, this kind of default-to-opposite pattern can be accounted for by constraints proposed by Zoll (1997) in her paper on conflicting directionality. She proposes that patterns of conflicting directionality arise from the opposition between the preferred edge of association for a prosodic unit and the need for marked prosodic structure to be licensed by a strong position. She discusses the stress pattern of Selkup, an Ostyak-Samoyed language, which has a stress pattern similar to that of Khalkha. In Selkup, the rightmost heavy syllable (containing a long vowel) receives the stress; otherwise the initial syllable is stressed. The constraint responsible for ensuring that primary stress falls as close to right edge as possible in words containing long vowels is the peak-alignment constraint given in (32).

(32) Peak-alignment constraint

    ALIGNR(σ́, PrWd): (Primary) stressed syllables should be word final.

This constraint (which is similar to the ALIGNHD-R constraint introduced in the preceding section for Paumari) is in opposition with a licensing constraint aligning marked prosodic structure at the left edge of the word. Zoll claims that the marked structure for Selkup is a light stressed syllable. That light stressed syllables are marked is evident by the fact that so many languages stress heavy syllables or make stressed syllables heavier via processes of vowel lengthening or consonant gemination. The fact that a light stressed syllable must be left-aligned in Selkup stems from the fact that it must be licensed by a prosodically strong position, namely, the initial syllable.

(33) Licensing constraint

    ALIGNL(σ́$_\mu$, PrWd): Light stressed syllables should be word initial.

The licensing constraint must outrank the general peak-alignment constraint since ALIGNR(σ́) will be violated in a word with all light syllables in order to preserve licensing. In a word with long vowels, ALIGNR(σ́) will be decisive in selecting the optimal candidate.

(34) Selkup word containing long vowels

/H H L/	ALIGNL(σ́$_\mu$, PrWd)	ALIGNR(σ́, PrWd)
a. H́ H L		**!
b. ☞ H H́ L		*
c. H H Ĺ	*!*	

Candidate (a), with the leftmost heavy syllable stressed, violates ALIGNR(ớ)

twice, since the primary stressed syllable is two syllables away from the right edge.

Candidate (c), with stress on the only light syllable, violates the licensing constraint since

the marked structure of a light stressed syllable is not in word-initial position. Candidate

(b) wins, since it does not violate licensing, and the rightmost of the two heavy syllables

is stressed, which best satisfies ALIGNR(ớ).

The following tableau demonstrates how this ranking selects the winner in a word

with all light syllables.

(35)   Selkup word containing only light syllables

/L L L/	ALIGNL(σ_μ, PrWd)	ALIGNR(ớ, PrWd)
a. ☞ Ĺ L L		**
b. L Ĺ L	*!	*
c. L L Ĺ	*!*	

Since all syllables in the word are light, any stressed syllable that is not word-

initial will violate the high-ranked licensing constraint to some degree. Thus, candidates

(b) and (c) are eliminated. Candidate (a) is selected as optimal since it stresses the initial

syllable, even though it fares worst with respect to ALIGNR(ớ).

It will be shown that these same constraints can account for the Khalkha pattern

of default-to-opposite side stress. However, what is interesting about the Khalkha pattern

that differs from that of Selkup is that in addition to the conflicting directionality pattern,

Khalkha evidences a nonfinality effect. If the final syllable contains the only heavy

syllable, it receives primary stress. However, if there is more than one heavy syllable in

the word, the rightmost nonfinal heavy syllable receives the primary stress. That this

nonfinality effect is specific to primary stress can be seen in the following data.

(36)   Secondary stress pattern

Ħ Ħ	[á:rù:l]	'dry cheese curds'
Ħ L Ħ	[úitgartàe]	'sad'
L̀ Ħ L Ħ	[dòló:dugà:r]	'seventh'
Ħ Ħ L L	[bàegú:lagdax]	'to be organized'
Ħ Ħ Ħ	[ù:rtáegà:r]	'angrily'
Ħ Ħ L Ħ	[bàigú:llagà:r]	'by means of the organization'
L̀ Ħ Ħ L Ħ	[ùlà:nbá:tarà:s]	'Ulaanbaatar' (ablative)
L̀ Ħ Ħ Ħ L	[ùlà:nbà:trí:nxan]	'the residents of Ulaanbaatar'

As shown here, secondary stresses fall on all heavy syllables not bearing primary

stress, even if they are word final. Walker (1997:24) also mentions a possible secondary

stress on initial (light) syllables, though she notes that there is some disagreement on the

matter. I follow Walker in marking initial secondary stress here, though I will not account

for it in the following analysis, as the presence or absence of this stress is irrelevant to the

pattern under consideration.[9] What should be noted is that the ban on final stress does not

extend to secondary stress.

In addition to the alignment constraints mentioned above, a constraint is needed to

account for the quantity sensitive nature of primary and secondary stress assignment in

Khalkha. This constraint is the WEIGHT-TO-STRESS PRINCIPLE (Prince 1990), defined in

(37).

(37)   WEIGHT-TO-STRESS PRINCIPLE (WSP): Heavy syllables must be stressed.

As all heavy syllables receive some kind of stress in this language, WSP must be

undominated. Furthermore, since a heavy syllable can receive stress in word-final

position, WSP must outrank the constraint banning word-final stress, NONFINALITY, as seen in the following tableau.

(38)   WSP >> NONFINALITY

/galu:/ L H	WSP	NONFINALITY
a. Ĺ H	*!	
b. ☞ L Ĥ		*

Candidate (a), with stress on the initial light syllable, satisfies NONFINALITY, but fatally violates WSP by not stressing the final heavy syllable. Candidate (b) is selected as optimal since it satisfies WSP at the expense of violating NONFINALITY.

As in the case of Paumari discussed in the previous section, Khalkha exhibits an asymmetry with respect to NONFINALITY. While final primary stress is allowed when the final syllable contains the only heavy syllable in the word, it is otherwise prohibited. However, final secondary stress is unconstrained. To account for this, NONFINALITY must be exploded into a primary-stress specific version of the constraint that is ranked independently of the general version. I have already demonstrated above in (38) that the ranking of WSP above general NONFINALITY can account for the pattern of primary stress falling on a final syllable when it contains the only heavy syllable in the word. That is, it is more important to stress a heavy syllable than it is to avoid stressing a final syllable. Furthermore, this ranking is also responsible for the pattern of secondary stress on a final heavy syllable.

However, to achieve the pattern of primary stress falling on the rightmost nonfinal heavy syllable when there is more than one heavy syllable in the word requires the primary-stress-specific NONFINALITYHD constraint to outrank the constraint demanding

right-alignment of primary stress, ALIGNR(ó). The following tableau demonstrates how these rankings account for the stress pattern in a word with multiple heavy syllables.

(39)   WSP >> NONFINALITYHD >> ALIGNR(ó) >> NONFINALITY

/baigu:llaga:r/ H H L H	WSP	NONFINHD	ALIGNR(ó)	NONFIN
a. Ḧ Ḧ L Ḧ			***!	*
b. ☞ Ḧ Ḧ L Ḧ			**	*
c. Ḧ Ḧ L Ḧ		*!		*
d. H H Ĺ H	*!**		*	

Because of high-ranking WSP, candidate (d), which fails to stress any of the heavy syllables, is eliminated. Candidate (c), with primary stress on the final syllable, is eliminated by its fatal violation of NONFINALITYHD. Of candidates (a) and (b), which both comply fully with WSP and NONFINALITYHD, candidate (b) is chosen as the winner because it better satisfies ALIGNR(ó) by having primary stress fall on the rightmost nonfinal heavy syllable.

The final constraint ranking for Khalkha Mongolian is given in (40).

(40)   Final ranking for Khalkha Mongolian

WSP

ALIGNL(ó$_\mu$, PWd)

NONFINALITYHD

ALIGNR(ó, PWd)
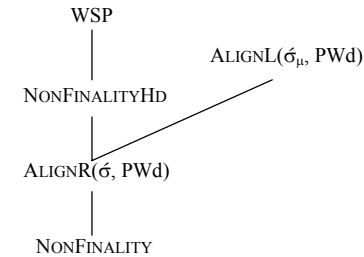
NONFINALITY

Other prominence-based languages with nonfinal primary stress but final secondary stress include Buriat, another Eastern Mongolian language, and Sindhi (Walker 1997).

2.3.3   Unifying the Paumari and Khalkha patterns

Both Paumari and Khalkha display almost identical patterns of primary stress placement, even though one language assigns stress with reference to foot structure and the other with reference to prominence alone. Both languages try to place primary stress on (an eligible) syllable as close to the right edge of the word as possible without having it fall on a final syllable. I have shown that by referring to a primary-stress-specific NONFINALITY constraint and ranking this constraint above the alignment constraint responsible for primary stress placement constraint (i.e., ALIGNR(σ́), ALIGNHD-R), the primary stress pattern of both of these languages is not only easily accounted for, but unified under a single analysis.

Everett's use of the superfoot in his (2002) analysis of Paumari, while able to account for the facts, is not able to generalize across these two languages. According to Hayes (1995:119), superfeet (or cola, as he refers to them) can only be built on feet. Green (1997:100) argues that they can also incorporate unfooted syllables, but that the head of the colon must be built over a foot. The reason for this is that a superfoot or colon built only on syllables would violate the Strict Layer Hypothesis, which says that a category of level *n* in the prosodic hierarchy must dominate a category of level *n-1* (Selkirk 1984). However, Khalkha is a prominence-based stress system; it lacks foot structure. Therefore, referring to a superfoot in order to assign primary stress in Khalkha would violate the Strict Layer Hypothesis. A superfoot, which is built on regular stress

feet, cannot be responsible for the placement of primary stress in a language that lacks feet altogether.

It should be noted that some researchers have analyzed prominence-driven stress systems within OT using foot structure, both bounded and unbounded. However, both types of analyses can be shown to be problematic. Kenstowicz (1994) analyzes sonority-driven stress systems, a type of prominence-based stress, using the unbounded feet first proposed in derivational theory. However, as Walker (1997) points out, the status of unbounded feet in metrical theory has been questioned. For instance, while bounded feet can be extrametrical, extrametricality of an unbounded foot is unattested (Wheeler 1979). Furthermore, they are never used in non-stress-related prosodic phenomena that can make reference to feet, such as reduplication, tone patterns, word minimality requirements, *etc*.

Prince (1985), arguing for the elimination of unbounded feet, demonstrates that the so-called unbounded or prominence-based stress systems can be analyzed using bounded feet that are built iteratively in words with heavy or prominent syllables, and built noniteratively at a default edge in words with all light syllables. It is this strategy that Baković (1998) uses in his typology of prominence-driven systems analyzed within OT. However, the use of bounded feet to account for prominence-based systems is also problematic; it allows for the overgeneration of unattested patterns. For example, if, as it is argued, a noniterative trochaic foot accounts for default initial stress in a word with all light syllables, it should be possible for a noniterative iamb to place default stress on the peninitial syllable. Similarly, it should be possible to have an antepenult default in a system with nonfinality and a right-aligned trochee. However, both of these patterns are unattested in prominence-based systems.

2.4   Unattested nonfinality pattern

In this chapter, I have discussed three patterns of final stress/stresslessness: 1) languages, such as Southern Paiute, that ban both primary and secondary stresses from the final syllable; 2) languages, such as Araucanian, that allow both primary and secondary stresses in the final syllable; and 3) languages, such as Paumari and Khalkha Mongolian, that ban a final primary stress, but allow secondary stresses in the final syllable. These patterns were achieved by ranking a primary-stress-specific and a general NONFINALITY constraint in a stringency relation among the regular stress placement constraints.

Such a stringency relation among the NONFINALITY constraints makes certain typological predictions about the type of nonfinality effect that would be expected not to occur in the world's languages. That is, one would not expect to find a fourth logically possible pattern in which only secondary stresses are banned word-finally, but a final primary stress is allowed. The difficulty comes in trying to test for such a language, since confounding factors can come into play that can make it appear as if a counterexample exists.

2.4.1   Apparent counterexample

I have already discussed in §2.2.1 left-to-right syllabic trochaic languages that fail to place secondary stress on a final syllable. If there is also no minimal word requirement, these languages will have a final primary stress in monosyllabic words. Examples of languages with this type of pattern include Badimaya, Dalabon, Dehu, Mansi,

Maranungku, Mayi, and Ono (Hayes 1995:198-200). The stress pattern of these languages could be described as disallowing final secondary stresses, but allowing final primary stress. This is the precisely the pattern predicted not to occur when the two NONFINALITY constraints in the stringency relation are active. However, the pattern in these languages does not result from the NONFINALITY constraints being active; rather, the pattern results from a combination of left-to-right directionality of footing, nonexhaustiveness of foot parsing, and the fact that there is no minimal word constraint.

That there is no final secondary stress in these languages follows from the fact that 1) directionality of footing is left-to-right, which in longer words will place secondary stress near the right or final word edge, and 2) footing is nonexhaustive. As demonstrated in (4) and (5) above, this pattern results from the interaction of FTBIN >> PARSE-σ >> ALIGNFT-L, independent of the NONFINALITY constraints. That primary stress can fall on a final syllable in monosyllabic words results from the fact that a constraint demanding that lexical words have prosodic structure, LX≈PR (Prince & Smolensky 1993/2002:45), outranks FTBIN; this allows for monosyllabic words to be made up of a degenerate foot bearing primary stress. Thus, there is no need to refer to a secondary-stress-specific NONFINALITY constraint to generate this pattern.

What kind of language, then, would we have to find that would be a true counterexample, with nonfinal secondary stresses but final primary stress, that could not be accounted for by the NONFINALITY constraints as I have defined them here? It would have to be a language that truly targeted only secondary stresses for the prohibition of final stress, while allowing final primary stress to surface, independent of any considerations about directionality of footing or subminimal words. Such a language

might resemble Southern Paiute, in that it would demonstrate foot reversal for a final iambic secondary stress foot in words with more than one stress foot; however, this language would crucially differ from Southern Paiute in that foot reversal would not take place in disyllabic words composed only of a primary stress foot. The foot would remain iambic. The NONFINALITY constraints as I have defined them here could not account for such a pattern, as shown in the following tableau.

(41)   Ranking paradox

/σσσσ/		NONFINHD	NONFIN	IAMB
a.	(σσ́)(σσ̀)		*!	
b. ☞	(σσ́)(σ̀σ)			*
/σσ/				
c. ☞	(σσ́)	*!	*	
d. ☛	(σ́σ)			*

There is no way to rank the above three constraints to get the intended winners (marked with '☞') for both a four-syllable word with primary and secondary stress feet (b) and a disyllabic word with only one stress foot (c). A word with more than one foot would have to exhibit iambic foot reversal for the final foot to prevent a secondary stress from falling on a final syllable. This would require NONFINALITY (the unexploded or general version of the constraint) to be ranked above IAMB. However, to get a final primary stress and no foot reversal in a disyllabic word, the ranking must be IAMB >> NONFINALITY. This constitutes a ranking paradox.

This is a desirable result, since all of the languages that exhibit iambic foot reversal that I am aware of either do so for all final stress feet, whether primary or secondary (e.g., Southern Paiute discussed in §2.2.3; also Asheninca Campa, Aguaruna),

or only for final primary stress feet (e.g., Hopi, Ulwa, Sentani). Thus, a primary-stress-specific NONFINALITY constraint and a general NONFINALITY constraint in a stringency relation make the correct typological predictions and do not overgenerate unattested patterns.

2.5   Conclusion

In this chapter, I proposed a primary-stress-specific version of the NONFINALITY constraint, which stands in a stringency relation with a general version of this constraint. Both of these constraints are necessary to account for languages in which primary and secondary stresses behave asymmetrically with respect to a ban on final stresses.

A table summarizing the general schema for the nonfinality effects of primary and secondary stress is given in (42).

(42)   Ranking schema for nonfinality effects

Ranking	Banned from final syllable	Example
a. Stress constraints >> NONFINHD, NONFIN	Neither primary nor secondary	Araucanian (§2.2.2)
b. NONFINHD, NONFIN >> stress constraints	Both primary and secondary	Southern Paiute (§2.2.3)
c. NONFINHD >> stress constraints >>NONFIN	Primary but not secondary	Paumari (§2.3.1), Khalkha (§2.3.2)
d. None	Secondary but not primary	Unattested

When primary and secondary stresses are allowed to fall on a final syllable, both NONFINALITY constraints are ranked below the constraints responsible for footing and stress placement. In Araucanian, the relevant stress constraints are FTBIN and PARSE-σ

which are ranked above NONFINALITY. This allows both primary and secondary to fall on a final syllable.

In Southern Paiute, both primary and secondary stresses are banned from falling on a final syllable. The strategy employed by this language to avoid having stress fall on a final syllable is iambic foot reversal. The ranking that accounts for this pattern is for both NONFINALITY constraints to be ranked high above IAMB.

In Paumari and Khalkha Mongolian, it was shown that while final primary stress is disallowed, secondary stress is free to surface on a final syllable. This pattern was shown to result from high-ranking NONFINALITYHD, the primary-stress-specific version of the constraint, which must be ranked above ALIGNHD-R, the constraint responsible for right alignment of primary stress. The general NONFINALITY constraint is ranked low, since final secondary stress is allowed. Further, it was concluded that an analysis using a primary-stress-specific NONFINALITY constraint is to be preferred over an analysis using superfeet since it can account for the same asymmetrical pattern of nonfinal primary stress but final secondary stress in both bounded an unbounded systems.

Finally, it was demonstrated that no ranking of the primary-stress-specific NONFINALITYHD constraint, the general NONFINALITY constraint, and the ALIGNHD-R stress placement constraint will yield a language with nonfinal secondary stresses but final primary stress. This is a desirable result, as languages with a true asymmetry of this type are unattested.

Notes

[1] Hung (1994) proposes that final stress avoidance and avoidance of stress clash are due to the same pressure, namely that a stressed syllable should be followed by an unstressed syllable. As such, she proposes a single constraint, RHYTHM, to unite these two phenomena. See, however, Elenbaas (1999) for arguments against combining these two pressures into one constraint.

[2] This is not to say that syllabic trochaic languages do not display other types of nonfinality effects not discussed here. For example, some trochaic languages demand that a final syllable be left unfooted. This places stress on the antepenultimate syllable (e.g., Macedonian). See Hung (1994) for a discussion of a wide variety of nonfinality effects beyond the final stresslessness type discussed in this chapter.

[3] There are a few special patterns of stress described by Echeverría & Contreras (1965:134) that I do not explore here, such as final secondary stress in trisyllabic words ending in a consonant (indicating that closed syllables may occasionally be considered heavy), and an optional trochaic pattern in vowel-final disyllabic words. This final pattern may hint at a possible nonfinality effect, but it is clear that at least in some words in this language, final stress is allowed.

[4] Short vowels in final position are always devoiced. A short vowel (or the second half of a long vowel or diphthong) also devoices in an unstressed syllable before a voiceless consonant (Sapir 1930:39). Wheeler (1979) demonstrates that the alternation of voiced and voiceless vowels is related to the language's metrical structure.

[5] I consider here only words containing all light syllables (i.e., syllables with short vowels). However, heavy syllables (containing long vowels or diphthongs) do occur in the language. Sapir (1930:39) describes Southern Paiute as assigning stress to even-numbered moras, instead of syllables, counting from the beginning of the word. This has the potential of dividing a heavy syllable into two feet, as shown in (i).

(i)   (wɨ.ɣɔ́)(ɔ̥.pàq.)(q̥ɨ.nḁ)   'vagina'   (Sapir 1930:13)

If the stress pattern counted syllables instead of moras, the second syllable containing the long vowel [ɔɔ] would count as one unit and the wrong stress pattern would result.

(ii)   *(wɨ.ɣɔ́ɔ.)(paq.q̥ɨ.)nḁ

There would be no stress on the third syllable and the second half of the long vowel would not be devoiced, as this only happens to vowels in unstressed position. However, Hayes (1995:122) argues that stress assignment in Southern Paiute takes place at a stage in the derivation in which surface CVV syllables are disyllabic CV+V sequences, which are later converted into single syllables. I leave aside this issue as it is beyond the scope of this chapter.

[6] While Sapir (1930) posits underlying geminates in Southern Paiute, Wheeler (1979) argues that gemination is predictable and is an example of iambic consonant lengthening; voiceless consonants geminate after a stressed syllable. I follow her analysis for the form presented here.

[7] Aljutor also demonstrates another strategy for final stress avoidance. When the initial syllable in a disyllabic word is light and contains a schwa (an unstressable syllable), a dummy CV syllable is inserted at the end of the word (e.g., /səgaj/ → [səgájjə] 'sand'). Thus, in Aljutor NONFINALITY outranks both FTFORM=IAMB and DEP.

[8] These systems have also been called 'unbounded' systems because there is no limit to the distance that can occur between a stress and the word edge towards which it is oriented.

[9] It is easily accounted for, however, with a high-ranking ALIGNL(PrWd, Peak) constraint that demands that the left edge of the prosodic word be aligned with a stress peak of some kind.

CHAPTER 3:

STRESSED SYLLABLE LENGTHENING

3.1   Introduction

Many languages exhibit a phonological process of lengthening in stressed open syllables. When this process occurs in iambic languages, it is referred to as *iambic lengthening*. Hayes (1995) claims that the motivation behind this process is to create a well-formed, canonical (LH) iambic foot in accordance with the Iambic/Trochaic Law, defined below in (1).

(1)   Iambic/Trochaic Law (Hayes 1995:80)
   a.   Elements contrasting in intensity naturally form groupings with initial prominence.
   b.   Elements contrasting in duration naturally form groupings with final prominence.

This law reflects the perceptual preference of listeners for well-formed rhythmic grouping, both in linguistic and extralinguistic domains such as music. In applying this law to stress, the claim is that trochaic feet should have initial prominence and consist of units equal in duration and that iambic feet should have final prominence and consist of syllables with a durational contrast. An iambic foot consisting of two light syllables (LL) violates the Iambic/Trochaic Law (henceforth I/T Law) by having syllables of equal duration but final prominence. Languages with such feet often convert them into

canonical light-heavy (LH) iambs through quantity adjustment processes that make the second syllable heavy, e.g., through vowel lengthening (2a) or gemination of the onset of the following syllable (2b).[1]

(2)   Iambic lengthening
   a.   (.   x)   (.   x)   b. (.   x)   (.   x)
        CV CV   →   CV CV: CV CV C_iV →   CV CVC$_i$ C_iV

While lengthening of a stressed syllable is most common in iambic languages, it is also found in trochaic languages. However, unlike iambic lengthening, trochaic lengthening cannot be motivated by the pressure to create well-formed feet since, according to the I/T Law, trochaic feet should consist of units equal in duration. Lengthening a stressed syllable in a trochaic foot actually creates an ill-formed foot with a durational contrast. Therefore, the motivation behind it must lie elsewhere.

According to Hayes (1995:84), lengthening in trochaic languages is typically phonetic in character. He discusses as support for this claim the fact that the duration of lengthened vowels in trochaic languages often falls short of that of phonological long vowels. Furthermore, trochaic lengthening is often limited to the primary stressed syllable, which, according to Hayes, "makes sense if in such cases lengthening is simply a direct manifestation of stress and not an optimization of foot structure" (1995:84). By claiming that trochaic lengthening is a purely phonetic effect, Hayes is then able to avoid compromising the predictive power of the I/T Law.

However, there are many problems with these claims that have caused some researchers to question the status of the I/T Law (e.g., Eisner 1997; Everett 2002; Kager 1993; Revithiadou & van de Vijver 1996; van de Vijver 1998). First of all, this so-called 'law' is often violated. While many iambic languages do exhibit lengthening effects,

there are some iambic languages that do not. For example, Araucanian (Echeverría & Contreras 1965) and Paumari (Everett 2002) do not exhibit any stressed vowel lengthening effects (see §2.2.2 and §2.3.1, respectively, for a discussion of these languages). While it might be argued that this is due to the fact that neither language has phonemic long vowels, there are iambic languages that do have phonemic vowel length yet still do not exhibit stressed vowel lengthening (e.g., Hopi, Negev Bedouin Arabic – Hayes 1995; Asheninca Campa – McCarthy & Prince 1993b).

Second, while all of the observations that Hayes makes about trochaic lengthening are valid, they also are not absolute. For example, the claim that the duration of lengthened vowels in trochaic languages often falls short of that of phonological long vowels is also true of some iambic languages (e.g., Choctaw and Chickasaw, §3.3.2.4). Furthermore, while Hayes (1995:81) says that stressed syllables must be 1.5 to 2 times longer than unstressed syllables for iambic rhythm to be perceived, Goedemans (1997) finds that stressed syllables in Mathimathi, a Kulin language with a trochaic stress pattern, are 2 to 2.3 times as long as unstressed syllables. For Hayes to say, then, that trochaic lengthening is phonetic while iambic lengthening is phonological is questionable.

Third, if trochaic lengthening is simply the phonetic manifestation of primary stress, why is it that some trochaic languages lengthen secondary stresses as well? Moreover, if lengthening were purely the phonetic manifestation of stress, why is it not reported for all trochaic languages, or for that matter, for all stress languages in general?

While I do not question the validity of the I/T Law as a general organizing principle of rhythmic structure that has real consequences for stress, I do not think that

the distinction between phonetic and phonological lengthening can be made on the basis of foot structure alone. While languages that undergo lengthening of stressed syllables in order to comply with the I/T Law will undoubtedly be iambic, there are other motivating factors behind stressed syllable lengthening besides the requirement that feet be well-formed. It is argued that some cases of lengthening, such as that observed in trochaic languages as well as in unbounded systems, which are often assumed to lack foot structure, are due to the preference for stressed syllables to be heavy, rather than to any requirement on the well-formedness of foot structure. Weight is just one characteristic that contributes to a syllable's prominence; heavy stressed syllables are phonetically more prominent or salient than light stressed syllables. If an augmentation constraint demanding that stressed syllables be heavy is high-ranking, lengthening will result.

This chapter is organized as follows. In §3.2, I discuss languages, both iambic (§3.2.1) and trochaic (§3.2.2), that lengthen vowels in all stressed syllables. It will be shown that constraints that have been proposed requiring well-formed feet in order to comply with the I/T Law can account for lengthening in iambic languages; however, they cannot account for lengthening in trochaic languages. Instead, I introduce a constraint (STRESS-TO-WEIGHT) that requires that stressed syllables be heavy. When this constraint is ranked above a constraint requiring faithfulness to input weight, lengthening is observed. In §3.2.3, I discuss languages that do not exhibit vowel lengthening in any stressed syllables. That this is true not only of trochaic languages but of some iambic languages as well is indicative of the violability of the I/T Law. This draws into question invoking the Law as an explanation both for why iambic languages tend to exhibit lengthening and why trochaic lengthening cannot be phonologically motivated.

In §3.3, I present languages in which primary and secondary stresses behave asymmetrically with respect to lengthening effects. First in §3.3.1, I discuss Wargamay, a trochaic language that lengthens vowels in primary stressed syllables but not in secondary stressed syllables. I show that this asymmetrical behavior can be captured by appealing to a primary-stress-specific version of the STRESS-TO-WEIGHT constraint that is ranked in a stringency relation with the general version of the constraint. In §3.3.2, I present data from Kuuku-Yaʔu, another language that exhibits asymmetrical lengthening effects in primary and secondary stressed syllables. Kuuku-Yaʔu is shown to differ from Wargamay in several interesting ways: 1) it is a prominence-based stress language, which assigns stress independent of foot structure, and 2) the lengthening observed in primary stressed syllables results in the gemination of a consonant, not vowel lengthening.

In §3.4, I discuss the pattern of lengthening predicted not to occur and demonstrate that this falls out from the proposed stringency relation of the general and primary-stress-specific stress-to-weight constraints. An apparent counterexample is demonstrated to result from an independently motivated high ranking markedness constraint. I conclude the chapter in §3.5 with a summary.

3.2 General stressed syllable lengthening

3.2.1 Iambic lengthening: St. Lawrence Island Yupik

Many iambic languages exhibit lengthening of vowels in all stressed open syllables. Examples given by Hayes (1995:83) include Hixkaryana, Choctaw, Menomini, Cayuga, Kashaya, and many Yupik dialects. Consider the following data from St.

Lawrence Island Yupik, a dialect of Central Siberian Yupik (Jacobson 1985; Krauss 1985). For more comprehensive analyses of stress in the Yupik dialects, see Baković (1996; 1997) and Hayes (1995).

(3)　　St. Lawrence Island Yupik[2]

    a.　(aŋyáχ)(ɬaχɬáŋ)(yuxtuq)　　　　　'he wants to make a big boat'

       (áːŋ)(qaχɬáχ)(ɬaŋyúx)tuq　　　　　'he wants to make a big ball'

    b.　/qayani/　　　　→　　(qayáː)ni　　　　'his own kayak'

       /saɣuyaːni/　　→　　(saɣúː)(yáː)ni　'in his (another's) drum'

       /akisimaŋisimakaŋa/　→　(akíː)(simáː)(ŋisíː)(makáː)ŋa

                          'he didn't have an answer for it'

According to the analysis in Hayes (1995:240), stress falls on all nonfinal heavy syllables (CVV(C)) and on nonfinal even-numbered syllables in a string, as shown in the forms in (a). Hayes states that the lack of final stress is due to the intonational system, though he argues that final eligible syllables are footed and do receive grid marks (1995:240). When stress falls on a light open syllable, the vowel undergoes iambic lengthening, as in (b). As is the case with many iambic languages, St. Lawrence Island Yupik does not assign higher metrical structure to the various stresses (other examples include Choctaw, Chickasaw, Seneca, and Macushi); therefore, all stresses are marked with an acute accent. What should be noted, however, is that every light stressed open syllable undergoes iambic lengthening.

Most OT analyses of languages with iambic lengthening appeal to a constraint that requires that the stressed syllable in an iambic foot must be heavy, in accordance with the I/T Law. Examples include UNEVEN-IAMB (Kager 1999:151), IAMBIC QUANTITY (Hung 1994a:46), ASYM (Buckley 1999:85), and FOOTFINAL (van de Vijver 1998:80).

To account for the wider range of lengthening patterns exhibited by the various Yupik dialects, Baković (1996, 1997) adopts a modified version of Prince's (1990) Grouping Harmony, which evaluates disyllabic feet, independent of prominence, according to a numerical scale (calculated by dividing the size, in moras, of the second syllable by that of the first). Feet with a greater numerical value are more harmonic than those with lesser values. This produces the following harmonic scale (where 'S' = 'superheavy' and '>' = 'is more harmonic than'): (LS) > (LH) > (LL) > (HL).[3] Because Grouping Harmony assigns a higher harmonic value to end-heavy feet, independent of trochaic or iambic prominence, it is necessary to appeal to the WEIGHT-TO-STRESS PRINCIPLE (WSP – Prince 1990) to rule out (LS) and (LH) trochees as well as (HL) iambs. The interaction of Grouping Harmony and the WSP is shown in (4). Underlining indicates feet not ruled out by the WSP, and bold typeface indicates the head of the foot.

(4)   Grouping Harmony and the WSP
    a. WEIGHT-TO-STRESS PRINCIPLE (WSP): Heavy syllables must be stressed.
    b. Trochaic feet: (**LS**) > (**LH**) > (**LL**) > (**HL**)
    c. Iambic feet: (L**S**) > (L**H**) > (L**L**) > (H**L**)

According to the scales, the best trochaic foot is (LL), since (LS) and (LH) are ruled out by the WSP. A (LL) foot, however, is the least harmonic iambic foot, since (LS) and (LH) feet have better harmony values, and (HL) is ruled out by the WSP.

Grouping Harmony forms the basis for Baković's constraint FTHARM, which states, "For every disyllabic foot *G*, increase Harmony of *G*" (1996:3). This allows him to account not only for regular iambic lengthening effects, but also for the overlengthening effects seen in some Yupik dialects (see §3.3.2.6), as well as for trochaic shortening effects.

All of these constraints are markedness constraints. What they have in common is that they achieve lengthening effects in iambic languages by calling for improved (i.e., less marked) foot structure. For example, by ranking one of these constraints, such as UNEVEN-IAMB, above a faithfulness constraint banning epenthesis of a mora (DEP-μ), lengthening is observed.

(5)   Iambic lengthening in St. Lawrence Island Yupik

/akisimaŋisimakaŋa/	UNEVEN-IAMB	DEP-μ
a. ☞ (akíː)(simáː)(ŋisíː)(makáː)ŋa		****
b. (akíː)(simá)(ŋisí)(maká)ŋa	*!**	*
c. (akí)(simá)(ŋisí)(maká)ŋa	*!***	

The optimal candidate in (a) wins because it best satisfies UNEVEN-IAMB; every stressed syllable is heavy, even though this forces multiple violations of DEP-μ. Candidates (b) and (c) are eliminated by failing to lengthen all of the stressed vowels, even though in doing so they fare better with respect to the faithfulness constraint.

In the next section, I discuss a trochaic language that lengthens vowels in all stressed open syllables. Because there are no markedness constraints that prefer a lengthened (HL) trochaic foot to one without lengthening (LL), I argue that it is necessary to appeal to a general constraint that demands that stressed syllables be heavy, independent of foot structure.

3.2.2   Trochaic lengthening: Chimalapa Zoque

Chimalapa Zoque is a Mixe-Zoque language spoken in Mexico. The data below are taken from Knudson (1975). A derivational analysis of this language is found in Hayes (1995).

(6)   Chimalapa Zoque

   a. mìnkéʔtpa   'he is coming again'

   b. mìnsukkéʔtpa   'they are coming again'

   c. mìnsukkeʔtpaʔitti 'they were going to come again'

   d. hóːho   'palm tree'

   e. wìːtuʔpayníksɨ   'he is coming and going'

   f. hùːkúːti   'fire'

   g. ʔòːtoŋɲíːpiʔtʰ   'if he had spoken'

Primary stress falls on the penult in words of two or more syllables. A secondary

stress falls on the initial syllable in words containing more than two syllables. This

pattern suggests that feet are trochaic. A general process lengthens vowels in all stressed

open syllables, whether they bear primary stress or secondary stress.[4] As vowel length is

not contrastive, all long vowels are derived by this rule.

    Like Garawa, discussed in §1.3.2, Chimalapa Zoque can be characterized as a

bidirectional language. That is, primary stress is assigned at one edge, while secondary

stress is assigned at the opposite edge. However, unlike Garawa, footing in Chimalapa

Zoque is noniterative; there is at most only one primary and one secondary stress per

word. According to Kager (1999), a noniterative bidirectional stress pattern can be

accounted for within OT by the constraints and ranking schema given in (7).

(7)   a. ALIGNWD-R

       Align(PWd, R, Ft, R): The right edge of every prosodic word must be aligned
            with the right edge of some foot.

       b. ALIGNFT-L

       Align(Ft, L, PWd, L): The left edge of every foot must be aligned with the left
            edge of some prosodic word.

       c. PARSE-σ

       Syllables must be parsed by feet.

       Ranking: ALIGNWD-R >> ALIGNFT-L >> PARSE-σ

    A tableau demonstrating how this ranking achieves a noniterative bidirectional

stress pattern in a three-syllable word is given in (8).

(8)   Noniterative bidirectional stress pattern: ALIGNWD-R >> ALIGNFT-L >> PARSE-σ

/minkeʔtpa/	ALIGNWD-R	ALIGNFT-L	PARSE-σ
a. ☞ (mìn)(kéʔtpa)		*	
b. min(kéʔtpa)		*	*!
c. (mín)keʔtpa	*!		**

    Candidate (c) is eliminated by ALIGNWD-R. Violations of this constraint are

marked categorically; since there is no foot aligned at the right edge of the word, the

candidate incurs one violation, which is fatal. Candidates (a) and (b) both satisfy

ALIGNWD-R by having a foot aligned at the right edge of the word. Furthermore, they

both tie with respect to ALIGNFT-L, the constraint that demands that all stress feet be

aligned at the left edge. Violations of this constraint are marked gradiently; one violation

mark is incurred for each syllable that stands between a foot edge and the edge of the

word towards which it is aligned. Candidate (b) has one foot that is one syllable away

from the left edge of the word and so incurs one violation of ALIGNFT-L. Candidate (a)

has two feet, one of which is perfectly aligned with the left edge of the word, and the other of which is one syllable away. It also incurs one violation of AlignFt-L. The tie is passed down to Parse-σ which selects candidate (a) as the winner since all of its syllables are parsed into feet.

To account for the pattern of stressed vowel lengthening, it is necessary to appeal to a markedness constraint. Unlike lengthening in iambic languages, however, trochaic lengthening cannot be triggered by a constraint demanding well-formed feet. Recall from §3.2.1 that Baković's FtHarm constraint can evaluate the well-formedness of trochaic feet, such that a (LL) trochaic foot is considered to be more harmonic than a (HL) trochaic foot; however, it is precisely a (HL) foot that results from the process of trochaic lengthening and must win out over a (LL) foot with no lengthening. Therefore, FtHarm cannot achieve this effect.

Instead, it is necessary to appeal to a constraint that demands that stressed syllables be heavy, independent of foot structure. Such a constraint, which I call Stress-to-Weight (S-to-W), has been proposed in the literature (Riad 1992; see also Stressed Syllable Length, van de Vijver 1998). This constraint reflects the general cross-linguistic tendency for stressed syllables to be lengthened. Because duration, along with amplitude and pitch, is one of the primary acoustic cues of stress (Fry 1955), this constraint is phonetically grounded.

By ranking Stress-to-Weight above a faithfulness constraint that prohibits epenthesis of moras (Dep-μ), the pattern of trochaic lengthening is achieved. These constraints and their ranking are given in (9), and a tableau demonstrating how this ranking evaluates words in Chimalapa Zoque is given in (10).

(9)   Stress-to-Weight (S-to-W): Stressed syllables must be heavy.
       Dep-μ: Output moras must have input correspondents.
       Ranking: S-to-W >> Dep-μ

(10)   Stressed vowel lengthening in Chimalapa Zoque

/hukuti/	S-to-W	Dep-μ
a. (hù)(kúti)	*!*	
b. (hù)(kú:ti)	*!	*
c. ☞ (hù:)(kú:ti)		**

Candidate (a) violates S-to-W twice, since neither stressed syllable is heavy. Even though it fully satisfies Dep-μ, the low ranking of this constraint allows the candidate to be eliminated from competition. Candidate (b), which only lengthens the vowel in the primary stressed syllable, still incurs one fatal violation of the markedness constraint, due to its failure to lengthen the vowel in the secondary stressed syllable. Candidate (c) fully satisfies the markedness constraint, at the expense of faithfulness, by lengthening the vowels in both the primary and secondary stressed syllables, thereby allowing it to be chosen as the optimal candidate.

Because lengthening does not occur in closed syllables, they must be heavy. Additional support for the weight of closed syllables comes from the fact that monosyllabic words are of the shape CVC or CV:, but not CV. This implies a bimoraic word minimum, which is met by CVC syllables. Heavy closed syllables result from satisfaction of Weight-by-Position (Hayes 1989), which says that coda consonants must be moraic. Thus, closed syllables vacuously satisfy S-to-W, so vowel lengthening is

not motivated. Furthermore, lengthening the vowel in a closed syllable would create a trimoraic syllable which is cross-linguistically dispreferred.

Other examples of trochaic languages that undergo vowel lengthening in all stressed syllables include Swedish (Bruce 1984; Riad 1992) and Chamorro (Crosswhite 1998).[5] For a discussion of stressed vowel lengthening and lowering in Chamorro, see §4.2.1. Other dialects of Swedish, such as the Fenno-Swedish dialects spoken along the Finland border, exhibit consonant gemination (of the following onset) in all stressed syllables instead of vowel lengthening (Kiparsky 2003).

3.2.3 *Faithfulness to input length: Anguthimri*

The S-to-W constraint, introduced in the previous section, was invoked to capture the cross-linguistic tendency for stressed vowels to lengthen. While this tendency is phonetically grounded, it is simply that – a tendency. Not all languages overtly lengthen stressed vowels. As such, this constraint can be violated.

Anguthimri, a Paman language spoken in Cape York, Australia, is described by Crowley (1981) and analyzed by Hayes (1995).

(11)   Anguthimri

pána	'friend'
pá:na	'level'
kálipwa	'gully'
kwíni:ɣi	'cassowary'
ʔúnuwàna	'blister'
máɣuʔɪ:ni	'mullet'
páɽupàɽaci	'cottonwood tree'

Anguthimri has phonemic vowel length, though long vowels only rarely occur in any syllable but the first. Primary stress falls on the initial syllable and secondary stresses fall on every other syllable thereafter, except on the final syllable. According to Hayes (1995), this pattern results from building syllabic trochees nonexhaustively from left to right, and assigning primary stress via End Rule Left to the leftmost foot. That the trochees are syllabic as opposed to moraic is evident from the fact that syllables are counted during footing, independent of their internal structure. If footing were quantity sensitive, built from moraic trochees, we would expect long vowels to always bear stress, though this is not the case (e.g., [kwíni:ɣi]).

To account for languages like Anguthimri with no stressed vowel lengthening, the ranking of S-to-W and DEP-μ is the opposite of that for Chimalapa Zoque; namely, the faithfulness constraint must outrank the markedness constraint.

(12)   No stressed vowel lengthening in Anguthimri

/ʔunuwana/	DEP-μ	S-to-W
a. ☞ ʔúnuwàna		**
b. ʔú:nuwàna	*!	*
c. ʔú:nuwà:na	*!*	

Because the faithfulness constraint is ranked high, candidate (a), which is fully faithful to the input vowel length, is chosen as the optimal candidate. The other candidates, with lengthening in one or both of the stressed syllables, fare better with respect to the markedness constraint than the winner in (a), but are eliminated due the ranking of this constraint below faithfulness in the hierarchy.

Other syllabic trochaic languages like Anguthimri with phonemic vowel length but no stressed vowel lengthening include Dalabon, Dehu, Djingili, Livonian, Mansi, Nengone, Pintupi, Piro, Pitta-Pitta, and Votic.

Because Anguthimri does have phonemic vowel length, it could be argued that stressed vowel lengthening does not occur due to pressure to preserve the length contrast. A lengthened short vowel and an underlying long vowel would be neutralized on the surface, something that many languages avoid (see §3.3.2.4 for a discussion). However, many trochaic languages that lack phonemic long vowels also do not exhibit trochaic lengthening (e.g., Bidyara, Diyari, Garawa, Malakmalak, Maranungku, Ono, Selepet, Wangkumara, and Warao). Badimaya (Dunn 1988), a Pama-Nyungan language of Australia, does not lengthen stressed vowels even though it exhibits a process of vowel lengthening in open monosyllables in order to satisfy a bimoraic minimal word requirement.

Examples of iambic languages that do not undergo stressed vowel lengthening include Araucanian and Paumari, which do not have phonemic long vowels, and Hopi, Negev Bedouin Arabic, and Asheninca Campa, which do have a vowel length contrast. If it is the constraint FTHARM that is the primary trigger for vowel lengthening in iambic languages, as opposed to the more general S-to-W constraint for trochaic languages, it, too, would have to be ranked below the faithfulness constraint prohibiting mora epenthesis to prevent lengthening of stressed vowels.

3.3 Asymmetrical patterns of stressed syllable lengthening

In the preceding sections, I have discussed two possible patterns of interaction between stress assignment and stressed vowel lengthening: those languages, such as St. Lawrence Island Yupik and Chimalapa Zoque, that undergo vowel lengthening in all stressed syllables, and those, such as Anguthimri, that do not. There is, however, a third possible pattern. In this section, I discuss languages that exhibit an asymmetrical pattern of stressed syllable lengthening, whereby syllables bearing primary stress lengthen while those bearing secondary stress do not.

3.3.1 Wargamay

Wargamay is a Pama-Nyungan language of Australia described by Dixon (1981) and analyzed within metrical stress theory by Hayes (1995). Neighboring Nyawaygi (Dixon 1983) has an identical stress pattern, though I give only Wargamay data here. Vowel length is distinctive in this language; however, phonemic long vowels (marked with 'ː') may only occur in the initial syllable.

(13) Wargamay

    a.   múːba   'stone fish'

          gíːbaɽa   'fig tree'

    b.   múˑŋan   'mountain-ABS'

          gíˑɹawùlu 'freshwater jewfish'

    c.   muŋáˑnda   'mountain-LOC'

          ɹuɽáˑgay-mìri 'Niagara-Vale-FROM'

If the first syllable of the word contains a long vowel, as in (a), it receives primary stress. If the first syllable does not contain a long vowel, then primary stress falls on the

initial syllable in even-parity words, as in (b), and on the second syllable in odd-parity words, as in (c). Secondary stresses alternate after the primary stress, but may not fall on the final syllable.

3.3.1.1 Accounting for count systems

The fact that the location of primary stress in words with no long vowel differs depending upon the number of syllables in the word indicates that Wargamay is a *count system*. In count systems, the primary stress foot is located at the opposite edge from which footing begins. In a derivational framework, stress assignment would proceed from right to left. Because the final syllable is always unstressed, feet must be trochaic. Since an initial long vowel bears primary stress even in a word with an odd-number of syllables, it must be considered heavy for stress, indicating quantity sensitivity. End Rule Left would assign primary stress to the leftmost foot in the word.

Within Optimality Theory, quantity sensitivity is accounted for by ranking the WEIGHT-TO-STRESS PRINCIPLE (Prince 1990) above the general stress placement constraints. Also undominated is a constraint demanding that feet be trochaic. These constraints are defined in (14).

(14)　WEIGHT-TO-STRESS PRINCIPLE (WSP):　Heavy syllables must be stressed.
　　　FTFORM=TROCHEE:　Feet must have initial prominence.

Right-to-left directionality of footing is achieved by a right-alignment constraint that demands that all feet be aligned with the right edge of the word. This constraint can only be fully satisfied if there is just one foot at the end of the word. Since words in Wargamay can have more than one stress, and thus more than one foot, the foot-alignment constraint must be dominated by a constraint demanding that syllables be

parsed into feet, PARSE-σ. Because a five-syllable word does not have stress on the initial syllable (unless it contains an underlying long vowel), this indicates that footing is not exhaustive. Thus, PARSE-σ must in turn be dominated by a constraint demanding that feet be binary, under some level of analysis.

(15)　FTBIN:　　　　Feet must be binary at some level of analysis (σ, μ).
　　　PARSE-σ:　　　All syllables must be parsed by feet.
　　　ALIGNFT-R:　　The right edge of every foot must stand at the right edge of the prosodic word.
　　　Ranking:　FTBIN >> PARSE-σ >> ALIGNFT-R

The following tableau demonstrates how these constraints account for the basic stress pattern in a five-syllable word.

(16)　Right-to-left footing in Wargamay

/ɟuɾaɡay-miri/	WSP	TROCHEE	FTBIN	PARSE-σ	ALIGNFT-R
a. ☞ ɟu(ɾáˑɡay)(mìri)				*	**
b. (ɟuɾáˑ)(ɡaymì)ri		*!*		*	*, ***
c. (ɟú)(ɾàɡay)(mìri)			*!		**, ****
d. ɟuɾaɡay(míri)				**!*	

Candidate (b) is eliminated by having iambic feet as opposed to trochaic feet. Because it has a degenerate foot, andidate (c) fatally violates FTBIN. Candidate (d), which best satisfies ALIGNFT-R by having one perfectly right-aligned foot, is nevertheless eliminated by its multiple violations of PARSE-σ. This allows candidate (a), with right-aligned nonexhaustive footing, to be chosen as the optimal candidate.

While the candidate in (c) with the degenerate foot could have been ruled by *CLASH, a constraint banning adjacent stresses, instead of by FTBIN, it turns out that this

constraint is independently needed to rule out a suboptimal parse in other forms. Consider the following tableau of a three-syllable word with a long vowel in the initial syllable.

(17)   *CLASH >> PARSE-σ

/gí:baɽa/	WSP	*CLASH	FTBIN	PARSE-σ	ALIGNFT-R
a. ☞ (gí:ba)ɽa				*	*
b. (gí:)baɽa				**!	**
c. (gí:)(bàɽa)		*!			**
d. gi:(báɽa)	*!			*	

In the tableau in (16) above, candidate (c) with the stress clash was ruled out by FTBIN, since the clash occurred between a binary foot and a degenerate foot. In tableau (17), however, the candidate with the stress clash in (c) has two binary feet – the first is bimoraic and the second is bisyllabic – and thus cannot be ruled out by FTBIN. It must instead be ruled out by the anti-clash constraint. Because candidate (c) actually fares better than the winner in (a) with respect to PARSE-σ, *CLASH must be ranked above this constraint. Candidate (a) is selected as the optimal form over candidate (b), due to its better satisfaction of PARSE-σ and ALIGNFT-R.

Note that even though these two candidates are phonetically identical, the hierarchy predicts that the structure of the candidate in (a) is optimal. This is actually different than the structure that Hayes posits for this form in his derivational analysis of Wargamay (1995:141). He uses moraic trochaic feet in his analysis, which can either contain two light syllables or a single heavy syllable. A heavy-light foot, such as the one in candidate (a), is ruled out by the theory. Thus, the structure that Hayes posits for this word resembles the form in candidate (b) with the single heavy syllable foot. Within OT,

both structures are possible output forms, due to the property of Freedom of Analysis, which says that any amount of structure can be posited in an output. Which one is selected as optimal is determined by the hierarchy.

There is one more constraint that is necessary to account for the basic stress pattern. That it is the leftmost foot in the word that bears primary stress is due to ALIGNHD-L, which, demands that the left edge of every prosodic word be aligned with the left edge of some foot. However, as seen in the following tableau, this constraint is not undominated since it can be violated in a three-syllable word with no underlying long vowel.

(18)   ALIGNFT-R >> ALIGNHD-L

/muŋanda/	TROCHEE	FTBIN	PARSE-σ	ALIGNFT-R	ALIGNHD-L
a. ☞ mu(ɲáˑnda)			*		*
b. (múˑŋan)da			*	*!	
c. (muɲáˑn)da	*!		*	*	
d. (múˑŋan)(dà)		*!		*	

Candidate (d) with the degenerate foot is ruled out by FTBIN. Candidate (c) fatally violates TROCHEE because it has an iambic foot. Candidates (a) and (b) both have one unparsed syllable, so they tie with respect to PARSE-σ. The decision is passed down to the lower ranked constraints. Because the optimal form is the candidate in (a) with the right-aligned foot instead of the form with the left-aligned foot in (b), ALIGNFT-R must outrank ALIGNHD-L.

3.3.1.2 Lengthening in primary stressed syllables

Like Chimalapa Zoque, Wargamay demonstrates a process of vowel lengthening that affects stressed syllables. However, unlike Chimalapa Zoque, this process does not affect all stressed syllables uniformly. According to Dixon, short vowels bearing primary stress may be "phonetically lengthened, e.g. [muŋá·nda]" (1981:20), which he indicates with half-length. However, vowels in secondary stressed syllables do not undergo this lengthening.

Because primary stressed syllables behave differently than secondary stressed syllables with respect to vowel lengthening, I propose that it is necessary to explode the markedness constraint S-to-W into a more specific version of the constraint that demands that only primary stressed syllables be heavy.[6]

(19) S_1-to-W: Primary stressed syllables must be heavy.

This specific version of the constraint stands in a stringency relation with the general S-to-W constraint. That is, violations of S_1-to-W are a proper subset of the violations of general S-to-W. Put another way, a violation of S_1-to-W necessarily implies a violation of general S-to-W, but not vice versa.

To account for the asymmetrical behavior of primary and secondary stressed syllables with respect to vowel lengthening, the faithfulness constraint DEP-μ must be ranked intermediately between the specific S_1-to-W and the general S-to-W. The ranking of DEP-μ above S-to-W ensures that vowel lengthening is, in general, prohibited. However, ranking the primary-stress-specific S_1-to-W constraint above the faithfulness constraint allows vowel lengthening in a restricted set of contexts, namely, in all primary

stressed syllables. The tableau in (23) demonstrates how this ranking accounts for the Wargamay pattern.

(20)   Lengthening in primary stressed syllables only[7]

/ɟuɽagay-miri/	S_1-to-W	DEP-μ	S-to-W
a. ɟuɽágay-mìri	*!		**
b. ☞ ɟuɽá·gay-mìri		*	*
c. ɟuɽá·gay-mì·ri		**!	

Candidate (a) is eliminated due to its failure to lengthen the vowel in the primary stressed syllable. While candidates (b) and (c) both lengthen the primary stressed vowel, candidate (c) is eliminated since it also lengthens the secondary stressed vowel, thereby incurring one extra violation of DEP-μ.

Vowels bearing primary stress that are underlyingly long do not overlengthen. This is due to the fact that they vacuously satisfy S_1-to-W. Thus, lengthening of long vowels is not motivated; furthermore, it is prevented by DEP-μ, the next highest ranked constraint.

Other bounded stress systems that have been described as lengthening primary stressed syllables but not secondary stressed syllables include Icelandic (Árnason 1980, 1985; Kiparsky 1984), Cebuano (Shryock 1993), Greek (Arvaniti 1991),[8] and Italian (Nagy & Napoli 1996).[9]

3.3.2   Lengthening in an unbounded system: Kuuku-Yaʔu

In the previous sections, it was argued that while lengthening in iambic languages can be motivated by constraints enforcing the Iambic/Trochaic Law, calling for stress feet to be well-formed, the same cannot be true for trochaic languages. It was proposed

instead that lengthening in trochaic languages is due to a constraint calling for stressed syllables to be heavy, independent of foot structure. If this constraint is well-motivated, we might expect to see stressed syllable lengthening in unbounded systems as well, since, as discussed in chapter 2, it is often assumed that languages with unbounded stress systems lack foot structure. As demonstrated in this section, lengthening in unbounded systems is observed.

3.3.2.1 Default-to-opposite side stress

The stress pattern of Kuuku-Yaʔu, a Pama-Nyungan language spoken in Cape York, Australia, is described by Thompson (1976) and is analyzed within a derivational framework by Hayes (1995) and within an OT framework by Baković (1998) and Walker (1997). Stress assignment in Kuuku-Yaʔu is prominence-driven, based on syllable weight; syllables containing long vowels are considered to be heavy for the purposes of stress assignment. Closed syllables and syllables containing short vowels are light. The basic stress pattern of this language is described and illustrated in (21). Vowel length is phonemic, but long vowels are prohibited from occurring in a final syllable.

(21)   Kuuku-Yaʔu

a. Primary stress falls on the rightmost long vowel

[páːla]	'behind'
[wíːmumu]	'large number of ants'
[kùláːn]	'possum'
[ʔɪlpíːna]	'return'
[tàwuráːlu]	'with a knife'
[mùːmáːɲa]	'rub'

b. In words with no long vowels, primary stress falls on the initial syllable.

[cílpu]	'old man'
[kúlkul]	'skin/bark'
[ʈálnpuy]	'lip'
[kúnpantin]	'flog'
[púyŋaʈiɲa]	'shut'

As seen in (a), primary stress falls on the only long vowel in the word or on the rightmost long vowel if there is more than one. If there is no long vowel in the word, primary stress falls on the initial syllable (b). Secondary stresses fall on all long vowels not bearing primary stress, as well as on the initial syllable. In this way, the Kuuku-Yaʔu stress pattern closely resembles the pattern of Khalkha Mongolian, discussed in §2.3.2, except that it does not exhibit any nonfinality effects.

Thompson (1976:217) also describes a posttonic secondary stress in Kuuku-Yaʔu on the syllable immediately following the initial primary stress in words with no long vowels. Hayes (1995:296) questions the status of these syllables as being metrically strong and instead attributes the perceived stress to a pitch effect. I therefore do not mark these stresses, though their stressed/unstressed status does not affect the analysis presented here.

Like Khalkha Mongolian, Kuuku-Yaʔu has a default-to-opposite stress pattern. When there are heavy syllables in the word, stress falls towards the right edge of the word (i.e., on the rightmost syllable containing a long vowel). When there are no heavy syllables in the word, default stress falls towards the opposite edge (i.e., on the initial syllable).

3.3.2.2 Lengthening in primary stressed syllables

What is interesting about the stress pattern of this language is that, like

Wargamay, Kuuku-Yaʔu evidences a process of lengthening that only applies to primary

stressed syllables. However, unlike the pattern in Wargamay, the process in Kuuku-Yaʔu

lengthens a consonant rather than a vowel. In words with an initial primary stress on a

light open syllable, the onset of the peninitial syllable geminates, effectively closing the

initial syllable, as illustrated in (22) below.

(22)   Consonant gemination in light open syllables bearing primary stress

    a. /pama/   →   [pámma]   'Aboriginal person'

    b. /waliʔi/   →   [wálliʔi]   'spotted lizard'

    c. /wukuṭuru/   →   [wúkkuṭuru]   'coral cod'

    d. /kacinpinta/   →   [káccinpinta]   'female'

    e. /maʔupimana/   →   [máʔʔupimana]   'build/make'

Unlike vowel length, consonant length in Kuuku-Yaʔu is fully predictable; it only

occurs after a short vowel bearing primary stress in an open syllable. That is, gemination

is blocked when the primary stressed syllable contains a long vowel, when the primary

stressed syllable is closed, or when the syllable bears secondary stress, even if it is light

and open.

That this lengthening effect is specific to light open syllables bearing primary

stress is evident in words with an initial secondary stress. If the lengthening effect

occurred in all light open initial syllables, or if it applied to both primary and secondary

stressed syllables, one would expect lengthening following the initial secondary stressed

syllable in words having primary stress on a long vowel later in the word. This is not the

case, as can be seen in the following near minimal pair.

(23)   a. /miyumana/ → [míyyumana] 'be angry'

    b. /miyaaŋina/ → [mìyáːŋina]   'show himself'

The form in (a) has no underlying long vowel, so primary stress falls on the

default initial syllable. Because this syllable is open, the onset of the following syllable

geminates. The form in (b) has an underlying long vowel in the second syllable, which

receives primary stress. The initial syllable receives secondary stress. Even though this

syllable is open, gemination of the following consonant does not occur.

I assume that the process of gemination occurs due to the pressure for primary

stressed syllables to be heavy (i.e., to satisfy S_1-to-W). By geminating the onset of the

following syllable, the preceding syllable bearing primary stress is closed. Assuming

Weight-by-Position, the principle that assigns a mora to a coda consonant (Hayes 1989),

the newly closed syllable is made heavy, thereby satisfying S_1-to-W. This explains why

gemination is blocked when the primary stressed syllable contains a long vowel or when

the primary stressed syllable is closed. Since long vowels are underlyingly bimoraic, a

stressed long vowel bearing primary stress will vacuously satisfy S_1-to-W; geminating

the following consonant serves no purpose. In fact, it would create a trimoraic syllable,

which is cross-linguistically more marked and, thus, dispreferred. Along the same lines, if

coda consonants are moraic due to Weight-by-Position, gemination is not motivated

following a closed syllable with primary stress.

However, this raises several important questions that must be addressed before an

OT account of the Kuuku-Yaʔu stress pattern can be presented. First of all, if coda

consonants contribute to syllable weight in order to block gemination, why do closed syllables act as if they are light for the purposes of stress assignment, failing to attract stress? Second, why does this language meet the demand for heavy primary stressed syllables by geminating a following consonant rather than by lengthening the vowel? I address each of these questions in turn.

3.3.2.3 Weight-by-Position by position

I have described Kuuku-Yaʔu as having default-to-opposite-side stress. That is, stress falls on the rightmost heavy syllable if there is one; if not, stress defaults to the leftmost syllable. Only long vowels are considered to be heavy for the purposes of stress assignment. However, if a closed syllable in initial position in a word with no long vowels blocks gemination, it must be bimoraic, vacuously satisfying the requirement that primary stressed syllables must be heavy. This would seem to imply that all closed syllables are heavy, in which case they should attract stress in the same way that long vowels do.[10] In fact, they do not.

Kuuku-Yaʔu exemplifies a phenomenon that Rosenthall & van der Hulst (1999) call 'Weight-by-Position by position'. That is, closed syllables display variable weight that is contextually dependent. They are heavy in the initial syllable when they bear primary stress, elsewhere they are light.

Rosenthall & van der Hulst (1999) show that within OT, contextually-dependent weight is a consequence of comparing in parallel monomoraic and bimoraic parses of closed syllables with respect to the overall constraint hierarchy. The weight of a closed syllable is due to the interaction of two constraints: *μ/CONS, which bans moraic coda

consonants, and its antagonist WEIGHT-BY-POSITION (WT-BY-POS)[11], which demands that coda consonants be moraic. If a language has light closed syllables, *μ/CONS will outrank WT-BY-POS. If a language has heavy closed syllables, the ranking will be the reverse. When the weight of a closed syllable is contextually dependent, it is due to a higher-ranking metrical constraint whose satisfaction must be met in a particular context at the expense of violating the coda weight constraints.

The fact that closed syllables are generally light in Kuuku-Yaʔu, since they do not attract stress in the way that long vowels do, follows from the ranking of *μ/CONS >> WT-BY-POS. The contextual heaviness of closed syllables bearing primary stress in the initial syllable is due to the higher ranking of the metrical constraint S_1-to-W, which demands that primary stressed syllables must be heavy. A tableau demonstrating how these constraints interact to yield contextually heavy syllables in Kuuku-Yaʔu is given in (24). Moraic coda consonants are indicated with underlining.

(24)   Closed syllables bearing primary stress in initial position are heavy

/kulkul/	S_1-to-W	*μ/CONS	WT-BY-POS
a. kúl.kul	*!		**
b. ☞ kúḷ.kul		*	*
c. kúḷ.kuḷ		**!	

Candidate (a), with no moraic coda consonants best satisfies *μ/CONS, but is eliminated due to its violation of the higher ranking S_1-to-W, since the primary stressed syllable is light. Candidate (c) satisfies S_1-to-W, since the initial syllable has a moraic coda; however, since the final closed syllable is also heavy, it incurs an extra violation of

*μ/Cons, which is fatal. This allows candidate (b), with one heavy closed syllable in initial position and one light closed syllable, to be selected as the optimal form.

Because it is a primary-stress-specific constraint that compels violation of *μ/Cons, closed syllables will only be heavy in the initial syllable when they bear primary stress. If they bear secondary stress, they will be light. That the weight of closed syllables can be dependent not only upon their position in the word but also to the type of stress they bear is a unique observation, one that is not discussed in either Rosenthall & van der Hulst (1999) or in some of the other typological studies on the interaction of quantity and stress assignment, such as Ahn (2000) or Gordon (1999).

(25)   Closed syllables bearing secondary stress in initial position are light

/ʔilpiːna/	S₁-to-W	*μ/Cons	Wt-by-Pos
a. ☞ ʔìl.píː.na			*
b. ʔìl̩.píː.na		*!	

Because there is a long vowel in the word, it attracts primary stress. Thus, S₁-to-W is vacuously satisfied in both of the candidates. The ranking of *μ/Cons above Wt-by-Pos then selects candidate (a) with the nonmoraic coda consonant in the initial syllable as the optimal form over candidate (b) with the heavy closed syllable.

Because closed syllables are heavy in initial position when they bear primary stress, they satisfy S₁-to-W. No quantity adjustment is necessary. When the initial syllable is light and open, however, it must adjust to satisfy S₁-to-W, either by vowel lengthening or consonant lengthening. In the next section, I discuss the reason behind why Kuuku-Yaʔu geminates a consonant rather than lengthens a vowel to make a

primary stressed syllable heavy, as well as the constraints necessary to account for such a pattern.

3.3.2.4 Gemination as contrast preservation

Recall that while there is a phonemic vowel length distinction in Kuuku-Yaʔu, consonant length is nondistinctive. If this language were to lengthen an underlying short vowel bearing primary stress, it would neutralize the length contrast on the surface; all primary stressed vowels would be long on the surface. That is, underlying long vowels would not be distinguished from underlying short vowels that had undergone stressed vowel lengthening.

In an effort to preserve this contrast, languages may use one of several strategies to avoid such neutralization processes. For example, Choctaw and Chickasaw, two closely related Muskogean languages, exhibit iambic lengthening whereby a short stressed vowel in an iambic foot lengthens to create a canonical iamb. However, according to Munro & Ulrich (1984), this process is non-neutralizing; the lengthened vowels are phonetically not as long as underlying long vowels. This is similar to the lengthening effect described by Dixon (1981) for Wargamay.

Two other strategies for contrast preservation are exhibited by two different dialects of Central Siberian Yupik, which also exhibit iambic lengthening (Krauss 1985). In the St. Lawrence Island dialect, speakers from the older generation preserve the vowel length contrast by lengthening both short and long stressed vowels in open syllables, creating long and overlong vowels, respectively. This strategy is not possible in the Norton Sound dialect, however, which disallows overlong vowels. Instead, the distinction between lengthened vowels and underlying long vowels is signaled by stressing the

syllable immediately preceding an underlying long vowel. If this preceding syllable is light, it is made heavy by geminating the following consonant. This process, which also occurs in Chugach, a dialect of Pacific Yupik, is called Pre-Long Strengthening (Hayes 1995:243).

While the strategy that Kuuku-Yaʔu employs to preserve the underlying vowel length contrast is not precisely the same as any of the strategies discussed above, it most closely resembles that exhibited by Norton Sound. To avoid neutralizing the vowel length contrast, light primary stressed syllables undergo consonant gemination rather than vowel lengthening.

Because underlying long vowels show up faithfully, a constraint preserving input moras, MAX-μ, must outrank a markedness constraint banning long vowels, *VV. However, since short vowels do not lengthen, *VV must outrank the faithfulness constraint preventing mora epenthesis, DEP-μ. These constraints and their ranking are given in (26).

(26) MAX-μ: Input moras must have output correspondents.
      *VV: No long vowels.
      DEP-μ: Output moras must have input correspondents.
      Ranking: MAX-μ >> *VV >> DEP-μ

The constraint S$_1$-to-W, which demands that primary stressed syllables must be heavy, must also outrank DEP-μ or else lengthening will never occur. DEP-μ must in turn dominate the general S-to-W constraint to prevent lengthening in secondary stressed syllables. The ranking of these three constraints, S$_1$-to-W >> DEP-μ >> S-to-W, is the

same as that for Wargamay and are responsible for the asymmetrical lengthening pattern. The interaction of all of these constraints is shown in the following tableaux.

(27) Gemination following primary stressed syllable

/pama/	MAX-μ	*VV	S$_1$-to-W	DEP-μ	S-to-W
a. pá.ma			*!		*
b. pá:.ma		*!		*	
c. ☞ pám.ma				*	

The candidate in (a), which does not undergo any quantity adjustment, is eliminated by its fatal violation of S$_1$-to-W, since it fails to make the primary stressed syllable heavy. Candidate (b), which satisfies S$_1$-to-W by lengthening the vowel of the primary stressed syllable, is eliminated by its violation of *VV. This allows candidate (c) to win, since it makes the stressed syllable heavy via gemination, violating only low-ranking DEP-μ.

(28) No gemination following secondary stressed syllable

/kula:n/	MAX-μ	*VV	S$_1$-to-W	DEP-μ	S-to-W
a. kù.lán	*!		*		*
b. ☞ kù.lá:n		*			*
c. kùl̩.lá:n		*		*	

To ensure that an input long vowel will not be shortened, as in candidate (a), MAX-μ must outrank *VV. Candidates (b) and (c) both preserve the input vowel length and so tie with respect to *VV. The decision is passed down to the lower ranked constraints, which select candidate (b) with no gemination in the secondary stressed syllable as the optimal output, even though this results in a violation of S-to-W.

3.4 Unattested pattern of lengthening

So far, I have discussed three patterns of stressed syllable lengthening: 1) languages, such as St. Lawrence Island Yupik and Chimalapa Zoque, that lengthen all stressed vowels; 2) languages, such as Anguthimri, that do not lengthen any stressed vowels; and 3) languages, such as Wargamay and Kuuku-Yaʔu, that lengthen primary stressed syllables, but not secondary stressed syllables. The fourth logically possible stress pattern, the converse or complementary pattern of Wargamay and Kuuku-Yaʔu in which vowels lengthen in secondary stressed syllables only, is unattested. This fact finds an explanation in OT; it falls out from the nature of the stringency relation of the stress constraints, as shown in the tableau in (29).

(29) Unattested pattern of lengthening in secondary stressed syllables only

/cvcvcvcv/	S_1-to-W	DEP-μ	S-to-W
a. cv́ːcvcv̀ːcv		**	
b. cv́cvcv̀cv	*		**
c. cv́ːcvcv̀cv		*	*
d. ☠ cv́cvcv̀ːcv	*	*	*

There is no ranking of these constraints that will yield (d), with lengthening in secondary stressed syllables only, as the optimal candidate (as indicated by the '☠'). This is because candidate (d) has a proper superset of the violations that the complementary candidate in (c) has, with lengthening in primary but not secondary stressed syllables. In other words, candidate (c) *harmonically bounds* candidate (d) and will always fare better

with respect to the constraint hierarchy, no matter what the ranking. As a result, a language with this pattern is predicted to be unattested.

However, there is a language that has been described as having precisely this pattern, with lengthening in secondary stressed syllables but not in a primary stressed syllable. In the next section, I discuss this language and explain why it is not a true counterexample to the predictions made by the stringency constraints.

3.4.1 Apparent counterexample: Hixkaryana

Hixkaryana is a Cariban language spoken in northern Brazil. This language is described by Derbyshire (1985) and has been analyzed within metrical stress theory by Buckley (1998) and Hayes (1995), and within OT by Halle & Idsardi (2000), Kager (1999), and van de Vijver (1998). Secondary stress is quantity sensitive, falling on all closed syllables and on even-numbered non-final syllables in a string of consecutive light syllables. Word-final closed syllables do not occur, except as the result of an apocope rule in certain suffixes and particles. While there is no phonemic vowel length distinction, the language does exhibit stressed vowel lengthening, whereby stressed short vowels in open syllables become long. The secondary stress facts are illustrated in (30) below, taken from Derbyshire (1985).

(30) Hixkaryana secondary stress pattern
    a. toròːno   'small bird'
    b. àkmatàːrɨ   'branch'
    c. nemòːkotòːno   'it fell'
    d. tòhkurʲèːhonàːhaʃàːha   'finally to Tohkurye'
    e. jonɨ̀ːkonɨ̀jmòrmahàːtɨ   'he was still eating'

Within a metrical framework, this pattern can be accounted for by assigning iambic feet from left to right. A rule of iambic lengthening accounts for the pattern of long vowels in stressed open syllables.

An unusual characteristic of Hixkaryana is the assignment of primary stress. While Derbyshire (1985:181) asserts rather straightforwardly that "there is a primary stress on (phonological) word-final syllables," he claims that its position is dependent upon the intonation pattern rather than metrical structure. Roughly, it coincides with high or falling pitch.[12]

Besides its assignment, another interesting characteristic of primary stress in this language is that unlike vowels in secondary stressed syllables, a vowel bearing primary stress in a final open syllable does not undergo iambic lengthening. Examples are given in (31).

(31)   No lengthening of vowel in primary stressed syllable

    a. atʃòːwowó   'wind'

    b. tòhkurʲèːhoná   'to Tohkurye'

    c. mànhonó   'he danced'

    d. uhùtʃhurú   'his skin'

As these data show, the process of iambic lengthening applies in open syllables with secondary stress only, and not in a final primary stressed syllable. This pattern is unexpected, given the nature of the stringency relationship of the primary-stress-specific constraint S_1-to-W and the general S-to-W constraint. A tableau demonstrating the failure of constraints in a stringency relation to achieve this pattern is given in (32).

(32)   No ranking yields lengthening in secondary stressed syllables only

/atʃowowo/	S_1-to-W	DEP-μ	S-to-W
a. (atʃò)(wowó)	*		**
b. (atʃòː)(wowóː)		**	
c. (atʃò)(wowóː)		*	*
d. ☞ (atʃòː)(wowó)	*	*	*

As this tableau shows, there is no ranking of these constraints that will yield the intended winner in (d), with lengthening in the secondary stressed syllable but not in the primary stressed syllable, as the optimal candidate. It is harmonically bounded by candidate (c) with lengthening in the primary stressed syllable only since it has a proper superset of candidate (c)'s violation marks. How, then, can such an asymmetry be accounted for without contradicting the claims made in throughout this thesis about the nature of the stringency relation of the stress constraints?

I argue that while the Hixkaryana pattern does exhibit an asymmetry in the behavior of the primary and secondary stressed syllables, it does not represent a *true* asymmetry of the types discussed throughout this thesis (e.g., in §2.3, §3.3, §4.2.1, §4.3.2). Instead, I argue that the pattern exhibits only an *apparent* asymmetry that results from the demand to satisfy a high-ranking constraint banning final long vowels. That the domain of such a ban happens to be the same as that for primary stress assignment in Hixkaryana is coincidental.

3.4.1.1 A metrical analysis

The Hixkaryana stress pattern can be derived by assigning quantity-sensitive iambic feet iteratively from left to right. Degenerate monomoraic feet are disallowed. A

rule of iambic lengthening lengthens stresses vowels in open syllables. The metrical stress analyses of Hayes (1995) and Buckley (1998) both account for the lack of final lengthening in Hixkaryana by employing a rule of final extrametricality. This rule is responsible for preventing final syllables from receiving metrical prominence and thus, length. They cite as support for this claim the fact that disyllabic words of the shape CVCV undergo lengthening of the vowel in the initial syllable, as opposed to the final syllable as might be expected.

(33) Lengthening of first vowel in disyllabic words

    a. /kwaya/   →   kwaːya   'red and green macaw'

    b. /kiri/   →   kiːri   'male'

    c. /kana/   →   kaːna   'fish'

    d. /foru/   →   foːru   'plaintain'

It is notable that no lengthening occurs in disyllabic words when the first syllable contains a closed syllable.

(34) Initial closed syllable in disyllabic words

    a. kyakwe   'white-throated toucan'

    b. fotwo   'species of banana'

    c. arko   'take it'

    d. nahko   'he was'

Hayes (1995:206) argues that the words in (33) undergo lengthening of the vowel in the first syllable in order to meet the minimal word requirement. He notes that since there are no monosyllabic content words in Hixkaryana, there must be a minimal word requirement that demands that words be minimally bimoraic. Therefore, in CVCV words, if the final syllable is extrametrical and does not contribute to the final mora count, the

remaining initial light syllable must lengthen in order to meet the minimal size restriction, or else it will constitute an ill-formed monomoraic degenerate foot. The data in (34), on the other hand, have closed initial syllables. Since closed syllables are heavy in this language, the minimal word requirement is met and no lengthening needs to take place.

3.4.1.2 Prohibition against final long vowels

While the analysis summarized in the previous section is able to account for the lack of final lengthening in Hixkaryana, it is language-specific. However, both Hayes (1995) and Buckley (1998) recognize that the failure to lengthen a vowel in the final syllable is not unique to Hixkaryana. According to Hayes, "a mysterious property of iambic lengthening rules is their tendency not to apply to syllables in word-final position…. If the avoidance of final iambic lengthening is truly general, it deserves general explanation" (1995:269).[13]

Buckley (1998) furthermore demonstrates that such a ban on final long vowels is not a fact about the iambic lengthening rule itself, but rather the result of a general cross-linguistic tendency, independent of whether iambic lengthening or even iambic footing exists in the language.

For example, Italian (Buckley 1998; Nagy & Napoli 1996) is a trochaic language that has no underlying vowel length distinction. However, it does exhibit vowel lengthening in primary stressed syllables (see §3.3 for a discussion). When the primary stressed syllable is word-initial or -medial, the vowel lengthens. However, no lengthening occurs in stressed final vowels.

(35) Italian

   a. Lengthening of stressed vowel in word-initial and -medial position

     eco   [ɛ́ːko]   'echo'

     papa   [páːpa]   'pope'

     capitano [kàpitáːno]   'captain'

   b. No lengthening in word-final vowels

     papà   [papá]   'father'

     così   [kozí]   'thus'

     cafè   [kaffé]   'coffee'

The pressure for primary stressed syllables to be heavy can only be realized word-finally by geminating the initial consonant of the following word via a process called *radoppiamento sintattico*.

(36) Gemination after a word-final stressed vowel

     così buono   [kozíbbwɔ́ːno]   'so good'

     caffè nero   [kafféénɛ́ːro]   'black coffee'

Thus, because of a general restriction against word-final long vowels in Italian, a final stressed vowel must become bimoraic through gemination of a following consonant rather than via vowel lengthening.

Buckley (1998) also cites Luganda as an example of a language that prohibits final long vowels. Luganda is a tone language that, along with other Bantu languages, has a process of glide formation whereby a high vowel becomes a glide before another vowel. This process causes the following vowel to undergo compensatory lengthening. However, when this sequence is word-final, lengthening does not accompany the glide formation.

(37) Luganda

   a. Glide formation and compensatory lengthening

     /ku-kial-a/ → [kukyaːla]   'to visit'

     /ku-kuek-a/ → [kukweːka]   'to hide'

     /mu-ana/   → [mwaːna]   'child'

   b. No lengthening in word-final vowels

     /ku-li-a/   → [kulya]   'to eat'

     /ku-gu-a/   → [kugwa]   'to fall'

     /mu-mo-i/ → [mumwi]   'barber'

That the vowels do not lengthen by virtue of being in final position is evident when these words are followed by a clitic. When the same morphemes in (b) above are followed by a clitic, the vowel is no longer word-final and lengthening is allowed to take place.

(38) Lengthening before a clitic

     /ku-li-a=ki/ → [kulyaːki]   'to eat what?'

     /ku-gu-a=ko/ → [kugwaːko]   'to fall on (top of)'

     /mu-mo-i=ki/ → [mumwiːki] 'which barber?'

As in Italian, a general prohibition against word-final long vowels in Luganda blocks the lengthening process from applying.

Finally, Buckley (1998) gives an example of a language that shortens certain underlying long vowels in word-final position. Kashaya has an underlying vowel length distinction. Underlying long vowels are allowed to surface in word-final position when they contrast with short vowels, as seen in the following (near) minimal pairs.

(39) Kashaya vowel length contrast preserved word-finally

    a. [ʔihyaː]   'bone, strong'

       [ʔihya]   'wind'

    b. [haduː]   'different, other'

       [hayu]   'dog'

However, derived final long vowels undergo a process of shortening. For example, in some verbs, the second of two vowels in a sequence deletes. If the second vowel is word-final and the first vowel is underlyingly long, the vowel shortens.

(40) Vowel deletion and shortening

    a. /du-k'iː-i/ →   duk'iː →   duk'i 'scratch it with your fingernail'

    b. /q'aː-i/   →   q'aː   →   q'a   'leave him/her'

    c. /hi-s'aː-i/ →   his'aː →   his'a 'break!'

This is an example of a *grandfather effect*, as discussed by McCarthy (2002b). While Kashaya generally prohibits final long vowels, pre-existing final long vowels (i.e., underlying long vowels in nonderived environments) are saved from shortening; that is, they are grandfathered. However, new instances of final long vowels are prohibited, so final long vowels derived by some other process undergo shortening.

These examples from Italian, Luganda, and Kashaya are intended to demonstrate that the failure to lengthen final stressed vowels in Hixkaryana is not unique to the language, nor even to languages with iambic lengthening in general. As such, they lend support to positing a constraint banning word-final long vowels, *VV#.[14] It is the high-ranking of this constraint in Hixkaryana that is responsible for the fact that final vowels do not lengthen; their failure to lengthen has nothing to do with the fact that they bear primary stress while the vowels that do lengthen bear secondary stress.

As a result, an OT analysis of the Hixkaryana pattern will not run afoul of the central claim stated throughout this thesis that primary-stress-related constraints ranked in a stringency relation with a general stress constraint will only generate patterns of asymmetry whereby a process (such as vowel lengthening) occurs in primary stressed syllables to the exclusion of secondary stressed syllables. The constraint responsible for stressed vowel lengthening in the languages discussed in this chapter, S-to-W, is relevant in Hixkaryana but remains unexploded. Most importantly, it is dominated by *VV#, as demonstrated in the following tableau.

(41) No final lengthening in word-final vowels

/atʃowowo/	*VV#	S-to-W	Dᴇᴘ-μ
a. (atʃòː)(wowóː)	*!		**
b. ☞ (atʃòː)(wowó)		*	*

Candidate (a) with iambic lengthening in both stressed syllables fully satisfies the S-to-W constraint, but in doing so it violates the high-ranking *VV# constraint, since the final primary stressed syllable is long. This allows candidate (b), with lengthening in the secondary stressed syllable only, to win.

As a final note, it is worth returning to a point made by Hayes (1995) that was discussed in §3.4.1.1. Hayes notes that Hixkaryana has a bimoraic word minimum, a claim he supports by noting the lack of monosyllabic content words. He points out that while monosyllabic CVC words would fulfill the word minimum, there are no words that end in a consonant underlyingly. As a result, the smallest words in Hixkaryana are at least two syllables. However, derived CVC words that result from apocope do exist in the

language (e.g., /hati/ → [hat] 'hearsay', /hami/ → [ham] 'deduction'). This is not too surprising, given that they do meet the minimal word requirement by being bimoraic.

However, since vowel lengthening is a process that is widespread in the language, it is not readily apparent why this strategy is not available for meeting the minimal word requirement in open monosyllables. One might argue, from a derivational perspective, that extrametricality would render an open monosyllable unstressable, since it is the only syllable in the word and thus must be extrametrical. However, the theory of extrametricality that Hayes proposes does not allow for extrametricality to exhaust the entire domain of the stress rules (Hayes 1995:58). Thus, extrametricality is revoked in monosyllabic words so as to allow the word to be stressable. As a result, in a derivational account with extrametricality, it is not easily explained why vowel lengthening is not an option for meeting the word minimum in an open monosyllable. In the OT analysis presented here, on the other hand, the reason is clear. If *VV# is undominated, outranking a constraint demanding that every word must have a stress (i.e., LxWD≈PRWD; Prince & Smolensky 1993/2002), then the null parse candidate will win over a monosyllable with a lengthened vowel.

3.5   Conclusion

In this chapter, I have proposed a primary-stress-specific version of the STRESS-TO-WEIGHT constraint, which stands in a stringency relation with a general version of this constraint. Both of these constraints are necessary to account for languages in which primary and secondary stressed syllables behave asymmetrically with respect to a process of stressed syllable lengthening.

A table summarizing the general schema for the various patterns of stressed syllable lengthening is given in (42).

(42)   Factorial typology of stressed vowel lengthening

Ranking	Context for stressed σ lengthening	Example
a. S_1-to-W, S-to-W >> DEP-μ	Both primary and secondary	Chimalapa Zoque (§3.2.2)
b. DEP-μ >> S_1-to-W, S-to-W	Neither primary nor secondary	Anguthimri (§3.2.3)
c. S_1-to-W >> DEP-μ >> S-to-W	Primary but not secondary	Wargamay (§3.3.1), Kuuku-Yaʔu (§3.3.2)
d. None	Secondary but not primary	Unattested

In both St. Lawrence Island Yupik, an iambic language, and Chimalapa Zoque, a trochaic language, vowel lengthening occurs in both primary and secondary stressed syllables. While patterns of iambic lengthening can be shown to result from a constraint requiring well-formed iambic feet which is ranked above a faithfulness constraint banning mora epenthesis (e.g., FTHARM >> DEP-μ), this ranking cannot account for patterns of trochaic lengthening, since lengthening in the stressed syllable of a trochaic foot does not improve foot structure. Instead, trochaic lengthening in all stressed syllables results from the ranking of both versions of STRESS-TO-WEIGHT, which requires that stressed syllables be heavy, above the faithfulness constraint DEP-μ.

In Anguthimri, neither primary nor secondary stressed syllables undergo vowel lengthening. This results from ranking the faithfulness constraint DEP-μ above both of the STRESS-TO-WEIGHT constraints.

In Wargamay and Kuuku-Yaʔu, it was shown that while primary stressed syllables are subject to lengthening processes, secondary stressed syllables are not. This asymmetrical pattern can be accounted for by ranking the faithfulness constraint DEP-μ intermediately between the primary-stress-specific and the general STRESS-TO-WEIGHT constraints.

Finally, it was demonstrated that no ranking of the primary-stress-specific STRESS-TO-WEIGHT constraint, the general STRESS-TO-WEIGHT constraint, and DEP-μ will yield a language with lengthening in secondary stressed syllables but not in primary stressed syllables. A language with this pattern, Hixkaryana, was shown not to be a true counterexample to this claim. The fact that vowels bearing primary stress in the final syllable in Hixkaryana do not lengthen has nothing to do with the fact that they bear primary stress (as opposed to a secondary stress), but rather with the fact that they are in final position. The apparent asymmetry results from an independently motivated constraint that targets final long vowels, independent of the type of stress they bear.

[1] Hayes (1995:84) suggests that another strategy that iambic languages may use to satisfy the I/T Law, besides stressed vowel lengthening, is unstressed vowel reduction. Again, such reduction increases the durational contrast of the foot. However, as pointed out by Kager (1993) and Revithiadou & van de Vijver (1996), many trochaic languages also exhibit unstressed vowel reduction, something that is not predicted by the I/T Law.

[2] The data given here are from the younger generation of speakers of St. Lawrence Island Yupik. A discussion of the facts of the older generation is given in §3.3.2.4.

[3] Baković modifies Grouping Harmony so that it evaluates only disyllabic feet, thereby removing a monosyllabic heavy foot (H) from its evaluation.

[4] According to Knudson (1975:291), in primary or secondary stressed syllables closed by a glottal stop preceding a single consonant (other than a glottal stop) and a following vowel, the stressed vowel is rearticulated after the glottal stop, e.g., [kíʔim-iʔ] 'climb (imperative)' (cf. [kíʔm-pa] 'climb (incompletive)'). This creates a surface exception to the regular penultimate primary stress pattern, since stress is on the antepenult. I do not discuss this pattern here.

[5] See however Chung (1983), who says that lengthening in Chamorro occurs only in penultimate syllables bearing primary stress.

[6] See Nagy & Napoli (1996:219) for a similar constraint in their analysis of Italian, which they call HEAVY SYLLABLE.

[7] I abstract away from the issue of how to represent the moraic structure of underlying long vs. half-lengthened vowels. Hayes (1995:211) suggests that in Choctaw and

Chickasaw, which also have lengthened vowels that fall short of the length of underlying long vowels, the underlying contrast of one vs. two moras may be realized on the surface as two vs. three.

[8] While Modern Greek is a lexical accent system, it exhibits a default trochaic pattern.

Though Arvaniti (1991) calls into question the status of rhythmic secondary stress in Modern Greek, she does say that syllables that are analyzed as having rhythmic secondary stresses are more prominent than unstressed syllables because they have a higher amplitude integral.

[9] See however Prince (1990) and D'Imperio & Rosenthall (1999) who say that phonological lengthening of primary stressed syllables in Italian is positionally restricted to the penultimate syllable. However, a final primary stressed syllable does undergo lengthening via gemination of the following word-initial consonant, rather than vowel lengthening, in a process known as *radoppiamento sintattico*. See §3.4.1.2 for additional discussion.

[10] These facts also complicate matters for the OT analysis of the default-to-opposite stress pattern, which I do not present here. The constraints introduced in §2.3.2 for the analysis of Khalkha Mongolian, which exhibits a similar default-to-opposite stress pattern (with nonfinality), are unable to account for the Kuuku-Yaʔu pattern. Recall from that section that to account for default-to-opposite stress, ALIGNL($\acute{\sigma}_\mu$, PWd), which orients a light stressed syllable toward the left edge, must be ranked above ALIGNR($\acute{\sigma}$, PWd), which aligns a (primary) stressed syllable at the right edge. However, in Kuuku-Yaʔu, an initial syllable bearing default primary stress is always heavy, either due to gemination or, if it

is closed, due to WEIGHT-BY-POSITION. Because ALIGNL($\acute{\sigma}_\mu$, PWd) would not be relevant for evaluating such words (since the stressed syllable is heavy, not light), ALIGNR($\acute{\sigma}$, PWd) would select a candidate with stress on the rightmost syllable, contrary to fact. To account for the Kuuku-Yaʔu pattern, it is necessary for the right-alignment constraint to refer only to primary stressed syllables containing long vowels, not closed syllables. This provides support for the claim made by de Lacy (1997) in his analysis of Kara that alignment constraints "must refer to syllable weight categories, not simply to 'stressed syllables', or 'mono-moraic stressed syllables'" (150). See also Gordon (to appear) for another argument in favor of reconsidering the Zoll (1997) alignment constraints in default-to-opposite stress systems.

[11] Rosenthall & van der Hulst (1999:502) refer to this constraint as *APPEND(to-σ): 'No nonmoraic syllable appendix'. I use the more conventional WEIGHT-BY-POSITION instead, as this is the term used by Hayes (1989) for the principle that assigns moras to coda consonants.

[12] In four out of the five intonation contours listed by Derbyshire (1985:182), primary stress falls on the last syllable of the word; in the other instance (i.e., interrogatives), it falls on the penult.

[13] Other examples of iambic languages that ban final lengthening include Choctaw and Chickasaw (Lombardi & McCarthy 1991; Munro & Ulrich 1984), Surinam Carib (Buckley 1998), and Yupik (Baković 1997).

[14] See Morén (1999) and Baković (1997) for use of a similar constraint in their accounts of Italian and Yupik, respectively.

CHAPTER 4:

VOWEL SONORITY

4.1   Introduction

Sonority plays a major role in determining which segments are optimal for filling the structural slots of the syllable: the more sonorous a segment is, the more harmonic it is as a syllable nucleus or *peak*; the less sonorous it is, the better it is as a syllable onset or *margin*. To capture this relationship between sonority and syllable structure within Optimality Theory, Prince & Smolensky (1993/2002) propose a set of constraints called the Peak and Margin Hierarchies which are responsible for generating the set of acceptable nuclei and onsets within a language.

(1)   The Peak and Margin Hierarchies (Prince & Smolensky 1993/2002:147-148)
    a. Peak Hierarchy: *P/t >> *P/n >> … >> *P/i >> *P/a
    b. Margin Hierarchy: *M/a >> *M/i >> … >> *M/n >> *M/t

> P = peak, M = margin, t = obstruent, n = nasal, i = high vowel/glide, a = low vowel

These hierarchies are generated through the *harmonic alignment* of two prominence scales. The Syllable Position prominence scale is based on the relative markedness of syllabic constituents. A syllable peak (nucleus) is more prominent than a syllable margin (onset or coda), which yields the scale Peak > Margin (where '>' reads 'is more prominent than'). The Segmental Sonority prominence scale is based on the

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inherent prominence of a segment given its relative sonority. A low vowel is more prominent than a high vowel, which is more prominent than a liquid, etc., leading to the least prominent obstruent, as represented by the following: low vowel > high vowel/glide > liquid > … > obstruent. These two scales are combined via harmonic alignment, which associates the more prominent syllable position (the peak) with the most prominent segments (vowels) and the less prominent syllable position (the margin) with the least prominent segments (obstruents), to yield the corresponding Peak and Margin Hierarchies. For example, in the Peak Hierarchy, markedness constraints banning low sonority segments from the peak (e.g., *P/t) are ranked highest, and those banning high sonority segments from the peak (e.g., *P/a) are ranked lowest. This ensures that high sonority segments are the most optimal as syllable peaks.

Sonority does not just play a role in determining the optimal peaks of syllables in general; it can also be key to determining the optimal peaks of stressed syllables. In some languages, it is the relative sonority of the vowels or nuclei in the word that determines whether or not a particular syllable will attract (or repel) stress. To account for such languages, researchers such as Kenstowicz (1994), de Lacy (1997, 2000, 2002a), and Smith (2002) have adapted the Peak Hierarchy to refer specifically to stressed syllables. For instance, while Prince & Smolensky (1993/2002) combine the sonority prominence scale with the syllable position prominence scale to derive the Peak Hierarchy, Kenstowicz (1994) combines the sonority scale with a foot prominence scale, which says that the peak or head of a foot (a stressed syllable) is more prominent than the margin of a foot (an unstressed syllable): Foot-peak > Foot-margin. The result is the Peak and Margin Prominence Hierarchies given in (2).

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(2)   Peak and Margin Prominence Hierarchies (Kenstowicz 1994:3)

    a. Peak Prominence Hierarchy: *P/ə́ >> *P/í >> *P/é >> *P/á

    b. Margin Prominence Hierarchy: *M/ă >> *M/ĕ >> *M/ĭ >> *M/ə̆

ə = central vowel, i = high peripheral vowel, e = mid peripheral vowel, a = low vowel

According to these hierarchies, more sonorous vowels are preferred as foot peaks (i.e., stress bearers) over less sonorous vowels, and less sonorous vowels are preferred as foot margins (i.e., unstressed syllables) over more sonorous vowels. The distinctions in the sonority scale for vowels most often reflect two dimensions: height and peripherality. Regarding peripherality, central vowels are less sonorous and thus less preferred as foot peaks than peripheral vowels.[1] On the height dimension, lower vowels are more sonorous and thus more preferred as foot peaks than higher vowels.

As with the Peak and Margin Hierarchies in (1) above, the constraints in the prominence hierarchies reflect the encapsulation of individual segments into classes of segments that refer to ranges of sonority (Prince & Smolensky 1993/2002:141). Which sonority distinctions are collapsed and which must be more fine-grained differs from language to language and these differences are incorporated into the constraint hierarchy. Ultimately, the sonority distinctions that a language makes will depend upon how the language interleaves other constraints (such as faithfulness or alignment constraints) into the hierarchy.

When sonority does play a role in stress assignment, a language may do one of two things: either stress placement will be determined by the relative sonority of the syllable nuclei (which will be referred to as *sonority-driven stress*), or the nucleus of a stressed syllable will change to become higher in sonority (i.e., *stress-driven sonority*). In the remainder of this section, I present languages that exhibit each of these patterns. In

§4.1.1, I discuss Mokshan Mordwin, a language with sonority-driven stress. In §4.1.2, I present data from Old Church Slavonic, which exhibits stress-driven sonority. These examples are intended to demonstrate how the general Peak Prominence Hierarchy interacts with stress placement constraints and faithfulness constraints to yield general patterns of sonority-sensitive stress in languages with only one stress per word.[2] A reader familiar with the workings of the Peak Prominence Hierarchy may wish to skip these two subsections. In §4.1.3, I provide an interim summary and lay out the organization of the remainder of the chapter.

4.1.1 Mokshan Mordwin

Kenstowicz (1994) discusses various languages with sonority-driven stress. In each case, stress placement is determined or driven by the sonority of the syllable nuclei. For example, in the Mokshan dialect of Mordwin (Tsygankin & Debaev 1975), a Finno-Ugric language, vowels are divided into two classes: the high and central vowels [i, u, ə] (referred to as 'narrow' vowels) and the non-high vowels [e, o, æ, a] (or 'broad' vowels). In words containing only narrow vowels (3a) or only broad vowels (3b), stress falls on the initial syllable. However, stress is never assigned to a narrow vowel if there is a broad vowel elsewhere in the word. If a word contains both broad and narrow vowels (3c), stress falls on the leftmost broad vowel. (In these data, C' = a palatalized consonant.)

(3)   Mokshan Mordwin

   a. Words containing only narrow vowels [i, u, ə]

      púvəndəms   'to press'   pǻs't'ərdəms   'to roll'

      kíz'əfnəms   'to ask'   kúlit'i   'in that ash'

   b. Words containing only broad vowels [e, o, æ, a]

      s'ǽr'æd'an   'I ache'   rǽmasak   'you buy it'

      kél'askæ   'fox'   nóldasak   'you release it'

   c. Words containing broad and narrow vowels

      sáʃəndat   'you arrive'   tuʃəndát   'you go away'

      tərgádat   'you fight'   tuc'ǽnæ   'cloud'

As these data illustrate, stress strives to be as far to the left as possible but will move away from the left edge of the word to avoid stressing a high or central vowel. The OT analysis presented here is adapted from Kenstowicz (1994:4-7) and Smith (2002:94-95).[3] To account for left-alignment of stress in an unbounded system, it is necessary to appeal to the constraint ALIGNLσ, which demands that the left edge of every word begin with a stressed syllable. However, since stress moves away from the left edge when possible to avoid falling on a high or central vowel, this constraint must be dominated by the markedness constraints banning stressed central and high vowels. Since this language makes no distinction between these two types of vowels, treating them as being equally sonorant, I follow Kenstowicz (1994:6) in allowing for the possibility that these two constraints can be collapsed or encapsulated into one constraint that bans either central or high vowels from a stressed syllable.[4]

(4)   Stress avoids falling on a high or central vowel

/tərgadat/	*P/ǯ,í	ALIGNLσ
a. tǻrgadat	*!	
b. ☞ tərgádat		*
c. tərgadát		**!

As this tableau demonstrates, stress falls as close to the left edge as possible without falling on a high or central vowel. Candidate (a) is eliminated by the high ranked constraint banning stressed schwa, even though it fully satisfies alignment by stressing the initial syllable. Of the remaining two candidates, candidate (b), with stress on the second syllable, wins out over candidate (c) with final stress because it fares better with respect to ALIGNLσ.

When there are no high or central vowels in the word, the initial syllable is stressed, even if there is a more sonorous vowel to the right (e.g., [nóldasak] 'you release it'). This means that ALIGNLσ is ranked above both *P/é and *P/á, the constraints that ban mid and low vowels, respectively, from stressed syllables.

(5)   In a word with no central or peripheral vowels, stress is leftmost

/noldasak/	*P/ǯ,í	ALIGNLσ	*P/é	*P/á
a. ☞ nóldasak			*	
b. noldásak		*!		*
c. noldasák		*!*		*

This tableau demonstrates that mid and low vowels are treated as equally sonorous in this language. Since there are no high or central vowels in the word, none of the candidates violates the highest ranked constraint. The alignment constraint then

makes the decision, selecting candidate (a) as the winner, since it fully satisfies the constraint by stressing the initial syllable. Even though *P/é outranks *P/á, because both of these constraints are ranked below the stress placement constraint, stress does not move away from the mid vowel at the left edge to fall on a more sonorous low vowel to its right.

Despite the fact that *P/ɔ́,í is high ranking, it is not the case that central or high vowels never get stressed. In words with only narrow vowels, violation of *P/ɔ́,í is inevitable. One option to avoid violation of *P/ɔ́,í would be to alter one of the vowels to make it more sonorous. However, this strategy is not employed in Mokshan Mordwin. This means that a faithfulness constraint prohibiting vowel feature changes (which I simply call FAITH) must be ranked above *P/ɔ́,í.

(6)   High-ranked FAITH prevents vowel changes

/kulit'i/	FAITH	*P/ɔ́,í	ALIGNLσ́
a. kólit'i	*!		
b. ☞ kúlit'i		*	
c. kulít'i		*	*!
d. kulit'í		*	*!*

High-ranked faithfulness rules out candidate (a) in which an input high vowel is realized in the output as a more sonorous mid vowel. Each of the remaining candidates violates *P/ɔ́,í once. Alignment breaks the tie, selecting the candidate in (b), with initial stress, as the optimal form.

While stress in Mokshan Mordwin is sonority-driven, there are languages in which sonority is stress-driven. That is, low-sonority stressed vowels change to become more sonorous. In such languages, the stress placement constraints are ranked above the Peak Prominence markedness constraints which, in turn, are ranked above faithfulness. In the next section, I discuss an example of a language with stress-driven sonority, Old Church Slavonic.

4.1.2   Old Church Slavonic

Zec (2003) presents data from Old Church Slavonic (OCS), the language preserved in the earliest Slavic written documents between the 9th and 11th centuries. As in Mordwin, OCS prohibits certain types of vowels from occurring in stressed syllables, namely, the class of vowels called jers. The following is a list of the vowels of OCS (vowels in boldface are historically long).

(7)   OCS vowels[5]
     i I **ɨ** U **u**   high   jers: [-tense]
     ę e   o ǫ   non-high
     ě   **a**

The jer vowels are the high lax vowels [I U], which differ from all of the other OCS vowels by being [-tense]. According to Zec (2003:131), citing Isačenko (1970), these two vowels exhibited a particular pattern of lowering called Havlík's Law.

(8)   Havlík's Law
     a.   Word-final jers and jers in syllables followed by vowels other than jers
           become weak
     b.   Jers in syllables followed by a weak jer become strong
     c.   Strong jers *I* and *U* merge with *e* and *o* respectively

According to this law, jers in strong positions lower to mid vowels, while those in weak positions remain unchanged. What should be noted is that strong jers are always followed immediately by another jer, suggesting that this process is foot-related.

Zec provides the following data to illustrate the alternations described in Havlík's Law.

(9)   Words containing jers in OCS[6]

    a. Non-alternating forms

        i) /cvcU/

          /stolU/ → [stolU] 'throne (nom.)'

        ii) /cUcvcv/

          /vUzglasi/ → [vUzglasi] 'announce'

        iii) /cvcvcU/

          /bolitU/ → [bolitU] 'ache (3p.sg.pres.)'

        iv) /cUcvcU/

          /mUnogU/ → [mUnogU] 'many'

    b. Alternating forms

        i) /cUcU/

          /sUnU/ → [sonU] 'dream (nom.)'

          /dInI/ → [denI] 'day (nom.sg.)'

        ii) /cvcUcU/

          /otIcI/ → [otecI] 'father (nom.sg.)'

          /rabUtU → [rabotU] 'this slave'

        iii) /cUcUcU/

          /sUnInU → [sUnenU] 'of sleep (nom.sg.m.adj.)'

          /tImInU/ → [tImenU] 'dark (nom.sg.m)'

Havlík's Law states that only strong jers (which are immediately followed by another jer) are subject to lowering. Thus, the forms in (9a) do not alternate because they do not contain consecutive jer vowels. Zec concludes that because it is the first of two consecutive jer vowels that lowers in the alternating forms in (9b.i), OCS has trochaic feet; it is the head of the foot bearing stress that is subject to lowering (thus, (cUcU) → (cvcU)). The forms in (9b.ii) and (9b.iii) indicate that the directionality of footing is right-to-left: they are footed as cv(cUcU) and cU(cUcU), respectively. If footing were from left-to-right, the forms in (9b.iii), for example, would be footed as *(cUcU)cU, which would yield *(cvcU)cU, with lowering in the first syllable, contrary to fact.

To account for this pattern of right-aligned trochaic footing, the following constraints are necessary.

(10)   Stress constraints

    TROCHEE: Feet must have initial prominence.

    FTBIN: Feet are binary under a syllabic or moraic analysis

    ALIGNFT-R: Align every foot with the right edge of the prosodic word.

The head of a foot may not coincide with a jer vowel. This is because stress in OCS, as in Mokshan Mordwin, is sensitive to sonority and the jers are the least sonorous vowels in OCS. However, unlike Mordwin, stress in OCS does not shift off of a jer to fall on a more sonorous vowel. Instead, a stressed jer undergoes lowering (and tensing). This means a constraint banning stressed lax vowels, which I will indicate as *P/Ú, must be ranked below the stress placement constraints and above faithfulness. The rest of the Peak Prominence Hierarchy referring to the tense vowels (*P/í >> *P/é >> *P/á) is ranked below FAITH.[7]

The following tableau demonstrates how these constraints interact to yield the OCS pattern of avoiding stressed jers through lowering. I assume that FTBIN and TROCHEE are undominated and leave them out of the tableau.

(11)   Stressed jer lowers to mid vowel

/cvcUcU/	ALIGNFT-R	*P/Ú	FAITH	*P/í	*P/e
a. (cv́cU)cU	*!				
b. cv(cÚcU)		*!			
c. cv(cúcU)			*	*!	
d. ☞ cv(cócU)			*		*

Candidate (a) avoids stressing a jer by shifting stress off of the default penult onto a non-jer in the antepenult. While this satisfies the peak prominence constraint, it fatally violates ALIGNFT-R. Candidate (b) is eliminated by *P/Ú for stressing a jer. Of the remaining two candidates, which both violate FAITH, candidate (d) with the stressed mid vowel is selected as the optimal form since it is more sonorous than a stressed high vowel.[8]

At least one example of a modern Slavic dialect exhibits a very similar pattern of high-to-mid vowel lowering. Crosswhite (1999), citing Rigler (1963), discusses the Zabiče dialect of Slovene, a South Slavic language which exhibits stress-driven sonority. Zabiče Slovene has the following (monomoraic) 7-vowel inventory in unstressed syllables: [i, ɨ, u, e, ə, o, a]. However, only four of these vowels may occur in stressed syllables: [e, ə, o, a]. That is, the high vowels [i, ɨ, u] are banned from occurring in stressed syllables. Unfortunately, Crosswhite does not provide any data from Zabiče Slovene that would demonstrate this phenomenon, saying this of her source: "Although Rigler does not provide dialectal forms illustrating the relevant neutralizations, he indicates that in this dialect etymological short accented high vowels are realized as mid vowels: /í, ɨ́/ > [é], /ú/ > [ó]" (Crosswhite 1999:47). This pattern is very similar to that

described above for OCS except that all of the high vowels are subject to lowering, not just a subset, and there is no tense-lax distinction. This means that the relevant high-ranking Peak Prominence constraint that dominates FAITH in Zabiče Slovene is *P/í, the constraint banning stressed high vowels.

4.1.3   Summary

These examples of sonority-driven stress (Mokshan Mordwin) and stress-driven sonority (Old Church Slavonic, Zabiče Slovene) are intended to show how the Peak Prominence Hierarchy can interact with faithfulness and stress placement constraints to yield stress systems that are sensitive to sonority in different ways. The general ranking schemata for these types of languages are given below.

(12)   Ranking schemata for sonority-stress interactions
    a.   Sonority-driven stress (e.g., Mokshan Mordwin)
            Faithfulness >> *Peak/x̂ >> Stress placement constraints >> *Peak/ŷ
    b.   Stress-driven sonority (e.g., Old Church Slavonic)
            Stress placement constraints >> *Peak/x̂ >> Faithfulness >> *Peak/ŷ

For sonority-driven stress systems, faithfulness is high ranking. The contents of the syllables themselves do not change. In order for a word to have the most harmonic stress pattern, it is the placement of stress that must change or shift to fall on the most harmonic syllable. That is, stress placement is determined (or driven) by the sonority of the vowels; to avoid falling on a syllable with (low-sonority) nucleus x, stress will shift away from its default position to fall on a more sonorous syllable with nucleus y.

For systems with stress-driven sonority, the stress placement constraints are high ranking while faithfulness is ranked low. Thus, stress is assigned to its default position. It is the contents of the stressed syllables that change in order to make the syllable more

harmonic for stress. That is, a stressed syllable with a low-sonority nucleus *x* will change to have a more sonorous nucleus *y*.

Most of the languages with sonority-stress interactions described in this section and in the literature have only one stress per word (other examples include Kobon, Chukchee, Aljutor, Northwest Mari – Kenstowicz 1994; Gujarati, Kiriwina, Harar Oromo – de Lacy 2002a). On this basis, some analyses claim that the Peak Prominence Hierarchy is relevant to any stressed syllable, even when the data only have primary stress. Others claim explicitly that it is only relevant to main-stressed syllables (e.g., de Lacy 2000). Still others make no claim about it either way.

In this chapter, I examine languages with sonority-sensitive stress systems that have both primary and secondary stresses. While in some of these examples, primary and secondary stresses behave identically or symmetrically with respect to sonority considerations, in other languages, these two types of stresses behave asymmetrically.

In §4.2, I present data from Chamorro, which has stress-driven sonority. Like Old Church Slavonic, this language exhibits stressed vowel lowering. However, primary and secondary stressed syllables can behave differently with respect to this process. While high vowels in primary-stressed syllables obligatorily undergo lowering, lowering in (rhythmic) secondary-stressed syllables is optional. It will be shown that these facts can be accounted for with a partial ordering of two constraints.

In §4.3, I examine languages with sonority-driven stress. First, in §4.3.1, I present data from Yimas. In this language, both primary and secondary stresses are shown to shift away from their default positions to fall on a more sonorous vowel. In §4.3.2, I discuss Asheninca, a language in which primary stress shifts to fall on a more sonorous vowel but

secondary stresses do not. Taken together, these cases demonstrate that it is not only necessary to have a general Peak Prominence Hierarchy that refers to all stressed syllables, but it is also necessary to have a Peak Prominence Hierarchy relativized to primary stressed syllables in particular. Only by appealing to both of these hierarchies is it possible to account for the full range of sonority-sensitive stress patterns exhibited by languages with multiple stresses.

I conclude the chapter in §4.4 with a summary.

4.2   Stress-driven sonority

4.2.1   Chamorro

Chamorro is an Austronesian language spoken in the Mariana Islands. The stress pattern of the Saipanese dialect of Chamorro is analyzed within a derivational framework by Chung (1983) and Halle & Vergnaud (1987), and within an OT framework by Crosswhite (1998) and Klein (1997). While stress assignment in Chamorro interacts with a number of phonological processes – including vowel lowering, vowel lengthening, gemination, and umlaut – the focus in this section is on the interaction between stress assignment and vowel lowering.

4.2.1.1 Vowel lowering and primary stress assignment

Primary stress in Chamorro falls almost exclusively on one of the last three syllables in the word, although the default pattern is on the penultimate. This indicates that footing is trochaic. Rhythmic secondary stresses are assigned from left to right, avoiding clash with the primary stress. Like Chimalapa Zoque discussed in §3.2.2, all

stressed vowels lengthen in open syllables, whether they bear primary or secondary stress. The only vowels that can occur in the main-stressed syllable of a word are [iː, uː, e, o] and the low vowels [a, aː, æ, æː]; that is, the short high vowels [i, u] may not occur in a syllable bearing primary stress. Consider the following data (taken from Crosswhite 1998), which show the distribution of mid and high vowels in words with only primary stress.

(13)　Chamorro

　　a.　Short mid vowels in stressed closed σ

　　　métgut　'strong'

　　　tsóʔgʷi　'fall'

　　b.　Long high vowels in stressed open σ

　　　píːsaw　'fishing line'

　　　úːtsan　'rain'

　　c.　Unstressed short high vowel in closed σ alternates with stressed mid vowel

　　　láːpis　'pencil'　　(cf. lapéssu 'my pencil')

　　　hugándu　'play'　　(cf. hùgandóŋŋa 'his playing')

　　　malǽːguʔ 'wanting'　(cf. màlægóʔmu 'your wanting')

As these data illustrate, mid and high vowels are in complementary distribution; mid vowels occur only in stressed closed syllables and high vowels occur elsewhere. The fact that (short) high vowels are banned from primary stressed syllables is reminiscent of the languages discussed in the previous section, particularly Old Church Slavonic and Zabiče Slovene. For this reason, Crosswhite (1998) appeals to the Peak Prominence Hierarchy introduced in §4.1. I summarize her analysis here.

First, to account for the fact that vowels lengthen in stressed open syllables, Crosswhite assumes high-ranking STRESS-TO-WEIGHT PRINCIPLE, or S-to-W (Prince

1990; see chapter 3 for a discussion of this constraint), and *TRIMORAIC, which bans trimoraic syllables, thereby preventing lengthening in closed syllables. Because it is only short high vowels that are banned from primary stressed syllables, Crosswhite incorporates a *P/V́ː into the Peak Prominence Hierarchy. As shown in (14), this constraint (which is actually an abbreviation for the set of ranked Peak Prominence constraints that refer specifically to long vowels, e.g., *P/íː >> *P/éː >> *P/áː) is ranked below *P/á, since long vowels are more sonorous than short vowels, regardless of quality. (Crosswhite assumes that the other constraints in the hierarchy, i.e., *P/í >> *P/é >> *P/á, refer only to short vowels.)

(14)　Peak Prominence Hierarchy for Chamorro
　　　*P/í >> *P/é >> *P/á >> *P/V́ː

When lengthening is not an option, namely in closed syllables, a non-low vowel (whether it is assumed to be mid or high underlyingly) will be realized as mid when it is stressed, rather than high. This is due to the ranking of the constraints in the Peak Prominence Hierarchy. The fact that these vowels do not become low in stressed syllables is due to the high ranking of the faithfulness constraint IDENT[low].[9]

(15)　Non-low vowel in stressed closed syllable is realized as mid

/mitgut/ or /metgut/	IDENT[low]	*TRIMORA	*P/í	*P/é	*P/á	*P/V́ː
a. ☞ métgut				*		
b.　mítgut			*!			
c.　míːtgut		*!				*
d.　mǽtgut	*!				*	

As this tableau demonstrates, regardless of whether a high vowel or a mid vowel is posited in the first syllable of the input (in conformance with Richness of the Base), it will be realized as a mid vowel in the output.[10] Lowering it all the way to a low vowel, as in (d), would violate IDENT[low] fatally. Lengthening the vowel as in (c) would best satisfy the Peak Prominence constraints, but this fatally violates *TRIMORAIC. Of the two remaining candidates, candidate (a), with a mid vowel in the initial stressed syllable, fares better than candidate (b) with respect to the Peak Prominence constraints and is thus selected as optimal.

In stressed open syllables, however, non-low vowels are realized as (long) high vowels, rather than as mid vowels (e.g., [píːsaw], *[péːsaw] 'fishing line'). The constraint ranking introduced so far, however, would predict *[péːsaw]. To rule out such forms, Crosswhite introduces an additional markedness constraint PERIPHERAL, which demands that vowels be peripheral. All mid vowels incur a violation of this constraint. By ranking this constraint below *P/í but above the *P/V́ː constraints, the correct forms are predicted, as demonstrated in (16).[11]

(16)   Non-low vowel in stressed open syllable is realized as high

/pesaw/	*P/í	PERIPHERAL	*P/íː	*P/éː
a. ☞ píːsaw			*	
b. péːsaw		*!		*
c. písaw	*!			

Again, regardless of what is posited for the non-low vowel in the initial syllable in the input, a word like that in (16) above will be realized with a long stressed high vowel in an open syllable. Candidate (c) with a short stressed high vowel fatally violates *P/í.

Candidate (b), which fares better than candidate (a) with respect to the Peak Prominence Hierarchy for long vowels, is nevertheless eliminated by it fatal violation of PERIPHERAL. This allows candidate (a), with the high vowel in the open syllable, to be chosen as the winner.

4.2.1.2 Vowel lowering and secondary stress assignment

Thus far, I have only discussed the pattern of vowel lowering in primary stressed syllables. As it turns out, vowel lowering in rhythmic secondary stressed syllables is optional.[12]

(17)   Optional vowel lowering in rhythmic secondary stressed syllables
    a.   tintáːguʔ   'messenger'
          tìntagóʔta ~ tèntagóʔta   'our messenger'
    b.   mundóŋgu   'cow's stomach'
          mùndoŋgóɲɲa ~ mòndoŋgóɲɲa 'his cow's stomach'

Because primary and secondary stressed syllables can behave differently with respect to the vowel lowering process, the Peak Prominence Hierarchy must be exploded into two different versions that apply at two different levels in the prosodic hierarchy; one operates at the level of the word and is specific to primary stressed syllables, and the other operates at the level of the foot and is relevant to stress in general (both primary and secondary). These hierarchies are given in (18).

(18)   Word-peak and Foot-peak Prominence Hierarchies
    a. Word-peak: $*P_{WD}/í \gg *P_{WD}/é \gg *P_{WD}/á \gg *P_{WD}/V́ː$
    b. Foot-peak: $*P_{FT}/í \gg *P_{FT}/é \gg *P_{FT}/á \gg *P_{FT}/V́ː$

The Word-peak Prominence Hierarchy in (a) is primary-stress specific: it prevents less sonorous vowels (i.e., the short high vowels [i u]) from occurring in primary stressed syllables (i.e., the peak or head of the word). This is the hierarchy that is responsible for the pattern of vowel lowering in primary stressed syllables discussed in §4.2.1.1. The Foot-peak Prominence Hierarchy is the more general version of this hierarchy. It prevents less sonorous vowels from occurring in either primary or secondary stressed syllables. This is because any syllable that is a word peak is necessarily a foot peak as well (but not vice versa). This means that these two hierarchies are in a stringency relationship (i.e., for every violation of a word-peak constraint, there will also be a violation of the corresponding foot-peak constraint), just like the other examples of stringent constraints discussed throughout this thesis.

Following Anttila (1997), Crosswhite accounts for the variability of vowel lowering in secondary stressed syllables through *partial ordering* of constraints, in which the constraints PERIPHERAL and *P_{FT}/í are crucially unranked with respect to one another. Partially ordered constraints generate multiple tableaux for a single grammar, one for each ranking that could be imposed on the tied constraints. This is shown in (19).

(19)   Optional vowel lowering in secondary stressed syllables due to partial ordering

/tintaguʔta/	*P_{WD}/í	PERIPHERAL	*P_{FT}/í
a. ☞ (tìnta)(góʔta)		*	*
b. (tènta)(góʔta)		**!	

/tintaguʔta/	*P_{WD}/í	*P_{FT}/í	PERIPHERAL
a. (tìnta)(góʔta)		*!	*
b. ☞ (tènta)(góʔta)			**

In these tableaux, all of the candidates in consideration obligatorily lower the vowel in the primary stressed syllable. Otherwise, they would incur a fatal violation of high ranked *P_{WD}/í. When PERIPHERAL outranks *P_{FT}/í, lowering in a secondary stressed syllable does not occur. When the ranking of these two constraints is the reverse, lowering of a non-low vowel occurs in any stressed syllable, regardless of whether it bears primary stress or secondary stress.

The ranking in the first tableau in (19), *P_{WD}/í >> PERIPHERAL >> *P_{FT}/í, resembles the rankings discussed throughout this thesis that account for asymmetrical behavior of primary and secondary stress (see Paumari §2.3.1, Khalkha Mongolian §2.3.2, Wargamay §3.3.1, Kuuku-Yaʔu §3.3.2). By ranking a primary-stress-specific constraint above the more general version of that constraint with an antagonistic constraint in between, the asymmetry is captured.

The ranking in the second tableau in (19), *P_{WD}/í >> *P_{FT}/í >> PERIPHERAL, is tantamount to having the unexploded version of the constraint ranked high above the antagonistic constraint. This ranking accounts for languages in which primary and secondary stressed syllables behave symmetrically with respect to a particular process (see Southern Paiute §2.2.3, Chimalapa Zoque §3.2.2).

4.2.2   Unattested pattern of lowering

Two patterns of vowel lowering in Chamorro were discussed in this section: 1) vowel lowering may occur in all stressed syllables, whether they bear primary or secondary stress; and 2) vowel lowering may occur only in primary-stressed syllables. These patterns represent two of the four logically possible patterns that can be generated

by the interaction of (high-to-mid) vowel lowering and stress assignment. Of course, numerous languages exhibit the third pattern of no stressed vowel lowering, allowing the full inventory of vowels to occur in stressed syllables (see Beckman 1998 for a discussion of such positional faithfulness effects).

The fourth logically possible stress pattern, in which vowels lower in secondary-stressed syllables but not in primary-stressed syllables, is unattested. Once again, this fact finds its explanation in the nature of the stringency relation of the Word- and Foot-Peak Prominence hierarchies, as shown in the tableau in (20).

(20)   Unattested pattern of lowering in secondary stressed syllables only[13]

/CìCVCíCV/	*P$_{WD}$/í	IDENT[high]	*P$_{FT}$/í
a. CìCVCíCV	*		**
b. CìCVCéCV		*	*
c. CèCVCéCV		**	
d. ☠ CèCVCíCV	*	*	*

There is no ranking of these constraints that will yield (d), with lowering in secondary stressed syllables only, as the optimal candidate (as indicated by the '☠'). This is because candidate (d) has a proper superset of the violations that the complementary candidate in (c) has, with lengthening in primary but not secondary stressed syllables. That is, candidate (c) harmonically bounds candidate (d) and will always fare better with respect to these constraints, no matter what their ranking. As a result, a language with this pattern is predicted to be unattested.

4.2.3   Sonority-sensitivity at higher prosodic levels

The Chamorro facts raise the question of whether there are higher levels in the prosodic hierarchy at which the Peak Prominence constraints can apply. It was discussed

in §4.1 that Prince & Smolensky's (1993/2002) Peak Hierarchy evaluates sonority at the level of the syllable. One of the patterns exhibited by Chamorro – as well as Mokshan Mordwin, Old Church Slavonic, and Zabiče Slovene – must minimally appeal to the Peak Prominence constraints operating at the level of the foot (i.e., the Foot-Peak Prominence constraints) to yield their stress patterns. Crucially for Chamorro, however, sonority is relevant at higher levels in the prosodic hierarchy as well, namely, at the word level for primary stressed syllables (i.e., the Word-peak Prominence constraints). If peaks of syllables, feet and words all strive to be more sonorous, is there a language in which even higher levels of prosodic structure are sensitive to sonority as well?

I have found only one tentative example in which high vowels in stressed syllables at the phrasal level must become more sonorous. In Havasupai chants or songs (Hinton 1984), high vowels in strong positions (bearing stress) in a phrase or line of meter optionally lower to mid. Each meter has two to four strong positions or 'song-stresses', one of which is considered the primary song-stress and the others secondary song-stresses. These stresses often, but do not always, correspond to stressed syllables in the spoken language. (More specifically, the primary song-stress always corresponds to a primary-stressed syllable in a word, though the secondary song-stresses may correspond to an unstressed syllable.) If a high vowel occurs in one of these strong positions, whether it is in the primary or secondary song-stress position, it optionally lowers to a mid vowel. Mid vowels do not lower in these positions. This indicates that phrasal-level stresses are sensitive to sonority, in much the same way as was demonstrated for Old Church Slavonic and Chamorro for the lower levels of the prosodic hierarchy. However, this pattern of lowering is only exhibited in sung speech and is not active in the phonology of

spoken Havasupai. Whether it is the same motivating factor of Peak Prominence that is relevant for Havasupai songs as well as for the sonority-sensitive languages discussed throughout this chapter is a question I leave for future research.

4.2.4   Summary

The Chamorro data demonstrate the need for primary-stress-specific Peak Prominence constraints, in addition to the more general Peak Prominence constraints, to account for the asymmetrical behavior of primary and secondary stressed syllables with respect to vowel lowering. Lowering is obligatory when the syllable carries primary stress, but only optionally applies in syllables carrying rhythmic secondary stress. Without the Word-peak Prominence constraints, the pattern of lowering only in primary stressed syllables cannot be accounted for.

In the next section, I present two languages with sonority-driven stress, in which stress shifts from its default position in order to fall on a syllable nucleus of greater sonority. In Yimas (§4.3.1), both primary and secondary stresses shift to fall on a more sonorous vowel. In Asheninca (§4.3.2), only primary stresses do so, while secondary stresses are not sensitive to sonority.

4.3   Sonority-driven stress

4.3.1   Yimas

Yimas is a Papuan language spoken on the island of New Guinea. Its stress pattern is described by Foley (1991) and analyzed within OT by Alderete (1999) and McGarrity (2001).

According to Foley (1991), Yimas has four vowel phonemes /i ɨ u a/ of which /i/ and /a/ make up over 90% of all of the vowel tokens in the language. The central vowel /ɨ/ is the default epenthetic vowel and is inserted to break up impermissible consonant clusters.[14] Epenthesis of this sort is a pervasive feature of Yimas, as there are many examples of words, roots, and affixes that are underlyingly vowelless or that have long strings of consonants. This fact is relevant because epenthetic vowels play a role in how stress is assigned in this language.

The data in (21), taken from Foley (1991), illustrate the basic stress pattern in words containing only underlying vowels.

(21)   Basic Yimas stress pattern in words with no epenthetic vowels

a.	wút	'night'	b.	múraŋ	'paddle'
	káy	'canoe'		áwak	'star'
c.	tántayŋkraym	'spider'	d.	wánkanàwi	'insect (species)'
	kúlanaŋ	'walk'		wúratàkay	'turtle'
e.	mámantàkarman	'land crab'			
	yámpukàɲumpuk	'caterpillar'			

Primary stress falls on the initial syllable and secondary stresses fall on odd-numbered, non-final syllables. In derivational terms, this language assigns stress by building syllabic trochees iteratively from left to right, with End Rule Left assigning primary stress to the initial foot. Since odd-numbered final syllables do not receive secondary stress, footing is non-exhaustive, disallowing degenerate feet in weak position. To account for the fact that feet are trochaic, FtForm=Trochee is assumed to be undominated. The pattern of left-to-right, nonexhaustive iterative footing results from the

ranking of FTBIN >> PARSE-σ >> ALIGNFT-L. Initial primary stress is due to ALIGNHD-L. A tableau demonstrating how these constraints yield the basic Yimas stress pattern is given in (22).

(22)   Preliminary constraints

/yampukaŋumpuk/	ALIGNHDL	TROCHEE	FTBIN	PARSE-σ	ALIGNFTL
a. ☞ (yámpu)(kàŋum)puk				*	**
b. (yámpu)ka(nùmpuk)				*	***!
c. (yámpu)kaŋumpuk				**!*	
d. (yámpu)(kàŋum)(pùk)			*!		**,****
e. (yampú)(kaŋùm)puk		*!*		*	**
f. (yàmpu)(káŋum)puk	*!*			*	**

4.3.1.1 Epenthetic [ɨ] and primary stress

There are some words in Yimas in which the primary stress falls on the second syllable instead of on the initial syllable as would be predicted by the constraints and ranking introduced in the previous section. For example, in words with an epenthetic [ɨ] in the initial syllable, primary stress falls on the second syllable.

(23)   Words with epenthetic [ɨ] in the initial syllable

  a. /pkam/   →   pɨkám   'skin of back'
  b. /tmi/   →   tɨmí   'say'
  c. /tnwantŋ/   →   tɨnwántiŋ   '2 days removed from today'
  d. /kcakk/   →   kɨcákɨk   'cut'
  e. /klakyanŋ/ →   kɨlákyaniŋ   'parrot (sp.)'

These data indicate that primary stress on [ɨ] is avoided. Unlike Old Church Slavonic (§4.1.2) or Chamorro (§4.2.1), Yimas does not alter the vowel to make it more sonorous. Instead, like Mokshan Mordwin (§4.1.1), stress shifts away from the initial syllable to fall on a more sonorous vowel to its right. In other words, stress is sonority-driven. To capture this pattern, the Peak Prominence constraint banning a stressed central vowel [ɨ] must be ranked above the alignment constraint.[15] Because Yimas does not make a distinction between the peripheral high vowels and the low vowel [a] in terms of sonority (e.g., [múraŋ] 'paddle', *[muráŋ]), the rest of the Peak Prominence constraints are encapsulated into one constraint which is ranked below the stress placement constraints.

(24)   In word with [ɨ] in initial syllable, stress falls on second syllable

/pkam/	*P/ɨ	ALIGNFT-L	*P/í,á
a. (pɨ́kam)	*!		
b. ☞ pɨ(kám)		*	*

As this tableau demonstrates, it is more important to avoid stressing [ɨ] than it is to satisfy alignment. Candidate (b) is the optimal candidate, even though it has a degenerate foot that is not left-aligned, because it satisfies high-ranked *P/ɨ.

However, it is not the case that [ɨ] can never be stressed. If both the first and the second syllable contain an epenthetic [ɨ], stress falls on the initial syllable, even if there is a third syllable that contains a more sonorous vowel.

(25)   Words with epenthetic [ɨ] in first two syllables

    a. /tkt/   →   tɨkit   'chair'

    b. /klwa/   →   kɨliwa   'flower (species)'

    c. /krmknawt/   →   krɨmkɨnawt   'wasp'

    d. /tmpnawkwan/ →   tɨmpɨnàwkwan 'sago palm'

According to Foley (1991), "Yimas has a surface phonetic constraint that one of the first two syllables of the phonetic form of the word must carry primary stress" (76). In other words, while stress can shift one syllable away from the left edge to avoid falling on [ɨ], it cannot fall outside of a two-syllable stress window. To account for this pattern, I appeal to *LAPSE (also called Parse-Syl-2 in Kager 1994), which bans two adjacent unstressed, unfooted syllables.[16] This constraint must dominate *P/ɨ.

(26)   In word with [ɨ] in first and second syllable, stress falls on initial syllable

/klwa/	*LAPSE	*P/ɨ	ALIGNFT-L	*P/í,á
a. ☞ (kɨ́li)wa		*		
b. kɨ(lɨ́wa)		*	*!	
d. kɨlɨ(wá)	*!		**	*

Candidate (c) avoids stressing [ɨ] by shifting stress to the third syllable containing [a]. While this satisfies *P/ɨ, it fatally violates *LAPSE, since the first two syllables are unstressed and unparsed by feet. As candidate (b) demonstrates, nothing is gained by shifting stress away from the first syllable onto the second since it also contains [ɨ]. As a result, the alignment constraint resolves the tie and selects candidate (a), with the perfectly left-aligned foot, as the winner. Note that this candidate does not violate

*LAPSE, which is defined so as to eliminate candidates with two adjacent unstressed, *unfooted* syllables. One of the two unstressed syllables in (a) is parsed into a foot.

4.3.1.2 Epenthetic [ɨ] and secondary stress

Up until this point, I have only examined the role that sonority plays in the assignment of primary stress. It turns out, however, that secondary stress in Yimas is also sensitive to the sonority of the vowel. This finding is important, as it goes against the claims of de Lacy (2001) who says that "sonority can be significant in the placement of main stress, but not secondary stress" (19).

Typically, as was shown in the data in (21) above, secondary stress falls two syllables to the right of primary stress in an alternating pattern. However, as Foley notes, in five syllable words with epenthetic [ɨ] in the first two syllables, "when the vowel of the third syllable is also epenthetic, [secondary] stress is retracted to the penultimate syllable" (77). He gives as an example the following form:

(27)   /tŋkmpɲawa/ → [tɨ́ŋkɨmpiɲnàwa], *[tɨ́ŋkɨmpɨ̀ɲawa] 'wild fowl'

This form has an initial dactyl, with primary stress on the initial syllable, and secondary stress on the fourth syllable instead of on the expected third. This is reminiscent of the pattern seen in (23). In those words, primary stress shifts one syllable to the right of where it regularly falls to avoid falling on an epenthetic [ɨ]. In the example in (27), it is the secondary stress that is shifting one syllable to the right to avoid falling on an epenthetic [ɨ]. As shown in the following tableau, no additional constraints are needed to account for this pattern.

(28) Secondary stress shifts to avoid [ɨ]

/tŋkmpɲawa/	*Lᴀᴘsᴇ	*P/ɨ	AʟɪɢɴFᴛ-L	*P/í,á
a.　(tíŋkɪm)(pɪ̀ɲa)wa		**!	**	
b.　tɪŋ(kímpɨ)(ɲàwa)		*	*,***!	*
c. ☞ (tíŋkɪm)pɨ(ɲàwa)		*	***	*
d.　tɪŋkɪmpɨ(ɲáwa)	*!*		***	*

In its attempt to satisfy *P/ɨ by skipping the first three syllables and stressing the fourth, candidate (d) violates *Lᴀᴘsᴇ multiple times and is eliminated. Candidate (a), which best satisfies alignment by not shifting the secondary stress off of the third syllable, incurs an extra violation of *P/ɨ as a result. Of the remaining two candidates, candidate (c) with the initial dactyl better satisfies AʟɪɢɴFᴛ-L and is chosen as the winner. Though the initial dactyl creates a gap of two unstressed syllables in between two stressed syllables, since one of the unstressed syllables is in a foot, *Lᴀᴘsᴇ is not violated.

The fact that primary and secondary stresses behave symmetrically with respect to the avoidance of stressed [ɨ] indicates that it is the unexploded version of the Peak Prominence Hierarchy (i.e., the Foot-peak Prominence Hierarchy, relativized to stressed syllables in general) that is responsible for the sonority-driven stress pattern in this language.

4.3.1.3 Preference for stressed [a]

As a final note, there are additional data that suggest that Yimas might make finer-grained sonority distinctions than simply distinguishing between central [ɨ] and the peripheral vowels. Foley (1991:78) discusses an optional pattern in which disyllabic and trisyllabic words with no epenthetic vowels may place stress on the second syllable, rather than the first, if it contains the low vowel [a].

(29) Optional stress shift
　　a.　kíka ~ kiká　　　'rat'
　　b.　píam ~ piám　　　'arrow'
　　c.　yúan ~ yuán　　　'good'
　　d.　kúnapa ~ kunápa　'mushroom'

This suggests that, like Chamorro (§4.2.1), Yimas might have a partial ordering of constraints – in this case, between AʟɪɢɴFᴛ-L and *P/í, the constraint banning high peripheral vowels.

(30) Partial ordering of AʟɪɢɴFᴛ-L and *P/í

/kika/	AʟɪɢɴFᴛ-L	*P/í	*P/á
a. ☞ (kíka)		*	
b.　ki(ká)	*!		*

/kika/	*P/í	AʟɪɢɴFᴛ-L	*P/á
a.　(kíka)	*!		
b. ☞ ki(ká)		*	*

When *P/í is ranked below AʟɪɢɴFᴛ-L with *P/á, stress shift is not observed. However, when it is ranked above the alignment constraint, stress moves away from the left edge of the word to fall on the low vowel in the second syllable.

However, Foley (1991:78) also gives, as examples of stress-shifting words, forms in which both the initial and the second syllable contain a low vowel (e.g., [mácawk] ~

[macáwk] 'father-in-law', [yánara] ~ [yanára] 'bark of clove tree'). In such cases, sonority obviously cannot be the deciding factor in determining stress placement, since the vowels in both syllables are equally sonorous. For this reason, there may be some other motivation behind the stress shift in the forms in (29) as well. I leave this for future research.

4.3.1.4 Summary

In Yimas, stresses of all types, both primary and secondary, avoid falling on the low-sonority central vowel. This is because of a general Peak Prominence constraint *P/ɨ that bans the central vowel from occurring in a stressed syllable. However, unlike Chamorro, Yimas does not change a stressed [ɨ] to make it more sonorous. This is due to the ranking of faithfulness above *P/ɨ. Instead, both primary and secondary stresses can shift away from their default positions in order to fall on a more sonorous vowel. This pattern of sonority-driven stress results from ranking the Peak Prominence constraint *P/ɨ above the constraints responsible for stress placement.

In the next section, I examine a different sonority-driven stress language with an asymmetrical stress pattern in which only primary stress assignment is sonority-sensitive while secondary stress assignment is not.

4.3.2 Asheninca

The Pichis dialect of Asheninca, an Arawakan language described and analyzed by J. Payne (1990), has a complex stress system that has been widely studied. It has been analyzed within a derivational framework by Hayes (1995:288-296). Various aspects of

its stress system (or that of the similar dialect Apurucayali Asheninca) have been analyzed within OT by de Lacy (1997), Hung (1994a), McCarthy & Prince (1993b), and Zec (2003).

Stress assignment in Asheninca is determined by several factors, including quantity, sonority and onset-sensitivity. In this section, I will focus on the influence of sonority on Asheninca stress assignment; however, I will briefly describe the remaining factors here. Syllables with long vowels (indicated in the data with a double vowel) and diphthongs are considered to be heavy and always attract stress (except in word final position). While, in general, closed syllables are considered to be light, a syllable that is closed with a nasal consonant and that contains the short high front vowel [i] in the nucleus is considered to be heavier than an open syllable containing short [i]. Finally, the syllables /tsi/ and /sʲi/ (which are realized as [tsɨ] and [ʃɨ] on the surface) are considered to be extralight; they are never stressed. Together, these facts yield the following 4-way prominence scale.

(31)   CVV(N) > CV(N), CiN > C̲i > tsi, sʲi   (where V ≠ i, C̲ ≠ ts, sʲ)

Beyond this description, I do not discuss the prominence of CiN syllables, or the fact that light syllables with [ts] or [sʲ] in the onset always repel stress, since primary and secondary stress assignment behave symmetrically with respect to both of these factors. However, as I discuss in the remainder of this section, primary and secondary stress behave asymmetrically with respect to light Ci syllables, such that primary stress is sensitive to the sonority of the vowel while secondary stress is not.

4.3.2.1 Basic stress pattern

The general stress pattern of Asheninca is illustrated in the following examples.

All data are taken from J. Payne (1990).

(32)   Asheninca

    a. Forms with all light syllables

        (há.ka)   'here'
        (no.pí)to   'my canoe'
        (ka.máN)ta.ke   'he/she said'
        (no.tòN)(ka.méN)to   'my gun'
        (no.kó)(wa.wé)ta.ka   'I wanted (it) in vain'
        (ha.mà)(naN.tà)(ke.né)ro   'he bought it for her'
        (pa.mè)(na.kò)(weN.tá)ke.ro   'take care of her'

    b. Forms with light and heavy syllables

        (pàa)(ti.ká)ke.ri   'you stepped on him'
        (pi.ñàa)(páa)ke   'you saw on arrival'
        (no.mà)(ko.ryàa)(wài)(ta.páa)ke 'I rested a while'

Stress in Asheninca follows a left-to-right iambic pattern – where feet can be

(LL), (LH), or (H) – as illustrated by the fact that stress falls on all heavy syllables (as in

32b) and on even-numbered syllables in a string of light syllables (32a). Final syllables

are considered to be extrametrical and are never stressed, even if the final syllable is

heavy (e.g., [jíñaa] 'water', *[jiñáa]). This fact, in conjunction with the fact that stresses

in clash are disallowed except in adjacent heavy syllables,[17] allows for a pattern in which

the rightmost stress can fall up to three syllables away from the right edge of the word

(e.g., on the penult in words with an odd number of all light syllables, and on the

antepenult in words with an even number of all light syllables).

Because final syllables are extrametrical, J. Payne (1990) assumes that disyllabic

words like [háka] 'here' are parsed as [(há)ka], with a degenerate foot. However, I

assume, as was proposed in chapter 2 for other iambic languages with nonfinality effects,

that disyllables undergo foot reversal to avoid stress falling on a final syllable. This falls

out from the ranking NONFINALITY >> IAMB. The pattern of clash avoidance, except in

cases of adjacent heavy syllables, is accounted for by ranking *CLASH below WSP

(WEIGHT-TO-STRESS PRINCIPLE: 'Heavy syllables must be stressed'). The left-aligned,

iterative stress pattern is accounted for by the ranking of PARSE-σ >> ALIGNFT-L.

Finally, ALIGNHD-R is responsible for that fact that primary stress falls on the rightmost

foot. Some relevant ranking arguments and the forms that illustrate them are given below.

(33)   Ranking arguments

        NONFINALITY >> IAMB   (há.ka) ≻ (ha.ká)
        WSP >> *CLASH   (pi.ñàa)(páa)ke ≻ (pi.ñàa)paake
        *CLASH >> PARSE-σ   (ka.máN)ta.ke ≻ (ka.màN)(tá.ke)
        PARSE-σ >> ALIGNFT-L   (no.tòN)(ka.méN)to ≻ (no.tóN)ka.meN.to

4.3.2.2 Primary stress and sonority

It was discussed above that primary stress falls on the rightmost foot at the end of

the parsing string. However, the pattern is more complicated than that. As the data in (34)

show, primary stress assignment is sensitive to the sonority of the nucleus in the head

syllable of the foot. If the head of the rightmost foot contains the high front vowel [i] and

the head of the preceding foot contains a vowel other than [i] (i.e., one of the more

sonorous vowels [a], [e] or [o]), primary stress shifts away from the right edge of the

word and falls on the head of the preceding foot. That is, of the final two feet in the word

(indicated by square brackets '[]'), primary stress falls either on the foot not headed by [i] or the rightmost one.

(34)   Primary stress pattern

    a.   [(sàa)(sáa)]ti   'type of partridge'
          [(no.tòN)(ka.méN)]to   'my gun'
          na.wì[(sa.wè)(ta.ná)]ka   'I went in vain'
          iN.kìN.ki.sʲi.re.tà[(ko.tà)(wa.ké)]ri   'he thought about it for a while'

    b.   [(máa)(ki.ri)]ti   'type of bee'[18]
          ñàa.wyàa[(ta.wá)(ka.ri)]ri   'what he saw in a vision'
          nò.sʲi.ya.pì.tsa.tàN[(ta.ná)(ka.ri)]ri   'I escaped from him'

In the words in (34a), the heads of the final two feet contain non-high vowels. These forms show that both the mid vowels and the low vowel are treated as being equally sonorous; as such, primary stress falls on the rightmost foot, the default position. This is especially evident in the form [iNkìNkisʲiretà(kotà)(waké)ri], in which the primary stress, which falls on a mid vowel in the head of the final foot (i.e., [ke]), does not shift onto the head of the preceding foot containing the low vowel (i.e., [ta]), even though it is more sonorous.

In the forms in (34b), on the other hand, the head of the final foot contains the low-sonority high vowel [i]. Because the head of the preceding foot contains a more sonorous vowel, primary stress shifts leftward to fall on the head of the penultimate foot.

4.3.2.3 Secondary stress and sonority

What should be noted is that the sonority of the vowel is only relevant for the placement of primary stress. This differs from the Yimas case discussed in §4.3.1. In Yimas, both primary and secondary stress assignment are sensitive to the sonority of the vowel; subsequently, both types of stresses can shift away from their default position in order to fall on a more sonorous vowel. In Asheninca, however, secondary stress is not restricted from falling on the low-sonority high vowel.

In the form [nò.sʲi.ya.pì.tsa.tàN.ta.ná.ka.ri.ri], notice that a secondary stress falls on the initial syllable instead of on the second syllable. This is due to the fact that the second syllable is extralight [sʲi], which cannot receive stress of any kind. If it is possible to shift a secondary stress to the left to avoid falling on an unstressable syllable, it should be possible to shift stress from the fourth syllable [pi] onto the third syllable [ya] (or even onto the fifth syllable [tsa]) in this same form, if sonority were relevant for the assignment of secondary stress as it is for primary stress. However, stress does not shift in this case, indicating that secondary stress assignment is sonority-insensitive.

As with the Chamorro case in §4.2.1, the asymmetrical behavior of primary and secondary stress in Asheninca can be accounted for by appealing to a Peak Prominence constraint that is specific to primary stress and operates at the word level, *P$_{WD}$/í. This constraint is ranked independently from its counterpart *P$_{FT}$/í that operates at the level of the foot and is relevant to all stressed syllables. The alignment constraint responsible for placement of primary stress, ALIGNHD-R, must be ranked below the Word-peak Prominence constraint. This is demonstrated using a schematic form in the following tableau. High ranked faithfulness is assumed, to prevent a stressed high vowel from becoming more sonorous via feature changing.

(35)   Primary stress shifts from default position to fall on more sonorous vowel

/σCaσCiσ/	*P$_{WD}$/í	ALIGNHD-R
a. (σ.Cà)(σ.Cí)σ	*!	
b. ☞ (σ.Cá)(σ.Cì)σ		*

In this tableau, I mark violations of AlignHd-R gradiently according to the number of feet standing between the primary stress foot and the right edge of the word. In candidate (a), the primary stress is as close to the right edge as it can be without violating NonFinality. Thus, it fully satisfies AlignHd-R. However, in doing so, it places primary stress on a low-sonority high vowel, fatally violating *P_WD/í. Candidate (b) wins, by placing primary stress on a more sonorous low vowel, even though this moves the stress farther away from the right edge of the word.

If the heads of both the final and the penultimate foot contain non-high vowels, no stress retraction takes place. This results from the fact that the Peak Prominence constraints banning stressed mid and low vowels – *P_WD/é, *P_WD/á – are ranked below the stress placement constraint.

(36)   No retraction to low sonority antepenult

/σCaσCeσ/	*P_WD/í	AlignHd-R	*P_WD/é	*P_WD/á
a. ☞ (σ.Cà)(σ.Cé)σ			*	
b. (σ.Cá)(σ.Cè)σ		*!		*

Neither candidate violates *P_WD/í, so AlignHd-R breaks the tie by selecting the candidate in (a) with primary stress in the rightmost foot as the winner. Because *P_WD/é and *P_WD/á are ranked below the alignment constraint, they are rendered inactive. Thus, alignment considerations will always be the deciding factor in determining primary stress placement in words such as those in (34a) with mid or low vowels in the stressable syllables.

Although J. Payne (1990) provides no examples in which the heads of both of the final two feet contain high vowels (except for [i.kàN(ta.sʲi)(ta.rí)ra] 'he said it without

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thinking', in which the head of the penultimate foot is the extralight, unstressable syllable [sʲi]), the analysis predicts that the rightmost foot will bear the primary stress.

(37)   No retraction from a high vowel to a high vowel

/σCiσCiσ/	*P_WD/í	AlignHd-R
a. ☞ (σ.Cì)(σ.Cí)σ	*	
b. (σ.Cí)(σ.Cì)σ	*	*!

In this case, both of the candidates violate *P_WD/í. Once again, the tie is passed down to the alignment constraint which selects candidate (a) with primary stress in the rightmost foot as the optimal form.

It is worth noting that while stress may retract off of a low-sonority vowel to fall on a more sonorous vowel to its left, it may not shift to the right onto the final syllable, even if it contains a more sonorous vowel (e.g., [jíñaa] 'water', *[jiñáa]). This is due to the ranking of NonFinality >> *P_WD/í. Furthermore, primary stress cannot shift off of a high vowel onto a more sonorous vowel within the same foot (e.g., [(no.pí)to] 'my canoe', *[(nó.pi)to]). This is due to the ranking of Iamb >> *P_WD/í.

The fact that secondary stress does not shift off of a high vowel to fall on a more sonorous vowel is due to the ranking of AlignFt-L, the constraint ultimately responsible for secondary stress placement, and Iamb above the Foot-peak Prominence constraint *P_FT/í.

(38)   No shift of secondary stress

/CaCiCaσσ/	Iamb	AlignFt-L	*P_FT/í
a. ☞(Ca.Cì)(Ca.ɕ́)σσ		**	*
b. (Cà.Ci)(Ca.ɕ́)σσ	*!	**	
c. Ca(Ci.Cà)(σɕ́)σ		*,**!*	

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Candidates (b) and (c) avoid violating *P_FT/í by shifting secondary stress away from the second syllable, either by making the initial foot trochaic, which incurs a fatal violation of IAMB, or by shifting stress onto the third syllable, which causes gratuitous violations of ALIGNFT-L. Thus, candidate (a) is selected as the winner even though it places secondary stress on a low-sonority vowel.

4.3.2.4 Summary

Asheninca exhibits an asymmetry of primary and secondary stress. While primary stress is sonority-sensitive, secondary stress is not. That is, if the head of the final foot contains a high vowel, primary stress can shift onto the head of the preceding foot as long as it contains a more sonorous vowel. However, secondary stress is not similarly affected. This pattern falls out from the following ranking schema.

(39)   Ranking and schema for asymmetrical pattern of sonority-sensitivity in Asheninca

Faith >> Word-peak-prominence >> Stress placement >> Foot-peak prominence

(… >>   P_WD/í   >> ALIGNHD-R, ALIGNFT-L >> P_FT/í   )

The Word-peak Prominence constraint banning primary stressed high vowels, *P_WD/í, is ranked above the stress placement constraints. This allows stress to shift off of a high vowel onto a more sonorous as long as it is a primary stress. The fact that secondary stress does not shift off of a high vowel results from ranking the general Foot-peak Prominence constraint *P_FT/í below the stress placement constraints.

4.4   Conclusion

In this chapter, I have shown that it is necessary to have primary-stress-specific Peak Prominence constraints that operate at the word-level, as well as to have the more general version of these constraints that operate at the level of the foot. Both of these constraint hierarchies are crucially necessary to account for languages in which primary and secondary stressed syllables behave asymmetrically with respect to sonority considerations.

In systems with stress-driven sonority, stress placement is determined by the relative sonority of the syllable nuclei. That is, a stressed syllable with a low-sonority nucleus will change to become more sonorous. The general ranking schemata for languages with stress-driven sonority are as follows.

(40)   Ranking schemata for stress-driven sonority
   a. High vowels lower in all stressed syllables (e.g., Old Church Slavonic)
       Stress placement constraints >> ***P_WD/x́, *P_FT/x́ >> Faithfulness** >> *P/ý
   b. High vowels lower only in primary stressed syllables (e.g., Chamorro)
       Stress placement constraints >> ***P_WD/x́ >> Faithfulness >> *P_FT/x́** >> *P/ý

Three languages with stress-driven sonority were discussed in this chapter: the Slavic languages Old Church Slavonic and Zabiče Slovene (§4.1.2), and Chamorro (§4.2.1), which exhibited two different patterns. All of these languages have the stress placement constraints ranked high to prevent stress from shifting away from its default position onto a more sonorous vowel. In Old Church Slavonic, Zabiče Slovene and one of the patterns exhibited by Chamorro, all of the stressed syllables behave symmetrically; if either primary or secondary stress falls on a syllable with nucleus *x* (namely, a high vowel), the vowel changes to become a more sonorous nucleus *y* (i.e., a mid vowel). This

is represented by the schema in (40a). The active Word- and Foot-Peak Prominence constraints ($*P_{WD}$/x́, $*P_{FT}$/x́) are essentially unexploded, being ranked in the same stratum above the faithfulness constraints. The faithfulness constraints in turn are ranked above the inactive Peak Prominence constraints ($*P$/ý). In the other pattern exhibited by Chamorro, however, primary and secondary stressed syllables behave asymmetrically with respect to sonority; only high vowels in primary stressed syllables undergo lowering to become more sonorous, not those in secondary stressed syllables. This is represented by the schema in (40b). The active primary-stress-specific Word-Peak Prominence constraint ($*P_{WD}$/x́) must be ranked above faithfulness which in turn must be ranked above the general Foot-Peak Prominence constraint ($*P_{FT}$/x́) to yield the asymmetrical pattern.[19] It was demonstrated in §4.2.2 that a stress system in which high vowels undergo lowering in secondary stressed syllables but not in primary stressed syllables is predicted to be unattested. This falls out from the stringency relation of the Word- and Foot-Peak Prominence constraints.

In sonority-driven stress systems, on the other hand, stress placement is determined by the relative sonority of the syllable nuclei. That is, stress shifts away from its default position to fall on a more sonorous vowel. The general ranking schemata for the sonority-driven stress systems discussed in this chapter are as follows.

(41)   Ranking schemata for sonority-driven stress
   a.   All stresses shift onto more sonorous vowel (e.g., Mokshan Mordwin, Yimas)
        Faithfulness >> **$*P_{WD}$/x́, $*P_{FT}$/x́** >> **Stress placement constraints** >> $*P$/ý
   b.   Only primary stress shifts onto a more sonorous vowel (e.g., Asheninca)
        Faithfulness >> **$*P_{WD}$/x́** >> **Stress placement constraints** >> $*P_{FT}$/x́ >> $*P$/ý

Three sonority-driven stress systems were discussed in this chapter: Mokshan Mordwin (§4.1.1), Yimas (§4.3.1), and Asheninca (§4.3.2). All of them have faithfulness ranked high to prevent altering a stressed syllable to make it more sonorous. In both Mokshan Mordwin and Yimas, all stressed syllables behave the same way; they shift away from their default positions off of a syllable with nucleus *x* to fall on a more sonorous vowel with nucleus *y*. This is represented by the schema in (41a). The active Word- and Foot-Peak Prominence constraints ($*P_{WD}$/x́, $*P_{FT}$/x́) are ranked in the same stratum above the stress placement constraints which in turn are ranked above the inactive Peak Prominence constraints ($*P$/ý). In Asheninca, however, primary- and secondary-stressed syllables behave asymmetrically with respect to sonority; only primary stress shifts away from its default position onto a more sonorous vowel while secondary stresses do not. This is represented by the schema in (41b). The active primary-stress-specific Word-Peak Prominence constraint ($*P_{WD}$/x́) must be ranked above the stress placement constraints which must in turn be ranked above the general Foot-Peak Prominence constraint ($*P_{FT}$/x́).

It may seem safe to argue, as was the case for the stress-driven sonority patterns, that by appealing to a primary-stress-specific constraint in a stringency relation with a general stress constraint and ranking them in a factorial typology with an interacting antagonistic constraint, that there is no ranking that will yield a sonority-driven stress system that is the counterexample to Asheninca in which only secondary stressed syllables are sensitive to sonority while primary stressed syllables remain unaffected. However, examples of such languages are attested (e.g., Armenian).

In the next chapter, I examine languages such as Armenian that display asymmetrical patterns in which secondary stressed syllables are targeted for some phonological process that leaves primary stressed syllables unaffected. In particular, I present cases of languages in which quantity-sensitivity interacts with primary and secondary stress assignment to yield the full range of logically possible patterns, contrary to what stringency might seem to predict. I argue that the existence of such languages does not compromise stringency or undermine the claim made throughout this thesis that specific constraints can only be relativized to primary stress to yield patterns of asymmetry. I argue that the incongruities apparent in the typologies involving processes like vowel lengthening and lowering in stressed syllables vs. those involving quantity- and sonority-sensitivity are due to a fundamental dichotomy: whether stress assignment is process-driven or whether the process is stress-driven.

Notes

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[1] See, however, Smith (2002:49) who argues against including a *P/ə́ constraint specific to reduced central vowels in the Peak Prominence Hierarchy on the grounds that it would imply (but should not) a *ONSET/ə (or *MARGIN$_{syll}$/ə) counterpart, since both hierarchies are derived from the same sonority scale. Such a constraint, which would be ranked below *ONSET/i, would predict that reduced vowels would make better onsets than glides would, contrary to fact. Instead, Smith suggests that reduced vowels differ from full vowels, not in terms of sonority, but in some other dimension that could be targeted in a constraint outside of the prominence hierarchy.

[2] In this chapter, I only examine languages that make reference to the Peak Prominence Hierarchy. In these languages, stressed syllables are sensitive to sonority. However, in some languages, stress placement is sensitive to the sonority distinctions of vowels that would occur in unstressed positions. Accounts of these languages must make reference to constraints (e.g., the Margin Prominence Hierarchy) that prohibit certain segment types from occurring in an unstressed or non-head syllable. Examples of such languages include Northwest Mari (Kenstowicz 1994), Kiriwina and Harar Oromo (de Lacy 2002a), and some languages that undergo unstressed vowel reduction (see Crosswhite (1999) for examples and references therein).

[3] For another OT analysis of Mokshan Mordwin using different constraints, see Zec (2003:128-130).

[4] This may not be necessary. While there are words that have a stressed high vowel in the initial syllable followed by a schwa in the second and subsequent syllables (e.g.,

[púvəndəms] 'to press'), there are no forms with a stressed schwa in the initial syllable followed by high vowels in the following syllables. Only this type of form would definitively indicate whether the central and high vowels are equally sonorant. However, since Kenstowicz's analysis allows for this possibility, I follow his lead here.

While Prince & Smolensky (1993/2002:141) allow for the encapsulation of multiple sonority categories into one constraint within the Peak and Margin Hierarchies, de Lacy (2002a) argues against constraint encapsulation in fixed hierarchies, such as the Peak Prominence Hierarchy, in favor of hierarchies that contain freely permutable constraints in a stringency relation. While fixed and stringent rankings of markedness constraints often produce the same result for any given phenomenon, de Lacy demonstrates that freely permutable stringent constraints are able to account for certain types of category conflation (such as that exhibited by Mokshan Mordwin in §4.1.1) that fixed ranking accounts without encapsulation cannot. However, as a full discussion on this topic is beyond the scope of this thesis, I refer the interested reader to de Lacy (2002a) and will continue to refer to the fixed Peak Prominence Hierarchy throughout this chapter for expositional purposes.

[5] Zec (2003:fn.8) notes that the vowels ę and ǫ were nasalized, and ě was an open mid vowel that may have been a diphthong in some dialects.

[6] In these data, the following abbreviations are used: c = any consonant, v = any non-jer vowel, U = any jer vowel, nom. = nominative, 3p = 3rd person, sg. = singular, m. = masculine, adj. = adjective, pres. = present.

[7] I follow Zec in assuming that lax vowels are less sonorous than tense vowels. This assumption is echoed in Lightner (1972:33) who states, "[The jers] are the least vowel-

like of the vowels in that they are close and lax. These are the vowels that tend to become glides before vowels, voiceless between voiceless consonants and word finally."

While the analysis presented here is based in large part on Zec (2003), I have changed some of the constraint names in order to better draw parallels with the other languages considered in this chapter. For instance, instead of using Peak Prominence constraints to account for stressed jer avoidance, Zec uses a constraint (Son(ority)-Ft) that imposes a minimum sonority threshold on the heads of feet (in this case, they must be [-cons, +tense]). Furthermore, Zec describes additional data (including four-syllable words with multiple feet) and additional complications that require a two-level analysis that I do not present, as they are beyond the scope of this chapter.

[8] In her analysis, Zec does not evaluate a form like candidate (c) in which the stressed jer only undergoes tensing without also lowering. It might seem that candidate (c) would only violate Faith once (because of the change in tenseness) while candidate (d) would violate it twice (for tenseness and height). However, as was shown in the vowel chart in (7), the jers and the mid vowels with which they alternate are historically short, and the remaining vowels are historically long. I suggest that these vowels differ in some respect – possibly their moraic structure (however, since Zec (2003:131) notes that vocalic length was not phonologically relevant in OCS, these vowels may differ in some other respect). Assuming this is the case, changing a jer to an [u] would involve a change in tenseness and weight, while changing a jer to an [o] would involve a change in tenseness and height. The two candidates would still tie with respect to faithfulness, and the Peak Prominence constraints would again select in favor of the candidate with the mid vowel.

[9] I assume that the faithfulness constraint DEP-μ is ranked low to allow for vowel lengthening to occur.

[10] While it is possible to posit either mid vowels or high vowels underlyingly for those vowels that alternate in stressed syllables, I will continue to refer to the phonological process discussed in this section as vowel lowering, as this is the term most often used to describe this process in the literature on Chamorro.

[11] Instead of ranking PERIPHERAL below *P/í but above the *P/V́ː constraints, ranking the faithfulness constraint IDENT[high] in that stratum would also yield the Chamorro pattern. However, because mid vowels and high vowels are in complementary distribution, Crosswhite makes no assumptions about the status of the non-low vowels in the input, in accordance with Richness of the Base. As a result, it is necessary for the markedness constraint to rule out forms with a lowered vowel rather than faithfulness.

The ranking of *P/í >> PERIPHERAL, while not evident in this tableau, is nevertheless crucial for forms like [métgut], with a stressed mid vowel in a closed syllable, to win out over *[mítgut].

[12] In addition to rhythmic secondary stresses, Chamorro also has 'derived' or 'cyclic' secondary stresses in affixed forms that correspond to primary stress in the nonderived base form of the word. Vowel lowering in derived secondary stressed syllables is obligatory, as it is for primary stressed syllables (e.g., [éttigu] 'short' ~ [èttigóŋŋa] 'shorter', *[ìttigóŋŋa]). Crosswhite (1998) accounts for this pattern with Base-Affix (BA) correspondence. I do not present these cases here.

[13] In this tableau, I use IDENT[high] as the antagonistic constraint that interacts with the Word- and Foot-peak Prominence constraints, instead of PERIPHERAL, which was used in the discussion on Chamorro. This allows for languages, like Old Church Slavonic or Zabiče Slovene, in which vowel lowering neutralizes a contrast between high and mid vowels. However, either constraint in the ranking yields the same general set of predictions.

[14] For a discussion about the rules for [ɨ]-epenthesis, see Foley (1991:44-50). While [ɨ] is the default epenthetic vowel, the other two high vowels are also used in epenthesis as a result of contextual coloring. Epenthetic [u] is inserted when an adjoining syllable contains [u] or [w], and [i] insertion occurs when an adjoining syllable contains [i] or [y]. There are no cases of [a] epenthesis.

[15] In order to draw parallels between Yimas and the languages discussed throughout this chapter, I use the Peak Prominence constraint *P/ɨ to capture the pattern of stress avoidance on an epenthetic [ɨ]. For a similar sonority-based analysis of stress-epenthesis interactions, see Cohn & McCarthy (1994/1998). However, other analyses of languages with stress-epenthesis phenomena refer to the HEAD-DEP family of faithfulness constraints proposed by Alderete (1995, 1999), which bans epenthesis into prosodic heads (such as the head foot of the word or the head syllable of a foot). See Broselow (1999) for an analysis of Selayarese loans using HEAD-DEP constraints, and McGarrity (2001) and Alderete (1999) for Yimas.

[16] This is just one definition of the anti-lapse constraint that has been used in the stress literature. For other possible definitions and uses of this constraint, see Alber (2002), Elenbaas & Kager (1999), and Green & Kenstowicz (1995).

[17] More explicitly, the stress on the rightmost of two adjacent stressed light syllables at the end of the parsing string is deleted. When a stressed heavy syllable follows a stressed light Ci syllable, the stress on the light syllable is deleted. When a stressed heavy syllable follows a stressed CV(N) or CiN syllable, deletion of the stress on the lighter syllable is optional.

[18] Payne (1990:198) does not mark secondary stress on the final foot in words like those in (34b), in which the primary stress shifts away from the right edge onto an adjacent foot. Hayes (1995:295) assumes that they are present. Payne, Payne & Santos (1982:193), in their description of the Apurucayali dialect of Asheninca, claim that such posttonic secondary stresses are variably realized. McCarthy & Prince (1993b:150) take this to mean that these secondary stresses are authentically present in the phonology though not always impressionistically prominent, while Hung (1994:64) argues the opposite – that they may occasionally have impressionistic prominence, but that they are not present in the phonology. (For further discussion on similar posttonic secondary stresses, see §2.3.1.2 in this thesis.) For expository purposes, I will assume that these posttonic secondary stresses are present; however, this assumption is not crucial to the overall analysis.

[19] See note 13 on the use of antagonistic faithfulness instead of markedness in this schema to characterize the Chamorro pattern.

CHAPTER 5:

WEIGHT-DRIVEN STRESS

5.1   Introduction

Throughout this thesis it has been demonstrated that when a primary-stress-specific constraint (S1), a general stress constraint (S), and an interacting antagonistic constraint (C) are ranked in a factorial typology, it makes certain predictions about the types of stress systems that should and should not occur in the world's languages. These predictions are summarized in the following table.

(1)   Patterns predicted by factorial typology of S1, S and C

Ranking	Process applies in…
a. S1, S >> C	Both primary and secondary stressed syllables
b. C >> S1, S	Neither primary nor secondary stressed syllables
c. S1 >> C >> S	Primary stressed syllables only
d. No ranking	*Secondary stressed syllables only

Symmetrical patterns of primary and secondary stress assignment (1a,b) result from ranking S1 and S together, either above or below C. An asymmetrical pattern (1c) results from ranking primary-stress-specific S1 above the interacting constraint C, which in turn is ranked above the general stress constraint S. The typology predicts that there will be no language with the complementary asymmetrical pattern, in which the process applies only in secondary stressed syllables to the exclusion of primary stressed syllables

(1d). In previous chapters, apparent counterexamples to this prediction (e.g., Hixkaryana in §3.4.1) were shown to result from a separate process whose domain of application coincides with the domain of primary stress assignment, thereby obscuring the pattern and creating an apparent asymmetry.

However, there is another set of languages in which the pattern predicted not to occur by the factorial typology (i.e., (1d) above) is, in fact, attested. In §5.2 of this chapter, I demonstrate that stress assignment and quantity sensitivity interact in such a way as to yield all four of the patterns described in the table in (1), including the two different patterns of asymmetries in which: a) only primary stress is quantity sensitive (e.g., Huariapano, §5.2.3), and b) only secondary stress is quantity sensitive (e.g., Finnish §5.2.4).

In §5.3, I demonstrate that sonority-driven stress systems pattern like quantity-driven stress systems. I present data from Armenian, a language in which secondary stress is sensitive to sonority but primary stress is not. This is the converse of the pattern presented for Asheninca in §4.3.2, in which it was primary stress that was sonority-sensitive while secondary stresses were not.

I argue in §5.4 that it is possible to determine when the fourth logically possible pattern, in which a process applies only in secondary stressed syllables, will be attested and when it will not. I propose that the difference between those processes (such as quantity- and sonority-sensitivity) that do induce the fourth asymmetrical pattern and those that do not (e.g., stressed syllable lengthening – ch. 3) rests in a fundamental dichotomy: whether stress assignment is process-driven or whether the process is stress-driven. In process-driven stress languages, the contents of the syllables themselves do not

change due to high ranked faithfulness. In order for a word to have the most harmonic stress pattern, it is the placement of stress that must change or shift to fall on the most harmonic syllable. In languages with stress-driven processes, faithfulness is low ranking. The contents of the stressed syllables change in order to make the syllable more harmonic for stress.

I argue that in process-driven stress languages, a demand for primary stress to be edge-prominent may outweigh the need for primary stress to fall on a prominent syllable. It is because of such competing pressures on primary stress that the fourth asymmetrical pattern, in which secondary stressed syllables are targeted for a particular phonological process while primary stressed syllables are not, can arise.

I conclude the chapter in §5.5 with a summary.

5.2   Quantity sensitivity

In chapter 3, I discussed languages in which quantity and stress can interact. It was shown that some languages require stressed syllables to be heavy. One strategy that languages use to meet this requirement is through some form of quantity adjustment, typically, by lengthening the vowel of the stressed syllable (e.g., Chimalapa Zoque §3.2.2, Wargamay §3.3.1) or by geminating the onset of the following syllable (Kuuku-Yaʔu, §3.3.2). This was achieved by ranking the STRESS-TO-WEIGHT (S-to-W) constraint (Prince 1990) above faithfulness constraints preserving input weight (e.g., DEP-μ). In these languages, it can be said that weight is stress-driven.

However, there is another strategy for ensuring the relationship between stress and weight. In some languages, stress is attracted to weight, shifting off of a light syllable

in its default position in order to fall on a heavy syllable elsewhere. These languages are said to be *quantity sensitive*. Languages in which weight does not play a role in stress assignment are *quantity insensitive*.

In this section, I discuss languages with symmetrical and asymmetrical patterns of quantity (in-)sensitivity. In §5.2.1, I provide a brief discussion of Anguthimri, a language with phonemic vowel length but quantity insensitive stress assignment. In §5.2.2, data from Fijian are presented. In Fijian, primary and secondary stress assignment are both quantity sensitive.

While these two languages exhibit symmetrical behavior of primary and secondary stress assignment with respect to quantity, other languages exhibit an asymmetrical pattern of quantity sensitivity. In Huariapano (§5.2.3), only primary stress is quantity sensitive; secondary stresses are not. As demonstrated throughout this thesis, this can be accounted for by appealing to a primary-stress-specific constraint that stands in a stringency relation with a general version of that constraint. The asymmetrical pattern results when interacting constraints, in this case the stress placement constraints, are ranked intermediately between the two.

Due to the nature of the constraints in the stringency relation, we would not expect to find the converse or complementary pattern of Huariapano in which primary stress is quantity insensitive while secondary stress is quantity sensitive. However, such languages are attested. In §5.2.4, I provide data from Finnish, one of many languages that exhibits this pattern and show that an account of such a language does not compromise the stringency relation of the stress constraints.

5.2.1   *Quantity insensitive primary and secondary stress: Anguthimri*

In chapter 3, I discussed Anguthimri, a Paman language spoken in Cape York, Australia (Crowley 1981). It was shown that even though Anguthimri has a quantity distinction in the form of phonemic vowel length, it does not exhibit stressed vowel lengthening. That is, stress does not induce lengthening. As it turns out, long vowels do not attract stress either.

In Anguthimri, primary and secondary stress are both quantity insensitive. As seen in the following data (originally presented in §3.2.3 and repeated here) stress follows a left-to-right syllabic trochaic pattern, in which primary stress falls on the initial syllable and secondary stresses fall on every other nonfinal syllable thereafter, regardless of the weight of the syllables. That the trochees are syllabic as opposed to moraic is evident from the fact that syllables are counted during footing, independent of their internal structure. If footing were quantity sensitive, built from moraic trochees, we would expect long vowels to always bear stress, contrary to fact (e.g., [kwíniːɣi]).

(2)   Anguthimri

pána   'friend'

páːna   'level'

kálipwa   'gully'

kwíniːɣi   'cassowary'

ʔúnuwàna   'blister'

máɣuʔiːni   'mullet'

páʈupàʈaci   'cottonwood tree'

Within OT, nonexhaustive footing results from ranking FTBIN above PARSE-σ, while iterative footing results from ranking PARSE-σ above ALIGNFT-L. These

constraints, together with undominated TROCHEE, yield the basic alternating stress pattern. Because primary stress is aligned at the same edge as secondary stress, the ranking of ALIGNHD-L (the constraint responsible for aligning the primary stress foot at the left edge of the word) in the overall hierarchy is not critical. As long as it is ranked above its counterpart ALIGNHD-R, its ranking cannot be determined.

(3)   Basic stress pattern

/paɽupaɽaci/	FTBIN	PARSE-σ	ALIGNFT-L	ALIGNHD-L
a. ☞ (páɽu)(pàɽa)ci		*	**	
b. (pàɽu)(páɽa)ci		*	**	*!*
c. (páɽu)pa(ɽàci)		*	***!	
d. (páɽu)paɽaci		**!*		
e. (páɽu)(pàɽa)(cì)	*!			

By parsing the final syllable into a degenerate foot, candidate (e) fatally violates FTBIN. While candidate (d) fully satisfies ALIGNFT-L by having one perfectly left-aligned foot, it does so at the expense of violating PARSE-σ multiple times. Candidate (c) is eliminated by having one right-aligned foot. Candidates (a) and (b) tie with respect to PARSE-σ and ALIGNFT-L. ALIGNHD-L breaks the tie in favor of candidate (a), regardless of where it is ranked in the overall hierarchy.

Because both primary and secondary stress assignment are quantity insensitive, any constraint that would favor or demand a stressed heavy syllable (e.g., Smith's (2002) HEAVYσ/σ́, Prince & Smolensky's (1993/2002) PKPROM) must be ranked below the constraints responsible for the placement of primary and secondary stress. In the following tableau, I illustrate this with the constraint most often used to effect quantity

sensitivity in stress assignment: WEIGHT-TO-STRESS PRINCIPLE (WSP – Prince 1983, 1990).[1] Unfortunately, there are no forms in the data provided by Crowley that definitively demonstrate that a crucial ranking of the stress placement constraints above WSP is necessary, but we can illustrate this with a hypothetical form

(4)   Quantity insensitivity in Anguthimri

/cvcv:cvcv:cv/	ALIGNFT-L	ALIGNHD-L	WSP
a. ☞ (cv́cv:)(cv̀cv:)cv	**		**
b. (cv́cv:)cv(cv̀:cv)	***!		*
c. cv(cv́:cv)(cv̀:cv)	*,**!*	*	

Candidate (c) fully satisfies WSP by stressing both long vowels. However, it does so at the expense of violating the alignment constraints by shifting both primary and secondary stress away from the left edge of the word. Candidate (b) shifts the secondary stress onto a long vowel, but this too causes gratuitous violations of ALIGNFT-L. The winner in (a), which does not stress either of the long vowels, is selected as optimal because it best satisfies the higher ranking stress placement constraints.

5.2.2   *Quantity sensitive primary and secondary stress: Fijian*

Another language that exhibits a symmetrical pattern of primary and secondary stress assignment with respect to quantity sensitivity is Fijian, an Austronesian language described by Schütz (1985) and analyzed within derivational theory by Hayes (1995:142-147). In Fijian, (C)V syllables are light and (C)VV syllables, which can contain long vowels or diphthongs, are considered to be heavy (C can be a prenasalized consonant [m͡b], [n͡d], [ŋ͡g], or [n͡r]). There are no closed syllables. In Fijian, primary and secondary stresses pattern together in that they are both quantity sensitive.

(5)   Fijian

  a. láko   'go'   b. seŋái   'no'

      βináka   'good'   kilá: 'know'

  c. perèsiténdi   'president'   d. n͡rè:n͡ré: 'difficult'

      mìnisìtirí: 'minister'   paràimarí: 'primary'

      terènisìsitá: 'transistor'   n͡dàirèkitá: 'director'

If the final syllable is light, primary stress falls on the penult, as in (a). If the final syllable is heavy, it receives primary stress (b). Secondary stresses fall on every other light syllable preceding the primary stress (c) as well as on all remaining heavy syllables in the word (d).

Because primary stress falls on the penult as a default, else on the final syllable if it is heavy, feet must be trochaic. Therefore, the Fijian stress pattern can be described as assigning nonexhaustive, moraic trochaic feet iteratively from right to left. As was the case with Anguthimri, presented above, the basic pattern of iterative nonexhaustive footing results from ranking FTBIN >> PARSE-σ >> ALIGNFT-R. Again, the relative ranking of ALIGNHD-R cannot be established. Furthermore, high-ranked TROCHEE is assumed. In the following tableau, I consider a form with all light syllables.

(6)   Right-aligned trochees

/peresiten͡di/	FTBIN	PARSE-σ	ALIGNFT-R	ALIGNHD-R
a. ☞ pe(rèsi)(téndi)		*	**	
b. (père)si(téndi)		*	***!	
c. (père)(síte)n͡di		*	*,**!*	*
d. peresi(téndi)		**!*		
e. (pè)(rèsi)(téndi)	*!		**,****	

While candidate (e) fully satisfies PARSE-σ, it does so as the expense of violating high-ranked FTBIN. Candidate (d) fails to have iterative footing, thereby incurring extra violations of PARSE-σ. Candidate (c) violates both of the alignment constraints by having left-aligned instead of right-aligned feet. Of the remaining two candidates, candidate (a) emerges as the winner due to its better satisfaction of ALIGNFT-R.

To account for the fact that heavy syllables are always stressed, either with a primary or a secondary stress, regardless of where that stress would fall in the word, WSP must be ranked above the stress placement constraints. The following tableau demonstrates how WSP is decisive in assigning primary stress in a form with a final heavy syllable.

(7)   Quantity sensitive primary stress

/kila:/	WSP	FTBIN	PARSE-σ	ALIGNFT-R	ALIGNHD-R
a. ☞ ki(lá:)			*		
b. (kíla:)	*!				
c. (kí)la:	*!	*	*	*	*

Candidate (c) is completely ill-formed, violating each of the constraints once. While candidate (b) fares better than candidate (a) with respect to PARSE-σ, it places the stress on the light syllable instead of on the heavy syllable, thereby fatally violating WSP. This demonstrates that WSP must crucially dominate PARSE-σ (and, by transitivity, the alignment constraints) to allow candidate (a) to be selected as the optimal form. The ranking of WSP with respect to FTBIN cannot be determined.

This same ranking is responsible for the quantity sensitive secondary stress pattern. (I leave ALIGNHD-R and any candidates that would violate it out of the tableau for space considerations).

(8) Quantity sensitive primary and secondary stress

/paraimaɾːː/	WSP	FTBIN	PARSE-σ	ALIGNFT-R
a. ☞ pa(ràima)(ɾíː)			*	*
b. pa(rài)ma(ɾíː)			*!*	**
c. pa(rài)(mà)(ɾíː)		*!	*	*,**
d. (pàrai)ma(ɾíː)	*!		*	**
e. (pàrai)(máɾːː)	*!*			**

Candidate (e) fails to place either primary or secondary stress on a heavy syllable, thereby incurring two violations of WSP. While primary stress in candidate (d) is quantity sensitive, falling on the final heavy syllable, secondary stress fails to be attracted to the heavy second syllable, fatally violating WSP. Candidate (c) is eliminated by FTBIN for having a degenerate foot. While the final two candidates (a) and (b) are phonetically identical, the overall hierarchy selects (a) as the winner, since it better satisfies PARSE-σ than its competitor in (b). This is actually different than what a derivational analysis would predict for this form. In derivational theory, a moraic trochee can only contain two light syllables (LL) or a single heavy syllable (H); a (HL) foot, such as the one in candidate (a), would be ruled out by the theory. Thus, derivational theory would generate the structure in candidate (b), with a stranded light syllable. Within OT, both structures are possible output candidates, due to the property of Freedom of Analysis, which says

that any amount of structure can be posited in an output. Which one is selected as optimal is determined by the hierarchy.

By ranking WSP, the constraint requiring that heavy syllables be stressed, high above the general stress placement constraints, the pattern of quantity sensitive primary and secondary stress can be captured. Other languages like Fijian that have a symmetrical pattern of quantity sensitivity with respect to primary and secondary stress assignment include most iambic languages – since, by definition, iambic feet are quantity sensitive (see however, the descriptions of Araucanian and Paumari in chapter 2) – and the trochaic languages Lenakel and Southwest Tanna. Examples of unbounded systems with quantity sensitive primary and secondary stresses include Sindhi, Buriat and Khalkha Mongolian (§2.3.2), and Kuuku-Yaʔu (§3.3.2).

In some languages, however, primary and secondary stresses behave asymmetrically with respect to quantity sensitivity. In the next section, I provide data from Huariapano, which exhibits quantity sensitive primary stress but quantity insensitive secondary stress.

5.2.3   Asymmetry I: Quantity sensitive primary, quantity insensitive secondary

Huariapano, a Panoan language of Peru, is described and analyzed by Parker (1994, 1998). This language exhibits interesting interactions between metrical structure and various phonological phenomena. Of interest to us in this section is the relation between quantity sensitivity and stress assignment. The other metrically dependent phenomenon observed in this language, rhythmic coda epenthesis, in which a syllable-final [h] is inserted into certain odd-numbered syllables, will not be discussed here.

The vowel inventory of Huariapano consists of the short vowels [i], [o], [a] and the high back unrounded vowel, which Parker transcribes as [ï]. Long vowels only occur in monosyllabic open syllables as a means of meeting the bimoraic minimal word requirement, and thus are not phonemic. Monosyllabic closed syllables do occur, indicating that coda consonants are moraic.

The basic primary stress pattern of Huariapano is exemplified in (9). All data are taken from Parker (1998).

(9)   Huariapano primary stress pattern
       a. Penultimate stress

átˢa	'manioc'			
kóʂni	'beard'			
kanóti	'bow (weapon)'			
máyti	'hat'	cf.	maytíβuʔ	'hats'[2]
payáti	'hand-held fan'	cf.	pàyatíra	'fan (topic)'

       b. Final stress

yawíʂ	'opossum'
ʂomóʂ	'needle'
ʂaβín	'bee'

When the final syllable is open (i.e., light), primary stress falls on the penultimate syllable, as in the forms in (a). That this is the default position is evident from the fact that stress predictably shifts to the right when a suffix is added to the root. When the final syllable is closed (i.e., heavy), it attracts primary stress (b).[3] This pattern can be accounted for by assigning a moraic trochee at the right edge of the word.

Unlike primary stress, however, secondary stresses are insensitive to weight. They alternate in a quantity insensitive fashion.

(10)   Secondary stress pattern

       a. nòβirána   'we'
           hìimanóra   'in the village'
           yòmïirànoʂíki   'he is going to hunt'

       b. hàβombíβi   'they'
           ìnawkónra   'jaguar (topic)'
           čìβaŋkáŋki   'they followed'

       c. mìirayβaʂíki   'we found'
           kùβyayβaʂíki   'I cooked'
           čùkayβahkáŋki   'they washed'

The forms in (a) all have an even number of light syllables preceding the primary stress. It can be seen from these forms that, at the very least, secondary stress assignment is iterative and trochaic, though it is ambiguous as to whether they must be assigned with moraic trochees or syllabic trochees. The forms in (b) indicate that secondary stresses are quantity insensitive and therefore must be assigned using syllabic trochees. If secondary stress assignment were sensitive to weight, one would expect a secondary stress to fall on the closed second syllable. That it is not a rule of stress clash resolution that prevents a stress from surfacing on the closed syllable is evident from the forms in (c), since the closed second syllable is not immediately adjacent to the primary stress.

A further complication of secondary stress assignment is that the direction of parsing can either be from right to left or from left to right.

(11) Variation in the directionality of parsing

    a. Left-to-right

        β̃inanošíki   'he is going to seek/look for'

        wàn̈ikiráŋki   'they have returned'

        ìštokiráŋki   'it came running'

        yòm̈iràyβakanšíki   'they hunted'

    b. Right-to-left

        šinàkošón   'spider'

        miβòmbiráma   'you (plural)'

        βismànohkònošíki   'I forgot'

Parker argues, based on statistical frequency, that the default pattern is the one in (a), with left-to-right secondary stress assignment. The forms in (b) must be marked in the lexicon as having right-to-left parsing. In the remainder of this section, I will only present forms with the default left-to-right pattern of secondary stresses.

5.2.3.1 OT analysis

Parker's (1998) analysis, which I summarize here, appeals to the following constraints to capture the Huariapano pattern.

(12) TROCHEE: Feet must be trochaic.

     PARSE-σ: Syllables must be parsed into feet.

     FTBIN: Feet must be binary at some level of analysis (σ, μ)

     ALIGNHD-R: The right edge of the head foot must be aligned with the right edge of the prosodic word.

The constraints in (12) account for the primary stress pattern in words with a final light syllable. TROCHEE is assumed to be undominated.

(13) Penultimate primary stress

/kanoti/	ALIGNHD-R	FTBIN	PARSE-σ
a. ☞ ka(nóti)			*
b. (káno)ti	*!		*
c. (kà)(nóti)		*!	
/košni/			
d. ☞ (kóšni)			
e. (kóš)ni	*!		*
f. (kòš)(ní)		*!	

In the top half of the tableau for the form with all light syllables, candidate (b) is eliminated by ALIGNHD-R since there is one syllable standing between the head foot and the right edge of the word. Candidate (c) fatally violates FTBIN by having a monosyllabic degenerate foot. This establishes the crucial ranking of FTBIN >> PARSE-σ. Candidate (a) emerges as the winner by having a right-aligned binary foot, at the expense of leaving one syllable unparsed.

The form in the bottom half of the tableau has a heavy penult. Once again, FTBIN eliminates a candidate with a degenerate foot (f). Note that even though the remaining two candidates are phonetically identical, the hierarchy predicts that the structure of the candidate in (d) with the generalized trochee is optimal.

5.2.3.2 Primary-stress-specific PKPROM

To account for the fact that primary stress is quantity sensitive, being assigned with a moraic trochee, while secondary stress is quantity insensitive, Parker appeals to a primary-stress-specific version of Prince & Smolensky's (1993/2002) PKPROM constraint, the general version of which is defined below.

(14)   PKPROM: Peak(x) ≻ Peak(y) if |x| > |y|.

This constraint says that an element *x* is a more harmonic peak than *y* if the intrinsic prominence of *x* is greater than that of *y*. For Huariapano, prominence is determined on the basis of moraic content. That is, a heavy syllable makes a better stress peak than a light syllable (i.e., H́ > Ĺ). This constraint is not strictly binary, as it can assess scalar evaluations of the relative harmony of stress peaks. This is done by decomposing the non-binary PKPROM constraint into a fixed ranking of binary constraints that (negatively) correspond to each element on the harmony scale, e.g., *PK/Ĺ >> *PK/H́. (See chapter 4 for the scalar use of Peak-Prominence to evaluate languages in which relative prominence is based on vowel sonority rather than quantity). However, since the scale relevant for Huariapano is itself binary (heavy > light), I follow Parker in using the collapsed PKPROM constraint. (See also Walker 1997 for the use of Peak-Prominence to account for quantity sensitivity in unbounded systems.) Violation of scalar constraints is marked by listing in the appropriate cell the contents of the evaluated element (Prince & Smolensky 1993/2002:18). That is, violation of PKPROM for a candidate *x* with a stressed heavy syllable would be 'H' while that for a candidate *y* with a stressed light syllable would be L. Candidate *x* is considered to be more harmonic with respect to PKPROM than candidate *y*, since H > L.

PKPROM and WSP, the constraint that was appealed to in the previous sections to account for quantity sensitivity, overlap to a large extent. Both constraints result in a heavy syllable being stressed. In words where there is only a single heavy syllable, the two constraints evaluate candidates in exactly the same way: the candidate with stress on the heavy syllable is preferred over any competing candidate that has stress on a light syllable. However, they differ when it comes to evaluating words with multiple heavy syllables. PKPROM only compares the relative harmony of heavy and light stressed syllables, evaluating a heavy stressed syllable as being more harmonic than a light one. As long as a heavy syllable is stressed, it is not violated. PKPROM does not, however, require that all heavy syllables be stressed. This is the effect of WSP.

The constraint that Parker proposes to account for quantity sensitive primary stress is PKPROMMAIN, defined in (15).

(15)   PKPROMMAIN (Parker 1998:20):
       With respect to main stress, H́ > Ĺ.

This constraint says that a heavy primary-stressed syllable is better than a light primary-stressed syllable. It does not, however, evaluate the relative harmony of secondary-stressed syllables.

To demonstrate how this constraint evaluates candidates, consider first the following form with a final closed syllable. In this tableau, PKPROMMAIN is decisive in selecting the optimal form.

(16)   Quantity sensitive primary stress

/yawiš/	TROCHEE	FTBIN	ALIGNHDR	PKPROMMAIN	PARSE-σ
a. ☞ ya(wíš)				H	*
b. (yáwiš)				L!	
c. (yá)wiš		*!	*	L	*
d. (yawíš)	*!			H	

This tableau demonstrates the crucial ranking of PKPROMMAIN >> PARSE-σ. Candidate (b) fully satisfies PARSE-σ by parsing both syllables into a foot. However, it places stress on the light syllable, instead of on the heavy syllable. This incurs a fatal

violation of PKPROMMAIN. Candidate (a) satisfies PKPROMMAIN by stressing the final

heavy syllable at the expense of violating low-ranked PARSE-σ once, and is thus selected

as optimal. While candidate (d) fully satisfies PARSE-σ and PKPROMMAIN, it does so

using an iambic foot instead of a trochee. This demonstrates the crucial ranking of

TROCHEE >> PARSE-σ.

　　　To account for the default pattern of left-to-right parsing for secondary stress in a

form with all light syllables, it is necessary to appeal to ALIGNFT-L, which demands that

the left edge of every foot be aligned with the left edge of the prosodic word.

(17)　Left-aligned secondary stress

/β̃inanošiki/	ALIGNHD-R	FTBIN	PARSE-σ	ALIGNFT-L
a. ☞ (β̃ina)no(šíki)			*	***
b.　βi(nàno)(šíki)			*	*,***!
c.　(β̃ina)(nò)(šíki)		*!		**,***
d.　(β̃ina)(nóši)ki	*!		*	**

　　Candidate (d) demonstrates that ALIGNHD-R must dominate ALIGNFT-L,

otherwise the primary stress foot will be left-aligned, like the secondary stress feet,

instead of right-aligned. Candidate (c) is eliminated by FTBIN due to the fact that it has a

degenerate foot. The remaining two candidates fare equally well with respect to the high-

ranking constraints and PARSE-σ. ALIGNFT-L then selects the candidate in (a) with the

left-aligned secondary stress feet as the winner over candidate (b), which has all right-

aligned feet. Although it is not established in this tableau, PARSE-σ must crucially

dominate ALIGNFT-L to ensure that secondary stress footing is iterative in longer words.

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5.2.3.3 Asymmetrical pattern of quantity sensitivity

　　　In (16) above, it was demonstrated that the pattern of quantity sensitive primary

stress can be accounted for by ranking PKPROMMAIN above the stress constraint PARSE-σ

(which in turn must dominate ALIGNFT-L, as discussed above for (17)). In order to yield

a pattern of quantity insensitive secondary stress, it is necessary to rank all of these

constraints above general PKPROM. The following tableau illustrates this ranking for a

word with unparsed heavy syllables. I leave TROCHEE, ALIGNHD-R and any candidates

that would violate them out of the tableau for space considerations.

(18)　Quantity insensitive secondary stress

/mïrayβašiki/	PKPROMMAIN	FTBIN	PARSE-σ	ALIGNFTL	PKPROM
a. ☞ (mï̀ray)βa(šíki)	L		*	***	LL
b.　mï(ràyβa)(šíki)	L		*	*,***!	HL
c.　mï(rày)βa(šíki)	L		**!	*,***	HL
d.　(mïray)(βà)(šíki)	L	*!		**,***	LLL
e.　(mï̀)(ràyβa)(šíki)	L	*!		*,***	LHL

　　　All of the candidates in this tableau satisfy PKPROMMAIN as neither of the final

two syllables is heavy.[4] Candidates (d) and (e) fatally violate FTBIN by forming

degenerate feet. Candidate (c) picks up an extra violation of PARSE-σ by failing to parse

two of the syllables into feet and is thus eliminated. Of the remaining two candidates, (b)

better satisfies general PKPROM by shifting secondary stress away from its default

position at the left edge to fall on the heavy syllable. This demonstrates that ALIGNFT-L

must outrank PKPROM to ensure candidate (a)'s survival as the optimal form.

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5.2.3.4 Summary

In Huariapano, primary and secondary stresses behave asymmetrically with respect to syllable weight. Primary stress is quantity sensitive; it falls on the penultimate syllable as the default but shifts to the final syllable if it is closed. This was shown, in tableau (16), to result from ranking a primary-stress-specific PKPROM constraint over PARSE-σ. Secondary stresses, on the other hand, are quantity insensitive; they are left-aligned and do not shift to fall on a closed syllable to the right. This was shown in (17) to result from the ranking of ALIGNFT-L above the general PKPROM constraint. Because PARSE-σ must outrank ALIGNFT-L to account for the pattern of iterative footing, by transitivity, the following ranking schema is responsible for the asymmetrical pattern of primary and secondary stresses with respect to quantity sensitivity.

(19)   Asymmetrical pattern of quantity sensitivity:

Primary-stress-specific >> Stress placement constraints >> General stress

(PKPROMMAIN   >>   PARSE-σ >> ALIGNFTL >>   PKPROM   )

Without a primary-stress-specific version of the PKPROM constraint, the asymmetrical pattern of quantity sensitivity cannot be captured.

Given the nature of the stringency relationship between the two PKPROM constraints, we would not expect to find the complementary pattern of Huariapano, in which primary stress is quantity insensitive and secondary stress is quantity sensitive. This is, in fact, the conclusion that Parker independently draws in his (1998) paper. However, as it turns out, such languages are attested. In the next section, I present data from Finnish, just one of many languages that exhibits this asymmetrical pattern.

5.2.4   Asymmetry II: Quantity insensitive primary, quantity sensitive secondary

The stress pattern of Finnish (Uralic – Carlson 1978) has received a lot of attention in the OT literature. A few such analyses include Alber (1997), Elenbaas (1999), Elenbaas & Kager (1999), Hanson & Kiparsky (1996) and Kager (1992). Stress assignment in Finnish is fairly complex, being dependent upon various phonological and morphological factors. I focus in this section on the role of weight in stress assignment.

5.2.4.1 The data

As in Huariapano, primary and secondary stresses in Finnish behave asymmetrically with respect to quantity sensitivity. However, the Finnish stress pattern is complementary to that described above for Huariapano: primary stress is quantity insensitive while secondary stress is quantity sensitive. The following data (from Elenbaas 1999) illustrate the Finnish pattern. (C)V syllables are light, while (C)VV, (C)VC, and (C)VVC syllables are heavy.

(20)   Finnish

a.   #(σ́σ)…

á.te.rì.a   'meal.NOM'
rá.vin.tò.la   'restaurant.NOM'
ér.go.nò.mi.a   'ergonomics.NOM'
jǎr.jes.tèl.mä   'system.NOM'

b.   #(σ́σ)(L̀L)…

ré.pe.ä̀.ma   'crack, rupture.NOM'
pú.he.lì.me.na   'telephone.ESS'
pú.he.lì.me.nà.ni   'telephone.ESS.1SG'

c. #(σ́σ)L(H̀L)…

má.te.ma.tìik.ka	'mathematics.NOM'
pú.he.li.mìs.ta.ni	'telephone.ELAT.1SG'
rá.kas.ta.jàt.ta.rè.na	'mistress.ESS'
vá.lis.tu.màt.to.mi.àn.ne	'your uneducated'

Primary stress is quantity insensitive; it always falls on the initial syllable of the word regardless of its weight (or the weight of the second syllable), as shown in (a). Note that even if the first syllable is light and the second is heavy, primary stress falls on the initial light syllable. The secondary stress pattern is more complicated. Generally, secondary stresses follow a binary alternating pattern. After the primary stress, secondary stresses fall on all odd-numbered, nonfinal syllables in a string of light syllables, as in (b). However, secondary stress assignment is sensitive to quantity. When an odd-numbered light syllable is followed by a heavy syllable, the light syllable is skipped and secondary stress falls on the heavy syllable, creating a ternary pattern (c).[5]

5.2.4.2 OT analysis

It was demonstrated in §5.2.3 for Huariapano that by ranking a primary-stress-specific weight constraint in a stringency relation with a general weight constraint with the stress placement constraints ranked in between them, an asymmetrical pattern of quantity sensitive primary stress and quantity insensitive secondary stresses can be captured. For the other phonological processes discussed throughout this thesis (e.g. nonfinality effects, stressed vowel lengthening, high vowel lowering), it has been shown that there is no ranking of such a set of constraints that can account for the complementary asymmetrical pattern, in which the process applies only in secondary

stressed syllables and not in primary stressed syllables (see, for example, the discussion in §3.4 for stressed vowel lengthening).

It might seem that to account for the Finnish pattern in which only secondary stress is quantity sensitive, it is necessary to refer to a weight constraint that is relativized to secondary stress (as opposed to primary stress or even stress in general). A few proposals have appealed to positional constraints that are specific to weak positions as well as strong positions. For example, McCarthy & Prince (1995) propose both Root-faithfulness and Affix-faithfulness constraints. To account for the fact that there are languages that neutralize contrasts in affixes only but none that do so only in roots, these constraints are universally fixed so that the faithfulness constraints specific to the strong position Root are ranked above the weak-position-specific Affix-faithfulness constraints.

However, there are several reasons to reject the notion that constraints can be relativized to weak positions, such as affixes or secondary stressed syllables. First of all, there is no need to universally fix rankings in a theory that allows only general constraints and constraints specific to strong positions. The nature of the stringency relation of specific and general constraints allows free ranking permutability while generating only attested patterns. Furthermore, some analyses have proposed a general >> specific ranking for certain languages (e.g., de Lacy 2002a; Lombardi 1999). A theory of fixed strong >> weak would not be able to account for such languages.

Finally, as pointed out by Smith (2002), a weak position is not always an independently identifiable class; in some cases, it is only weak relative to some strong position. For example, the first syllable of a word is a strong position. Consequently, all remaining syllables are weak positions. In order for a constraint to refer only to the weak

position of a non-initial syllable, it must identify 'any syllable that is not the initial syllable'; thus, the grammar must still make reference to the strong position 'initial syllable' to conclude that its complement, any non-initial syllable, is weak. For this reason, Smith proposes that positional constraints may only make reference to strong positions. This is also the tack I adopt in this thesis.

How, then, can the Finnish pattern of quantity sensitive secondary stress be accounted for within OT using only general constraints or constraints specific to primary stress? As it turns out, such an account is fairly straightforward.

The pattern of quantity insensitive primary stress can be accounted for through an appeal to a high-ranking primary-stress-specific alignment constraint that demands that primary stress be left-aligned.

(21) ALIGNHD-L: Align(Hd, L, PrWd, L)
The left edge of every prosodic word must be aligned with the left edge of the head foot of the prosodic word.

When this constraint is undominated, it ensures that every word has initial primary stress.

The fact that stresses fall on odd-numbered, nonfinal syllables in a word with all light syllables indicates that stress is assigned by building trochaic feet, nonexhaustively from left to right. Once again, as demonstrated throughout this chapter, this pattern falls out from the ranking of FTBIN >> PARSE-σ >> ALIGNFT-L. These constraints, along with undominated TROCHEE, yield the basic alternating pattern.

(22) Left-aligned trochaic feet

/ergonomia/	ALIGNHD-L	FTBIN	PARSE-σ	ALIGNFT-L
a. ☞ (érgo)(nòmi)a			*	**
b. (érgo)no(mia)			*	***!
c. (érgo)nomia			**!*	
d. (érgo)(nòmi)(à)		*!		** ,****
e. er(góno)(mìa)	*!		*	* ,***

By placing primary stress on the second syllable instead of the first, candidate (e) incurs a fatal violation of ALIGNHD-L. Candidate (d), which creates a degenerate foot by exhaustively parsing the syllables, fatally violates high-ranked FTBIN. Candidate (c), on the other hand, is eliminated for its underparsing of syllables. The remaining two candidates tie with respect to PARSE-σ, leaving ALIGNFT-L to resolve the tie in favor of the candidate in (a) with all left-aligned feet.

An additional constraint is necessary to account for the influence of quantity on stress assignment. While primary stress is quantity insensitive, secondary stress assignment is sensitive to weight. For Huariapano in the previous section, it was necessary to appeal to both a primary-stress-specific and a general weight constraint. For Finnish, it is adequate to appeal only to the general version of a weight constraint, in this case, WEIGHT-TO-STRESS PRINCIPLE (WSP).

By ranking WSP below ALIGNHD-L, the quantity insensitivity of primary stress is assured.

(23) Quantity insensitive primary stress

/ravintola/	ALIGNHD-L	WSP
a. ☞ (rávin)(tòla)		*
b. ra(vínto)la	*!	

Candidate (a) with initial primary stress wins, even though it fails to stress the heavy second syllable, because of the high ranking of ALIGNHD-L. Candidate (b), with primary stress on the heavy second syllable, is eliminated due to its imperfect left-alignment of the head foot.

To account for the effects of quantity sensitivity on secondary stress placement, WSP must outrank the constraint responsible for left-alignment of all stress feet, ALIGNFT-L. This allows a heavy syllable to receive secondary stress, even though that results in a shift of stress away from the left edge of the word.

(24)   Quantity sensitive secondary stress

/matematiikka/	WSP	ALIGNFT-L
a. ☞ (máte)ma(tiikka)		***
b. (máte)(màtiik)ka	*!	**

Candidate (b) has the default, left-aligned binary pattern of secondary stress and thus fares better with respect to ALIGNFT-L than candidate (a). However, it fatally violates WSP by failing to stress the heavy fourth syllable. Candidate (a) satisfies WSP by shifting secondary stress away from its default position on the light third syllable in order to fall on the heavy fourth syllable, and is thus selected as optimal.

The following tableau demonstrates that WSP must outrank PARSE-σ as well.

(25)   WSP >> PARSE-σ

/puhelimestani/	WSP	PARSE-σ	ALIGNFT-L
a. ☞ (púhe)li(mèsta)ni		**	***
b. (púhe)(lìmes)(tàni)	*!		**, ****

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Although candidate (b) fully parses all of the syllables into disyllabic feet, it fails to place secondary stress on the heavy fourth syllable. Therefore, candidate (a) is selected as optimal, even though it violates PARSE-σ twice.

By transitivity, the asymmetrical pattern of quantity insensitive primary stress and quantity sensitive secondary stress falls out from the following ranking: ALIGNHD-L, FTBIN >> WSP >> PARSE-σ >> ALIGNFT-L.

Other examples of languages that have an asymmetrical pattern similar to that of Finnish include Cahuilla, Western Shoshoni, Apalai, Tübatulabal, and the unbounded system Koya.

5.2.5   Summary

In this section I have presented data from languages that exhibit an interaction between quantity sensitivity and stress assignment. In quantity sensitive languages, syllables with inherent weight (i.e., heavy syllables) attract stress, often shifting stress away from its default position. I demonstrated that stress assignment and quantity sensitivity interact in such a way as to yield four typological patterns, two of which are symmetrical and two asymmetrical. These patterns are summarized in (26).

(26)   Typological patterns of quantity sensitivity and stress assignment

Pattern	Example
a. Quantity insensitive primary and secondary stress	Anguthimri §5.2.1
b. Quantity sensitive primary and secondary stress	Fijian §5.2.2
c. Quantity sensitive primary, quantity insensitive secondary	Huariapano §5.2.3
d. Quantity insensitive primary, quantity sensitive secondary	Finnish §5.2.4

In the first two patterns (a,b), primary and secondary stress behave symmetrically with respect to quantity sensitivity. These language types are accounted for rather

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straightforwardly by ranking both the primary-stress-specific and general versions of the weight constraints (i.e., the unexploded weight constraint) in the same stratum above or below the interacting stress placement constraints. The asymmetrical pattern in (c) is of the type seen throughout this thesis, in which a particular phonological phenomenon interacts with primary stress but not with secondary stress. In Huariapano, quantity sensitivity affects primary stress placement but not secondary stress placement. This was accounted for by ranking the primary-stress-specific version of the weight constraint, PKPROMMAIN, above the stress placement constraints, which in turn were ranked above general PKPROM.

Due to the nature of the stringency relation of the weight constraints, we might not have expected to find the fourth pattern in (d), the complementary pattern of Huariapano, in which secondary stress is quantity sensitive while primary stress is not. However, Finnish exhibits such a pattern. In Finnish, primary stress always falls on the initial syllable, regardless of its weight. Secondary stress assignment, however, can switch from the default binary pattern to a ternary pattern if this results in secondary stress falling on a heavy syllable instead of a light syllable. I argued that it was not necessary to appeal to constraints specific to secondary stress to capture this pattern. Instead, I showed that this asymmetrical pattern of quantity-sensitivity can be accounted for by ranking the primary-stress-placement constraint ALIGNHD-L above unexploded WSP which, in turn, is ranked above the general stress placement constraint ALIGNFT-L.

In the next section I discuss another example of a process-driven stress language that exhibits an asymmetry like that seen in Finnish. In Armenian, sonority-sensitivity interacts with secondary stress assignment but not with primary stress assignment. This

pattern is the complementary or converse pattern of that discussed for Asheninca (§4.3.2), a language in which primary stress is sonority-sensitive but secondary stress is not.

5.3 Sonority-driven stress revisited: Armenian

A comprehensive description and analysis of the phonology of Armenian (Indo-European) and its numerous dialects is found in Vaux (1998). Of particular interest is his description of the metrical phonology of this language. While Vaux discusses several complexities of Armenian stress, most notably the interaction of stress and epenthetic vowels, I focus in this section on the role that sonority plays in stress assignment.

5.3.1 Primary stress

Vaux describes two basic types of Armenian stress systems, termed 'final stress' and 'penultimate stress' (1998:132). I describe here the stress facts of the 'final stress' dialects.

The superficial facts of the basic stress pattern are fairly straightforward. As the name suggests, primary stress in Armenian falls on the last full (i.e., non-epenthetic) vowel in the word.[6]

(27) Primary stress pattern
      morúk^h 'beard'
      artasúk^h 'tears'
      himá   'now'

Although I do not include an analysis of words with epenthetic vowels in this discussion, I will briefly describe the facts. If an epenthetic vowel is inserted to break up

a final cluster, stress falls on the penultimate vowel (i.e., the last full vowel of the word; e.g., /manr/ → [mánər] 'small', /erb-emn/ → [jerpʰémən] 'sometimes'). Words with no underlying vowels and one or more epenthetic schwas have initial stress (e.g., /tʰrmpʰ/ → [tʰə́rəmpʰ] 'noise made by heavy but soft object falling').

5.3.2   Secondary stress and vowel reduction

In many Armenian dialects, secondary stress is assigned to the initial syllable. (Languages such as Armenian, in which primary and secondary stress are assigned noniteratively at opposite word edges, are sometimes referred to as 'hammock' languages.) Vaux cites as evidence in support of this claim the fact that vowels in the initial syllable do not undergo unstressed vowel reduction/deletion.

(28)   Unstressed vowel reduction

    a. /ʃalakel/   →   [ʃalkel]   'carry on one's back'

    b. /sovorel/   →   [sovrel]   'study (v.)'

    c. /ʃalak/   →   [ʃalak], *[ʃlak]   'back'

Vaux asserts that the vowel in the penultimate syllable in (a) and (b) reduces because it is unstressed. Since reduction only applies to unstressed vowels, the initial and final vowels are immune to reduction because they bear secondary and primary stress, respectively. Likewise, the penultimate vowel in (c) does not reduce because it bears secondary stress. Compare this with the penultimate stress dialects. Vaux argues that the penultimate stress dialects do not assign secondary stress to the initial syllable because this syllable does exhibit vowel reduction. For example, the Classical Armenian form *harsanikʰ* 'wedding' is realized as [hàrsníkʰ] in Standard Western Armenian (a final stress dialect) vs. [hərsánikʰ] in the penultimate stress dialect Goris (1998:148).

Like the mid and low vowels shown above, high vowels also delete (or are reduced to schwa) in unstressed syllables, e.g. /makʰur-el/ → [màkʰrél] 'clean'. [7] However, they also reduce when in the initial syllable.

(29)   High vowel reduction in initial syllables

    /bun-ak/   →   [bənák]   'inhabitant'

    /gir-e-l/   →   [gərél]   'write'   (cf. [gír] 'letter')

    /kʰir-kʰ-a-dun/ →   [kʰərkʰadún]   'library, bookshop'

If initial syllables bear secondary stress, and vowel reduction is restricted to unstressed syllables, why do high vowels in the initial syllable undergo reduction? Vaux (1998:149) proposes that secondary stress assignment applies only to nonhigh vowels. That is, secondary stress assignment is sonority-sensitive. However, primary stress is insensitive to vowel sonority, as it may fall on both high and nonhigh full vowels in the final syllable (e.g., [morúkʰ]).

5.3.3   Analysis of the hammock pattern

While Vaux (1998) provides a derivational analysis of Armenian stress using the theory of Halle & Idsardi (1995), I analyze the primary and secondary stress facts within the framework of Optimality Theory.

Within OT, final primary stress can be assigned in one of two ways: either by right-aligning an iambic foot or via right-edge prominence. If it is assumed that Armenian has iambic feet in order to place primary stress on the final syllable, then assigning secondary stress is problematic, since a left-aligned iambic foot cannot place stress on the initial syllable. Furthermore, most iambic languages are sensitive to quantity distinctions, but Armenian is quantity insensitive. Therefore, final primary stress must result from right-edge prominence.

The pattern of final stress in prominence-based systems results from appealing to a high ranking peak-alignment constraint that aligns a primary stressed syllable at the right edge of the word.

(30) ALIGN(PWd, R, Hd-ó, R):

The right edge of every word must be aligned with a (primary) stressed syllable.

This constraint is similar to the ALIGNHD-L/R constraint used for the languages discussed in the preceding sections except that it makes reference to the head syllable of the prosodic word as opposed to the head foot. (For this reason, I abbreviate this constraint ALIGNHDó-R.)

Similarly, assigning a secondary stress to the initial syllable can be achieved by appealing to a general peak-alignment constraint that aligns a stressed syllable at the left edge of the word.

(31) ALIGN(PWd, L, ó, L)

The left edge of every word must be aligned with a stressed syllable.

I abbreviate this constraint as ALIGNó-L. Together, these two constraints generate the hammock pattern of noniterative stresses at opposite word edges.

(32) Hammock pattern

/ʃalak/	ALIGNHDó-R	ALIGNó-L
a. ☞ ʃàlák		
b. ʃalák		*!
c. ʃálak	*!	

Candidate (c) places primary stress on the initial syllable. This causes a fatal violation of ALIGNHDó-R, since the primary stress is one syllable away from the right

edge of the word. ALIGNó-L, however, is satisfied since there is a stress of some kind at the left edge of the word. Candidate (b), satisfies ALIGNHDó-R, but by not having a secondary stress on the initial syllable, it fatally violates ALIGNó-L. The winner in (a) satisfies both constraints by placing a secondary stress on the initial syllable and a primary stress on the final syllable. The relative ranking of these two constraints with respect to one another cannot be established at this time.

5.3.4 Analysis of sonority sensitivity

To account for the avoidance of secondary stress assignment on high vowels, we can appeal to the constraints in the Peak Prominence Hierarchy, discussed in chapter 4. This hierarchy is repeated here for convenience.

(33) Peak Prominence Hierarchy: *P/ə́ >> *P/í >> *P/é >> *P/á

According to this hierarchy, less sonorous vowels (such as the central and high vowels) are avoided as foot peaks in favor of more sonorous vowels (i.e., the nonhigh peripheral vowels). I discussed in chapter 4 two strategies that languages use to avoid stressing low-sonority vowels. Some languages increase the sonority of the stressed vowel at the expense of violating faithfulness. It was shown that this is the strategy used by Chamorro, which lowers stressed high vowels to mid (§4.2.1). Other languages shift stress away from a low-sonority vowel in its default position to fall on a more sonorous vowel elsewhere. In Asheninca (§4.3.2), primary stress shifts leftward from a low-sonority vowel in the final foot to a more sonorous vowel in the penultimate foot. As it turns out, Armenian employs a third strategy – it foregoes the stress altogether.

First, I discuss an account of the asymmetrical pattern of sonority-insensitive primary stress/sonority-sensitive secondary stress. In Armenian, the sonority asymmetry results from ranking the primary-stress placement constraint ALIGNHDσ́-R above the (general) Peak Prominence constraint prohibiting stressed high vowels (*P/í), which in turn is ranked above the general stress placement constraint ALIGNσ́-L. The remaining Peak Prominence constraints are ranked below the left-alignment constraint.[8]

(34) Sonority-sensitive secondary stress

/bun-ak/	ALIGNHDσ́-R	*P/í	ALIGNσ́-L
a. ☞ bunák			*
b. bùnák		*!	
c. búnak	*!	*	

The worst candidate is the one in (c) which not only stresses a high vowel, but also places primary stress one syllable away from the right edge, fatally violating ALIGNHDσ́-R. Candidate (b), with the hammock pattern, satisfies both of the alignment constraints; however, it places secondary stress on a high vowel, fatally violating the general Foot-peak Prominence constraint *P/í. Candidate (a) satisfies *P/í by not placing secondary stress on the high vowel. Even though this compels a violation of ALIGNσ́-L, the low-ranking of this constraint ensures candidate (a)'s survival.

This ranking, by itself, does not account for the fact that Armenian avoids violating *P/í by failing to place secondary stress altogether, rather than by shifting the stress or changing the vowel. To account for this, we must appeal to an additional constraint that penalizes stresses. This constraint, called *GRIDSTRUC (Walker 1997), is a member of the *STRUC family (Prince & Smolensky 1993/2002:25, fn.13), which ensures

that structure is constructed minimally. *GRIDSTRUC penalizes each stress in a word and is only fully satisfied in a word with no stresses. It therefore must be dominated by LX≈PR (i.e., Lexical Word ≈ Prosodic Word; Prince & Smolensky 1993/2002:45), the constraint that demands that each word have at least one stress. *GRIDSTRUC cannot be ranked above ALIGNσ́-L or else secondary stress will never surface. Ranking *GRIDSTRUC just below ALIGNσ́-L ensures that it is generally inactive; however, as seen in the following tableau, it is decisive in just those cases when there is a tie between a candidate with a shifted secondary stress and one with no secondary stress.

(35) No secondary stress on high vowel

/kʰir-kʰ-a-dun/	ALIGNHDσ́-R	*P/í	ALIGNσ́-L	*GRIDSTRUC
a. ☞ kʰìrkʰadún		*	*	*
b. kʰìrkʰàdún		*	*	**!
c. kʰìrkʰadún		**!		
d. kʰìrkʰádun	*!	*		

Candidate (d) attempts to avoid a violation of *P/í by shifting primary stress away from the right edge; however, this causes a fatal violation of high-ranked ALIGNHDσ́-R. Candidate (c) places primary and secondary stress in their default positions, thereby incurring two violations of *P/í, the second of which is fatal. The remaining two candidates tie with respect to *P/í; they both place primary stress on the final high vowel. They also both violate ALIGNσ́-L once. Recall that this constraint demands that there be a stressed syllable at the left edge of the word. Neither (a) nor (b) places a stress on the initial syllable and so both violate the constraint equally. The tie is passed down to *GRIDSTRUC, which selects in favor of candidate (a) since it has no secondary stress. The

crucial ranking of ALIGNσ́-L above *GRIDSTRUC, though not evident here, is necessary for those forms that have a nonhigh vowel in the initial syllable which must be stressed.

Other examples of languages that show sonority-sensitivity in secondary stress assignment but not in primary stress assignment include Azerbaijani (Householder 1965; Hurch 1996) and Alyawarra (Yallop 1977).

5.3.5   Summary

Armenian exhibits an asymmetry of primary and secondary stress, whereby primary stress is insensitive to sonority but secondary stress is sonority-sensitive. This is the complementary pattern of the asymmetrical pattern discussed in chapter 4 for sonority-driven stress languages. In §4.3.2, it was demonstrated that in Asheninca, primary stress assignment is sonority-sensitive, avoiding high vowels in favor of more sonorous vowels. Secondary stress assignment has no such restrictions.

Armenian is similar to Finnish in that, in both languages, a phonological process interacts only with secondary stress and not with primary stress. It was demonstrated that such a pattern can be accounted for without the need to appeal to constraints that are specific to secondary stress. Instead, the ranking ALIGNHD σ́-R >> *P/í >> ALIGNσ́-L >> *GRIDSTRUC, which incorporates only general and primary-stress-specific constraints, is able to account for the pattern.

In the next section, I present a proposal for why quantity- and sonority-driven stress languages such as Finnish and Armenian can exhibit patterns of asymmetry in which only secondary stressed syllables are targets of the process in question while other kinds of languages, such as those that exhibit stressed vowel lengthening, cannot.

5.4   Predicting patterns of asymmetry

5.4.1   Stress-driven process vs. Process-driven stress

As demonstrated in the preceding sections (as well as in chapter 4), quantity- and sonority-sensitivity interact with stress assignment in such a way as to yield the full range of logically possible stress patterns. These patterns and the languages that exhibit them are summarized in the following table.

(36)   Typological patterns of weight-sensitivity and stress assignment

Pattern	Quantity	Sonority
a. Weight-insensitive primary and secondary stress	Numerous languages (e.g. Anguthimri §5.2.1)	Numerous languages
b. Weight-sensitive primary and secondary stress	Fijian §5.2.2	Yimas §4.3.1
c. Weight-sensitive primary, weight-insensitive secondary	Huariapano §5.2.3	Asheninca §4.3.2
d. Weight-insensitive primary, weight-sensitive secondary	Finnish §5.2.4	Armenian §5.3

The fact that there are languages in which a process interacts solely with secondary stress to the exclusion of primary stress seems to run counter to the claim made throughout this thesis that stress constraints can only be relativized to primary stress to capture patterns of asymmetry. Given the nature of the stringency relation between a primary-stress-specific constraint and the general version of that constraint, factorial typology predicts that when these constraints are ranked with respect to an antagonistic constraint, there will be no language in which the process interacts only with secondary stresses and not with primary stress. Thus, the patterns found in Finnish and

Armenian seem to foil any attempts at making generalizations about the types of stress patterns that would be expected to occur and not to occur in the world's languages.

However, I argue that it is possible to determine when the fourth logically possible pattern, in which a process applies only in secondary stressed syllables, will be attested and when it will not. I propose that the difference between those processes that do induce the fourth asymmetrical pattern and those that do not rests in a fundamental dichotomy: whether stress assignment is process-driven or whether the process is stress-driven.

For example, in the languages discussed in chapter 3, the process of quantity adjustment or lengthening is stress-driven: the vowel (or consonant) undergoes lengthening because it is stressed. For the quantity-sensitive languages discussed in this chapter, it is the process that drives the stress: a syllable is assigned stress if it is heavy.

If it is this distinction of stress-driven processes vs. process-driven stress that explains the difference in the predictions made about the kinds of typological patterns that are attested, it makes certain claims about how other kinds of phonological processes would be expected to interact with stress assignment. For instance, other phonological processes that can be driven by stress location (e.g., vowel lowering) would be expected to interact with stress in an asymmetrical way so as to produce three of the four typological stress patterns; the fourth, as in the vowel lengthening case, should be unattested. This was demonstrated in chapter 4 for languages with stress-driven sonority. While high vowel lowering can occur in a primary stressed syllable to the exclusion of secondary stressed syllables (as in Chamorro §4.2.1), there is no language in which only high vowels in secondary stressed syllables lower.

On the other hand, phonological processes that influence the location of stress would be expected to interact with stress in such a way as to generate the full range of stress patterns. In chapter 4, in addition to languages with stress-driven sonority, I discussed languages with sonority-driven stress, in which stress assignment is dependent upon whether the nucleus of the syllable is high in sonority. It was shown that in Asheninca (§4.3.2), primary stress assignment was sensitive to the sonority of the vowel while secondary stress assignment was not. Since sonority-driven stress systems pattern like quantity-driven stress systems in that stress is assigned based on the inherent properties of the syllable, we would expect to find a language that is the complement or converse of Asheninca, in which primary stress is immune to sonority considerations but secondary stress assignment is sonority-sensitive. As demonstrated in §5.3, such a language is attested.

It was shown that in Armenian, secondary stress is sensitive to sonority but primary stress is not. As with the quantity-sensitive language Finnish, secondary stress in Armenian is process-driven. It is assigned only so long as the vowel it would fall on is nonhigh; otherwise, it is not assigned.

5.4.2   *Competing pressures on primary stress*

I argue that the reason why process-driven stress systems can yield the (otherwise) unexpected pattern of asymmetry is because there are competing pressures being placed on primary stress. In many languages, it is important for primary stress to mark edge-prominence. In edge-prominent systems, the primary stress always falls on the initial or final (possibly also nonfinal, see Walker 1997 and the discussion in chapter 2) syllable in the word. Sometimes, this need can be subordinated to a competing demand

that primary stress fall on a syllable with inherent prominence, such as a heavy syllable or a syllable with a high sonority nucleus. In languages in which a phonological process interacts with primary stress only and not secondary stress, it is a primary-stress-specific constraint that compels main stress to shift away from its default edge-marking position (e.g., Huariapano). However, in other languages, the need for primary stress to mark edge-prominence outweighs the need for it to fall on a syllable with inherent prominence. In these languages, the primary-stress-specific constraint responsible for placing main stress on a fixed syllable at a particular edge outranks the primary-stress-specific constraint that would otherwise force the main stress to shift onto a more prominent syllable. It is in these cases, when one constraint demanding that primary stress be edge-aligned outranks another that would shift it away from that position, that we see patterns in which a process only applies in secondary stressed syllables.[9]

For example, the Finnish pattern discussed in §5.2.4 results from there being two such competing pressures on primary stress: 1) the pressure for primary (and secondary) stress to fall on a heavy syllable, and 2) the pressure for primary stress to fall on the initial syllable. The first of these is the one that is active and dominant in Huariapano (i.e., PkPromMain). This constraint is ranked high above the general stress placement constraints to achieve the pattern of quantity sensitive primary stress assignment. In Finnish, however, this pressure is subordinated to the other demand that primary stress be initial in the prosodic word (due to AlignHd-L). Thus, the weight constraint in Finnish (WSP in this case) is able to remain unexploded since the primary-stress-specific version of that constraint is rendered inactive by the higher ranking of AlignHd-L.

The same is true for Armenian. Secondary stress is sonority-sensitive: it does not fall on an initial syllable if that syllable contains an (underlying) high vowel. This is due to a constraint banning stressed high vowels (*P/í) being ranked above the constraint responsible for placing (secondary) stress on the initial syllable, Alignσ́-L. The sonority constraint for Armenian, however, is unexploded or defined generally at the level of the foot, prohibiting stressed high vowels of any kind, whether they would bear primary stress or secondary stress. If unchecked, this constraint would cause primary stress, as well as secondary stress, to avoid falling on a high vowel. However, this pressure on primary stress is subordinated to an overriding pressure for primary stress to mark edge-prominence in Armenian by falling on the final syllable. This is enforced by another primary-stress-specific constraint, AlignHdσ́-R, which dominates the Peak Prominence constraint, *P/í. The result is that primary stress is insensitive to sonority, falling on the final syllable regardless of the sonority of its nucleus.

The full typology of patterns resulting from the interaction of stress assignment and weight-sensitivity involves two competing sets of primary-stress-specific (S1) and general (S) constraints pertaining both to weight (Wt) and stress placement (Stress). The ranking schemata for the languages and stress patterns discussed in this chapter are summarized in the table below.

(37) Ranking schemata for patterns of stress-weight interactions

Ranking	Pattern
a. STRESS-S1, STRESS-S >> WT-S1, WT-S	Weight-insensitive primary and secondary stress
b. WT-S1, WT-S >> STRESS-S1, STRESS-S	Weight-sensitive primary and secondary stress
c. WT-S1 >> STRESS-S1, STRESS-S >> WT-S	Weight-sensitive primary, weight-insensitive secondary
d. STRESS-S1 >> WT-S1, WT-S >> STRESS-S	Weight-insensitive primary, weight-sensitive secondary

When the two primary-stress-specific constraints are in conflict, as in (37c,d), they yield two different patterns of primary and secondary stress asymmetries.

5.5   Conclusion

Languages with stress-driven processes like vowel lengthening and vowel lowering exhibit only three of the four logically possible stress patterns: two symmetrical patterns in which both primary and secondary stresses are uniformly targeted or ignored for the process in question, and one asymmetrical pattern in which only primary stressed syllables undergo the process. However, languages with process-driven stress, such as the quantity- and sonority-sensitive languages discussed in this chapter, also exhibit the fourth logically possible pattern, in which only secondary stressed syllables are targeted for a particular phonological process.

I argued that it is possible to account for this fourth pattern without the need to resort to secondary-stress-specific constraints. The reason why process-driven stress systems can yield the (otherwise) unexpected pattern of asymmetry is because there are

competing pressures being placed on primary stress. In many languages, it is important for primary stress to mark edge-prominence. When this pressure is given priority over the competing demand that primary stress fall on a syllable with inherent prominence, the asymmetrical pattern of weight-sensitive secondary stress/weight-insensitive primary stress results.

[1] Other constraints in the OT literature that have been used to demand the coincidence of heavy syllables and stress include Prince's (1990) STRESS-TO-WEIGHT PRINCIPLE (S-to-W, discussed in chapter 3), Prince & Smolensky's (1993/2002) PKPROM and Smith's (2002) HEAVYσ/σ́. Smith argues that her HEAVYσ/σ́ (which penalizes monomoraic stressed syllables) is equivalent to S-to-W, WSP, and one of the constraints encapsulated in PKPROM (see §5.2.3 for the use of this constraint in a quantity-sensitive language). The difference between those languages that make stressed syllables heavy by lengthening vs. those in which heavy syllables attract stress is due to the relative ranking of HEAVYσ/σ́ among the stress placement and faithfulness constraints. I have elected to use the more familiar (albeit separate) constraint names for the weight-related stress constraints in this chapter and throughout the thesis.

[2] When a word with a final vowel in its underlying form is pronounced in isolation, it often surfaces phonetically with a final [ʔ]. This consonant, which only surfaces in this context, does not contribute weight to the final syllable.

[3] There are exceptions. Some vowel-final words (about 25% of Parker's corpus) have exceptional final stress. Interestingly, all of these words are nouns. Parker argues that these forms have a final lexical accent which surfaces due to Noun Faithfulness (Smith 1998).

[4] One candidate I do not consider is one in which primary stress falls on the heavy pre-antepenultimate syllable. However, such a candidate would be ruled out by its egregious violations of ALIGNHD-R.

[5] A word-final heavy syllable that is preceded by an unstressed syllable is only optionally stressed. However, a word-final light syllable is never stressed.

[6] Exceptions to the final stress rule include ordinal numbers (which stress the final syllable of the root, e.g. [híŋkʰ-erortʰ] 'fifth'), some adverbs (which may optionally have initial stress, e.g. [híma]~[himá] 'now'), and hypocoristics (initial stress).

[7] There are apparent exceptions to this generalization. Vaux (1998:149) proposes that high vowel reduction is restricted to derived environments. For example, the high vowel in the second syllable in the monomorph [amusín] 'spouse' does not reduce because it is in a nonderived environment.

[8] I do not account for the reduction facts in this tableau, as it is beyond the scope of the present discussion. In actual fact, the output form for /bun-ak/ 'inhabitant' is [bənák], not *[bunák]. This is an opaque form. Secondary stress is not assigned to an initial syllable if it contains a high vowel, but the output form [bənák] does not contain a high vowel in the initial syllable. Because stress avoids falling on a schwa, one might account for this pattern by appealing to high-ranked *P/ə́, which is independently motivated since both primary and secondary stress avoid falling on schwa (except when forced to by LX≈PR in a word with only schwa vowels). However, this does not help in those cases when the high vowel is deleted completely instead of just being reduced. Furthermore, schwa resists bearing both primary and secondary stresses, while high vowels resist only secondary stress. A comprehensive OT account would require an appeal to one of the many proposals that have been put forth to deal with opacity effects (e.g., Kiparsky 2000; McCarthy 1999). The Armenian facts are not particularly problematic for such an account.

Dresher & van der Hulst (1998) analyze similar phenomena within Head-Dependency phonology. They claim that languages like Huariapano have what are called Head-Dependent Asymmetries (HDAs). These asymmetries result from the fact that phonological heads allow more complexity than their dependents. For example, in languages like Huariapano, the head foot of the word bearing primary stress is sensitive to a deeper level of analysis than the dependent feet. Only the head foot is built on lower-level projections from syllable structure in which the distinction between light vs. heavy is maintained. The dependent (secondary stress) feet have no access to this distinction, and are built on projections which do not differentiate lower-level syllable structures (Dresher & van der Hulst 1998:343).

Dresher & van der Hulst argue that languages like Finnish, which seem to go against their hypothesis by having a head foot that is less complex than the dependent feet, are not really examples of HDAs at all. They claim that in Finnish, primary stress is assigned at the lexical level (on the word plane), while secondary stresses are assigned at the postlexical level (or prosodic plane). Because primary and secondary stress are not derived from the same projection, they are independent of each other and have no bearing on the nature of HDAs (1998:346).

CHAPTER 6:

CONCLUSION

6.1   Residual issues

In this thesis, I have demonstrated that many languages exhibit asymmetrical stress patterns that support proposing a set of stress constraints that are formulated to refer specifically to primary stress as opposed simply to stress in general. I devoted the most attention to languages displaying asymmetrical stress patterns of nonfinality, stressed syllable lengthening, vowel lowering (i.e., stress-driven sonority), and quantity- and sonority-sensitivity. Importantly, I showed that these languages contrast with others that show symmetrical behavior of primary and secondary stresses with respect to these same processes. Together, these languages demonstrate that it is crucial to have both the general version of these markedness constraints as well as the primary-stress-specific version to account for the full range of attested patterns.

There are, of course, many other phonological processes that can interact with stress assignment. For instance, in addition to quantity- and sonority-related phenomena, Smith (2002) discusses cases of stressed syllables interacting with tone, the presence of an onset, and the need for low-sonority onsets. These types of stress/prominence interactions have received little or no attention in this thesis. In large part, this is due to the difficulty in finding languages that fill out the full range of predicted symmetrical and

asymmetrical patterns. However, of the languages that I am aware of that do exhibit asymmetrical patterns, none of them contradict the predicted patterns. I discuss some examples of languages with stress-tone interactions in §6.1.1 and languages with onset-sensitivity in §6.1.2.

Furthermore, there have been proposals for various primary-stress-specific constraints in the stress literature. Kager (2001) proposes several relating to stress lapses and clashes in an attempt to do away with the ALLFT-X constraints (or ALIGNFT-X, in my terminology), which have been claimed to overgenerate unattested patterns. I summarize his proposal in §6.1.3.

Finally, I have devoted the discussion in this thesis to positional markedness constraints that are specific to primary stress. I have made no claims about whether there is evidence in favor of proposing primary-stress-specific faithfulness constraints. I briefly address this notion in §6.1.4.

6.1.1 Stress-tone interactions

Stress-tone interactions have been widely documented (most notably by de Lacy 2002b). High tone is a perceptually prominent property and is often associated with stress. For example, in the Hare dialect of Slave (Rice 1987), a verb root's lexical high tone is attracted to the prefix immediately preceding the root because that is the location of stress. That is, the stressed syllable attracts high tone. In other languages, high tone attracts stress. In Golin (Bunn & Bunn 1970), stress falls on the rightmost high-toned syllable in the word (else on the final syllable in words with all low tones), while in Lithuanian (Blevins 1993) and Neo-Štokavian Serbo-Croatian (Zec 1999), stress falls on the leftmost high-toned syllable, else the initial syllable.

In each of these languages, which are the most often cited as illustrating stress-tone interactions, there is only one stress per word. In analyzing these languages, the constraints responsible for capturing the stress-tone interaction (HTONE/σ́ in Smith 2002, *HEAD/LOW in de Lacy 2002b) need only refer to stress (or prosodic heads) in general. There is no evidence that a primary-stress-specific constraint is necessary.

Few languages with stress-tone interactions have multiple stresses. Of those that do (e.g., Hixkaryana, Aguaruna), there is only one high tone per word which happens to fall at the same edge at which primary stress is aligned. Thus, they fail to provide definitive evidence for the need for a tone prominence constraint that is specific to primary stress. For example, in Aguaruna (Payne, D.L. 1990), high tone (or accent) falls on one of the first three moras (typically the peninitial mora) in the word. Primary stress is assigned to the syllable bearing high tone. Evidence for rhythmic secondary stresses comes in the form of a syncope rule that elides the third and every alternate vowel bounded by consonants. Assuming feet are iambic, the vowel in the unstressed syllable of every stress foot but the initial one is deleted. Because it is primary stress that is assigned to the syllable bearing high tone, it could be said that this language exhibits an asymmetrical pattern of primary and secondary stress-tone interaction. However, there is no evidence that secondary stress is *not* sensitive to tone. Because there is only one high tone per word which must fall at the left edge, there is never an opportunity for secondary stress assignment to be influenced by tone, since primary stress is also left-aligned. Similarly, in Hixkaryana (Derbyshire 1985), primary stress coincides with the location of high pitch in the various intonation patterns, which always falls on the final or penultimate syllable. Because there is only one high tone per word that falls at the right

edge, and secondary stresses iterate from left to right, there is no opportunity to test whether secondary stress assignment can be influenced by tone. Analyses of Aguaruna and Hixkaryana need not appeal to a primary-stress-specific constraint to assign primary stress to the high-toned syllable. The constraint may refer simply to stress in general; a separate constraint aligning primary stress with a particular word edge would suffice to ensure that the stress that appears on the high-toned syllable will be primary stress.

There are languages in which high tone is assigned iteratively using metrical structure. For example, in Lamba (Bickmore 1995), high tone falls on the leftmost mora of a certain class of prefixes (called 'attractor' prefixes) as well as on every other mora up to the root. Thus, the stress domain is parsed into trochaic feet and high tone is assigned to the head of each foot. There is some question as to whether there is actually a stress on the head of each foot. However, even if there are stresses, there is no evidence of a primary-secondary distinction and all of the stresses attract high tone in the same way. Once again, there is no evidence that a primary-stress-specific constraint is needed in stress-tone interactions over and above a constraint that refers simply to stressed syllables in general.

In sum, the languages that I am aware of with multiple stresses and/or multiple high tones do not contradict the claim made in this thesis that constraints may, and sometimes must, refer specifically to primary stress in order to capture certain asymmetrical patterns of primary and secondary stress. However, they do not actively provide evidence in support of it either. More investigation is needed to determine if there are languages with stress-tone interactions that must crucially refer to constraints demanding the coincidence of high tone and primary stress in particular.

6.1.2 Stress-onset interactions

Slightly better evidence for primary-stress-specific constraints can be found in languages with onset-sensitivity. Smith (2002) proposes a constraint [*ONSET/X]/ʹ, which penalizes onsets of sonority X in stressed syllables. (This is similar to de Lacy's (2000) *ʹ/MARGIN/X.) This constraint is active in languages that require low-sonority onsets in stressed syllables. For example, in Pirahã (Everett 1988; Everett & Everett 1984), while stress is quantity sensitive, being attracted to syllables with long vowels over those with short vowels, it is also onset sensitive. Stress falls on the rightmost heaviest syllable in the last three syllables of the word. If the syllables have the same rhyme weight, stress is attracted to a syllable with a voiceless onset over one with a voiced onset (which in turn is preferred over an onsetless syllable). Because there is only one stress per word, the constraints responsible for achieving the onset-sensitivity pattern (*[Onset/D]/ʹ >> *[Onset/T]/ʹ) need only refer to stressed syllables in general.

However, there are languages in which primary and secondary stressed syllables have different requirements on the kinds of onsets they may have. For example, in Niuafo'ou (de Lacy 2000, 2001; Tsukamoto 1988), glide onsets cannot appear in primary-stressed syllables. While glide onsets do not appear anywhere in native forms, loanwords with glide onsets in stressed syllables are realized in Niuafo'ou with a syllabic high vowel preceding the stressed syllable (e.g., [i.á.te] 'yard', *[já.te]; [u.í.pi̥] 'whip', *[wí.pi̥]). That primary and secondary stresses appear to behave asymmetrically with respect to glide onsets is evident in the form [njù.i.ó.ka] 'New York'. The first syllable [nju] contains a glide in the onset and bears secondary stress, but the primary stressed

syllable cannot contain a glide and instead is preceded by syllabic [i]. However, this is the only form cited by Tsukamoto (1988) in which it is possible to test the behavior of both primary and secondary stresses with respect to glide onsets.

A similar pattern is found in Alyawarra (Yallop 1977). Primary stress falls on the leftmost syllable with an onset (e.g., [rín.ha] '3p pronoun', [i.lí.pa] 'axe') unless that onset is a glide, in which case primary stress falls on the second syllable (e.g., [ju.kún.tʲa] 'ashes', *[jú.kun.tʲa]; [wa.líjm.pa.rra] 'pelican', *[wá.lijm.pa.rra]). However, secondary stress, which alternates after the primary stress on nonfinal syllables, can fall on a syllable with a glide onset (e.g., [atⁿ.tí.ri.jàl.pi.na] 'ran back'). Thus, primary and secondary stress behave asymmetrically with respect to glide onsets. This pattern falls out from the ranking of primary-stress-specific *[ONSET/glide]/ớ₁ above the stress placement constraint ALIGNHD-L which in turns outranks the general *[ONSET/glide]/ớ constraint.

Another language with an asymmetrical pattern of onset-sensitivity is Madimadi (Davis 1988; Hercus 1969). In this language, primary stress is attracted to a syllable with a coronal onset while secondary stress is not.

These languages provide support for positing onset-sensitive constraints that are specific to primary stress. To fill out the typology, we should also find a language in which primary and secondary stressed syllables behave symmetrically with respect to what kinds of onsets are allowed or disallowed. Asheninca is such a language.

While it was discussed in §4.3.2 that Asheninca (Payne, J. 1990) has a primary-secondary stress asymmetry with respect to vowel sonority, these two types of stresses behave symmetrically with respect to onset sensitivity. There are two syllables, /tsi/ and /sʲi/, that never receive stress. Because Ci syllables that contain onsets other than /ts/ and

/sʲ/ can be stressed, Payne concludes that it is the onset that makes these extralight syllables repel stress. That both primary and secondary stress avoid falling on these syllables is evident in the form [pì.sʲi.tá.tsi.ri] 'broom'. Even though Asheninca is a left-to-right iambic system, both primary and secondary stress fall on odd-numbered syllables, having each shifted to the left to avoid falling on the extralight second and fourth syllables.

However, de Lacy (1997) argues that Asheninca does not exhibit onset-sensitivity but rather sonority-sensitivity. Because these syllables are realized phonetically as [tsɨ] and [sʲɨ], with a high central vowel, he argues that stress avoids falling on them because they contain low-sonority vowels. As discussed in §4.3.2, Asheninca does exhibit sonority-sensitivity; primary stress avoids falling on light syllables containing the high vowel [i] in favor of syllables with more sonorous vowels (though secondary stress assignment is not so affected). This would mean that primary and secondary stress behave symmetrically with respect to avoidance of stressed [ɨ] but asymmetrically with respect to stressed [i]. While this pattern might seem counterintuitive, it is not problematic for an OT analysis. A high ranking general Foot-peak Prominence constraint *P_FT/ɨ would prevent the central vowel from bearing either primary or secondary stress. To account for the asymmetrical pattern of stressed high vowel avoidance, the Peak Prominence constraint against stressed high vowels would be exploded into its specific and general counterparts, with the interacting stress placement constraint ranked in between them: *P_WD/í >> ALIGNHD-R >> *P_FT/í. Besides Asheninca, I am not aware of any other languages in which both primary and secondary stresses behave identically

with respect to onset-sensitivity. Further research is necessary to determine if the full range of typological patterns is attested in onset-sensitive languages.

6.1.3   *Clash- and Lapse-at-Peak

Kager (2001) proposes several primary-stress-specific constraints to account for systematic gaps in factorial typologies of stress systems. The two main gaps he describes are: 1) the lack of right-to-left strictly binary iambic systems (e.g., *[0(02)(02)(01)]), and 2) the lack of bidirectional systems in which stresses alternate toward a fixed secondary stress at an edge (e.g., *[(20)0(20)(10)] or *[(10)(20)0(20)]). He proposes that languages with such patterns are disallowed because lapses of adjacent unstressed syllables (i.e., […00…]) are only allowed at the right edge of a word (at the end of a left-to-right parse) or adjacent to the primary stress. That is, lapses are licensed at the right word edge and at the word peak (i.e., main stress). He proposes two constraints that license the rhythmically marked structure of a stress lapse: LAPSE-AT-END ('Lapse must be adjacent to the right edge, i.e., if 00 then 00]), and LAPSE-AT-PEAK ('Lapse must be adjacent to the peak, i.e., if 00 then 100 or 001). Following Zoll (1996), these constraints license a marked property in a strong position. While stress lapses are typically excluded in a context-free fashion, they can be licensed in strong positions, such as at the word end or at a word peak. Of particular interest for the purposes of our discussion, is the constraint LAPSE-AT-PEAK, which is relativized to primary stress. Kager (2001:6) shows that these constraints, in conjunction with the context-free *LAPSE constraint, predict that languages with non-peripheral lapses between secondary stresses will not occur. Such languages are claimed to be unattested.

Some languages, however, avoid lapses strictly, at the expense of stress clashes. In these languages, there are fixed stresses at both word edges. In the string between the edge stresses, lapse is avoided in favor of clashes. Kager demonstrates that in every case, when there is an even-numbered string of syllables between the fixed stresses, ensuring a clash, the clash never involves the main stress. Instead, clash occurs between two secondary stresses (e.g., trochaic L→R [(10)(20)(2)(2)] or R→L [(2)(20)(10)]; iambic L→R [(01)(02)(2)] or R→L [(2)(2)(02)(01)]). Once again, Kager proposes a constraint relativized to primary stress: *CLASH-AT-PEAK ('No clash involves a word peak'). He claims that the two primary-stress-specific constraints LAPSE-AT-PEAK and *CLASH-AT-PEAK are functionally motivated. They move stresses away from the word peak, either by licensing lapse, or by banning clash. He claims this is necessary because "peaks are focal points of rhythmic density, which must be compensated in their immediate surroundings by less dense (rarified) portions" (Kager 2001:10).

It is not clear whether these constraints predict the same kinds of symmetrical patterns, in addition to the asymmetrical ones, that are predicted by the primary-stress-specific constraints discussed in this thesis. Kager does not discuss if there are other patterns of lapses and clashes that are attested. For instance, in languages in which clashes are allowed more freely, are there languages with symmetrical patterns in which clashes can occur both between secondary stresses and between a secondary and a primary stress? Once again, this is an avenue for future research

6.1.4   Primary-stress-specific faithfulness

In this thesis I have examined languages with process-driven stress and languages with stress-driven processes. In process-driven stress languages, faithfulness is high

ranking. The contents of the syllables themselves do not change. In order for a word to have the most harmonic stress pattern, it is the placement of stress that must change or shift to fall on the most harmonic syllable. The quantity- and sonority-sensitive languages discussed in chapter 5 are examples of such process-driven stress systems.

The remaining language types discussed in this thesis were the languages with stress-driven processes. In these languages, faithfulness is low ranking. The contents of the stressed syllables change in order to make the syllable more harmonic for stress.

I accounted for patterns of asymmetry, in which change occurs only in primary stressed syllables, by appealing to positional markedness constraints specific to primary stress rather than positional faithfulness constraints. This is due to the fact that it is precisely those syllables bearing primary stress that are the context for neutralization. A primary-stress-specific positional faithfulness constraint would prevent neutralization from occurring in primary stressed syllables, contrary to what is observed. Smith (2002) and de Lacy (2001) claim that these kinds of positional neutralization effects in strong positions are motivated either by the pressure to increase or augment phonetic prominence or to reduce prosodic markedness. Smith (2002) proposes a Prominence Condition Filter to rule out any strong-position-specific markedness constraints that do not call for or increase perceptually prominent properties.

It is clear that positional markedness constraints are necessary to account for such phenomena. It is also clear, as demonstrated in this thesis, that both general and primary-stress-specific positional markedness constraints are necessary to account for the symmetrical and asymmetrical stress patterns observed in the world's languages. What is

not clear is whether it is also necessary to have positional faithfulness constraints that refer specifically to primary stressed syllables as well.

Smith (2002:73) proposes that, just as there is a filter that restricts the set of markedness constraints that can refer to strong positions, there is a filter, which she calls the Feature Licensing Condition, that restricts certain faithfulness constraints from referring to strong positions. This filter is based on the observation made by Steriade (1993; 1995) that the special licensing abilities of strong positions (i.e., the ability to resist neutralization processes that affect weak positions) are restricted to features whose salient cues are found in that position. For instance, in all of the cases of languages with positional licensing effects in stressed syllables discussed by Beckman (1998), the positional faithfulness constraints only refer to vowel features, such as height, tone, tenseness, and nasality. None of them refer to consonantal features. Smith claims that this is because phonetically strong positions can only have a special faithfulness or licensing relationship with features for which that position possesses salient cues. Since the phonetic prominence of a stressed syllable is related to the duration, amplitude, and/or pitch contour of the rhyme, all of which increase vowel perceptibility, there are positional faithfulness constraints involving vowel features but not consonant features.[1]

The implication seems to be that there are no restrictions on the kinds of stress-specific positional faithfulness constraints that can occur, as long as they involve vowel features. We might expect positional faithfulness constraints referring specifically to primary stress to likewise be unrestricted. However, I am aware of only one type of primary-secondary stress asymmetry that lends itself to an account appealing to a

primary-stress-specific faithfulness constraint. Interestingly, however, languages with this pattern can also be analyzed using positional markedness constraints as well.

There are languages in which only primary stressed syllables may contain long vowels while secondary stressed syllables may not. For example, in Nez Perce (Crook 1999), phonemic long vowels only surface as long when they bear primary stress. In secondary stressed or unstressed syllables, underlying long vowels shorten. To prevent shortening in primary stressed syllables, a primary-stress-specific faithfulness constraint demanding preservation of input weight (IDENTWEIGHT-$\acute{\sigma}_1$) must be ranked above a context-free markedness constraint banning long vowels (*VV). Ranking *VV in turn above general IDENTWEIGHT would cause shortening elsewhere, in both unstressed and secondary stressed syllables. The ranking schema for this pattern resembles those seen for the languages with positional markedness accounts discussed throughout this thesis: primary-stress-specific >> antagonistic constraint >> general constraint.

A similar pattern is found in Gugu-Yimidhirr (Kager 1996; Zoll 1998). In this language, long vowels may only surface in the first two syllables of the word. This is true of derived length as well. Some suffixes trigger vowel lengthening in the preceding syllable. If this syllable is one of the first two syllables of the word, lengthening occurs. If it is not, lengthening is blocked. Kager (1996) argues that the first two syllables of the word form a prominent domain which he calls the Head Prosodic Word. The length contrast is only allowed in the Head PrWd and not outside of it. Because primary stress falls on every long vowel in the Head PrWd (even if both syllables are long), the same ranking as that proposed above for Nez Perce would account for the basic pattern of

vowel shortening in syllables not bearing primary stress (i.e., those syllables outside of the Head PrWd).

The problem is that, as pointed out by Zoll (1998), positional faithfulness of this kind cannot account for the fact that derived long vowels are blocked from occurring in non-primary-stressed syllables. Strong-position-specific faithfulness constraints only enforce preservation of input weight in primary stressed syllables. They cannot block derived long vowels in weak position. The existence of such constraints would wrongly predict that if derived marked structures are allowed to surface, they will do so in non-primary stressed syllables, contrary to fact.

For this reason, Zoll (1998) proposes a kind of positional markedness constraint to account for the Gugu-Yimidhirr pattern. The constraint, which she calls COINCIDE($\sigma_{\mu\mu}$, HeadPrWd), says that long vowels are only licensed in strong position, i.e., in the Head PrWd (or in primary stressed syllables, in my terminology). This constraint has the advantage of allowing derived vowel length if it occurs in the Head PrWd and disallowing it elsewhere, something that the positional faithfulness constraint cannot do. Smith (2002) demonstrates that licensing constraints of the COINCIDE type are similar to positional augmentation constraints – they are both markedness constraints that make reference to strong positions, and analyses using COINCIDE constraints have been proposed to account for cases of positional augmentation. (However, they cannot account for all types of positional augmentation. See Smith (2002:§5.2.3) for a more detailed discussion.)

I am not aware of whether derived long vowels are similarly blocked in Nez Perce. Regardless, the positional markedness analysis using the licensing-type COINCIDE

constraint would correctly derive the basic Nez Perce pattern of vowel shortening in weak position as it does in Gugu-Yimidhirr. That is, an analysis using primary-stress-specific faithfulness constraints is not necessary to account for the asymmetrical pattern in these languages.

A potential problem for either type of analysis is the existence of languages with the converse pattern of Nez Perce and Gugu-Yimidhirr in which long vowels in primary stressed syllables shorten while those in secondary stressed syllables do not. In Boumaa Fijian (Dixon 1988; Schütz 1985), a long vowel or a diphthong in a penultimate syllable bearing primary stress obligatorily shortens, while long vowels elsewhere in the word bearing secondary stress do not (e.g., /siːβi/ → [síβi] 'exceed', cf. [sìːβíta] 'exceed.TRANS'). This is an example of what is known as *trochaic shortening*. The motivation behind this process is the fact that a (HL) trochaic foot is considered to be less harmonic than a (LL) foot, due to the Iambic/Trochaic Law (Hayes 1995:80), which says that trochaic feet should consist of units equal in duration. (See chapter 3 for further discussion of this law.)

A positional faithfulness analysis cannot account for this pattern because it is a strong position, a primary stressed syllable, that undergoes neutralization, not a weak position. Neither can an analysis using positional augmentation constraints account for the pattern, since shortening the vowel in a stressed syllable decreases perceptual prominence.

Baković (1996; 1997) accounts for the primary stress pattern by appealing to a Foot Harmony constraint (FTHARM) that favors (LL) feet over (HL) feet and ranking it above the faithfulness constraint MAX-μ, which prevents input long vowels from

shortening (for additional discussion of FTHARM, see §3.2.1). However, this ranking predicts that trochaic shortening would also occur in secondary stressed syllables, though it does not. Allowing the FTHARM constraint to refer specifically to primary stress goes against Smith's (2002) theory that markedness constraints can only refer to strong positions if they increase perceptual prominence. However, it is consistent with de Lacy's (2000, 2001) proposal that markedness constraints referring to prominent or strong positions strive to reduce prosodic markedness. Trochaic (LL) feet are less prosodically marked than (HL) feet. Thus, the asymmetrical pattern of trochaic shortening in primary but not secondary stressed syllables could be accounted for by ranking a primary-stress-specific FTHARM constraint above MAX-μ above general FTHARM. However, since FTHARM is also relevant in evaluating iambic feet, the existence of a primary-stress-specific constraint MAINFTHARM would imply the existence of an iambic language that exhibits iambic lengthening in the main stress foot, but not in secondary stress feet. I know of no such language.[2]

In sum, I know of no clear cases of languages with primary and secondary stress asymmetries that would require an appeal to primary-stress-specific faithfulness constraints that could not also be accounted for using positional markedness constraints. This should, perhaps, not be surprising.

Working from the assumption that positional constraints can only refer to strong positions, then positional faithfulness constraints can potentially refer only to primary stress, but not specifically to secondary stress. For an asymmetrical pattern to emerge in an analysis appealing to positional faithfulness constraints, the primary-stress-specific faithfulness constraint must outrank an antagonistic markedness constraint which in turn

would outrank the faithfulness constraint specific to stress in general. This ranking would yield a pattern in which a particular process occurs only in secondary stressed syllables to the exclusion of primary stressed syllables. I have claimed that such patterns are predicted to arise only when a particular set of conditions is met, namely, when the process in question drives stress assignment, i.e., when stress is process-driven. For this reason, it would be appealing to be able to claim that primary-stress-specific faithfulness constraints do not exist and that all cases of stress asymmetry are due to positional markedness constraints. However, it is not clear how the theory should prevent these constraints from appearing in CON, especially when faithfulness constraints referring to stressed syllables in general are well-motivated.

6.2   Conclusion

As the languages discussed in this thesis demonstrate, phonological processes can interact with primary and secondary stress assignment in such a way as to produce a typology of different stress patterns. The inherent typological nature of Optimality Theory makes this an ideal framework for analyzing such phenomena. When primary and secondary stresses behave in the same way with respect to a particular process, a constraint that refers to stress in general is ranked either above or below an antagonistic constraint. The stress literature is rife with examples of languages whose primary and secondary stresses behave symmetrically with respect to some phonological phenomenon. Less common are examples of languages in which primary and secondary stresses behave differently or asymmetrically with respect to a particular process. An important empirical and typological contribution of this thesis is the table provided in

chapter 1, which contains numerous examples of languages that display asymmetrical behavior of primary and secondary stress with respect to a wide variety of different phonological phenomena. To account for such patterns within OT, I showed that a constraint referring specifically to primary stress must be ranked above its general counterpart in a stringency relation, with an interacting antagonistic constraint ranked intermediately between them.

It is proposed that stress constraints may only refer specifically to primary stress or to stress in general to capture such asymmetries, but never exclusively to secondary stress. This is in keeping with recent proposals that positional constraints (both faithfulness and markedness) can only refer to 'strong' positions, such as onsets, roots, or stressed syllables, and never to 'weak' positions.[3] Further, it expands on the set of proposed strong positions that have been discussed in the literature in order to account for the wide array of stress languages that treat primary and secondary stressed syllables differently with respect to particular phonological processes.

Some of the constraints that have been discussed in this thesis that can be relativized to primary stress include NONFINALITY, the STRESS-TO-WEIGHT PRINCIPLE (S-to-W), the Peak Prominence constraints that evaluate the relative harmony of stressed syllable sonority (*$PEAK_{FT}$/$\acute{V}$) and quantity (PKPROM), and the alignment constraints.

All of these constraints (or constraint hierarchies) stand in a stringency relation with their general counterparts, such that violation of the primary-stress-specific constraint (S1) necessarily implies violation of the general constraint (S), but not vice versa. When these constraints are ranked in a factorial typology with an antagonistic constraint (C), it makes certain predictions about the types of stress patterns that are

expected to occur and not to occur in the world's languages. These predictions are summarized in the following table.

(1)   Patterns predicted by factorial typology of S1, S and C

Ranking	Process applies in…
a. S1, S >> C	Both primary and secondary stressed syllables
b. C >> S1, S	Neither primary nor secondary stressed syllables
c. S1 >> C >> S	Primary stressed syllables only
d. No ranking	*Secondary stressed syllables only

The symmetrical patterns in (1a,b), in which primary and secondary stress behave identically with respect to the process in question, result from ranking the stress constraints together, either above the antagonistic constraint (in which case neither type of stress is affected by the process) or below it (in which case they both are affected). As discussed above, the asymmetrical pattern in (1c), in which only primary stressed syllables undergo the process while secondary stressed syllables do not, falls out from ranking the antagonistic constraint in between the stringent constraints, with the primary-stress-specific constraint ranked highest.

The pattern that is predicted not to occur (1d) is a language in which only secondary stressed syllables undergo some process to the exclusion of primary stressed syllables. This is due to the fact that there is no ranking of a primary-stress-specific constraint, its stringent general counterpart, and an interacting constraint that will yield such a pattern. In large part, this prediction is borne out. For example, there are no languages in which vowels lengthen or lower in secondary stressed syllables only.

However, there is another set of languages in which the pattern predicted not to occur by the factorial typology (i.e., (1d) above) is, in fact, attested. For example, stress assignment and weight-sensitivity (both quantity- and sonority-sensitivity) interact in such a way as to yield all four of the patterns described in the table in (1), including the two different patterns of asymmetry in which: a) only primary stress is weight-sensitive, and b) only secondary stress is weight-sensitive.

One of the primary contributions to emerge from this thesis is the claim that it is possible to predict when the fourth logically possible pattern, in which a process applies only in secondary stressed syllables, will be attested and when it will not. The difference between those processes that do induce the fourth asymmetrical pattern and those that do not rests in whether stress assignment is process-driven or whether the process is stress-driven.

In chapter 5, I argued that the reason why process-driven stress systems can yield the (otherwise) unexpected pattern of asymmetry is because there are competing pressures being placed on primary stress. In many languages, it is important for primary stress to mark edge-prominence by always falling on a (near-) peripheral syllable. Sometimes, this need can be subordinated to a competing demand that primary stress fall on a syllable with inherent prominence (e.g., a syllable with a long vowel, high sonority nucleus, low-sonority onset, etc.). In languages in which a phonological process interacts only with primary stress and not with secondary stress, it is a primary-stress-specific constraint that compels main stress to shift away from its default edge-marking position. However, in other languages, the need for primary stress to mark edge-prominence outweighs the need for it to fall on a syllable with inherent prominence. In these

languages, the primary-stress-specific constraint responsible for placing main stress on a fixed syllable at a particular edge outranks the primary-stress-specific constraint that would otherwise force the main stress to shift onto a more prominent syllable. It is because of such competing pressures on primary stress that the fourth asymmetrical pattern, in which secondary stressed syllables are targeted for a particular phonological process while primary stressed syllables are not, can arise.

Notes

[1] According to Smith, the same restriction does not hold for positional markedness or augmentation constraints; there are no restrictions on the possibilities for augmentation on phonetically strong positions besides the Prominence Condition, which ensures that all positional markedness constraints are augmentation constraints. Examples of positional augmentation constraints that refer to the strong position stressed syllable and consonant features include the ONSET/ɕ and *[ONSET/X]/ɕ constraints.

[2] See, however, Menomini (Bloomfield 1962; Buckley 1998), an iambic language that only exhibits iambic lengthening of a stressed open vowel in the initial foot. While the distinction between primary and secondary stress is problematic (Bloomfield (1962:19-21) claims that all long vowels bear primary stress; words without long vowels apparently have no primary stress), Hayes (1995:220) conjectures that the initial foot may have historically been assigned primary stress. This might explain why it is singled out for iambic lengthening.

[3] Notable exceptions include feature-markedness constraints that refer to weak positions such as codas, e.g., NOCODA and CODACOND. While codas are considered to be weak positions, no analyses have proposed a unified theory of feature-markedness constraints that can refer to weak positions in general. It is possible that the coda constraints can be reformulated so that reference solely to weak positions is not necessary. See Baertsch (2002), who proposes a unified set of constraints on syllable margins that governs both onsets and codas.

APPENDIX

CLASSIFICATION AND REFERENCES FOR LANGUAGES WITH STRESS ASYMMETRIES

The genetic classification of the following languages from the table in (4) in Chapter 1 are from the online version of the 14th edition of the SIL Ethnologue: Languages of the World (ed. by Barbara F. Grimes), found at http://www.ethnologue.com.

Language	Classification	References
Alabama	Muskogean	Rand (1968)
Alyawarra	Australian	Yallop (1977), Goedemans (1996)
Anyula	Australian	Kirton (1967)
Apalai	Carib	Koehn & Koehn (1986)
Aranda, Western	Australian	Strehlow (1945), Goedemans (1996)
Armenian	Indo-European	Vaux (1998)
Asheninca Campa	Arawakan	J. Payne (1990), Payne, Payne & Santos (1982)
Awtuw	Sepik-Ramu	Feldman (1986)
Azerbaijani	Altaic	Householder (1965)
Banawa	Arawan	Buller, Buller & Everett (1993)
Biangai	Trans-New Guinea	Dubert & Dubert (1973)
Buriat	Altaic	Walker (1997)
Cahuilla	Uto-Aztecan	Seiler (1965, 1977)
Cambodian	Mon-Khmer	Nacaskul (1978)
Carib, Surinam	Carib	Vijver (1998), Buckley (1998)
Catalan	Indo-European	Mascaró (1978)
Cayapa	Barbacoan	Lindskoog & Brend (1962)
Cebuano	Austronesian	Bunye & Yap (1971), Shryock (1993)
Chamorro	Austronesian	Chung (1983), Crosswhite (1998)
Delaware	Algic	Goddard (1979)
Djabugay	Australian	Patz (1991)
Estonian	Uralic	Hint (1973), Prince (1980), Hayes (1995)
Fijian, Boumaa	Austronesian	Schütz (1985), Dixon (1988)

Finnish	Uralic	Harms (1964), Elenbaas (1999)
Gaelic, Irish	Indo-European	Mhac an Fhailigh (1968)
Garawa	Australian	Furby (1974)
Georgian	South Caucasian	Zhgenti (1964), Aronson (1991)
Gidabal	Australian	Geytenbeek & Geytenbeek (1971)
Greek	Indo-European	Revithiadou (1999), Revithiadou & van de Vijver (1996)
Guahibo	Guahiban	Kondo (2001)
Gugu-Yalanji	Australian	Oates & Oates (1964)
Guugu-Yimidhirr	Australian	Haviland (1979), Kager (1996)
Hebrew, Tiberian	Afro-Asiatic	McCarthy (1979a), Hayes (1985)
Hixkaryana	Carib	Derbyshire (1979, 1985)
Huariapano	Panoan	Parker (1994, 1998)
Icelandic	Indo-European	Árnason (1980, 1985)
Inga	Quechuan	Levinsohn (1976)
Italian	Indo-European	Nagy & Napoli (1996), D'Imperio & Rosenthall (1999)
Kara	Niger-Congo	Schlie & Schlie (1993), de Lacy (1997)
Khalkha	Altaic	Walker (1997)
Koya	Dravidian	Tyler (1969)
Kuuku-Yaʔu	Australian	Thompson (1976)
Lenakel	Austronesian	Lynch (1974, 1978), Hammond (1985)
Lower Sorbian	Indo-European	Janas (1984)
Madimadi	Australian	Hercus (1986), Goedemans (1997)
Maithili	Indo-European	Jha (1958), Hayes (1995)
Margany/Gunya	Australian	Breen (1979)
Maung	Australian	Capell & Hinch (1970)
Mingrelian	South Caucasian	Klimov (2001)
Murut	Austronesian	Prentice (1971)
Nez Perce	Penutian	Crook (1999)

Nganasan	Uralic	Helimski (1998), de Lacy (2002a)
Niuafo'ou	Austronesian	Tsukamoto (1988), de Lacy (2001)
Nyawaygi	Australian	Dixon (1983)
Paumari	Arawan	Everett (2002, 2003)
Piro	Kiowa Tanoan	Matteson (1965)
Polish	Indo-European	Booij & Rubach (1985), Hayes (1985)
Romanian	Indo-European	Chitoran (1996)
Sanuma	Yanomam	Borgman (1989)
Seneca	Iroquoian	Stowell (1979), Michelson (1983)
Sentani	Trans-New Guinea	Cowan (1965), Elenbaas (1996, 1999)
Shoshoni, Western	Uto-Aztecan	Crum & Dayley (1993)
Sibutu Sama	Austronesian	Allison (1979), Kager (1997)
Sindhi	Indo-European	Khubchandani (1969), Walker (1997)
Spanish	Indo-European	Harris (1983), Roca (1986)
Tauya	Trans-New Guinea	MacDonald (1990)
Totonac, Misantla	Totonacan	MacKay (1994, 1999)
Tübatulabal	Uto-Aztecan	Voegelin (1935), Wheeler (1979)
Udihe	Altaic	Nikolaeva & Tolskaya (2001)
Veps	Uralic	Zaitseva (1981)
Votic	Uralic	Ariste (1968), Viitso (1997)
Waalubal	Australian	Crowley (1978), Hammond (1986)
Walmatjarri	Australian	Hudson (1978)
Wargamay	Australian	Dixon (1981)
Watjarri	Australian	Douglas (1981)
Yukulta	Australian	Keen (1983)
Yupik, Central Alaskan (Norton Sound)	Eskimo-Aleut	Krauss (1985)
Yupik, Pacific (Chugach)	Eskimo-Aleut	Leer (1985)
Zoque, Chimalapa	Mixe-Zoque	Knudson (1975)

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