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SELECTED TOPICS IN NOOTKA AND TŪBATULABAL PHONOLOGY

by

NORA AION

**A dissertation submitted to the Graduate Faculty in Linguistics
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy, The City University of New York.**

2003

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ABSTRACT

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by

Nora Aion

Adviser: Professor Charles E. Cairns

This dissertation undertakes a phonological analysis of two Native-American languages: Tūbatulabal, and Tseshah̄t, a dialect of Nootka. Phenomena in both languages make them ideal for evaluating competing phonological theories: extreme opacity in Tūbatulabal, and stress exceptions in Tseshah̄t.

In Tseshah̄t, the word-initial foot has a unique standing. Each word has just one foot, the leftmost two syllables in the word. Several phonological processes, such as Stress-Assignment and Vowel Coalescence occur only within the foot. Furthermore, Tseshah̄t has what appears to be a three-way distinction in vowel length: short, long, and “variable”. A variable-length vowel is long in either of the first two syllables of the word and is short in the third or later syllable of the word. Stress in Tseshah̄t falls on the first syllable, unless it is light and the second syllable is heavy, in which case the second syllable receives the stress. A heavy syllable in Tseshah̄t contains either a long vowel or a short vowel followed by a nasal. There are a number of exceptions to this stress rule in which stress is outside of the “foot”. No previous analyses have satisfactorily accounted for these exceptions.

In Tübatulabal, every odd-numbered vowel, starting from the left, is subject to a lengthening rule. Productive vowel deletion rules in the phonology render both reduplication and alternate lengthening opaque. The vowel-lengthening rule is rendered opaque by virtue of the deletion of the middle syllable, which makes vowels lengthened by alternate lengthening adjacent. Previous theories use stipulations and arbitrary rules to handle such cases. Tübatulabal stress occurs on odd-numbered vowels, starting from the right; underlying long vowels and those lengthened by alternate lengthening are also stressed. These facts suggest a powerful argument against the OT notion of one-level, parallel-processing. A derivational approach is required because the result of alternate lengthening is the input to stress. Furthermore, OT is unable to account for the cases of extreme opacity mentioned above.

The three-dimensional metrical model of stress, adopted here, along with a serial rule-ordering framework helps further us in our goal of explanatory adequacy for these phenomena.

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Bob Vago is responsible for igniting my interest in many of the issues discussed in this dissertation, e.g., moraic theory, geminates, and compensatory lengthening. His input into this dissertation is greatly appreciated.

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Chapter One: INTRODUCTION

1.0 Introduction. This dissertation undertakes a prosodic and segmental analysis of two Native-American languages: Tūbatulabal, and a dialect of Nootka called Tseshahat. Tseshahat is a viable language, whereas Tūbatulabal is almost extinct.

These two languages were originally chosen for study because the nasal in each language seemed to be mirror images of each other, prosodically. My studies within moraic phonology theory (Hyman 1985; McCarthy and Prince 1986; Hayes 1989), suggested an analysis in which, for Tseshahat, the nasal was moraic for Stress Assignment but not for Reduplication, whereas in Tūbatulabal, the reverse configuration held. This is problematic for moraic theory, because a principal assumption of the theory is moraic consistency, i.e., language-particular moraic segments should remain as such in all domains where the mora is relevant. Tseshahat and Tūbatulabal apparently violate moraic consistency, and thus these languages provide evidence against moraic theory. Following further investigation, I abandoned moraic theory in favor of a segmental prosodic theory (McCarthy 1981; Clements and Keyser 1983; Levin 1985). Arguments defending this choice are presented in Section 1.4.

No phenomenon can be taken in isolation, however. In the context of a close examination of nasal-related phenomena, many interesting and puzzling observations revealed themselves for each language. My focus changed from delving into one topic, nasals, to an in-depth examination of Tseshahat and Tūbatulabal phonology. In the context of a more complete grammar of the phonologies of these languages, it was discovered that they are governed by broad generalizations that cannot be ignored for my

descriptive purposes, and, furthermore, are far more interesting from the perspective of explanatory adequacy. The goal of this dissertation is primarily a descriptive analysis of the phenomena in both languages, although I speculate on some potentially explanatorily adequate solutions.

I briefly introduce some of the central phenomena of each language from which these generalizations arise. In Tseshaht, the most significant factor in its phonology is that the foot seems to have a unique standing. The language has just one foot, that being leftmost in the word. Several phonological processes, such as Stress-Assignment and Vowel Coalescence, occur only within the foot. Furthermore, Tseshaht has what appears to be a three-way distinction in vowel length: short, long, and “variable”. A variable-length vowel is long in either of the first two syllables of the word and is short in the third or later syllable of the word. Lastly, these variable-length vowels and nasals seem to be in complementary distribution. Neither may have two consonants following them in a syllable versus the three consonants permitted after a vowel, either long or short. Additionally, neither participates in Reduplication. It is the goal of Chapter 2 to address these issues in an explanatory fashion.

Moving on to Tübatulabal, there is a pattern of vowel lengthening whereby every odd-numbered vowel, starting from the left, is subject to a lengthening rule. The application of this rule is particularly apparent for verbs, because this language has a productive pattern of reduplication for verbs, which prefixes one syllable to the left of the root. Productive vowel deletion rules in the phonology render both reduplication and alternate lengthening (AL) opaque, e.g., /ʔolo/ [o:lin, o:li:n] ‘to help him up’ (Swadesh and Voegelin (1939: p. 90). The phonetic forms show first the unreduplicated form,

followed by the reduplicated one. In this example, the rule of AL is rendered opaque by syncope and deletion rules, because the syncope and deletion makes vowels lengthened by alternate lengthening adjacent.

Furthermore, AL resembles a metrical process. Heath (1981) suggests that it is a historical relic of the proto-Uto-Aztecan stress pattern. The metrical rules required for an account of AL are not the same as those required for stress, however. Indeed, stress, as reported by Voegelin (1935), operates from right-to-left across the word, and is sensitive to the length created by AL. It is the goal of Chapter 3 to provide an account of these phenomena that is plausibly explanatorily adequate.

The dissertation is organized as follows: Chapter 1 discusses the basic assumptions and theories adopted. Weight and length with its accompanying representation are the topics for the first half of the chapter, Sections 1.1 through 1.5. Included in Section 1.5 is the representation of geminates that is adopted. Because this dissertation is concerned with prosodic issues in *Tsashaht* and *Tübatulabal*, a representation for Stress and syllabic structure is crucial. The Three-Dimensional Metrical Model of phonology (Halle & Vergnaud 1987; Idsardi 1992; Halle & Idsardi 1995) is what is adopted. An overview of the theory is given in Section 1.6. In Section 1.7, Dynamic Phonology (Calabrese 2002) is presented. This is a ‘constraints and repair’ approach to phonological phenomena that seems well-suited to accounting for stress exceptions in *Tsashaht*. Dynamic Phonology is also helpful in getting a handle on opacity within *Tübatulabal*. Finally, in Section 1.8, Raimy’s (1999, 2000) representational approach to Reduplication is offered within a serial and modular framework.

Chapters Two and Three offer an in-depth prosodic analysis of Tsésaht and Tübatulabal, respectively. In Tsésaht, we concentrate on structural representation, Reduplication, and Stress. Of particular interest is the “variable vowel” and the properties of the one and only Foot. Chapter Three focuses on Tübatulabal. Here again we are interested in structural representation of prosodic structure. Additionally we look at Stress and the phonological process of Alternate Lengthening. Chapter Four presents concluding remarks.

1.1 Weight Phenomena. There are certain weight phenomena in languages that any theory of phonology must explain, and the means by which syllable weight and length are represented is crucial. Many languages contrast heavy syllables with light ones for purposes of Stress or Tone-Assignment. Heaviness is defined in moraic theory via the bimoraic syllable; in a segmental theory, via a branching nucleus or a branching rime. Each of these theories will be examined below. Hyman (1985) notes that languages that exhibit a syllable weight distinction do so only if they have a contrastive vowel length distinction, while Hayes (1989) suggests that this is typical but not mandatory. Some languages, according to Hayes, allow heavy syllables but do not permit long vowels, e.g., Ilokano and Andalusian Spanish.

Onsets (initial consonant(s) in a syllable), as non-weight-bearing segments, are unable to express syllable weight distinctions. Rimes (VV or VC), however, are able to express syllable weight distinctions. Stress and Tone-Assignment are sensitive to weight and their patterning reflects this asymmetry.

Much evidence has accumulated that implies that, in general, onsets do not count for phonological processes susceptible to weight: e.g., Hyman (1985) observes that across

languages, universally onsets are irrelevant for stress¹. Steriade (1991) claims that only vowels are tone-bearing units in Classical Greek; Pulleyblank (1994) for Yoruba and Hyman (1992) for Bantu languages agree. Compensatory Lengthening (CL) phenomena offer other compelling argument for the weightlessness of onsets. CL is a process whereby a nearby segment lengthens to compensate for the deletion of another segment. Hayes (1989) argues that while deletion of segments from a syllable-rime often triggers lengthening of a neighboring segment, deletion of an onset segment rarely, if ever, does.

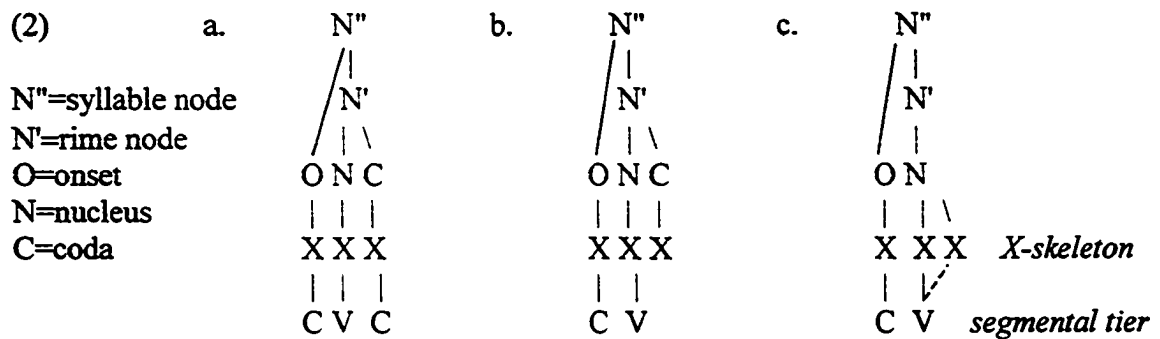
Any theory of phonology must address the onset/rime asymmetry for processes that distinguish weight, and below we present two theories that attempt to do so. We start with segmental models and move on to moraic models, looking in particular at their proposals for a solution to the problem of CL. Both use a serial approach to CL, whereby rules act upon underlying forms until the surface form is obtained. An intermediate representation is necessary.

1.2 Segmental Theories. Segmental theories, e.g., CV (McCarthy 1981; Clements & Keyser 1983) or X-Theory (Levin 1985) provide a many-to-one representation of length between the skeletal tier (prosodic tier) and a segmental (featural) tier. This representation allows for a two-tiered approach to complex segments, such as geminates and affricates.

(1)	a.	<i>/tt/ Geminate</i>	b.	<i>/tʃ/ Affricate</i>
timing tier		X X		X
		∨		∧
segmental tier (featural)		t		t s

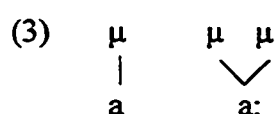
¹ See Davis (1999), however, for Trukese onsets that seem to bear weight.

The number of elements on the skeletal tier in an utterance corresponds intuitively to the number of segments it contains. The concept central to an account of CL phenomena in segmental theories is that deletion of a coda takes place on the segmental tier alone, leaving a slot on the prosodic tier with no featural affiliation. A rule then spreads vocalic features onto a following tautosyllabic empty skeletal position, deriving a long vowel. (2) depicts a segmental interpretation of CL within X-Theory (Levin 1985), illustrating an instance of the deletion of a coda consonant with subsequent spreading of the vowel:



X-theory does not distinguish between vocalic and consonantal slots; both are represented identically as X-slots. The Cs and Vs are displayed for convenience, but they should be understood as root nodes that have consonantal and vocalic featural geometries hanging off of them. The root nodes, in turn, hook up to the Xs on the X-skeleton. The distinction between vowels and consonants is made solely in terms of syllable structure, vowels being assigned to the nucleus node N, while consonants are linked to the syllable node N'' if they fall in the onset and to the rime node N' if they fall in the coda. It is the root nodes for both vocalic and consonantal segments that are the direct link to the X-slots. Weight in X-Theory is a branching nucleus, or, in some languages, a branching rime.

1.3 Moraic Phonology. X-slot theory views the skeleton from the perspective of the segment, whereas syllable weight theories develop an inherently prosodic conception of the skeleton. Phonological positions are terminal points where prosody intersects with segments or “melodies” (rooted feature trees). The mora (μ) is a direct representation of weight, unlike the Xs in X-Theory. The mora has a dual role, encoding both weight and length. First it represents the well-known contrast between light and heavy syllables: a light syllable has one mora, a heavy syllable, two. Second, the mora counts as a phonological position: a long vowel is normally represented as linked to two moras.



The mora is a prosodic unit, unlike Xs which are the skeleton and act as place holders. The mora relates directly to segments, whereas Xs act as an intermediary between prosodic units and segments. The mora links to the root, which in turn is linked to features. The root is itself a featured bundle containing crucial featural information.

The arguments for the mora tier are essentially that prosodic processes, like Stress, Tone and Reduplication, depend upon syllable weight rather than on the number of segments, and that the units necessary for the description of syllable weight—moras—are the same units motivated for the analysis of those processes.

1.4 Compensatory Lengthening: Theoretical Arguments. Hayes (1989) attacks segmental theories. He argues that segmental theories are incapable of handling certain types of CL in languages, whereas moraic phonology can, and does so with ease. Hayes suggests that segmental theories are unable to account for the asymmetries we see in languages between onsets as non-weight-bearing segments and codas as weight-bearing

ones. We outline the main points of Hayes' argument below, and assess each of them in turn.

1.4.1 *CL Within Moraic Theory*. Hayes (1989) argues that segmental theories of prosodic organization, i.e., CV theory (Clements and Keyser 1983) and X-Theory (Levin 1985), cannot account for the full array of CL processes. In fact, he claims that when trying to handle the full range of CL types, the segmental theories are reduced to claiming in effect that any segment can lengthen to compensate for the loss of any other segment.

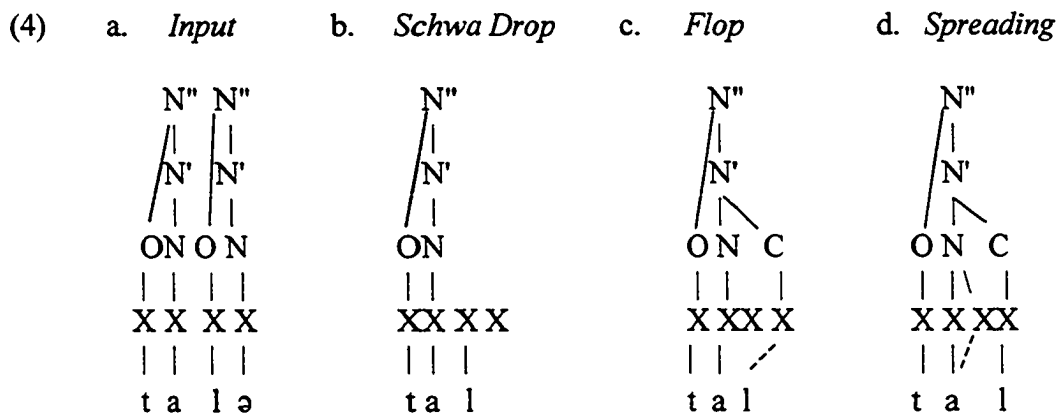
Hayes² points out that CL is subject to a number of prosodic constraints that determine which deleted segments can trigger CL, and secondly, which neighboring segments can lengthen compensatorily. Hayes claims that a moraic model of prosodic organization is the best-suited to act as the prosodic frame to capture these constraints. For instance, the fact that onset segments do not trigger CL upon deletion is directly reflected in the fact that onsets have no prosodic "position" in a moraic theory.

Hayes examines various patterns of CL from both a segmental and moraic perspective, highlighting several CL cases that are apparently damaging to a segmental approach. Hayes chooses Levin's (1985) X-Theory as his segmental theory example, although any segmental theory would substitute.

A problematic case of CL for X-theory involves CL through vowel loss. The pattern is $VCV \rightarrow V:C\emptyset$, where a final vowel is dropped with consequent CL of the vowel in the preceding syllable. Hock (1986) points out that this phenomenon is attested in many languages, including Hungarian and Korean. Hayes describes how, in Schwa

² From hereon, when referring to Hayes, we are referring to his 1989 article.

Drop, [talə] in early Middle English becomes [ta:l] in late Middle English. He argues that some kind of “double flop” must occur as only this will create an empty position for the stressed vowel to spread onto. As depicted in (4), flop attaches the *l* onto the final X-slot (4c) with subsequent vowel spreading onto the X-slot now left empty by Flop (4d). However, when implemented in X-Theory, the consonant rendered word-final by Schwa Drop must flop onto an X-position previously syllabified as the following nucleus. The stressed vowel segment must then spread onto an X-slot originally syllabified as an onset.



In (4b), following deletion of schwa, the second syllable and its intermediate structure has been eliminated, although the X-slot count remains the same. Hayes' claims that the principle of Parasitic Delinking is accountable.

(5) *Parasitic Delinking*

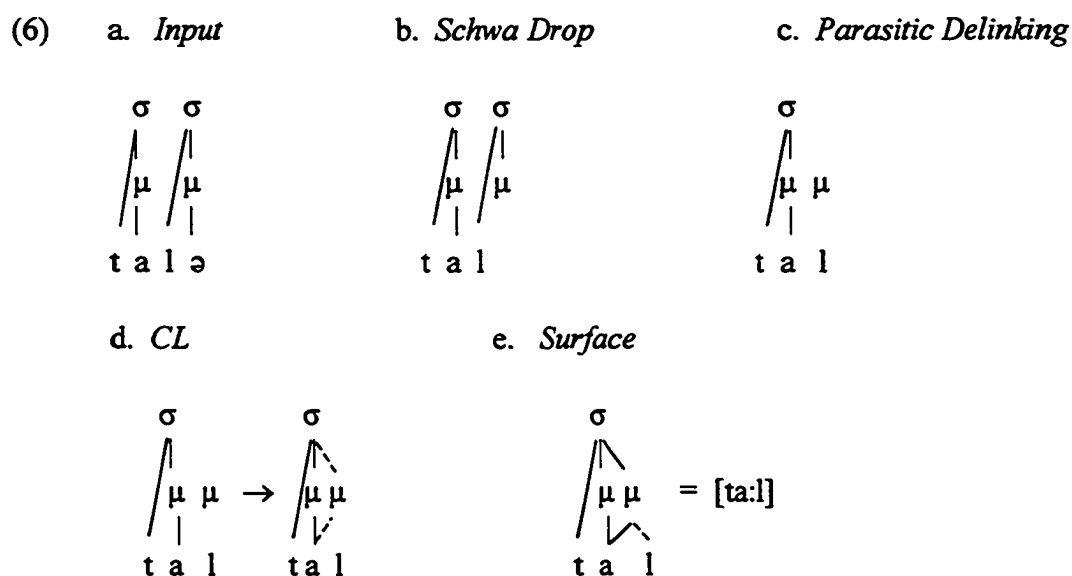
Syllable structure is deleted when the syllable contains no overt nuclear segment. (p. 268)

Both segmental *and* moraic accounts of CL utilize this principle. Hayes argues for its plausibility by pointing out that:

- 1) no well-formed syllables in any language lack a nuclear element on the surface.
- 2) the nuclear vowel is the only obligatory element of the syllable in all languages, and
- 3) it is the core to which other segments are syllabified by adjunction

Hayes points out that to account for CL in Middle English, X-theory must allow consonants to flop onto X positions *originally syllabified* as nuclei (4c), and allow vowels to lengthen by spreading onto *former* onset positions (4d). Hayes argues that these moves subvert the main principles that have previously constrained the power of X-theory. He argues that the descriptive power of X-theory is substantially expanded and that, thereby, it comes perilously close to maintaining that any segment can lengthen to compensate for the deletion of any other.

Hayes claims that moraic theory, unlike X-Theory, can treat this phenomenon without substantial expansions in its descriptive power. The essential mechanism is Parasitic Delinking, which appears to be needed in X-Theory as well. (6) shows Hayes' moraic derivation of the [talə]→ [ta:l] example from (4).

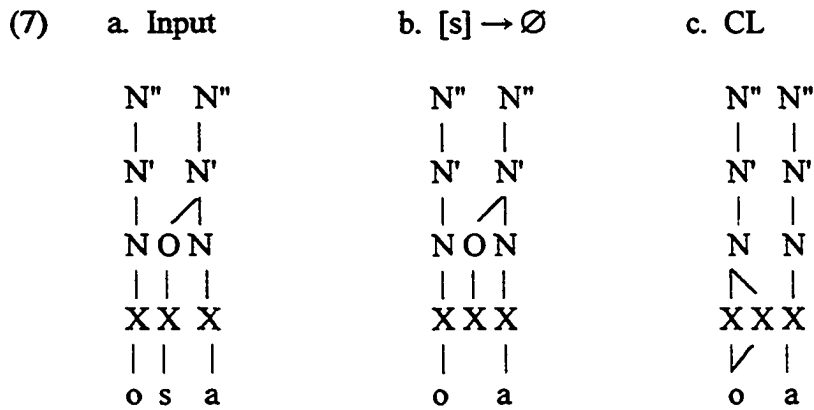


Hayes does not explain why in (6) we do not surface with [.t a_(μ) l_(μ)]. (The /l/ has changed from a weightless onset to a weightless coda.) Considering that English is a Weight-By-Position language (see Section 1.5), it is curiously unexplained why this form is not chosen.

1.4.2 *A Defense of CL Treatment Within Segmental Theories.* Sloan (1991), in her defense of segmental theories, claims that Hayes' arguments derive from a mistaken interpretation of the nature of deletion. She asserts that by using Hayes' own rule of Parasitic Delinking, segmental theories can easily handle the varieties of CL cases without undue expansion of the theory.

Sloan (1991) argues that Hayes' use of the words "originally syllabified as" and "former" is problematic. She claims that in each of these "allegedly subversive relinkings, an element of the melody spreads to an adjacent X-slot that is prosodically unaffiliated," pointing out that syllable structure has been deleted by Parasitic Delinking. Thus, at the time of spreading, the former associations of the critical X-slots are no longer present in the derivation. Syllabification automatically applies to the results of spreading, to form new syllabic associations. Sloan therefore concludes that the former status of prosodically unaffiliated X-slots is irrelevant.

1.4.3 *Moraic Theory Arguments from Asymmetries in CL.* Hayes presses his point further by discussing the asymmetries of CL. Certain patterns do not occur in languages and Hayes asserts that a theory of prosodic organization should rule out the non-occurring patterns as well as account for the occurring ones. He identifies one such asymmetry, in the lack of CL triggered by the deletion of onset consonants. In all cases of CL, the trigger is the deletion of an element of the rime, and there are no cases of $VCV \rightarrow V:\emptyset V$ where C is the onset. Hayes claims, though, that such an unattested case can be derived using X-theory. (7) gives his derivation.



Hayes claims that the crucial part of the derivation is (7c), where spreading onto a former onset position creates length. He maintains that the only mechanism in X-Theory to exclude this possibility is to add constraints concerning what linkages are possible and which ones count as length-creating. Hayes reiterates that such constraints are untenable, because, in particular, sequences formerly syllabified as onset plus nucleus can surface as long segments, and vowels may spread onto slots formerly associated with onset segments to create length.

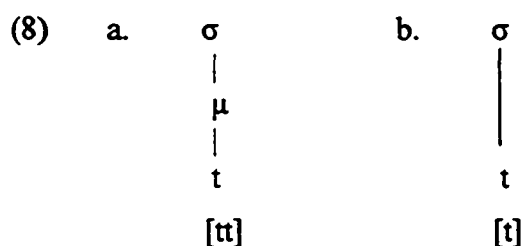
1.4.4 *Segmental Defense of CL Asymmetry*. Sloan (1991) argues that the situation in (7) is crucially different from that in (4), in that Parasitic Delinking does not occur in the former because the syllable nucleus is not deleted. Thus, at the point in the derivation when spreading applies, i.e., (7c), spreading involves not a “former” onset position, but an *actual* onset position. She further argues that it is a standard assumption in X-Theory that the types of segments that may project up to a syllable and which may be adjoined as onsets or codas are regulated by universal and language-specific constraints. It is these independently necessary constraints that prevent the empirically unattested spreading depicted in (7c). In other words, when Parasitic Delinking applies, it results in prosodically unaffiliated X-slots to which subsequent association is unconstrained. But

when it does not apply, association is governed by the independently motivated prosodic constraints on syllabification in the language.

1.4.5. *Summary.* Sloan (1991) presents a convincing case that we need not eliminate using a useful theory that for the most part can handle an array of problems in an explanatory fashion. She argues that Hayes' arguments against segmentalism based upon CL are not valid, primarily because his interpretation of the nature of deletion is not correct. In particular, she points out that Parasitic Delinking is a device with a precise definition that both moraic and segmental theories must use.

The prosodic representation assumed in this dissertation follows the segmental approach. Some opposing analyses to the Tseshaht and Tūbatulabal data assume a representation that contains both segments and the mora. That leads to an overly powerful, unconstrained theory. A more scientific approach would be to view them as competing theories.

1.5 **Geminate Representation.** There are two distinct representations for geminates: the single root node linked to a mora (McCarthy and Prince 1986; Hayes 1989) and the two-root representation (Selkirk 1990). Hayes (1989) distinguishes long consonants (geminates) from short consonants in terms of the former being underlyingly moraic, and the latter, underlyingly nonmoraic, as in (8).



Singleton consonants, being underlyingly weightless, must, therefore, be assigned a mora when they occupy the coda of a syllable that counts as heavy. Hayes accomplishes this by a language-specific Weight-By-Position (WBP) rule (p. 258).

(9)

Condition: σ dominates only one μ underlyingly	$\begin{array}{c} \sigma \\ \\ \mu \\ \\ \alpha \beta \end{array}$	→	$\begin{array}{c} \sigma \\ / \ \backslash \\ \mu \ \mu \\ \ \ \\ \alpha \ \beta \end{array}$
--	--	---	---

This rule does not operate in languages which are weight-insensitive, e.g. Polish. The WBP rule is not allowed to iterate, a stipulation which ensures that, in general, syllables will adhere to a bimoraic limit. Consonants will subsequently adjoin to the left or right edges of an already built syllable, subject to sonority sequencing constraints.

Selkirk (1990) proposes an opposing theory, representing geminates as a single set of place features mapping to two root nodes as in (10):

(10)

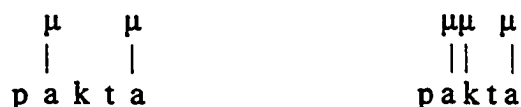
$\begin{array}{c} R \quad R \\ \swarrow \searrow \\ \text{PLACE} \end{array}$	where R = Root Node (consonant or vocalic)
---	--

In Selkirk's two-root theory, no segment is lexically moraic. Her theory is presented in a rule-based framework, and she claims that a language will have general rules for assigning moras to vowels and consonants.

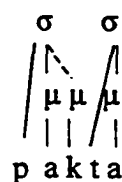
A major argument for Selkirk's position comes from Tranel (1991), who provides further evidence that geminates are not inherently moraic, but should be linked to two positions as they are in segmental theories. He claims that no language should treat a syllable closed by the first part of a geminate consonant (CVG) as light, since the first half of a geminate must be moraic under the single-segment analysis. We should not, then, find a non-WBP language contrasting syllables closed by a singleton C (CVC which

must be light) with a syllable closed by a geminate (CVG, which must be heavy). Tranel argues that, in fact, several languages including Malayalam, treat both CVG and CVC syllables as light for stress assignment, although these languages do have a weight contrast: CVV syllables are heavy. Conversely, he argues, no language appears to treat only CVG syllables as heavy. This pattern is in accord with the two-segment analysis of length: the first portion of the geminate is equivalent (for the purposes of WBP) to any other coda consonant. But it is inconsistent with the single-segment analysis. The phonology, he claims, needs to encode length directly, rather than resorting to weight. Tranel's (1991) arguments transfer well to Tübatulabal, which also treats CVG and CVC syllables as light for Stress-Assignment.

Sloan (1991) provides another argument against an underlying moraic representation of geminates, based on the behavior of morpheme-final geminates in Southern Sierra Miwok. As Sloan points out, the important thing to note is that the geminate in Hayes' (1989) theory is a derived structure: It is derived through a syllabification process in which prevocalic consonants are adjoined as onsets. She raises an interesting question as to how one represents final geminates. In Southern Sierra Miwok, this matter becomes more complicated because the language has morpheme-final geminates which can be followed by consonant-initial morphemes. Sloan shows in (11) that if we have two morphemes *pak* and *pakk* followed by a C-initial suffix, such as *-ta*, that Hayes' (1989) moraic account would predict *pakta* in both cases. The distinction between the single and geminate consonant is thus predicted, in Hayes' theory, to be neutralized in this environment.

(11) *Underlying forms**Syllabic assignment**Adjunction: Prevocalic consonants**Adjunction: Weight by Position**Adjunction: Remaining elements*

Not applicable



The derivational approach to gemination predicts that a consonant which is underlyingly geminate, i.e., has a lexically-assigned mora, will surface as a single consonant when followed by a consonant-initial morpheme. This prediction is wrong for Southern Sierra Miwok. This is because the only distinction between a singleton consonant and a geminate consonant in Hayes' theory is the underlying mora in the latter representation. But, in Southern Sierra Miwok, a coda consonant followed by a

consonant-initial morpheme receives a mora by the process of WBP. Therefore, the distinction between a singleton consonant and a geminate is neutralized.

Sloan (1991) spells out the derivation of two Southern Sierra Miwok words under moraic analysis and under X-slot analysis. Both words contain morpheme-final geminates followed by a vowel in the one instance (*?ynneNko?* ‘I’ll come while...’) and a consonant in the other (*?ynnyjakte?* ‘I’m from...’). The moraic account, shown in (12), fails to predict the correct surface form when a consonant follows:

(12) *Underlying forms*

$\begin{array}{cccc} \mu & \mu & \mu & \mu \\ & & & \\ ? & y & n & e N k o ? \end{array}$	$\begin{array}{cccc} \mu & \mu & \mu & \mu \\ & & & \\ ? & y n j a k t e ? \end{array}$
---	---

Syllabic assignment

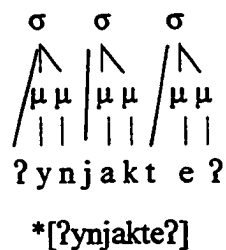
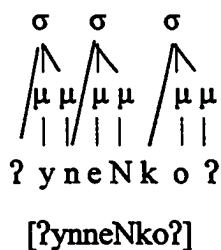
$\begin{array}{ccc} \sigma & \sigma & \sigma \\ & & \\ \mu & \mu & \mu \\ & & \\ ? & y n e N k o ? \end{array}$	$\begin{array}{ccc} \sigma & \sigma & \sigma \\ & & \\ \mu & \mu & \mu \\ & & \\ ? & y n j a k t e ? \end{array}$
---	---

Adjunction: Prevocalic consonants

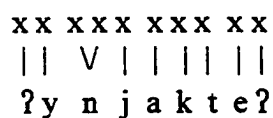
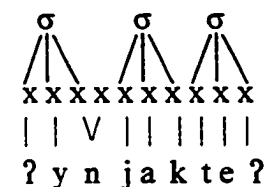
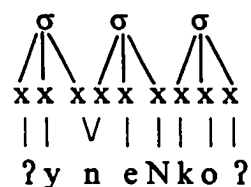
$\begin{array}{ccc} \sigma & \sigma & \sigma \\ / \mu & \mu \mu & / \mu \\ & & \\ ? & y n e N k o ? \end{array}$	$\begin{array}{ccc} \sigma & \sigma & \sigma \\ / \mu \mu & / \mu & / \mu \\ & & \\ ? & y n j a k t e ? \end{array}$
--	--

Adjunction: Weight by Position

$\begin{array}{ccc} \sigma & \sigma & \sigma \\ / \mu & \mu \mu \mu & / \mu \mu \\ & & \\ ? & y n e N k o ? \end{array}$	$\begin{array}{ccc} \sigma & \sigma & \sigma \\ / \mu \mu & / \mu \mu & / \mu \mu \\ & & \\ ? & y n j a k t e ? \end{array}$
--	--

Adjunction: Remaining elements

Sloan's (1991) segmental account of the data correctly predicts the data of Southern Sierra Miwok in (13). Note that in this language, epenthesis is the option chosen to provide well-formed syllables.

(13) *Underlying representation**Syllabification**Epenthesis*

Not applicable



[?y n n e N k o?]

[?y n y j a k t e?]

Sloan (1991) argues that the examples of morpheme-final geminates in Southern Sierra Miwok provide a clear counter-example to a major prediction of Hayes' (1989) moraic analysis of gemination, namely, that geminates are derived by a syllabification

process that provides an onset to a following vowel. Sloan claims that geminates will surface as geminate whether they are followed by a consonant or a vowel, and therefore they must underlyingly be marked as long, i.e., holding two positions, and not as merely moraic. The behavior of morpheme-final geminates in Southern Sierra Miwok follows, Sloan insists, from the representation that they are assigned in an X-slot account of syllabic structure.

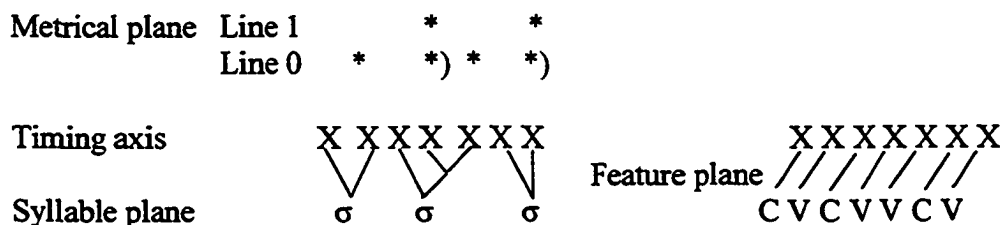
Both the double-root theory of geminates and a segmental X-slot representation eliminates one of the major claims of moraic theory, namely that length and weight are one and the same property for consonants.

Although both a segmental representation and a double-root representation of geminates can easily account for all the data, the representation adopted here will be the double-root one. Ringen and Vago (2002) provide arguments from Leti, Hungarian and other languages that motivate the double-root representation as the only universal property of geminates. Selkirk (1990), provides support for a theory in which there is no skeletal tier mediating between feature structure and prosodic structure. Each root is its own featural bundle, and the merging associated with geminates occurs at the Place node, not the skeleton. This distinction can account for cases of laryngeal fission, e.g., pre-aspiration in Icelandic, and diphthongization, none of which are relevant here.

1.6 Three-Dimensional Phonology (Halle & Vergnaud 1987; Idsardi 1992; Halle & Idsardi 1995). Proposed as an alternative to the prosodic hierarchy (Selkirk 1980), in which every prosodic category in the hierarchy has as its head an element of the next-lower level category, three-dimensional phonology rejects the assumption that the syllable is the stress-bearing unit. Instead, a three-dimensional representation places

syllables and feet on orthogonal planes, as sketched in (14). Feet are defined as marks on a metrical plane which designate constituents. The model is three-dimensional in the sense that half-planes radiate from a central axis, the timing tier, which is represented by a series of X's. One radiating half plane is the feature plane, indicated in (14) by 'C' and 'V' symbols designating feature geometric representations. There are two other half-planes in (14), the metrical plane and the syllable plane. The syllable plane represents only the organization of segments by syllables. Unlike the prosodic hierarchy, there are no other elements that in turn dominate syllables.

(14) *Three Dimensional Representation*



Halle and Idsardi (1995), based on Idsardi (1992), propose a reconceptualization of Halle and Vergnaud's (1987) theory of metrical stress. They assert that a formal account of stress phenomena will require at least the following three things: a device for designating the elements in a sequence that are capable of bearing stress; a means for delimiting the groupings of the elements; and a marker to distinguish in each grouping or constituent the prominent head-element from the remaining elements. Below, I sketch the mechanisms that build appropriate representations of stress in Halle and Idsardi's model. These mechanisms, parameterized rules and constraints, constitute their theory of stress assignment.

Halle and Idsardi (1995) start by representing the stressable elements in a phoneme string as a sequence of abstract marks. These marks appear on 'Line 0' of the

metrical tier. I shall present their theory using the English example they use—

autobiográphic.

(15) (* * (** (* * Line 0
 | | || | |
 auto-biographic

Every vowel receives a mark on Line 0, where *’s indicate syllable heads and the parentheses indicate foot boundaries. As Halle and Idsardi (1995) point out, an immediate consequence is the creation of two parallel sequences of elements: a sequence of phonemes and a sequence of abstract marks. These parallel sequences constitute a plane, which they call a *metrical plane*. According to Idsardi (1992), a single boundary serves to define a metrical constituent: a left boundary creates a grouping of the elements to its right, or a right boundary creates a grouping of elements to its left, up to the next boundary or the end of the word. Both rules and constraints apply in the calculation of the metrical grid. Metrical rules apply successively in a derivation. The constraints block the application of metrical rules that would generate universal or language-particular disfavored configurations (examples to follow).

“Projecting” adds an element to the grid, linked to the element which is projected. In other words, projection is the interface between strings of phonemes and the metrical grid. The parameterization in (16) governs projection.

(16) *Line 0 element projection*
 Project a Line 0 element for each element that can bear stress

Languages are subject to variation in which elements are capable of bearing stress³, stress being considered a matter of relative prominence rather than a distinctive feature.

³ Although many proponents of metrical theory reject the mora, Idsardi makes it clear that an ‘element’ may be any structural unit, including the mora.

Since the grid shows only two kinds of items, elements and parentheses, and (16) projects the elements up, (17) is the parameterization governing the interface projection of parentheses to Line 0.

- (17) *Line 0 parenthesis projection*
Project the {left/right} boundary of certain syllables onto Line 0

The two parameters (16) and (17) govern the interplay between syllabification and stress.

A central rule in Idsardi's (1992) theory is the Iterative Constituent Construction (ICC) Parameter:

- (18) *Iterative Constituent Construction Parameter*
Insert a parenthesis every two elements starting from the {left/right}-most element

Constituents are to be constructed by inserting the “far” parenthesis. That is, right parentheses are to be inserted left to right, and left parentheses, right to left. Since metrical rules are to have no “look-ahead”, it is the ICC parameter that governs the choice between the rules given in (19):

- (19) *Rules of iterative constituent construction*
 $ICC:R = \emptyset \rightarrow (/ _ x x$ (right to left)
 $ICC:L = \emptyset \rightarrow) / x x _$ (left to right)

The application of these rules yields a sequence of binary constituents. The Iterative Constituent Construction rules do not have the option of generating constituents with fewer than two marks. As a result, in a string with an odd number of syllables the application of an Iterative Constituent Construction rule will leave the far terminal element unmetrified. English chooses ICC:R in (15) above.

Two remaining parameters round out what Universal Grammar supplies: the Edge Marking Parameter accounts for prominence on a form's edge and the Headedness Parameter accounts for prominence of the first element of each constituent.

- (20) *Edge Marking Parameter*
Place a {left/right} boundary to the {left/right} of the {left/right}-most element
- (21) *Headedness Parameter*
Project the {left/right}-most element of each constituent onto the next higher line of the grid

Going back to our ‘autobiographical’ example, we can now project Line 1 and complete the metrical derivation. Line 1 indicates the heads of feet.

(22)

*	*	*)	Line 1		
(*	*	(**	(*	*)	Line 0
auto-biographic					

English chooses as its headedness parameter to project the leftmost element of each constituent from Line 0 onto Line 1. The edge marking parameter places a right boundary to the right of the rightmost element on Line 1. The next step is to project the head of Line 1. This time the parameter is set for the rightmost element of the constituent, which, as indicated by the parenthesis on Line 1 is just the one constituent. The final algorithm is depicted in (23):

(23)

	*	Line 2			
*	*	*)	Line 1		
(**	(**	(**	(**	(**	Line 0
auto-biographic					

Line 0 shows the “foot” boundaries, Line 1 shows the secondary stresses, and Line 2 shows the (main) word stress. The arrays of *’s and parentheses constructed in this manner are called metrical grids by Halle and Idsardi (1995). They contain the information about the groupings of elements into constituents, about the headedness of

the constituents, and about the different degrees of prominence of the elements in the string. Halle and Idsardi have employed only two formal mechanisms in constructing the grids: the placement of grid marks and the placement of parentheses. They emphasize that the same mechanism that marks elements in the phoneme string as stress-bearing is to be used for locating the heads of constituents.

In general, Idsardi (1992) handles extrametricality, not as a matter of lexically specified individual stress exceptions, but rather via constraints. He calls them “Avoid Constraints”. These are either edge avoidance constraints, e.g., *Avoid* (*#, in which a parenthesis is placed too close to an edge, or stress avoidance constraints, e.g. *Avoid* (*(. Avoid Constraints block the application of one of the above-mentioned parameters, e.g., the Edge parameter, much as an “active” formulation of the Obligatory Contour Principal (OCP) (McCarthy 1986) does. The OCP is a universal constraint banning adjacent identical elements from the lexical representation of a morpheme. The OCP prevents the application of rules which would produce unacceptable configurations. Halle and Idsardi (1995) point out that their formulation of Avoidance Constraints differs from the OCP in that some Avoidance Constraints are active only in particular languages. The rules are the only means of creating metrical structures, and the function of the constraints is to limit their application. As such, the Avoidance Constraints cannot be violated.

The 3-D Metrical Phonology model is adopted in this dissertation. As we examine stress patterns for Tseshaht and Tūbatulabal, we shall see that this model accounts for the data without the complications that other theories of stress encounter.

1.7 Dynamic Phonology (Calabrese 2002). Calabrese proposes a “constraints and repair” approach to the analysis of phonological phenomena, which he calls *Dynamic*

Phonology (DP). His theory provides a descriptive adequacy for the facts analyzed in this dissertation that not only captures generalizations more simply than previous scholars were able to do, but also it covers some generalizations that have eluded past scholars.

Calabrese's theory posits a set of markedness statements, provided by universal grammar (UG), as well as language-specific constraints. If a statement or constraint is active in a particular language, they mark some representations as absolutely ill-formed in that language. Individual languages have the option of deactivating markedness constraints.

If the representation is evaluated as ill-formed, it is subject to repair. Repair operations are provided by UG. These are few in number, and they are all triggered by markedness statements and absolute prohibitions. An absolute prohibition differs from a markedness statement in that it may not be deactivated. An example of an absolute prohibition would be a segment comprised of [+high, +lo]. Calabrese's manuscript allows only the repairs listed in (24).

(24) Repair Operations

- a. Addition/Removal of syllabic lines.
- b. Addition/Removal of syllabic nucleus position.
- c. Addition/Removal of skeletal positions (e.g., X's on timing tier).

The result of the repair operations to the offending representation provides a set of possible outputs, rather like the candidate set of Optimality Theory (OT) (Prince & Smolensky 1993). The repairs can apply in a serial order only if the output of the first repair produces a representation in need of further repair. Elements of repair operations apply in a random ordering, although the grammar of an individual language may specify the order in which it is checked.

The evaluation set is submitted to an evaluation component that uses the following criteria and procedures in (25) for evaluating candidates. Candidates are excluded from further consideration if they do not follow these criteria.

(25) Evaluation Set Criteria

- a. *Do not include a feature that has been assigned “premium value”.*
- b. *Any candidate violating an active markedness statement is excluded from the candidate set.*
- c. *Any candidate violating an absolute prohibition is excluded from the candidate set.*

A premium value is a value that individual languages may place on features or segments of the input. A segment has premium value if the grammar has a strong aversion to deleting it. This is reminiscent of a high-ranking faithfulness constraint in OT. For example, a language may specify that no segment may be deleted from a stressed syllable. Any candidate that has such a deletion will not be considered any further. Premium values always override active markedness constraints.

All candidates that pass the evaluation criteria of (25) are said to be convergent.

The convergent candidates are then compared with each other by the following criteria in

(26). These criteria should always yield a unique winner.

(26) Convergent Set Criteria

The relative markedness of the convergent repairs is checked as well as their structural and derivational complexities.

“Markedness or structural complexity adds cost to representations and the goal of the evaluation process is to minimize cost. The most economical output in terms of markedness, structural and derivational complexity is then chosen.” (Calabrese 2002, p. 36)

The term *markedness* in (26) refers to “deactivated” markedness statements (the active ones having already excluded candidates from the evaluation set). A deactivated markedness statement generally plays a passive role, by allowing representations that are prohibited in languages where the same markedness statement is active. The markedness statements are universally ranked constraining the order in which an individual language may deactivate a constraint. For example, UG might specify that constraints A and B have an implicational relationship, such that a language may not deactivate markedness constraint “B” unless constraint “A” has also been deactivated in that language.

Calabrese’s use of the term “structural complexity” is somewhat confusing. On the one hand, he wants word length (measured in terms of segments and/or syllables) to be a more important criterion than, for example, onset or coda complexity. Thus, Calabrese formally represents this by ranking complexity in the number of syllables (i.e., word length) over complexity in syllable structure.

He further states that “if a conflict arises among the different evaluation parameters, it will be solved in terms of universally fixed rankings, stating, for example, that avoidance of markedness is preferred over structural simplicity or that structural simplicity is preferred over derivational simplicity, and so on.” (Calabrese 2002, p. 37)

Despite the superficial similarity to OT, the theory of DP differs from OT. To single out one dramatic difference, DP proposes that constraints (and their ensuing repairs) may be checked in a specified order. Thus, this approach is akin to rule-ordering in SPE phonology (Chomsky & Halle 1968), and provides a natural approach to accounting for opacity.

The details of DP will be discussed in Chapters 2 and 3 in the context of some interesting and puzzling phenomena of Tseshaht and Tübatulabal.

1.8. Raimy's Reduplication Representation. Raimy (1999, 2000) presents a representational approach to Reduplication that, he argues, provides a conceptually and empirically satisfying model of Reduplication in a serial and a modular model of morphology and phonology. His representational theory of Reduplication, along with the Three-Dimensional Metrical Model theory, offers a satisfactory analysis of opacity in Tübatulabal reduplication, as we shall see in Chapter Three.

McCarthy and Prince (1995) argue that with respect to Reduplication, their Correspondence model, within an OT (Prince and Smolensky 1993) framework, is superior to serial derivational approaches, particularly for the phenomenon of “backcopying”, i.e., Reduplicant-influences-Base cases of Reduplication. Raimy agrees that their arguments are valid for previous models of Reduplication if the overt realization of Reduplication is computed *solely* within the phonological component.

Raimy (2000) proposes a revision on how precedence is represented within phonological forms: they must be explicitly encoded. Raimy states that “most theories seem to accept that precedence in phonological representations is asymmetrical, transitive, and irreflexive.” (Raimy 2000, p. 544) Consider example (27), Raimy's (4a) (Raimy 2000, p. 543):

(27) # k æ t # 'cat'

Raimy claims that “precedence is asymmetrical, because in (27), if “/k/ precedes /æ/” is true, then “/æ/ precedes /k/” is necessarily false (/kæ/ ≠ /æk/) if there are only unique instances of these segments. Precedence is transitive, because “/k/ precedes /t/” is

true if “/k/ precedes /æ/” and “/æ/ precedes /t/” are also true. Finally, precedence is irreflexive, because there is no way of encoding the idea that a segment precedes itself.” (Raimy 2000, p. 544).

Now consider the representation in (28), Raimy’s (5), where precedence is explicitly encoded.

- (28) a. # → k → æ → t → % 'cat'
 b. % ← t ← æ ← k ← # 'cat'
 c. % ← k ← æ ← t ← # 'tack'

The symbol ‘→’ is used to represent the relationship *precedes*. (28a) and (28b) are equivalent. The symbols ‘#’ and ‘%’ mark the beginning and end of a string of segments, respectively.

Raimy claims that the introduction of the ‘→’ symbol to phonological representations allows the addition of a novel precedence relationship to be treated as a *morphological process*. Loops, also called “jump links”, in representations can be added either by readjustment rules or directly by morphemes. For example, Raimy gives a morphological derivation of *anen-anen* ‘unconfirmed news’, a Malay reduplication, to illustrate his ideas, our (29), his (6) (Raimy 2000, p. 545).

(29) Morphology

a. Base
 # → a → ŋ → e → n → %

b. Base + Reduplicant?
 # → a → ŋ → e → n → %

Phonology

c. Pre-Linearization
 # → a → ŋ → e → n → %



d. Post-Linearization
ajen-ajen %

Loops are defined by specifying which segments they anchor to. ANCHOR 1 specifies the *start* segment and ANCHOR 2 specifies the *end* segment of an added precedence relationship. For the total reduplication in (29), ANCHOR 1: __% and ANCHOR 2: __#; “the last segment precedes the first segment.” The reduplication follows the most recently added loops first and traces out the minimal path, thus avoiding looping indefinitely.

The linearization process occurs in the phonology. It is similar in spirit to tier conflation (McCarthy 1979) that also acts as a copy process. This process converts phonological forms that contain loops into ones that are wholly asymmetrical.

In Chapter Three, we shall examine several cases of Tūbatulabal opacity, which have been problematic for previous analyzes of the data. Raimy’s precedence-based representation of Reduplication is crucial to an explanatory analysis of the data.

1.9 Summary. This chapter has provided the theoretical assumptions adopted in this dissertation. A segmental representation of the syllable is argued for on theoretical, as well as empirical grounds. A branching nucleus or rime accounts for length distinctions, i.e., geminates. This was contrasted with the moraic representation of the syllable in which a syllable’s weight (moraic count) distinguished geminates.

The 3-D Metrical Theory (Halle and Idsardi 1995; Idsardi 1992) adopted here rejects the assumption, put forth by the Prosodic Hierarchy, that prosodic structure strictly dominates one another in a specified order. The foot does not dominate syllables, nor are syllables the stress-bearing units. Instead, a metrical grid is employed whereby

the stressable elements in a phoneme string get represented as a sequence of abstract marks. Rules and constraints apply in the calculation of the grid. The model is three-dimensional in the sense that there are several half-plane radiating from a timing axis, including a syllabic half-plane. This syllabic plane represents only the organization of segments by syllables. Unlike the prosodic hierarchy, no other elements in turn dominate syllables.

The Dynamic Phonology theory (Calabrese 2002) assumed here is a constraints and repair theory that has similarities to OT (Prince and Smolensky 1993) and SPE (Chomsky and Halle 1968), but differs significantly from both. Unlike OT, Dynamic Phonology is a rule-based, serial approach. DP is ideal in tackling opacity, which is the undoing of OT and its parallel-processing approach. DP is superior to SPE in that in SPE all processes are completely unmotivated.

Finally, Raimy's (1999, 2000) precedence-relations-based Reduplication theory is superior to any other Reduplication approach (Wilbur 1973; Marantz 1983; McCarthy and Prince 1995), because it is the only theory that gives descriptive adequacy to the reduplication data in Tübatulabal and Tseshaht.

Chapter Two: TSESHAHT

2.0 Introduction. The variety of Nootka described by Sapir and Swadesh (1939; 1955) is primarily the Tseshah̄t (c'íʃá:ʔath̄ 'residing at such a place') dialect spoken near the town of Port Alberni. Tseshah̄t is the dialect we shall be examining.

Tseshah̄t has some very interesting phenomena. In this language, the first two syllables of the word appear to have a special status. Several phonological processes, e.g., Stress-Assignment, Vowel Coalescence and Iterative Lengthening occur only in these first two syllables. Secondly, the language appears to have a three-way distinction in vowel-length. In addition to long and short-length vowels, Tseshah̄t has what Sapir and Swadesh (1939) call "variable vowels." Their surface length is dependent on their position in the word. A variable-length vowel which is long in either of the first two syllables of the word is short when it is in the third or later syllable of the word. This being so, variable vowels provide additional evidence of the unusual character of the first two syllables in a Tseshah̄t word. Finally, coda nasals and variable vowels appear to share similar characteristics in vowel-consonant sequencing—neither may have more than two consonants following them, as opposed to the three consonants permitted after a non-variable vowel, whether short or long. Moreover, neither nasals nor variable vowels participate in Reduplication.

The sources are Rose (1981); Sapir (1925, 1938); Sapir & Swadesh (1939, 1955); Swadesh (1937, 1939) and Thomas & Arima (1970). The reason we are not accessing recent fieldwork on Tseshah̄t is because the original sources are adequate for our purposes in laying out the issues. Therefore, it is not necessary to do fieldwork, and

furthermore, recent fieldwork has confirmed the validity of Sapir and Swadesh's (1939) findings for this dissertation. This chapter is arranged as follows: Section 2.1 describes Tseshah structure, its vowel and consonant inventory, syllable structure, and a full discussion and analysis of nasals and variable vowels. Reduplication in Tseshah is the topic of 2.2, followed by an account of Tseshah Stress in section 2.3. The Three-Dimensional Metrical Analysis of Tseshah Stress adopted here is presented, as well as alternative analyses offered in the literature. We shall see how the theory of Dynamic Phonology (DP) succinctly accounts for some puzzling exceptions to stress. Section 2.4 argues for the unique status of the Tseshah foot. Again we shall examine how the theory of DP provides a reasonable explanation for why certain phenomena behave as they do, both within and outside of that foot. Concluding remarks occur in section 2.5.

2.1 Tseshah Structure. All the Wakashan languages, including Tseshah, are heavily polysynthetic and, except for Reduplication, exclusively suffixing. They all make use of several patterns of Reduplication (Wilson, 1986). The family also shows a distinction in vowel length, which in the Nootkan branch presents itself as long vs. short opposition. Under certain circumstances outlined below, the stress system is sensitive to syllabic weight. A light syllable contains a short vowel, the obstruents in the coda having no effect on syllable weight. A heavy syllable contains either a long vowel or a short vowel plus resonant, which in Tseshah would have to be a nasal.

2.1.1 *Tseshah Syllable Structure.* (1) is a taxonomy of allowable syllables in Tseshah. All these upper limits appear to be word-internally as well as word-finally. The upper limit refers to the maximum number of post-vocalic consonants, up to but not including

the onset of the next syllable. These limits also refer to word-final consonant sequences.

The symbol for a variable vowel is '(:)', the parentheses indicating the variability.

- | | | | | | | | | |
|-----|----|----------------------------------|----|-----------------------------------|----|-------------------------------------|----|-----------------------------------|
| (1) | a. | <u>CV</u> | b. | <u>CV:</u> | c. | <u>CV(:)</u> | d. | <u>CVN</u> |
| | | CV(C ³ ₀) | | CV:(C ³ ₀) | | CV(:)(C ² ₀) | | CVN(C ² ₀) |

- | | | | | |
|---------------|----------|------------------|------------------------|------------------------|
| An example of | (1a) is: | t'iq'sṭcisaʔat' | 'was sat alongside of' | (Sapir 1925) |
| | (1b) is: | pí:cḳsy'i- | 'corpse' | (Sapir & Swadesh 1939) |
| | (1c) is: | mu(:)ṭq- | 'to lop off' | (Swadesh 1937) |
| | (1d) is: | papíṇhṭanay'i | 'place' | (Sapir & Swadesh 1939) |

According to Sapir (1938), all syllables must begin with one and only one consonant, which may be any of the consonants of the language. The onset of the syllable is followed by a vowel, which may be long, short, or variable, which is followed by zero to three consonants in the coda (see below for an alternative analysis). The underlined consonants illustrate the permissible number of consonants after a short, long and variable-length vowel. Note that both variable vowels and postvocalic nasals may only have up to two consonants following them, neither of which may be a nasal. Short and long vowels, on the other hand, may be followed by three consonants. Stonham (1990) suggests that these facts provide evidence that nasals and variable-length vowels are in complementary distribution. We never see surface glides and glottal stop in the coda of a syllable, only in the onset. In fact, glides and glottal stop appear to be a natural class in Tseshaḥt. Neither have oral features, nor as stated, appear in the coda. /h/ can occur only root-initially and in the reduplicative copy of the /h/-initial root. Suffixes appear to have no restrictions on their shape other than the constraints on syllable structure described above, ranging from single segments to multi-syllable complexes. (Wilson, 1985).

Referring to (1), an observation can be made about the postnuclear consonants:

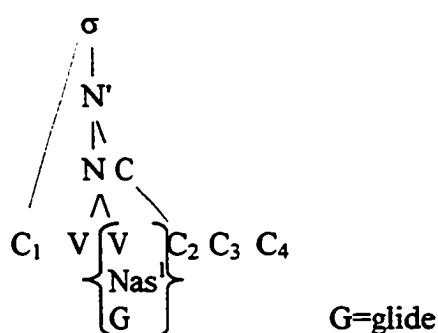
they do not abide by the sonority scale (e.g., (1a and b). Other examples are in (2):

- | | | | | |
|-----|----|----------------|---------------------|----------------|
| (2) | a. | yaqtʃiʔathʔitq | ‘he who was always’ | Stonham (1999) |
| | b. | apw’inqsʔi | no gloss | Stonham (1990) |

This can be construed as evidence that Tseshaht has at most one consonant in the coda of the syllable. Any other consonants following the coda are linked above the syllable, and are, therefore, not codas and so not subject to the Sonority Sequencing Generalization (SSG). The SSG governs what sequences can occur after a vowel in a syllable.

Adopting this view, I posit the syllable structure to be as in (3):

(3)



The unparsed consonants may occur word-internally as well as finally, as in (1a)

'i'q'st̥cisaʔat'. The internal status of these extrasyllabic consonants provides evidence that they must be linked above the syllable, if they have any prosodic analysis at all.

Another point needs to be raised: it is a contradiction to use both the Prosodic Hierarchy *and* the 3-D Metrical framework. Therefore, unlike the Prosodic Hierarchy, I posit only syllabic structure, which contains a rime that can branch in one of two ways. First, into a Nucleus and Coda, the coda containing at most one segment. Second, the

¹ The role of Nasal and Glide in this position will be discussed below.

Nucleus may branch. When it branches, it may contain two X's on the timing tier. If the Nucleus contains two X's, the second must be of a certain degree of sonority, either the second half of a long vowel, a glide (realized *phonetically* as the continuation of the preceding vowel) or a nasal. We can account for the constraint on the number of consonants that may appear after the various types of nuclei by saying there is an overall constraint on the number of consonants in a sequence, namely four. Consecutive segments within the syllable must obey the sonority hierarchy (Zec 1988). C₃ and C₄ do not obey the sonority hierarchy, however, as they reside outside of the syllable. A question to consider, then, is why a nasal consonant never occurs after a nasal consonant or a glide. The reason is that there are constraints for what may occur in these unsyllabified slots, but the constraints differ from what the prosodic hierarchy predicts. A perusal of the dictionary and the texts reveal that C₃ and C₄ may only be occupied by obstruents.

The analysis of the Tseshaht syllable presented here differs from Stonham's (1990) representation in at least the following respects: Stonham has the nasal in the coda of the branching rime, rather than as the second half of the branching nucleus. The representation adopted here neatly explains why we never get tautosyllabic long vowels followed by a nasal. Stonham's account is unable to do this. Next, Stonham has the nasal as underlyingly moraic. We shall examine this aspect more thoroughly later. Finally, Stonham crowds all the extra consonants into the coda, whereas I do not.

As will be explained in more detail later, stress in Tseshaht falls on the first syllable, unless it is light and the second syllable is heavy, in which case the second syllable receives the stress. A heavy syllable in Tseshaht contains either a long vowel or

a short vowel followed by a nasal. Notably, the variable vowel does not attract stress placement, although it may appear phonetically long.

2.1.2 *Vowel and Consonant Inventory*. The vowel system involves just 3 basic vowels, *i*, *u*, and *a*, and a length distinction as shown in (4):

- (4) *i* *u* *i:* *u:*
 a *a:*

Tseshah, as with all the languages in the Nootkan group, has no reduced vowels. Historically, schwa appears to have become /i/ in most environments in Nootkan, /u/ when adjacent to a rounded consonant (Wilson 1986).

A variety of allophonic variations occur, including *e* and *o* as secondary, nonphonemic vowels, which we do not analyze here. There are no diphthongs in the language.

Tseshah has a phonemic distinction between long and short vowels as exemplified by the following minimal pairs taken from Stonham (1990).

- (5) a. *wa-* 'to coil' *wa:-* 'to say'
 mas- 'healed up' *ma:s-* 'baking on open fire'
- b. *-ʔas* 'on the ground' *-ʔa:s* 'at the wrist'
 -it 'sleeping with...' *-i:t* 'to make...'

(5a) are examples of roots, whereas (5b) are of suffixes. Each category is distinguished only by length, either long or short. Long vowels are accepted in any syllable.

The consonant inventory of Tseshah is complex, involving 6 points-of-articulation—labial, alveolar, palatal, velar, uvular, and pharyngeal. There is also a glottal stop, which has no point-of-articulation. In addition, there are secondary

articulations, involving labialization and glottalization. Tseshaht has both plain and glottalized (ejectives) stops and affricates; fricatives, laterals, as well as plain and laryngealized nasals and glides. Like many of the other languages of the Northwest coast, Tseshaht lacks voiced obstruents and liquids.

Stonham (1990, p. 135) citing Sapir and Swadesh (1939) and Wilson (1985), points out that liquids that had appeared in the parent language, Proto-Wakashan, had evolved into nasals in Nootka. Therefore, the lateral is a fricative, not a liquid, making an interesting gap in the phonemic inventory; there are no liquids. Zec's (1988) sonority hierarchy theory, which predicts the scale of segments that can be mora-bearing, can be translated into this framework as a prediction as to which segments can occur in the nucleus. The mora concept is not essential for capturing this insight. Simply put, the most sonorous segments of the language, vocoids and nasals, may appear as the second half of a branching nucleus.

(6) gives an overview of the consonant inventory, as presented by Sapir and Swadesh (1939) except that IPA symbols are substituted whenever possible.

(6)

	Lab	Coronal		Lateral	Pal	Velar	Labialized Velar	Uvular	Labialized Uvular	Glottal	Phary
Voiceless (stops and Affricates)											
– plain	p	t	c	λ	ʃ	k	k ^w	q	q ^w	ʔ	ʕ
– glottalized	p'	t'	c'	λ'	ʃ	k'	k' ^w	q'	q' ^w		
Fricatives		s		ɬ	tʃ	x	x ^w	χ	χ ^w	ħ	ħ
Nasals											
– plain	m	n									
– glottalized	m'	n'									
Semivowels											
– plain					y		w				
– glottalized					y'		w'				

2.1.3 *The Nasal*. There are two immediately relevant distributional facts about nasals in Tseshaht. First, no more than two consonants may follow a nasal; and second, up to three consonants, not including a nasal, may occur in a syllable following either a long or short vowel nucleus. Illustrations of these distributional facts compiled by Stonham 1990 (p.140) are given in (7)²:

- (7):
- a. ʔú:cʔu:wimthwiʔin
 - b. k'icinkhʔim
 - c. ʔapw'ínqsʔi
 - d. ʔi(:)hck^wisaqa
 - e. * k'ici:nkhʔim

The form listed in (7e) is an impossibility in this language, i.e., there are no examples of autosyllabic V:N forms found in Tseshaht. But although nasals are not permitted after a long vowel in Tseshaht, other consonants are. As presented in (3) above, the nasal occupies a slot established by the branching nucleus, the exact slot occupied by the second half of a vocalic segment, in a long vowel. The same timing slot cannot simultaneously host two segments.

Swadesh (1939) provides further evidence that the distribution of nasals patterns with vowel length. In Tseshaht, certain suffixes lengthen the first vowel of the word. Wilson (1986) asserts that the process must be morphologically conditioned, because the suffixes triggering such vowel lengthening bear no phonological features that would explain their effect on stems. So, for example, the initial vowel of the stem in (8a) lengthens with the addition of the suffix in (8b), to produce the word form shown in (8c):

² Stonham provides no glosses.

- (8) a. n'un'up'itʃ- '(to do, be) once at intervals' (iterative)
 b. -mi:k^w 'getter of...'
 c. n'ú:n'up'itʃmi:k 'getter of 'once-at-intervals''

(9) and (10) are examples of another lengthening suffix. The stem-initial vowel is lengthened in (9a), but is blocked from lengthening in (10a).

- (9) a. hi:ʔiɬiɬ 'become unable to get'
 b. -iɬ 'go for, get'
 c. hiʔiɬ- 'unable to get'
- (10) a. ɬimʃyaʔisitaʔiɬ 'invite eaters of boiled'
 b. -iɬ 'go for, invite'
 c. ɬimʃaʔisita(q-) 'eater of boiled'

The stem vowel in (10a) is short in spite of the lengthening influence of the suffix. If length means a branching nucleus and the suffix is one that induces the nucleus to branch, then the lengthening rules can have no effect on -im- as it is already a branching nucleus.

The form in (7d) suggests that the variable vowel might also pattern distributionally like the nasal, laying ground for the claim that nasals and variable vowels are in complementary distribution to each other. We turn now to variable vowels.

2.1.4 *The Variable Vowel*. The last distributional fact that needs to be discussed is the variable vowel. Wilson (1985) says that variable vowels in Tseshaht, as in all Nootkan languages, occur only in suffixes. Thus, variable vowels are long in the second syllable of a word, and short elsewhere as shown by these examples taken from Wilson (1986, p. 284-5):

- (11) a. -na(:)k^w 'having, possessing...'
 b. ʔúna:k 'possessing it'
 c. tʃápacnak 'having a canoe'

The variable vowel in (11a) is long in (11b) and short in (11c). Despite being phonetically long in (11b), the lengthened variable vowel does not draw stress. Given examples such as (11), we would expect to find minimal triplets in the language, in which there is a three-way distinction in the behavior of vowel length. And, in (12) below, taken from Stonham (1990), we see that we do:

- | | | | | | | |
|------|------|---------------|-------|---------------|---------|----------------|
| (12) | -ʔaɭ | 'aware of...' | -ʔa:ɭ | 'to come off' | -ʔa(:)ɭ | 'on a surface' |
| | -uɭ | 'place of...' | -u:ɭ | Iterative | -u(:)ɭ | 'on the face' |

This three-way distinction has been discussed by Wilson (1985) with respect to suffixes, yet Swadesh (1937) proposes that the distinction may occur for roots, too. If variable vowels can be shown to be a property of the root, as well as suffixes, then the first syllable of the Tseshaht word should show vowel length, as well. The problem in detecting these roots is not only the infrequency of variable-length stem vowels, but also the fact that such roots must undergo double reduplication in order to be placed in the third syllable of the word. Examples drawn from Swadesh's corpus are given in (13):

- | | | | |
|------|----|-----------------------------|-------------------------------|
| (13) | a. | mu(:)tq- | 'to lop off' |
| | | múmu:tqn'uk | 'lopped off at the head' |
| | | múmumutqn'uk | 'to lop off (distributive)' |
| | b. | ya(:)k ^w - | 'sore' |
| | | yáyak ^w an'uɭ | 'sore of shin' |
| | | yáyayak ^w an'u:h | 'sore-shinned (distributive)' |

Notice that the vowel is long when reduplication places the variable vowel in the second syllable, but the vowel length is short as soon as it goes beyond the second syllable. Also, variable vowels in the first syllable of the stem get reduplicated and the reduplicant appears short. We can see from (13) that variable length is in all probability a property of root vowels as well as of suffix vowels. The definition of a variable-length

vowel, therefore, is a vowel which is long in the first two syllables of the word, and is short when it is in the third or later syllable of the word. We thus conclude that it is plausible to posit a phonological segment, like a normal phoneme of the language, that can appear as the second half of a long vowel under certain phonologically determined circumstances. Our present task is to determine what that segment is, and what its distributional properties are.

I posited that the second timing slot created by a branching nucleus on the timing tier could be filled by a nasal. I further posit a dummy symbol ‘Q’ as a place holder for the segment that determines the variable vowel. Q occupies the same slot as a post-vocalic nasal, i.e., the second half of the nucleus. Note that element Q is not specified in the consonantal chart in (6). However, gaps in the segmental inventory, together with the distributional facts and certain observations about stress, suggest some likely candidates for Q’s quality. The absence of surface glides in the coda suggest that ‘Q’ is a glide underlyingly (as Stonham (1990) proposes); and the fact that ‘Q’ is posited on distributional grounds as a component of the nucleus supports this analysis. Because Q must be sonorous enough to appear in that constituent, it seems reasonable to propose that it is a vocoid, no less sonorous than a nasal. But Q does not contribute to syllable weight (as determined by stress facts, illustrated in Section 2.3), or participate in reduplication, unlike the second half of a long vowel (see below). Therefore, I conclude that Q is a glide or a liquid underlyingly. Since we cannot tell whether Q is a glide or a liquid, I arbitrarily choose to posit a glide for the analysis.

2.2 Reduplication. Reduplication is the only morphological process that provides apparent prefixes in Tsshaht, otherwise, it is an exclusively suffixing language. Sapir

and Swadesh (1939) state that reduplication is suffix-driven, and depending upon the suffix, seven different types of reduplication occur. (14) gives their notation and brief description for the seven types.

- (14) a. [R] Normal Reduplication: the reduplicated syllable has the same consonant and vowel as the stem.
 b. [R·] Reduplication with lengthened vowel in the reduplicant.
 c. [Rc, R·c, Rt, R·t] Reduplication with an infix consonant, either /c/ or /t/.
 d. [R+L, R·+L, R+S, R·c+s, etc.] Reduplication with lengthening or shortening of the stem vowel.
 e. [T] Iterative reduplication. Full stem copying.
 f. [T·] Iterative reduplication with lengthening (of the reduplicant and stem vowel).
 g. [T(:)] Iterative length change. The first two vowels are lengthened and the last vowel is long; all other vowels are shortened.

Raimy's (1999, 2002) theory of reduplication seems promising in accounting for all the reduplication facts in Tseshah. He claims the reduplicant is not a morpheme in any language, although all reduplication is morphologically triggered, in conjunction with true affixation. Reduplication is, in Raimy's view, a rule-based manipulation of precedence relations. A full exploration of Raimy's theory of reduplication as it applies to Tseshah is beyond the scope of this paper and must remain a topic for the future. For the present, we focus on the so-called "normal" reduplication (14a above), as it is the most prevalent and most discussed form of reduplication in the literature.

Raimy's theory suggests that normal reduplication in Tseshah is to be understood as the copying of all segmental material from the beginning of the word up to and including the first vowel melody, rather than as the copying of any prosodically defined constituents. A nasal consonant, occupying the second timing slot of the Nucleus is ineligible for reduplicating, simply because it is not a vowel melody. Note that while this analysis does not posit a constituent over which reduplication operates, neither does

any other theory: the material copied under reduplication in Tseshaht cannot constitute a constituent under most theories of the syllable, because it is the sequence Onset plus Vowel (but see Clements' (1990) notion of "demisyllable"). Raimy's theory is going to have a loop, the base of which is going to start after the stress-bearing unit. Turning now to stress, my analysis provides a metrical analysis for determining stress: A parenthesis is projected on Line 0 by a branching nucleus, but not by a branching rime. Recall that the Projection Parameter in the 3-D Metrical Theory states: Project the {left/right} boundary of certain syllables onto Line 0. In Tseshaht, the trigger for projecting the boundary are syllables containing a branching nucleus. This will account not only for the stress facts of Tseshaht (see below), but also for the difference between those languages that count long vowels as heavy, but not coda consonants, as we saw in Chapter 1.

(15) gives examples of normal reduplication initiated by two suffixes: *-tʃiʔ* 'naming' and *-ʔi:h* 'hunting'. Examples of suffixes affixed to a root containing a short vowel are shown in (15a) and (15b), while (15c) and (15d) show the same suffixes with a long-vowel root.

- | | | | | |
|------|----|------------------------------------|---|-----------------------|
| (15) | a. | c'á c'awat ʃiʔ
CV stem suffix | 'naming one' | (Stonham 1990: p.131) |
| | b. | ʔú ʔu ʔi:h
CV stem suffix | 'hunting it' | (Stonham 1990: p. 19) |
| | c. | wá: wa:s tʃiʔ
CV: stem suffix | 'naming where...' (Stonham 1990: p.131) | |
| | d. | tá: ta:kwa ʔi:h
CV: stem suffix | 'hunting only that' (Stonham 1990: p. 19) | |

In (16), we see what happens when the same suffixes occur with a root containing a nasal.

- (16) a. tʃi tʃims tʃiʃ ‘naming a bear’ (Stonham 1990: p.131)
 CV stem suffix
- b. tʃi tʃims ʔi:h ‘hunting bear’ (Stonham 1990: p. 19)
 CV stem suffix

As can be seen from these examples, what is reduplicated is only the onset and the vowel. Nasals are not reduplicated because although part of the nucleus, they are not a vowel.

Interestingly, just as nasals do not participate in Reduplication, neither do variable length vowels, as seen in (17) below (taken from Stonham 1990, p.139):

- (17) a. tú tu:t ʃ ‘thundering (at intervals)’
 CV(:) stem suffix
- b. ʔi ʔi: h ‘big here and there’
 CV(:) stem suffix

Wilson (1986) claims that because variable vowels do not participate in reduplication, they are underlyingly short. However, in the analysis adopted here, the failure of variable length to be copied in the reduplicant is part of the evidence that Q (the determinant of variable length) is not a vowel. The behavior of variable vowels during Reduplication reinforce the notion that the nasal and Q occupy the same timing slot—the second half of a branching nucleus. The similarities end with the Reduplication and distributional facts, however. The nasal, like a long vowel, is heavy and thus contributes to Stress-Assignment, the variable vowel does not.

In the 3-D Metrical Theory adapted for Tseshaht, heaviness projects a parenthesis onto Line 0. Therefore, in Tseshaht we would claim that a branching nucleus projects a parenthesis onto Line 0. But the branching nucleus accommodating the variable vowel with its attendant Q, either must be said to not project a parenthesis onto Line 0 (to account for the fact that the variable vowel is not heavy), or to project a parenthesis which is later discarded under a rule. I adopt the latter proposal, and discuss the details of the analysis in Section 2.4.2.

2.3 Stress. Stress in Tseshaht falls on the first syllable, unless that syllable is light and the second syllable is heavy, in which case the second syllable receives the stress. A heavy syllable in Tseshaht contains either a long vowel or a short vowel followed by a nasal, where by “long” vowel, we mean a vowel which consists of a V that is spread over two timing slots. A light syllable has either an open short vowel or a short vowel followed by one or more non-nasal consonants. In metrical terms, then, a heavy syllable has a branching nucleus. There are no secondary stresses marked in the data.³

Examples, most taken from Wilson (1985, p. 55-6), show the possible patterns of light and heavy syllables.

- | | | | | |
|------|----|-----|-----------------|---|
| (18) | a. | L L | húʔacatʃiʎa:ʎma | ‘he will come back’ (Stonham 1999: p. 59) |
| | b. | L H | tʰasi:ʔakʰi | ‘his door’ |
| | c. | L H | nitʃínk | ‘packed tightly together’ |
| | d. | L H | ʃaxskímltʃʰaʃ | ‘baldheaded, it turns out to be’ |

³ Stonham (1999) claims that secondary stresses do occur in Tseshaht on alternating syllables from the main stress. He bases this on Sapir’s original field notebooks compiled in 1910-11 and 1914 residing in the archives of the Boas Collection at the American Philosophical Society in Philadelphia [W2a.18]. The secondary stresses are inconsistent, however. For that reason, along with the fact that several phonological processes (to be discussed below) occur only within the first foot, if secondary stresses do occur, it seems reasonable to assume that they do so at a post-lexical level.

e.	H L	ʔink'i	'the fire'
f.	H H	ʔú:simtʃaλ	'now trained at...'
g.	L L	ʔi(:)hck ^w isaqa	no gloss (Stonham 1990, p. 140)
h.	L L	wim'a(:)qstuʔaλ	'he was unhappy' (Stonham 1999: p. 66)

In (18e) we cannot tell the nasal's weight role, because the stress could be placed there as the default placement, whereas in (18f) we still cannot ascertain the weight of the nasal, because, according to the stress rules of the language, the nasal in the second syllable would lose out to the long vowel in the first syllable in attracting stress. We are able to establish the heaviness of the nasal in (18c), where the syllable with the nasal –jink attracts the stress. If both of the syllables were light, then the first syllable *nit-* would receive the stress. (18g) and (18h) establishes that a variable vowel behaves as a light vowel for stress. In (18d), we have the L H stress pattern, despite having the first syllable closed by more than one consonant. As Wilson (1985) points out, the stress rule of Tseshaht cannot be “stress the first heavy syllable in a word.” As Sapir (1925) notes, when both of the first two syllables are light, stress falls on the first, even when there are other heavy syllables later in the word, e.g. (18a).

The domain of the stress rule for Tseshaht is the first two syllables. If we make crucial assumptions about foot structure, the rule may be described as follows: (See below for a more detailed account.)

(19) *Tseshaht Stress Rule*

Within the first foot stress the leftmost heavy syllable; if both are light, stress the leftmost.

2.3.1 *A Three-Dimensional Metrical Analysis of Stress.* Tseshaht stress is a good candidate for a metrical analysis (Halle & Vergnaud 1987; Idsardi 1992; Halle & Idsardi 1995). The specific parameter settings and rules for Tseshaht are in (20):

(20) Parameter Settings and Rules in Tsshaht

Line 0

Project: L
 Edge: LLL
 ICC: R
 Avoid (*(
 Head: L

Line 1

Edge: LLL
 Head: L
 Conflate

Reviewing from Chapter 1, on Line 0, we first project a Line 0 element for each syllable head, which in this language equals the nucleus. Tsshaht chooses to project the left boundary of a heavy syllable. (In this language, a heavy syllable is either a long vowel or a short vowel followed by a nasal.) The Iterative Constituent Construction Parameter inserts a parenthesis on Line 0 every two elements; Tsshaht prefers starting from the left-most element. The Headedness Parameter accounts for prominence of the first element of each constituent. Tsshaht chooses to project the left-most element of each constituent onto the next higher line of the grid. Moving onto Line 1, the remaining parameter to define is the Edge Parameter. Tsshaht opts to place a left boundary to the left of the left-most element.

In addition to the parameters, Tsshaht stress involves rules and constraints. One such rule is Conflation, which is a rule that eliminates all stress but the main word stress. All secondary stresses are eliminated by demetrifying all but the main constituent (Halle & Vergnaud 1987, p. 52). In other words, all the Line 1 asterisks that do not have a Line 2 asterisk above them are deleted, with accompanying deletion of the metrical constituents which triggered their projections. Thus, conflation also deletes the metrical parentheses on Line 0.

Idsardi (1992) proposes constraints to block the application of a stress rule. The constraints act as output conditions on the rules. The avoid constraint used in Tseshaht is Avoid (*(), making a constituent with less than two projections onto Line 0 impossible.

In the following derivations, Line 0 shows the foot boundaries, Line 1 shows the secondary stresses, and Line 2 shows the word (main) stress. The order for the derivations in (21) follows the ordering of the parameter setting and rules from (20). Form A is bisyllabic, while form B is an odd-numbered syllabic example.

The Edge Parameter does not apply to either form on Line 0. Form A already contains a parenthesis on its left edge because the VN sequence projects a left parenthesis. The Avoid constraint blocks the application of the Edge parameter in Form B. The parameters and rules now apply to Line 1.

(21)		<u>A</u>	<u>B</u>
<u>Line 0</u>	0	* *	* * * * *
		tʃim'smi:t 'Bear-son'	hupinwafukʔi 'his little canoe'
Project: L	0	(* (*	* (* * * *
		tʃim'smi:t	hupinwafukʔi
Edge: LLL		—	— [Avoid (*()
ICC: R	0	—	* (* *) * *)
			hupinwafukʔi
Head: L	1	* *	* *
	0	(* (*	* (* *) * *)
		tʃim'smi:t	hupinwafukʔi
Edge: LLL	1	(* *	(* *
	0	(* (*	* (* *) * *)
		tʃim'smi:t	hupinwafukʔi

Head: L	2	*	*
	1	(* *	(* *
	0	(* (*	* (* *) * *)
		tʃim'smi:t	hupinwafukʔi
Conflate:	2	*	*
	1	*	*
	0	(* (*	* (* *) * *)
		tʃim'smi:t	hupinwafukʔi

The 3-D Metrical analysis of stress in Tseshahat accounts for the data using a minimal set of parameters and rules. Unlike the other analyses yet to be discussed, the syllable is not the stress-bearing unit, nor do prosodic constituents, e.g., the foot, have any bearing. Although the terminology used is the same in the 3-D Metrical theory and in prosodic theory, they mean very different things. In the former theory, feet are constituents on the metrical tier, whereas in prosodic theory, feet literally gather syllables, and ultimately segments, in them.

2.3.2 Other Analyses of Stress in Tseshahat. Wilson (1985) analyzes Tseshahat within a metrical framework, building its binary feet over moras. Stonham (1990) distinguishes the structure of the first foot in a Tseshahat word from the structure of the remaining feet. Both theories shall be elaborated on below.

2.3.2.1 Wilson (1985). Wilson's metrical framework predates the publication of the 3-D Metrical approach assumed in this paper, and represents stress prominence as a stress tree (following Liberman and Prince (1977)). In Wilson's framework, syllables are grouped into pairs. Within each pair, one syllable has prominence over the other. In metrical notation, this is shown as a binary branching tree, or a metrical foot:

(22) Metrical Foot

\wedge s=strong metrical position; w=weak metrical position
 s w

In this theory, stress is assigned by grouping syllables into feet, then grouping the feet into pairs, beginning at either the left or right boundary of the word, creating higher-level structure. This process continues until all the feet are gathered into a single tree.

To correctly assign stress in a given language, certain parameters must be known in the construction of the feet. We need to ascertain if the feet are strong-weak or weak-strong, the trochaic/iambic distinction. We need to know the directionality for building feet: left or right. Finally, there is a parameter that determines whether footing is iterative or non-iterative. The latter builds only a single foot.

Wilson claims that the pattern of Tseshaht stress within the first two syllables can be explained metrically if it is assumed that Tseshaht builds its binary feet not over syllables, but over moras; this departure from the Liberman and Prince (1977) model is how he accounts for the role of syllabic weight. Thus, a foot can be built over the two vowel-slots in a single syllable, or over two syllables, each containing a short vowel. Wilson proposes two rule parameters in the construction (1985: pp.56-57):

(23)

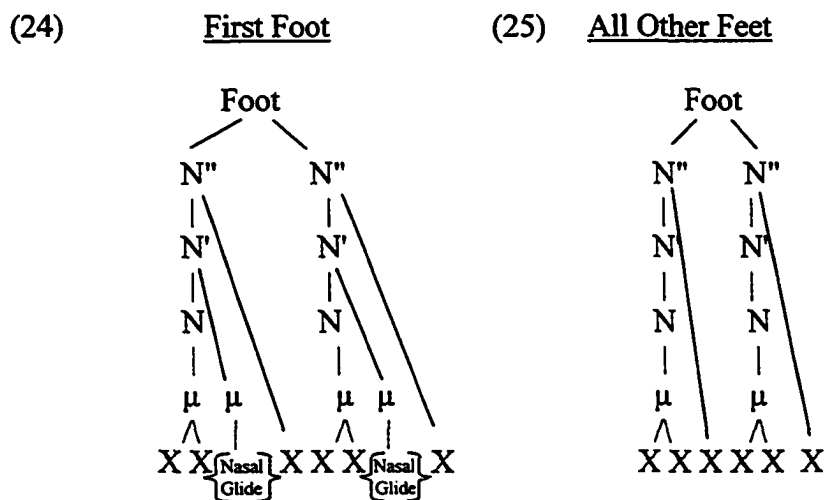
- (1) Build a single binary quantity-sensitive foot on morae, left-to-right in the word;
- (2) Label the tree as 'right is strong' only if the right node dominates a branching vowel.

Wilson contends that the two rules together will build a foot over an initial long vowel and then stop. A long vowel in the first syllable will always get the stress. If the first syllable's vowel is short, the foot will be built over the first and second syllables. If

the second syllable also contains a short vowel, the first syllable will be the strong node since the right node does not branch. If, on the other hand, the second syllable contains a long vowel, it will meet the description in Rule (2) and be labeled strong.

Wilson's theory incorporates both moras and branchedness to account for weight. He considers it crucial to have both, although he never once defines a mora. The primary argument against Wilson's theory is that, as argued for in Chapter One, a representation that includes both moraic and segmental structure arises as part of an overly powerful, unconstrained general theory. A more constrained approach would be to view moraic and segmental theories as competing theories. Furthermore, since Wilson builds binary feet over moras, a word-initial sequence with a light syllable followed by a heavy syllable would not yield a foot with a long syllable to the right. Instead, the foot would bisect the second syllable, unless some special constraint were to be invoked. Lastly, a real problem with Wilson's analysis is that he cannot account for the morphologically conditioned stress exceptions. In Section 2.3.4, I shall describe the Tseshaht stress exceptions and discuss the various attempts to deal with them, including Wilson's.

2.3.3.2 *Stonham (1990)*. Stonham, following Wilson (1985, 1986) also makes the point that the first foot in Tseshaht has a special status, as being not only the domain of stress, but also the domain of several other phonological rules, as we will see in more detail in Section 2.4. Stonham distinguishes the first foot from all other feet in a word by its structural representation of the syllables within that foot. The first foot has the representation in (24), whereas the remaining feet have the structure in (25).



Stress, Stonham says, can be assigned to the first foot and appear on the head of the first branching nucleus or on the first nucleus if neither branches. Additionally, he maintains that the feet structures in (24) and (25) account for all the other phenomena that occur in Tseshaht.

Stonham argues further for his foot structure (1990: p.145): “Given this distinction of an extra position, we can account for the nature of variable-length vowels by placing them in the coda, but linked to the nucleus in the first foot. If they occur later than this, then there will be no link for them and they will be left in the coda.” Stonham seems to be saying implicitly that there are *two* properties that distinguish the first foot from the later feet. First, syllables differ in just the way depicted in (24) and (25), and secondly, that the glide portion of the variable vowel will link to the nucleus in the first foot, but not in subsequent feet.

It is stipulative to posit different syllabic structure for first and subsequent feet. And Stonham’s constraint against linking coda material, specifically glides, to the nucleus outside of the first foot is yet another language-particular stipulation. Furthermore, Stonham implicitly assumes that first-footed syllables allow a more

elaborate structure than remaining footed syllables. If this were the case, then one would expect reductions in coda structure in unstressed syllables, not simply the non-occurrence of glides. Stonham posits that it is just the non-branching of N' that characterizes the unstressed syllable. Why should this be the case?

Stonham is not entirely clear in his definitions of coda and nucleus. He suggests that the segments that attach directly to the N" node are in the coda, whereas the elements that link to *either* the N' or N node are in the nucleus. He wants to define the nucleus one way to get stress to work out right, and he wants the glide in the coda to get his analysis of variable vowels to come out right. Stonham's analysis is not only circular (branching rimes occur only in the first foot, because only in the first foot does the branching rime attract stress), but it fails to account for the complementary distribution of long vowels with nasals and glides.

Stonham claims that nasals prohibit length in the nuclei to their left, and yet his theory does not motivate this prohibition. He posits both the nasal and the glide as occupying the first position in the coda, for a total of three nonglottalized coda consonants, the last two always obstruents. His motivation is to have reduplication take along the entire nucleus with the onset, a string that does not amount to a constituent. Therefore, if we have to reduplicate what would be a nonconstituent, by anybody's analysis, he has really no motivation at all.

It is simpler to describe reduplication as involving a repetition of a string that starts at the beginning of the word and goes on through the first vowel melody, as I propose using Raimy's (1999, 2000) theory. Then we can posit both the glide and the nasal in the nucleus, explaining the lack of long vowels to their left. We can account for

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the constraint on the number of consonants that may appear after the various types of nuclei by saying there is an overall constraint on the number of consonants in a sequence, namely four. All the facts are handled nicely. Additionally, it accounts for the so-called hierarchy of sonority for moraic segments, as follows: the Sonority Sequencing Generalization (SSG) governs what sequences can occur after a vowel in a syllable. There are no languages, therefore, with a post-vocalic segment in the nucleus that is less sonorous than coda segments by virtue of the SSG. Yet, as shown in (2), Tseshaht has consonants following the coda consonant that do not abide by the SSG, providing evidence that these consonants cannot be coda consonants. The syllabic representation of Tseshaht presented in this dissertation and Raimy's theory of Reduplication, along with the SSG, makes the hierarchy of sonority for moraic segments totally redundant.

Stonham argues that both moras and syllabic structure are essential in Tseshaht. He claims that the moras allow for the observations about the non-moraic status of onsets and allows for various types of copying templates. The varying levels of the syllable, which incorporate the notions of rime and nucleus, account for the various patterns of reduplication in the language. However, as argued for above, following Raimy (1999, 2000), the claim here is that reduplication is not closely tied to prosodic structure in Tseshaht. Furthermore, most theories that propose the mora have a flat syllable structure, because the mora concept is supposed to do the work of a rich internal structure. It is, therefore, a weakening of explanatory adequacy to have both moras and a rich syllable structure.

The same arguments against Wilson's (1985) representation of the syllable hold for Stonham's, as well. Having both moras and X'-notation is overly powerful and unconstrained.

Finally, it is not the difference between the first foot and subsequent feet that is crucial here. It is that the *only* foot in the word lies against the left edge of the word. In the 3-D Metrical Phonology theory, unlike the theory of prosodic hierarchy, feet are constituents on the metrical tier, they are not constituents that dominate syllables and ultimately segments. Phonological rules may refer to metrical constituents, just as they refer to syllables. Tseshaht has rules that delete glides, as well as glottal stops (as we shall see), in all positions of the word *except* the one and only foot of a word. We shall adopt here the idea of "premium values" presented by Calabrese (2002); premium value is assigned to X-positions in the foot. Recall from Chapter One that a feature, or segment has premium value if the grammar has a strong aversion to deleting it. In a rules and repairs approach, repairs that involve deletion of premium value entities are not considered "convergent," or are not accepted as outputs.

2.3.4 *Stress Exceptions.* A number of exceptions to the basic stress rule exist. The analysis of exceptions is a significant proving ground for evaluating alternative hypotheses. The following descriptions follows Stonham (1999) and Wilson's (1985) account. The phenomena will be described here, along with Wilson's and Stonham's analyses; the analysis adopted here, within the 3-D Metrical Phonology theory, follows in Section 2.3.6.

2.3.4.1 *Consonant deletion preceding a hardening suffix with concomitant stress shift.* Tseshaht, like all the Wakashan languages, shows a set of morphologically determined

- (27) a. $tʃimsʔi:$ vs. $tʃimsáʔa\lambda\lambda a:$
 $c'i:qa:$ $c'i:qá:ʔa\lambda$
- b. $yaqtʃiʔathʔitq$ ‘he who was always’
 $yaq -tʃi -ath -ʔi(:)tq$
- $\lambda upkʃiʔa\lambda weʔin$
- c. $ʔi:hʃiʔa\lambda qu:weʔin$
- $qa:hk^w áʔap$ ‘causing the death’
 $qa:h -na(:)k^w -a\lambda$
- $m'a:m'i:qsúʔi$ ‘oldest child’
 $m'a:m'i:qsu -ʔi(:)$
- $wim'a:qstúʔa\lambda$ ‘poor as far as’
 $wi -m'a(:) -ʔaqsu\lambda -a\lambda$
- $ʔuya:q\lambda éʔic$ ‘after a while’
 $ʔu -(y)i(:) -ʔa:q\lambda -me(:)ʔic$

Stonham (1999) points out that the V?V sequence behaves as a single, long vowel for the purposes of stress assignment. (27a) illustrates the shift of stress assignment to these sequences, whereas (27b) shows the placement of stress on them rather than on the preceding light syllables. The examples in (27c) suggest that the V?V sequence may even take precedence over heavy syllables, and demonstrate that the stress can go beyond the second syllable.

It seems likely that the phenomena that Stonham observes are the same ones that Wilson (1985) discusses. Wilson maintains that the stress shift to the V?V sequences is optional, and Stonham, that it is mandatory. We will defer analysis of this phenomenon until 2.3.6.

2.3.4.3 *Empty Stems*. This is another set of stress exceptions. Empty stems are stems with very little semantic content, being used as placeholders for a following object (Swadesh 1939). These stems generally do not bear stress unless reduplicated or otherwise affected by morphological processes. Examples are *ʔo-*, a general object marker meaning ‘it, him, so-and-so’; *hita-* or *hin-*, a general locative, often translated ‘there’.

- (28) a. ʔoyóʔaifʔaλ ‘now perceived so-and-so’ from
ʔo- empty stem, ‘so-and-so’ + -yoʔaʔ ‘perceive’ + ’—aλ
- b. hitáqʃiλ ‘went into (a canoe)’ from
hita- empty locative + -aq ‘to go in’ + -ʃiλ momentan.

We now evaluate Wilson’s (1985) analysis of these stress exceptions, followed by my analysis of them within the 3-D Metrical framework.

2.3.5 *Wilson’s Analysis of Stress Exceptions*. Wilson suggests that the best solution to the movement of stress caused by the loss of a consonant lies in the concept of the Designated Terminal Element (DTE) (Wilson 1985, p. 58). This is the term for a specific type of segment or syllable that must be present for foot construction to begin. For example, some stress rules cannot start assigning stress until some specific type of syllable (usually defined by heaviness) is met (Wilson 1985, p. 10). Wilson hypothesizes that the loss of the (λ) before a hardening suffix could designate the vowel immediately preceding it as a DTE. Complications ensue from this analysis, however, because a rule must state that a Tseshaht word may have only one DTE and that a DTE created by a specific rule takes precedence over the general DTE⁴. Foot construction would begin

⁴ Wilson does not say what the general DTE is.

there. Since in every case, the following syllable contains only a short vowel, the stress would fall in the correct place. Thus a generalization would be lost under this analysis. As Wilson himself acknowledges, this solution adds a great deal of ad hoc machinery to the system, and therefore, does not advance our understanding of the phenomena.

Wilson (1985) declares that empty stems are cases of extrametricality. When a morpheme on the edge of a stress domain does not take the stress even though the phonological conditions are met, Wilson maintains that it is outside the scope of the stress rules. Wilson makes no attempt to connect the status of the so-called “empty” morphemes with their linguistic status. Instead, he asserts that they are “extrametrical” and leaves it at that. In actuality, these morphemes seem to be proclitics, subject only to post-lexical rules, although the fact that they are subject to stress when reduplicated shows that they can also function in the word grammar. This is, again, stipulative and does not help us understand the behavior of “empty stems.”

2.3.6 *A Three-Dimensional Metrical Analysis of Stress Exceptions.* The examples which exemplify the empty-stem phenomena are all examples of grammatical formatives which are clitics, and are affixed to lexical items in the postlexical component. Accordingly, it seems reasonable to suggest that the stress rules in (20) apply in the morphological component, where these so-called “empty stems” do not appear.

The analysis proposed in the preceding paragraph is supported by the observation that these empty-stems are the only grammatical formatives that appear superficially to be prefixes, in an exclusively suffixing language. These elements might not even be present when the word level grammar is operating—they are proclitics, not affixes, put in by the syntax. Therefore, they are subject only to post-lexical rules. The fact that they

are subject to stress when reduplicated shows that these elements can also function in the word grammar, in which case they are subject to readjustment rules or reduplication, then to the lexical stress rules.

The second type of stress exception discussed, the case of the first vowel of a V?V sequence attracting stress regardless of its position in the word, is puzzling. (27) gave examples of these. The interesting point is that the V?V seems to attract stress even when the first V in this sequence is in the third or later syllable, and when the first or second syllable of the word is heavy. Stonham (1999) conjectures that this sequence, V?V, may be ‘heavier’ than a VV or VN sequence in Tseshah. Stonham’s (1999) weight hierarchy idea is not very attractive. If the V?V sequence were acting like a single, long vowel, then why is the stress on the first of these two? After all, the appearance of stress on the first vowel of this sequence is typical of the trochaic stress foot of Tseshah, not an especially “heavy” sequence. Additionally, in all of these cases, the glottal stop is in onset position, and therefore should not be weight-bearing. In fact, as mentioned above, glottal stop is never seen in the coda position in this language. Furthermore, intervocalic glottal stops typically delete outside the two syllable window at the left edge of the Tseshah word. An adequate analysis of this phenomenon should draw some connection between the attraction of stress to the V?V sequence and the failure of the /ʔ/ to delete.

Let us assume that in Tseshah, the foot assigns premium value (Calabrese 2002) to the segmental material within it, specifically, disallowing consonantal and vocalic segmental material from being deleted. When two vowels outside of the foot become

adjacent by suffixation, Vowel Coalescence usually occurs.⁵ Let us assume that the V?V sequence is, in fact, an underlying sequence of VV, in need of repair, because it violates the injunction that syllables must have onsets. We must also assume that there is a rule somewhere in the grammar that effects this repair by means of ?-insertion. It is proposed here that, for whatever the reason, when two vowels outside of the foot (the third syllable or beyond) are not contracted, either on morphological or phonological grounds, that stress will be drawn to those vowels. A stress foot will be created, and since no segments are allowed to be deleted within a foot, glottal-stop, as the default consonant, will be inserted between the two vowels.

What might be motivating all this, is that for reasons that may extend beyond the phonology proper, the grammar assigns premium value to *both* vowels that are adjacent to each other. Tsashaht does not allow vowel hiatus, however. The only mechanism Tsashaht allows for avoiding vowel hiatus, given the premium value assigned to each vowel, is ?-insertion. But, unless /ʔ/ appears in a stress foot, it gets slated for deletion. Therefore, the grammar has no alternative but to shift stress to the first vowel of a V?V sequence, no matter where in the word this sequence occurs.

The mechanism for achieving the ends mentioned in the preceding paragraph is problematic at the moment, but see below. It seems as if stress appears on the first V of the V?V sequence. It is, therefore, a non-branching nucleus and would not, under normal circumstances, project a parenthesis. And the trigger for this parenthesis does not even

⁵ The details of this process, as well as several other phonological processes that support the special status of the foot will be described in section 2.4.

occur in that same syllable. Furthermore, this projected parenthesis obliterates all the Line 0 parentheses to the left, those resulting from either a long vowel, a VN sequence, or the edge parenthesis. No where else in the language does this occur. As inelegant as it may be, to stipulate a parenthesis in this circumstance is what must happen. At least this stipulation does not have the problem that it invokes an ad hoc UG mechanism, it shows only that UG must give individual languages the power to create crazy rules. There are certain things we can say about this mechanism: it must be in the “hardening” suffixes. In fact, it is possible that the occurrence of this glottal stop is usually concomitant with the occurrence of hardening suffixes; this is a topic of future investigation.

Borrowing ideas from Calabrese’s (2002) theory of Dynamic Phonology (DP), we shall assume a constraints and repair approach to the problem of stress shift. To quickly review, DP posits a set of constraints that mark representations as either well-formed, ill-formed or complex. Individual languages have the option of deactivating markedness constraints. Any representation that violates a markedness constraint that is active in the language must undergo repairs. Such repairs include the addition or removal of syllabic nuclei, syllabic lines or other skeletal positions. The analysis proposed here goes beyond Calabrese’s proposal by proposing an ad hoc movement of parentheses on Line 0 of the metrical tier, in the morphological component. The set of repairs is applied to the offending representation and provides a set of possible outputs that are evaluated to choose the most convergent. The theory of DP proposes that certain features or configurations may be assigned premium value, to be determined individually by language.

Let us see how this approach may be applied to the problem at hand, proceeding with the caveat that the upcoming analysis is highly tentative and speculative, because it assumes language-particular mechanisms not supported in Calabrese's highly constrained theory of DP.

Let us assume a hypothetical representation like (29), in the morphology. The first two syllables have been grouped by normal application of the rules of the metrical phonology into the only foot in the word.

(29) Line 0 (* *) * *
 [σ σ CV.V...

I posit the following assumptions, as suggested above:

(30) *Assignment of premium values:*

- a. A morphological readjustment rule, operating under the influence of an affix, to be determined by future research, assigns premium value to each of the vowels in the V.V sequence.
- b. Tsessaht assigns premium value to skeletal positions within feet.

(31) *Constraints and Markedness statements:*

- a. Syllables must have onsets (active).
- b. /ʔ/ is marked (active) (language-particular).

(32) *Repairs:*

- a. Delete segment (from UG).
- b. Epenthesize /ʔ/ (presumably from UG).
- c. Move metrical foot (language particular).

The application of the repair operations in (32) to the representation in (29) results in the following set of possible outputs:

(33) a. Line 0 (* *) * * No change. Unacceptable by (31a).
 [σ σ CV.V...

b.	Line 0	(* *) * [σ σ CV....	Delete one vowel. Acceptable, but violates (30a).
c.	Line 0	(* *) * * [σ σ CV.?V...	Epenth /?/. Unacceptable by (31b).
d.	Line 0	* * (* *) [σ σ CV.?V...	Epenth /?/ and move parentheses. Acceptable.

(33a) is rejected, because it violates an active constraint of the language. (33b) is less highly valued than (33d), because it has deleted a segment to which a premium value had been assigned by a morphological mechanism of some kind. (33c) is unacceptable by virtue of (31b). (33d) is chosen; recall that premium values override active marking constraints.

An advantage of the analysis described above is that it claims that the only statement that needs to be made about the behavior of the V?V sequence is (30a). Everything else follows from assumptions needed elsewhere in the grammar of Tsshaht. This analysis must remain sketchy and speculative, and awaits further research.

The final type of stress exception in Tsshaht is triggered by the loss of a consonant before a hardening suffix pulling the stress back, even to the third syllable. It could very well be that all cases of V?V stress shifting is triggered by suffixation, among which is ?-insertion due to consonantal deletion before a hardening suffix. The same analysis we have seen above holds here.

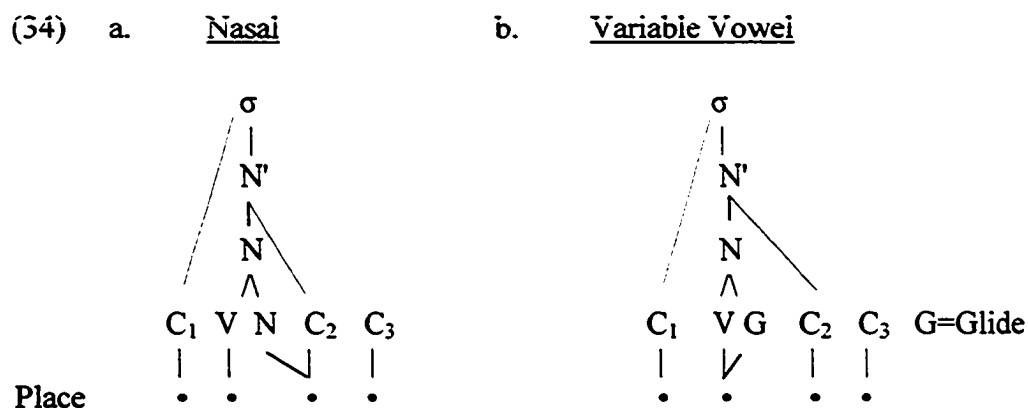
We now turn to a discussion of the phenomena associated with the first foot in Tsshaht.

2.4 The First Foot. The first two syllables of a word in Tseshahṭ appear to have a special status. Five phonological processes: Stress Assignment, Variable Vowels, Vowel Coalescence, Glottal Stop Deletion and Iterative Lengthening all suggest that the first two syllables in the word are different from all the others. Evidence comes from each phonological process occurring only within the first two syllables of a word. This evidence suggests that there are a number of phonological processes that are sensitive to the metrical structure imposed by the rules in (20). As we have seen, the foot assigns premium value to the segmental material within it, specifically, disallowing consonantal segmental material from being deleted. We have no reason to think that the Stonham/Wilson approach of positing a special syllable structure for within the foot is viable.

2.4.1 Stress. We saw in Section 2.3 that the normal application of the metrical stress rules of the language apply stress within what we have called the “two syllable window,” which we have seen to be the one and only foot in the word. Recall that the concept of “foot” in the 3-D Metrical Theory framework is very different from that in the Prosodic Hierarchy. The metrical foot is merely a constituent on the metrical tier; it does not hierarchically dominate syllables nor elements on the timing tier. Nevertheless, as we shall see below, rules and constraints are subject to the presence or absence of constituents on the metrical tier. In the sections below, we will sometimes refer to segments or syllables that occur “within the foot.” This phrase is shorthand for referring to elements that are within a string of elements on the timing tier that are, on the one hand, dominated by syllables on the syllable tier, and, on the other hand, the nuclei of

these syllables project marks on Line 0 of the metrical tier that are enclosed within a constituent.

2.4.2 *Variable Length Vowels*. Recall that whereas three consonants are permissible after a short vowel, only two consonants may follow a nasal or variable vowel. To account for their distributional pattern, the structure of both a vowel plus nasal sequence and a variable vowel is represented as almost the same in (34).



(34a) and (34b) are different in regards to Place structure, although the surface effects are the same for both: nasals and glides are banned from the reduplicant. The nasal in (34a) shares place with the following onset, making it a preconsonantal nasal. The glide shares its place with the preceding vowel nucleus. The glide can merge with the preceding vowel since they share both Place and the nucleus. The nasal is prohibited from merging with the nucleus vowel, because of its Place affiliation. Both segments are banned from the reduplicant because they are not vowels, even though they are in the nucleus.

Glides are never found in the coda of the syllable in Tseshaht, but rather, only in the onset. Wilson (1985) places nasals and glides in the same structural position, noting that both tautosyllabic vowel plus nasal and tautosyllabic vowel plus glide get treated as a

single long vowel. In both cases, Wilson adds that the vowel must be short, and that also the vowel+glide combination contracts, yielding a long vowel. Stonham (1990) suggests that it would be odd for nasals to be in a post-nuclear position in the syllable, but not glides, particularly since, according to Zec (1988), glides have a higher status in the sonority hierarchy. Therefore, we can conclude that glides, too, appear post-nuclearly, but that they become merged with the nucleus resulting in a lengthened vowel.

I contend that the lengthened vowel resulting from the merger of the post-nuclear glide and the preceding vowel is actually a variable vowel. Therefore, it will be long. As we have seen, however (cf (11)), variable vowels are not heavy, i.e., they do not project a parenthesis onto Line 0. Or, they project a parenthesis and a later rule deletes it. The regular stress rules of the language, (20), decide if the variable vowel gets stressed, e.g., the Projection rule, the Iterative Constituent Construction Parameter and the Edge Parameter.

How might variable length vowels be handled within the DP framework? Again, this must remain somewhat speculative, but it appears that a straightforward extension of the analysis presented earlier for the behavior of stress shift offers a promising approach.

Evidently, Tseshahat has developed an aversion to glides, except in the onset of the syllable. Therefore, we might extend the list of language-specific constraints in (31) to include (31c), now renumbered for clarity as (35):

(35) *Constraints and Markedness statements:*

- a. Syllables must have onsets (active).
- b. /ʔ/ is marked (active).
- c. There is an active language-particular constraint against glides in the rime.

No other changes in the rules and constraints need be made, except a stipulation, needed in any theoretical approach to this language, that the postnuclear glide shares place features with the vowel to its left. More precisely, recall that there is a premium value assigned to X-slots in the foot. When the glide is eliminated due to (35c) above, the X-slot remains and the features of the adjacent vowel associates to the empty X-position.

Let us consider the application of our modified set of constraints and repair operations to the hypothetical input in (36).

(36) Line 0 (* *) *
 [σ σ CVQ...

(36) needs repair, because it violates the active markedness constraint in (35c).

The application of the repairs we saw earlier, in (32), provide the following set of possible outputs:

(37)	a	Line 0	(* *) *	No change. Unacceptable by (35c).
			[σ σ CVQ...	
	b.	Line 0	(* *) *	Apply (32a). Acceptable.
			[σ σ CV...	
	c.	Line 0	* * (*	Shift stress. Acceptable.
			[σ σ CVQ...	

The trouble with (37c), is that it is an unnecessary violation of the stress rules. More formally, (37c) represents both the application of (32c), plus the appearance of a marked element. This was necessary in (33d), because the other leading candidate (33b), deleted a premium vowel. (37c) is, therefore, derivationally more complex than (37b). If the glide appears in the first foot, it acquires a premium value, so application of (32a)

does not produce an acceptable analysis, by virtue of (30b). This analysis falls together nicely with the analysis of the /V?V/ sequence.

2.4.3 Other Analyses For Variable Vowels. The solution offered by Sapir and Swadesh (1939) is to allow an abstract three-way distinction among vowels, representing them as short /V/, long /V:/ and variable /V(:)/. They then posit a rule which shortens or lengthens the variable-length forms depending on position. Although this accounts for the data, no other language to our knowledge allows a three-way, phonemic distinction in vowel length. And neither is it evident in the surface form of Tseshah vowels, where we find only a two-way distinction of long versus short. Thus, their analysis is descriptively adequate, not explanatory.

A possible solution to the problem is in terms of stress placement, where the vowel appears long when stressed and short when not. However, as Stonham (1990) points out, we cannot appeal to the stress system of the language as it operates independently of this phenomenon and unstressed vowels are found to occur both long and short, and in any position of the word. Furthermore, variable-length vowels do not necessarily correlate with the stressed vowel of a word.

Wilson (1986) argues that the phenomenon of variable vowels may be explained by allowing the metrical structure of Tseshah to be a single non-iterating stress foot at the beginning of the word. Variable vowels, along with other processes that are the topic of Section 2.4 are sensitive to the metrical status of the vowel, i.e., whether the vowel is within the metrical foot or outside it. Wilson (1985) claims that the first two syllables are phonologically and morphologically “stronger” than the rest of the word because they are capable of bearing stress. Thus, the foot becomes a conditioning environment for a

collection of rules of quantity, including the variable length vowel. His approach incorporates some of the same insights that are explored here, but lacks a framework for characterizing them formally.

Similar arguments given for the 3-D Metrical analysis of stress exceptions apply to the phenomenon of variable length vowels. Feet are constituents on the metrical tier in 3-D Metrical Phonology, not a prosodic entity. Tseshahat has rules that delete glides, as well as glottal stops, in all positions of the word *except* the one and only foot of a word. The non-deletion of these elements within the foot are due to the premium value that exists within the foot. Wilson's account misses a generalization, namely that the /ʔ/ phenomena and the variable-length vowel phenomena can be handled under one analysis.

As we saw in his analysis for stress, Stonham (1990), states that the first foot in Tseshahat has a special status, not only as being the domain of stress, but also the domain of several other phonological rules, including the phenomenon of variable length vowels. Stonham distinguishes the first foot from the other feet in a word by its structural representation of the syllables within that foot (as represented in (24) and (25) above.

Stonham never addresses why his structure of variable vowels, with their underlying moraic glide, are bypassed for Stress in Tseshahat. The non-moraic structure of variable vowels adopted here has no such restriction. A variable vowel does not project a parenthesis onto Line 0. When a variable vowel gets stressed, it is because the stress rules (20) have applied, treating the syllable that contains the variable vowel like any other "light" syllable. The 3-D Metrical framework has no need for ad hoc machinations to bypass the variable vowel if it is mora-bearing.

We now turn to Vowel Coalescence, a third phonological process that is sensitive to the first two syllables.

2.4.4 *Vowel Coalescence*. Recall according to Wilson (1985), citing Sapir and Swadesh (1939), vowels in Wakashan cannot be directly adjacent. V+V sequences must either be separated by a glottal stop if within the two syllable window, otherwise they contract producing a single vowel. The resulting vowel is long if either of the original vowels were long, and is short otherwise. Examples are from Wilson (1986, p. 285)⁶ and Stonham (1999, p. 66-68):

- (38) a. nu-ʔatu-ap ‘the singing is stopped’ → núʔatup⁷
 b. ʔu-i:c-’aλ ‘it belonged to her’ → ʔú:c’aλ
 c. puʔaʔatu-i:tʃiλ-’aλ-we(:)ʔin ‘she became sleepy’ →
 puʔaʔatu:tʃiʔaλweʔin

However, if the first and second syllables contract in Tseshaht, the result is always long, even if both vowels involved are short:

- (39) a. ʔu-aqsti: ‘within it’ → ʔú:qsti:
 b. cf. ʔu-ʔu-aqsti: ‘within it here and there’ → ʔúʔuqsti:
 c. wi-as ‘failing to reach’ → wí:s

Stonham (1990) claims that the long vowel resulting from coalescence in (39a) and (39c) is actually a variable-length vowel, appearing long within the first foot. When further reduplications push the form into the third or later syllable, the underlying short length is revealed, e.g. (39b)⁸.

⁶ Hyphens indicate morpheme boundaries.

⁷ The quality of the resulting vowel is predictable and will be reviewed next.

⁸ Note the stem vowel is originally in the third syllable accounting for the short duration of the resulting vowel.

not available in (41e), for the same reason it was not in connection with the discussion of the variable vowel.

2.4.4.1 *Vowel Quality Resulting from Coalescence*. Sapir and Swadesh (1939) observe that the vowel quality is predictable during vowel contraction. The rule is that any vowel conjoined with /u/ yields /u/, any non-/u/ vowel conjoined with /i/ yields /i/ and only /a/ + /a/ yields /a/. Stonham (1999) formulates the rule in (42) to account for the data.

(42) Vowel Coalescence

$$V_1 + V_2 \rightarrow V_3 \quad (V_3 = u > i > a)$$

Examples are numerous. The ones given in (43) are from Stonham (1999, p.

64-65):

(43) u + u

u-uk-taqa → ?u:ktaqaλ 'he did it for that reason'

u + i

?u-i:c-'aλ → ?ú:c'aλ 'it belonged to her'

a + i

hita-inqis-(q)h → hitinqish 'they were at the beach'

i + a

CVdup-?aqi-ayuk → ?a?a:qi(yuk)hak 'they were at the beach'

u + a

?u-a(:)nu:λ-'aλ-(q)h-we(:)?in → ?u:nu:ʔaḥwe?in 'That is why...'

i + i

?i:naxi-i:tʃiλ → ?i:naxi:tʃiλ 'they were at the beach'

i + u

CVdup-ʔaqi-wa(:)-ħa(:)k → ʔaʔa:qu:ħak ‘What did you say?’

a + a

hina-as-iλ-’aλ-we(:)ʔin → hinasiʔaλweʔin ‘they reached shore’

a + u

ʔaya-uwa → ʔa:yuwa ‘many were (living) together’

Calabrese’s (2002) concept of premium value extends to features. He claims that each language has vocalic values that it considers a premium value. For Tseshaht, these values are for the features [round] and [high]. Essentially, this means that Tseshaht may not delete the features [rd] and [hi]. Hence when contracting [u] + [i], the vowel melody, including both of these premium features, will be chosen over the one containing just one, i.e., [u]. [i] + [a] chooses [i], because one premium value is more highly regarded than none. Calabrese’s concept captures the phenomenon by putting markedness and its attending hierarchy of featural types into the theory of DP.

2.4.5 Vowel Contraction Across Glottal Stop. Vowels in Tseshaht may also contract across an intervening glottal stop, except between the first and second syllable of the word, i.e., in the first foot. If the VʔV occurs later in the word, the glottal stop deletes.

The resulting vowel follows the quantity and quality rules of Vowel Coalescence discussed above. The second and third syllables may contract across a glottal stop producing a long vowel, now, of course, in the second syllable. Any other syllables that contract in this fashion produce a short vowel. Stonham (1999) states the rule of Glottal-Deletion in (44):

(44) ʔ → 0 / #σ₂CV_V

(45) lists plausible candidates:

	<i>Input</i>	<i>Output</i>	
(45) a.	[CV?VCV...]	[(CV?V)CV...]	*[(CVV)CV]
b.	[σσCV?VCV...]	[σσCVCV]	
c.	[σCV?VCV...]	[σ(CVV)CV]	*[σ(CV)?VCV...]

Wilson's examples (1986, p. 286) correspond to (46a, b and c, respectively):

(46) a.	máʔas		'tribe'
b.	ʔu-wi:hta-ʔas	→	ʔuwi:htas 'he is in the lead on the ground'
c.	hawa-ʔas	→	hawá:s 'go in order to eat'

In (46a), no contraction is possible since the glottal stop is between the first and second syllable. In (46c), contraction across the glottal stop is allowed because the reduplicated distributive form places the glottal stop between the second and third syllables. The result is a long vowel because it is now in the second syllable of the word. In (46b), the same thing happens between the third and fourth syllables and the result is a short vowel. The important point is that the contraction does not occur within the first foot, because of the premium value assigned to the metrical foot preventing segmental deletion within it.

Recall that V?V appears to draw stress, under what we took to be morphologically determined circumstances. In the normal course of events, however, an underlying V?V sequence shows the application of two processes, the deletion of the glottal stop and of one of the vowels, in accordance with the normal rules of vowel coalescence discussed above.

Let us consider a hypothetical representation, as in (47).

(47) Line 0 (* *) * *
 [σ σ CV?V...]

(47) is in need of repair, because it violates (31b). Note that neither of the V's nor the /ʔ/ in (47) has been assigned premium value.

Now, consider the following representations, in (48), all outputs of application of the repairs in (32).

(48)	a.	Line 0	(* *) * * [σ σ CV?V...]	No change. Unacceptable, by (31b).
	b.	Line 0	(* *) ** [σ σ CVV...]	Application of (32a). Unacceptable, by (31a).
	c.	Line 0	(* *) * [σ σ CV...]	Application of (32a) twice. Acceptable.

(48c) is the only acceptable candidate. It shows more derivational complexity than either (48a) or (48b), which would render it more marked than either or them. However, (48a) and (48b) both violate active markedness statements, and are, therefore, ruled out.

Recall that segments may not be deleted within the stress foot due to Tseshaht assigning premium value to skeletal positions within feet. This analysis uses no machinery beyond what is independently needed to account for this additional “two-syllable window” phenomenon.

2.4.6 *Iterative Lengthening.* Wilson (1985, p. 21-2) discusses that one of the formal markings of the iterative aspect in Tseshaht is shown by the lengthening of the first two vowels in a word, and by the shortening of all the other vowels, except the last. This last syllable generally consists of the morpheme – ʃi:l, part of the iterative marker.

- (49) ʔalak^wal- ‘eight’ + -mi:k ‘getter of...’ + ʃi:ʔ iterative marker
ʔa:la:k^walmikʃi:ʔ ‘become a getter of eight (animals) at intervals’

Lengthening and shortening processes in Tseshaht in general seem to effect only the first two syllables of a word, regardless of the position of the morpheme causing the change in quantity. Maybe something along the lines of this morphological readjustment rule is sensitive to foot structure.

2.4.7 Summary. These five processes: Stress Assignment, Variable Length Vowels, Vowel Coalescence, Glottal Stop Deletion and Iterative Lengthening all suggest that the foot in a word has a special status. The evidence suggests that Tseshaht chooses to have just one foot in the word, that foot being leftmost. The foot assigns premium value to the segmental material within it, specifically, disallowing any segmental material from being deleted.

2.5 Conclusion. The facts of Tseshaht fall out naturally utilizing a segmental structural representation, a 3-D Metrical framework and the theory of Dynamic Phonology. That Tseshaht chooses to have just one foot, and that foot being leftmost in the word, follows from a set of minimal parameter settings and rules. The foot assigns premium value to the segmental material in it explaining why certain phonological processes, e.g. Stress, Variable Vowels, Vowel Coalescence, Glottal Stop Deletion and Iterative Lengthening, either occur or do not occur within it.

The analysis adopted here provides deeper insights into the complementary distribution behavior of glides and glottal stop. Distributionally, neither can be found in the coda. The 3-D Metrical Theory, combined with DP Theory, gives an explanatorily adequate account of why glides and glottal stop are deleted in all positions in the word

except the one and only foot. Both segments are actively marked. Tseshaht assigns premium value to skeletal positions within the foot. Therefore, glides and glottal stop delete everywhere but the foot.

Nasals and glides are in complementary distribution in Tseshaht, and it has been shown that they behave the way they do because they have similar structural representations; both occupy the second half of a branching nucleus. They differ crucially in Place, however, explaining why we never see a glide in post-vocalic position whereas we do see nasals there. Both nasals and variable vowels may receive stress following the regular stress rules of the language, not because they are mora-bearing segments, but because they have branching nuclei. If these segments were mora-bearing, we would be hard-pressed to explain why they were not *always* stressed if within the first foot. VN sequences always project a parenthesis onto Line 0. V+Glide sequences project a parenthesis that must get deleted. The reason a variable vowel is sometimes stressed within a foot is that the foot assigns premium value to the segmental material, include the glide portion of the variable vowel. No deletion may occur within a foot. Therefore, since a glide may not surface post-vocalically in Tseshaht, it merges with the preceding vowel, making it eligible for other stress rules, e.g., the Projection rule, the Iterative Constituent Construction Parameter and the Edge Parameter. Outside of the foot, the glide gets deleted and the variable vowel will always surface as short.

A further advantage of representing nasals as the second half of a branching nucleus is that this representation provides a natural explanation for why we never see a long vowel followed by a nasal in Tseshaht. The nasal is occupying the slot that the long

vowel requires. Stonham's (1990) nasal representation, which has the nasal in the coda of the rime, is unable to account for this phenomenon.

Finally, the reason why we never see a coda consonant in Tseshaht Reduplication is because Reduplication carries over all the material from the beginning of the word up to and including the first vowel. Therefore, both the nasal and the glide from the VN and V+Glide sequences are not reduplicated. Although both segments share the same constituent as the first vowel, the nucleus, they are not vocalic.

Chapter Three: TŪBATULABAL

3.0 Introduction. Tūbatulabal, a Uto-Aztecan language spoken in southern California, exhibits two patterns of alternation, a right-to-left alternation of Stress and a left-to-right alternation of length. Stress is regular in the language: all final syllables and all long vowels receive stress. Every other syllable counting back from the final syllable, or from a long vowel, is also stressed, where possible. Tūbatulabal also has a phonological process, which Swadesh and Voegelin (1939) call *Alternate Lengthening* in an influential paper. As they describe it, every odd-numbered syllable counting from left-to-right has a long vowel, and each long vowel always receives stress. Previous analyses of Tūbatulabal have concentrated either on vowel-length or on Stress, each process being considered in isolation (Swadesh & Voegelin (1939, 1957), Lightner (1971) and McCawley (1969), among others). This chapter examines the interaction of the two processes. Although they are distinct phonological phenomena synchronically¹, they interact in ways that are revealing with respect to universal grammar (UG) as well as Tūbatulabal grammar.

The Three-Dimensional Metrical Theory (Halle & Vergnaud 1987; Idsardi 1992; Halle & Idsardi 1995) assumed here provides an account of the Tūbatulabal facts. The theory has three interacting modules: two metrical planes, one each for Alternate Lengthening (AL) and Stress, and a module for the segmental rules. A metrical analysis of AL is justified, since, according to Heath (1981), the AL rule is a historical remnant from Proto-Northern-Uto-Aztecan, where there was a left-to-right stress assignment rule.

¹ See Heath (1981) for a historical perspective.

The lengthening is a result of that process. The stress patterns we see in Tūbatulabal today also include a regular, right-to-left stress assignment rule that the language subsequently acquired.

Both Heath (1981) and Benki (1996) attempt integrated analyses of AL and Stress in Tūbatulabal. The problem for Heath, as well as for anyone analyzing Tūbatulabal, is the extreme opacity that we examine in Section 3.2.6.1.

Swadesh and Voegelin's (1939, p. 90) example #44 is an example of this extreme opacity. The unreduplicated form is [o:lin] and the reduplicated form is [o:li:n] 'to help him up'. Swadesh and Voegelin posit the underlying representation for each form as in

(1):

(1)	<u>Atelic</u> (unreduplicated form)	<u>Telic</u> (reduplicated)
	/ʔolin/	/oʔolin/

The vowel lengthening rule applies to the underlying form to give:

(2)	ʔo:lin	o:ʔoli:n
-----	--------	----------

Swadesh and Voegelin (1939, p. 92) posit a "rule of contraction that takes place between light vowels separated only by /ʔ/ except as between the two syllables of an unreduplicated dissyllabic stem..." Their contraction rule yields (3):

(3)	[ʔo:lin] (no change, dissyllabic stem)	[o:li:n]
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The vowel-lengthening rule is rendered opaque by virtue of the deletion of the middle syllable, which makes vowels lengthened by AL adjacent. Previous theories use

stipulations and arbitrary rules to handle such cases. Heath's goal was not to achieve descriptive adequacy, but to model the historical facts.

Benki's (1996) Optimality Theory (OT) (Prince and Smolensky 1993) should be an ideal framework for analyzing Alternating Length and Stress. Its parallel-processing approach to phonology should capture two distinct, but interacting processes. The problem for OT is that since the stress rule of Tübatulabal is sensitive to the length assigned by the AL rule, there is a real paradox for OT. OT has trouble handling productive rules that are the result of historical accident. These "unnatural" rules are not amenable to any analysis that insists that all phonological "action" is due to a drive toward unmarkedness. Some phonological processes have nothing to do with markedness and are simply the result of historical accident. OT is unable to account for the fact that such a process can be synchronically productive. The facts of Tübatulabal constitute a powerful argument against the OT notion of one-level, parallel processing. Specifically, OT is unable to account for the cases of extreme opacity. A modular approach is necessary to avoid paradoxes that arise within the OT framework.

The chapter is laid out as follows: the relevant facts of the language are first presented in 3.1. Next, we shall focus on previous analyses of AL in Section 3.2, beginning with Swadesh and Voegelin (1939), and followed by McCawley (1969), Heath (1981), Benki (1996), Alderete, J., J. Beckman, L. Benua, A. Gnanadesikan, J. McCarthy, and S. Urbanczyk (1996), and finally the Three-Dimensional Modular Theory adopted here. Next, we turn in Section 3.3 to previous analyses of Stress in Tübatulabal. Voegelin (1935), Heath (1981), Crowhurst (1990) and Benki (1996) are covered. Included in this section is Idsardi's (1992) 3-D Metrical account of Tübatulabal Stress, as

well as details of the 3-D analysis adopted here. We then turn to Heath's (1981) and Benki's (1996) analyses of both AL and Stress combined in Section 3.4, followed by a Three-Dimensional Modular approach.

3.1 The Facts². In this section, the facts of Tübatulabal relevant to AL and Stress will be presented, including the vowel and consonant inventory, and prosodic structure.

Wherever possible, sources and page numbers are cited for Tübatulabal lexical examples.

The primary sources are Voegelin (1935), Swadesh and Voegelin (1939, 1957), and Voegelin (1958).

3.1.1 Vowels. There are six vowels in Tübatulabal: *i*, *ə*, *u*, *e*, *ɔ*, and *a* with the following geometry:

- (4) [i] = high front unrounded
 [ə] = high central unrounded
 [u] = high back rounded
 [e] = upper-mid front unrounded
 [ɔ] = lower-mid back rounded
 [a] = low back unrounded

Vowels may be short or long, short vowels counting as one mora and long vowels as two.

Diphthongs are monomoraic (V: 58).

3.1.2 Consonants. The consonant inventory involves 5 points of articulation—labial, alveolar, palatal, velar and glottal. All the voiceless plosives are unaspirated. Phonetic transcriptions differ in the literature depending upon the author. Because a majority of the data in this paper are from V, that transcription is used, except that non-IPA symbols are replaced with their IPA equivalents. Therefore, V's alveolar *ts* and *dz* are replaced

² To facilitate data citation, the following Tübatulabal sources have been abbreviated as follows: Voegelin (1935) = V; Swadesh & Voegelin (1957) = S&V; and Voegelin (1958) = Dict.

throughout with *c* and *ʒ* respectively; alveopalatal *tc* with *tʃ*; *dʒ* with *dʒ*; and

c with *f*. (5) gives a visual overview of the consonant inventory, as presented by V.

(5)

	<i>Bilabial</i>	<i>Alveolar</i>	<i>(Alveo)- palatal</i>	<i>Velar</i>	<i>Glottal</i>
Plosives	p, b	t, d		k, g	ʔ
Affricates		c, ʒ	tʃ, dʒ		
Nasals	m	n		ŋ	
Lateral		l			
Fricative			ʃ		h

The pairs of stops and affricates in the above chart, e.g. [p] and [b], are both voiceless word-marginally. The distinctive difference between them has been a matter of some debate in the history of discussion of Tübatulabal, so we will defer an analysis of this point until Section 3.2.1.

With certain exceptions, all consonants may occur in any position. The exceptions are *ŋ*, which never appears in initial position, but only intervocalically or in final position, and the stops we have transcribed as voiced, which appear only intervocalically and never in initial or final position (V: 80).

3.1.3 *Prosodic Structure.* We shall examine Tübatulabal's prosodic structure, including syllabification, gemination and the default glottal stop.

3.1.3.1 *Syllabification.* In Tübatulabal, all syllables begin in one and only one onset consonant (S&V: 91). The maximal shape of a non-final syllable is CV(:)C as in (6):

- (6) a. togo:yʔan 'to decoy it for him' (S&V: 90)
 b. tiŋwa 'to name/call him' (Dict.: 223)

Long vowels are excluded from word-final position (S&V: 92).

3.1.3.2 *Geminates*. The language has underlying vowel length, e.g., (7a), and underlying consonant length (geminates), e.g., (7b), as well as phonetic gemination.

- (7) a. /puwá:n/ 'to irrigate it for him' (S&V: 90)
 b. /kinnán/ 'to bring it for him' (S&V: 90)

The following data, taken from V (1935:61), describes when and where to expect phonetic geminates. Voiceless stops in final position are geminated {pp,tt,kk,cc,tʃtʃ}.

This holds even when the stop is preceded by a long vowel, e.g., *tʃiŋŋíyyallá:pp* 'on the red thistle' (V:75).³ Intervocally, voiceless stops (except ʔ), nasal consonants and *l* are always geminated after a short vowel {V(pp,tt,kk,cc,tʃtʃ,mm,nn,ŋŋ,ll)} and do not occur after a long vowel. Fricatives and semivowels are consistently geminated after stressed short vowels {V́(ʃʃ,ww,yy)}. In consonant clusters, neither consonant of the cluster is geminated unless the second consonant of the cluster is a voiceless stop, in which case it is geminated, e.g. *ʔiʃti* 'coyote'. If the first member of the consonant cluster is *h* and the second member of the cluster is a nasal or a semivowel, the *h* geminates. It follows from the above that it will never be the case that Tübatulabal will have a singleton nasal, liquid or voiceless stop after a short vowel (*V{nasal, liquid, obs_{[-voi]}}).

³ Benki (1996) points out that word-final stops in V are described as voiceless geminate stops. Benki argues that this same voiceless stop surfaces as voiced in word-medial position and is thus a singleton.

- a. ʔá:dawí:kk 'to see' (V: 68)
 b. ʔá:dawí: igá:n 'to see for him'

Benki claims that the voicing behavior is consistent with vowel lengthening before a singleton consonant and not before a geminate. There are two possibilities to consider: V incorrectly transcribed final voiceless stop consonants as geminates, giving credence to Benki's theory, or V's transcriptions are correct and word-edge constraints are in effect. We will go with trusting V's ear, especially since edge effects are wide-spread cross-linguistically.

This is a very interesting distribution that deserves full elucidation in future research.

3.1.3.3 *Default Glottal Stop*. Since all syllables require an onset in Tübatulabal, when there is no consonant available to serve as an onset in a syllable, Tübatulabal inserts a glottal stop to surface in onset position. Evidence for the default glottal stop comes from Initial Reduplication. Initial Reduplication, the most productive reduplicative process in Tübatulabal (V: 88), copies the first vowel of the verb stem, maintaining its length. The reduplicant may not have any point-of-articulation. Syllables, however, in Tübatulabal must have an onset. Tübatulabal satisfies these constraints by epenthesis of a glottal stop, which has no point-of-articulation, in onset position, as in (8):

- (8) a. /hu:ʔ/ → ʔú: u-hú:ʔ 'it leaked' (Dict: 222)
 b. /pin/ → ʔim-bín '3rd brought it' (V: 66)

Further evidence for mandatory onsets comes from the behavior of forms in which two vowels become adjacent as a result of affixation. Hiatus is avoided. Depending upon the suffix, one of the vowels may be deleted as in (9a), or the two vowels are fused to form a unit which behaves phonologically as a single long vowel as in (9b). The goal of this vowel-deletion or fusion is to prevent onsetless syllables.

- (9) a. hámmaʃ-átt '3rd is/was sad' from /hamaʃa/ + /at/ (progressive)
 b. ʔahámmaʃá:n '3rd got sad for s.o' from /hamaʃa/ + /an/ (benefactive)

3.2 **Alternate Lengthening**. AL in Tübatulabal can be described as lengthening every odd syllable's vowel counting from left-to-right, and each long vowel always receives stress, subject to a few conditions. S&V's analysis (to follow) sparked much discussion and further evaluation. S&V achieved a descriptively adequate account of AL, which was quite an achievement, because the prevailing theories of the day did not allow for

regular principles to apply to phenomena. At most, what could be expected then was for the phenomena to be “presented as a series of distinct, partial, limited patterns (rules and irregularities)” (S&V 1939). The analyses to follow reflect the history of phonological theory. We begin with a thorough investigation of S&V’s paper.

3.2.1 *Swadesh and Voegelin (1939)*. S&V observe that “the vowel-length of suffixes is determined by the stem, or stem-suffix complex, to which they are attached. The vowel-lengths of the stem frequently vary as between unreduplicated and reduplicated forms, and the vowel-lengths of the suffixes may differ according to whether the stem is reduplicated or not” (p. 90). They term this phenomenon *Alternating Length*. S&V provide a list of words, reproduced in its entirety here in Table 1, to illustrate different patterns of vowel length. The first column gives the atelic to show the unreduplicated form. The second column presents the telic to show the reduplicated form. The final column depicts S&V’s proposed underlying representations (UR) for the stems, or, as they call them, “the morphophonemic formulae.” All of the examples in the list are verbs, except for (18), which is a noun. S&V do not indicate word-initial glottal stop, although V clearly states they exist; in my description of S&V, I likewise do not indicate word-initial glottal stops.

Table 1: Vowel Length

	Atelic ⁴	Telic ⁵	UR
(1)	ta·wəgi·na·na·-la ‘to go along causing him to see’	a·dawə·gina·nala ‘he went along causing him to see’	*dawəga
(2)	pələ·la ‘to arrive’	ə·bələ·la	*bələlaR
(3)	təwəla·-n ‘to fix it for him’	ə·dəwəlan	*dəWələ
(4)	to·yla·n ‘to teach him’	o·do·yla·n	*dōylāR
(5)	payʔigə·la ‘to go along turning’	a·bayʔigəla	*bāYʔgə
(6)	puwa·-n ‘to irrigate it for him’	u·buwa·n	*buwā
(7)	poioŋa·-n ‘to beat it for him’	opoioŋan	*poLoŋa
(8)	poholi·-n ‘to cause him to get blisters’	opoholin	*poHoLa
(9)	či·čwana·bə ‘to accompany him’	iči·čwana·bə	*čižwanābəR
(10)	təʔəbinugaʔadawa·-n ‘to tell a myth for him’	ətəʔəbinugaʔ·adawa·n	*təʔbinugāʔ·dawa
(11)	tugaʔana·-n ‘to make it deep for him’	utugaʔanan	*tugāʔna
(12)	togo·yʔa·-n ‘to decoy it for him’	otogo·yʔan	*togōyʔa
(13)	puški·na·-n ‘to blow it for him’	upuški·na·n	*pūška
(14)	kina·-n ‘to bring it for him’	iŋgina·n	*giNa
(15)	cami·-n ‘to burn it’	anzami·n	*zāmā
(16)	kami·ža·-n ‘to catch it for him’	akami·žan	*kamižə
(17)	cənənəʔ ‘to shake it’	əcənənəʔ	*cəNənəʔa
(18)	ta·twal ‘man’	ata·twa ‘group of men’	*tādwaR
(19)	ha·ya·-n ‘to stir it for him’	a·ha·ya·n	*hāyā
(20)	šiwga·-n ‘he combed his hair’	i·šiwganat ‘he is combing his hair for him’	*šīWga
(21)	halayʔi·-n ‘to make him wet’	a·halayʔin	*halāYʔa
(22)	hu·da ‘for the sun to be up’	uhu·da	*HūdāR
(23)	wi·mi·wi·mi·-n ‘to cause him to zigzag’	i·wi·mi·wi·mi·n	*wīmīwīmīna
(24)	mə·hli·-n ‘to hurt him’	ə·mə·hli·n	*məhliNa
(25)	ma·ncuʔi·-n ‘to make him tame’	a·ma·ncuʔin	*māncūʔu
(26)	ma·ygi·-n ‘to make him go ahead’	a·ma·ygin	*māyge
(27)	wi·na·gə·m ‘to come to give him a present’	i·wi·nagə·m	*wīna
(28)	wə·ʔin ‘to pour water’	ə·wə·ʔin	*wəʔina
(29)	lu·mi·-n ‘to take it off’	u·lu·mi·n	*lūmīna
(30)	yahna ‘to believe him’	a·yahnan	*yāHnana

⁴ S&V use the term ‘atelic’. The atelic is essentially the infinitive form.

⁵ S&V use the term ‘telic’. The telic is essentially the perfective form.

Table 1 (continued): Vowel Length

Atelic	Telic	UR
(31) yə-wa-n 'to hold it for him'	ə-yəwa-n	*yəʔəwūR
(32) ya-yayŋ 'to be timid'	a-yayaŋ	*yayaNa
(33) yilaho-la 'to go along happy'	iyilahola	*YiLaHo
(34) nəbaʔ 'to snow'	ənəbaʔ	*Nəbāʔ
(35) wi-bi-n 'to make him fat'	iwi-bin	*Wībə
(36) wimšini-n 'to make him move out of the way'	iwimšini-n	*Wīmšin
(37) u-di-na-n 'to unti it for him'	u-ʔu-dina-n	*ʔūda
(38) a-gi-na-n 'to cause him to open his mouth for him'	aʔa-gina-n	*ʔāga
(39) aya-w 'to grow'	aʔaya-w	*ʔayāwə
(40) əhcaw 'to help him'	əʔəhcaw	*ʔəHcawa
(41) a-na-hli-n 'to cause him to fast'	aʔana-hli-n	*ʔanaʔahlə
(42) ə-wəni-n 'to stop him'	ə-ʔə-wəni-n	*ʔəwənə
(43) ina-n 'to do it for him'	ina-n	*ʔiNə
(44) o-li-n 'to help him up'	o-li-n	*ʔolo
(45) i-ʔa-n 'to give him a drink'	i-ʔa-n	*ʔiʔa
(46) o-wi-n 'to mark it'	o-ʔowi-n	*ʔoʔowā
(47) kə-ʔi-n 'to cause him to bite'	ə-gi-n	*gəʔə
(48) šu-ʔa-n 'to dry it for him'	u-ša-n	*šuʔa

For the moment, ignore any unfamiliar symbols and uppercase letters in the above list. Also, ignore differences between symbols that usually refer to [\pm voice]. We shall return to them presently. S&V find that “some vowels are always long,” whereas “some vowels alternate between long and short.” They simplify matters by referring to fixed-long vowels as “heavy” and alternating-length vowels as “light.” For convenience, we extend their terminology to include “short” and “long” as short and long manifestations of “light” vowels, respectively. They note that with the exception of (S&V#31) and (S&V#45-48), the observed length of light vowels can be covered by simple rules (p. 91):

- (10) (a) In the syllable adjacent to one containing a heavy vowel, a light vowel is always short;
 (b) Otherwise, a sequence of light-vowel syllables alternate in length, the first being long, the next short, and so on.

Heavy vowels are illustrated in (S&V#4), (S&V#19), (S&V#23) and (S&V#24), among others, e.g., *to:yla:n ~ o:do:yla:n* (S&V#4)⁶. Heavy vowels are reduplicated as heavy. Otherwise, light vowels are reduplicated as light, and are then subject to AL. Alternating length of light vowels is illustrated in (1) *ta:wəgi:nana:la ~ a:dawə:gina:nala*. (S&V#37) and (S&V#42) show how a preceding heavy vowel affects the alternation of light vowels by preventing lengthening of a following vowel, e.g., [i] in *u:ʔu:d(i)na:n* (stem //ʔu:da//)⁷. In (S&V#2) and (S&V#6) the following heavy vowel prevents a preceding light vowel (indicated in parentheses) from being long, although the reduplicant (two syllables removed) is long, e.g., [u] in *p(u)wa:n*, cf. [u:] in *(u:)buwa:n* (stem //buwa://). Heavy syllables re-start the AL count. For example, any additional short-vowel suffixes that are added to a stem like //cama:-// (S&V#15), will show lengthening on the even-numbered syllables, not the odd-numbered ones.

Reduplication in Tūbatulabal copies the following “pieces”, the double line (≡) parts in the following example, where *b* = non-shortening; *p* = shortening; *v* = short vowel; *v:* = long vowel; *N*=nasal.

- (11) a. p v C V b. b v N V c. b v: C_{oral} V d. *b v: N{V,CV}

S&V note that the reduplicated vowel is always long before a voiced stop or

⁶ Underlining indicates heavy vowels.

⁷ The symbol //...// indicates S&V's UR.

affricate, (11c), and always short before a voiceless stop or affricate, (11a). In those positions where either a voiced or voiceless stop may occur, only a short vowel ever precedes a voiceless stop; either a short or a long vowel may precede a voiced stop. Other consonants that have no voiced-voiceless contrast reduplicate with long vowels for some stems and with short vowels for others.

Furthermore, when reduplication puts an initial voiceless stop in medial position, some are voiced (12a,b). This indicates that these stops are underlyingly voiced and surface as voiceless at word edges. Other apparently voiceless stops remain voiceless in medial position (12c,d). Consonants other than oral stops do not alternate in voicing. Stops which alternate in voicing permit copying of a nasal, as in (12a), but non-alternating stops prevent nasal copying, as in (12c). S&V claim that the nasal is assimilated to the consonant and note that the vowel before the nasal+consonant is short.

(12)	<u>Atelic</u>	<u>Telic</u>	(S&V: 90)
a.	<u>k</u> inan	ingina:n	'to bring it for him' (14)
b.	puwa:n	u: <u>b</u> uwa:n	'to irrigate it for him' (6)
c.	<u>k</u> ami:ʒan	akami:ʒan	'to catch it for him' (16)
d.	<u>t</u> ogo:yʔan	otogo:yʔan	'to decoy it for him' (12)

S&V, using the vowel lengthening behavior as a diagnostic, distinguish two classes of consonants. One class includes all the basic voiced stops, along with some instances of each of the other phonemes. The other class includes all fixed voiceless stops and some instances of each of the other phonemes. S&V refer to this latter group as *shortening* consonants, the former as *neutral* consonants. For S&V, the distinction being made here is phonologically arbitrary: consonants which suppress vowel length to their left are shortening, and those which allow vowel length (either underlyingly or caused by

AL) are neutral. This shortening vs. neutral distinction is manifested phonetically by (underlying) voiceless vs. voiced for the stops and affricates; however, S&V also posit an arbitrary designation “shortening vs. neutral” for the nonstops. They designate the shortening nonstops in Table 1 with a capital letter (except \exists for a shortening glottal stop). We will return to an explanatory adequate attempt later.

S&V point out that (S&V#31), (S&V#44), (S&V#45) and (S&V#46) seem to be exceptions to their rule in (10). “Take example 31, $y\bar{a}:w\bar{a}:n \sim \bar{a}:y\bar{a}w\bar{a}:n$. If the base were $//y\bar{a}:w\bar{a}:na//$, the reduplicated form should be $\bar{a}:y\bar{a}:w\bar{a}:n$, and it is not. If it were $//y\bar{a}w\bar{a}:na//$, the unreduplicated form should be $//y\bar{a}w\bar{a}:n//$, and it is not. Example 46 is similar. Examples 44 and 45 show no reduplication but only a change in the vowel lengths: $o:lin \sim o:li:n$; $i:\bar{?}an \sim i:\bar{?}a:n$. The clue to these anomalies can be found in 47 ($k\bar{a}:\bar{?}i-n \sim \bar{a}:gi:n$) and 48 ($fu:\bar{?}an \sim u:f\bar{a}:n$), which show that contraction takes place under some circumstances.” (p.91)

We illustrated above in examples (3-5), the contraction in S&V’s #44. S&V claim that this contraction is responsible for all of these examples (S&V#31, #44, #45, #46, #47 and #48). S&V explain that “the rule of contraction takes place between light vowels separated only by $\bar{?}$ except as between the two syllables of an unreduplicated dissyllabic stem (47, 48) and between the vowels of a certain type of extension of the stem final, illustrated in $w\bar{a}:\bar{?}inat$ ‘he is pouring water’ $\sim w\bar{a}:\bar{?}ina:\bar{?}at$ ‘he is pouring lots of water’ (stem $//w\bar{a}:\bar{?}ina//$). The quality of the contract vowel is that of the second of the two component vowels, as is seen in $u:f\bar{a}:n$ (from $//u:f\bar{u}:\bar{?}a:na//$), and the quantity is long if

one of the components is long, short if both are short. Only two of three light vowels separated by ʔ contract, as in i:ʔa:n from //i:ʔiʔa:na//.” (p.91)

In (13) and (14) are the derivations for (S&V#45) and (S&V#47), respectively, that would follow from their logic.

(13)	<u>Atelic</u>	<u>Telic</u>	<u>Gloss</u>
<i>S&V's UR</i>	ʔiʔan	iʔiʔan	‘to give him a drink’
AL	ʔi:ʔan	i:ʔiʔa:n	
Contraction	–	i:ʔa:n	
(14)	<u>Atelic</u>	<u>Telic</u>	<u>Gloss</u>
<i>S&V's UR</i>	gəʔin	əgəʔin	‘to cause him to bite’
AL	kə:ʔin	ə:gəʔi:n	
Contraction	–	ə:gi:n	

AL is rendered opaque by the deletion that makes vowels lengthened by AL adjacent. The above rule, shown in (13) and (14) is written discursively, not in any formal framework, and, therefore, could not even be a contender for explanatory adequacy. Second, it is the responsibility of a theory of phonology to explain why the rule does not apply in the unreduplicated, bisyllabic cases, and also why it only deletes two of three light vowels.

Recall that heavy vowels prevent AL from applying to adjacent syllables, and that these heavy vowels also act as a new edge for AL to begin again. S&V point out “that a shortening consonant affects only the vowel before it.” (p. 91) In their analysis, “a vowel, even though followed by a shortening consonant, may be identified as light or heavy according to the behavior of adjacent vowels, and consonants may be identified as shortening if vowels are short before them under conditions where one would expect a

long vowel before a neutral consonant. *təki-n ~ ətəkin* points to a stem //tə:ka-//: the heavy vowel is evidenced by the fact that the following vowel is always short, whether in the second or third syllable of the word. *poloŋa:-n ~ opolo:ŋan* points to a stem //poLoŋa-// in which all vowels are light.” (p.91) Also, in (S&V#36), there is a “heavy” vowel in UR before a shortening consonant, *wimʃini:-n ~ iwimʃini:n* from //Wi:Mʃin//. S&V’s shortening consonants rendered both underlying vowel length and AL opaque.

S&V observe that word-final vowels, insofar as they are retained, are shortened. They posit ‘R’, which they call a vowel-shortening consonantal morpho-phoneme, e.g. example ((S&V#4) //do:yla: R/).

There is an important distinction between two kinds of intervocalic glottal stop. One type, which S&V analyze as a V:ʔ sequence underlyingly, shows up as a phonetic VʔV sequence if the glottal stop is in the coda. This entity behaves like a long vowel for both AL and word stress. The “special VʔV group acts in the length theory like a single heavy vowel (see 5, 10, 11)” (p.92) in that it allows only short vowels in adjacent syllables. S&V “set these up as V:ʔ and state the rule that a heavy vowel plus a syllable-final ʔ is pronounced as VʔV,” (p. 92) as in (S&V#11) *tugaʔanan* from *tuga:ʔna-*.

The other type of intervocalic glottal stop is, in fact, underlyingly a bisyllabic VʔV sequence. It behaves like two light syllables for purposes of AL, and unlike V:ʔ, is subject to syncope and deletion rules as we have seen in connection with our example (S&V#44).

Examples (S&V#14-17) illustrate S&V's observation "that a nasal after the stem-vowel is included in the reduplication if the initial consonant is a basic voiced stop, but not if it is fixed voiceless: *iŋgin* 'he brought it', *anʒam* 'it burnt'," (p.91) but not *akami:tʃ* 'he caught it' and *əcənə:ʔ* 'he shook.' They claim that "the nasal is assimilated to the consonant. The vowel before the nasal + consonant is short." (p.91)

S&V conclude that their descriptive apparatus that uses two morpho-phonemic types of consonants (i.e., shortening (voiceless for the stops) and neutral (voiced for the stops)) and two vowel types (heavy and light) and a set of rules, can account for the apparent irregularity of Tübatulabal phonology. As they point out, truly irregular alternations could not be reduced to order, thereby giving descriptive power to their theory.

The disadvantage of S&V's analysis is that they have stipulative segments and no appeal to naturalness. Plus their appeal to processes is vague and awaited further development in linguistic theory. Their consonants having the phonological features "shortening vs. neutral" do not correspond to any identifiable phonetic correlates assumed in current linguistic theory. In other words, S&V make no attempt to get explanatory adequacy, but in the context of their linguistic framework, they could not have. They do achieve a descriptive adequacy, however, that remains the basis for later phonological theories to attempt their own explanatory adequacy.

3.2.2 McCawley (1969). McCawley recasts S&V's analysis in the new theory of generative phonology of his time. He attempts to discover what phonological feature might distinguish the "shortening" and "neutral" consonants. It is not plausible, he

argues, to suggest that the feature [voice] is the relevant feature, despite the fact that it is the phonetically presenting feature for the oral stops. Crucially it is not reasonable to suggest that a voicing distinction can apply to the glottal stop which participates in the relevant distinction. This is exemplified in *//ʔa:ga//* ‘open the mouth’ which has a short vowel in the reduplicative prefix (*ʔa:gina:n ~ ʔ(a)ʔa:gina:n*, S&V#38), vs. *//ʔu:da//* ‘untied’ in which the vowel of the reduplicative prefix remains long (*ʔu:dina:n ~ ʔ(u:)ʔu:dina:n*, S&V#37). McCawley points out that the voiced glottal stop is an anatomical impossibility: the vocal cords cannot be both pressed shut and vibrating at the same time. Therefore, the relevant feature must not be voicing.

McCawley suggests that the operative distinction is geminate vs. simplex consonants. It is, McCawley argues, quite plausible to suggest that a language might allow only short vowels before geminates. This choice is supported by his examination of the distribution of geminates as described in Voegelin (1935: 61) and detailed above in 3.1.3.2.

McCawley points out that all of the consonants that S&V assume to be underlyingly voiceless are preceded in surface phonetics by short vowels, and are pronounced as geminates. The exceptions are that /ʔ/ is always pronounced short, and fricatives and semivowels are optionally pronounced short. Meanwhile, the consonants that S&V set up as underlyingly voiced are usually pronounced short. His analysis claims that geminates resist intervocalic voicing, and require the preceding reduplicant to be short. McCawley summarizes this in a rule shortening vowels before long consonants. He claims that another advantage of his analysis is that it avoids S&V’s ‘unpronounceable

underlying segments” and “makes Tübatulabal’s underlying segment inventory virtually identical to the surface phonetic inventory,” instead of “wildly different from its surface inventory” (p. 414).

McCawley’s insight that the “voicing” and “shortening” characteristics noted in Tübatulabal are due to a geminate/singleton distinction is an important contribution to our understanding of the phenomena. The 3-D Metrical analysis given in Section 3.2.6 also assumes this distinction, although the 3-D framework is very different from the theory couched in generative phonology terms. We shall examine the 3-D metrical approach to AL in Tübatulabal along with AL’s interaction of Stress in Section 3.4.3.

McCawley works within the generative phonology framework in which a single rule cannot refer to earlier or later stages of a derivation. This is a criticism he levies against S&V, and necessitates that he divide up between two rules what S&V’s single rule accomplishes. Specifically, McCawley singles out S&V’s rule of contraction, converting a V?V sequence into a single vowel under certain circumstances.

McCawley states that when S&V refer to “light” they mean underlyingly short. And their reference to “short” has to do with vowel length after the application of the AL rule, since their clause “if one of the components is long” could only refer to length introduced by the AL rule. Thus, McCawley maintains, “their statement of conditions under which contraction takes place is in terms of the situation before the AL rule applies and their statement of its effect is in terms of the situation after the AL rule applies” (p. 408).

We have seen how S&V handle cases of opacity, and we now turn to McCawley’s analysis using S&V’s example (#48), *fu:ʔan ~ u:ʃa:n* from *//fuʔa//*. We first set out

those of his rules that are relevant (supplementing each with an informal sketch of its effect), and then examine his derivations.

(15) McCawley's Rule #3

$$\begin{pmatrix} +\text{syll} \\ -\text{long} \end{pmatrix} \begin{pmatrix} +\text{syll} \\ -\text{cons} \\ +\text{closure} \\ +\text{voiced} \end{pmatrix} \begin{pmatrix} +\text{syll} \\ -\text{long} \end{pmatrix}. \quad 2 \rightarrow \emptyset$$

(Delete a glottal stop intervocalically.)

(16) McCawley's Rule #4

LR iterative [+syll] → [+long] except in environment @⁸__ [-syll]₀ $\begin{pmatrix} +\text{syll} \\ +\text{long} \end{pmatrix}$

(Lengthen vowel except when next to long vowel.)

(17) McCawley's Rule #12

$$\begin{pmatrix} +\text{syll} \\ <+\text{long}> \end{pmatrix} [+ \text{syll}]. \quad \begin{matrix} < 2 \rightarrow [+long]> \\ 1 \rightarrow \emptyset \end{matrix}$$

(If two vowels occur adjacently, the first is lost; if the first is long, the second becomes long.)

We shall first look at the telic (reduplicated form):

(18)	<u>Underlying</u>	/uʃʉʉan/
	Rule #3	uʃuan
	Rule #4	u:ʃua:n
	Rule #12	u:ʃa:n
		[u:ʃa:n]

If the same rule-ordering of (16) applies to the atelic (unreduplicated form),

we get:

⁸ The @ symbol denotes a mirror-image rule.

(19)	<u>Underlying</u>	/[u?an/
	Rule #3	ʃuan
	Rule #4	ʃu:an
	Rule #12	ʃa:n
		*[ʃa:n]

The rule ordering that correctly predicted the telic form results in the incorrect surface form for the atelic, *[ʃa:n]. For the atelic form, rule #4 must apply first if [ʃu:ʔan] is to be derived.

(20)	<u>Underlying</u>	/[u?an/
	Rule #4	ʃu:ʔan
	Rule #3	n/a
	Rule #12	n/a
		[ʃu:ʔan]

Clearly, McCawley's analysis is flawed by a rule-ordering paradox. A competent theory of phonology requires its rules to apply across the board, unless true lexical exceptions are called for. As we shall see, both Heath (1981) and the 3-D Metrical analysis adopted here have no trouble with these opaque cases. Therefore, no exceptional rule status should apply.

3.2.3 Heath (1981). Heath is the first to analyze AL and Stress as interacting processes. His goal was to elucidate diachronic issues in Uto-Aztecan. Nevertheless, his analysis is couched within generative phonology, and is adequate as a synchronic description. We will restrict ourselves here to Heath's analysis of AL and the contraction/syncopation phenomena and return to his Stress analysis later.⁹

⁹ Heath also discusses other important and interesting morphological and phonological issues which are beyond the scope of this paper.

Heath points out that while the initial reduplication associated with the telic¹⁰ primarily occurs for verbs, reduplication also occurs with a few nouns, where it functions as a pluralizer. (For some verbs, the reduplicated stem is telic and the unreduplicated stem atelic, for others it is the reverse.) Heath observes that initial consonants in reduplicative segments have been lost in Tūbatulabal, so the synchronic process is one of V-reduplication; as we have seen, the reduplicant surfaces with an initial glottal.

Reduplication is particularly important in Tūbatulabal because it reveals the process of AL. Heath (1981) suggests that AL is productive throughout the language, but that it is only apparent in the verbs¹¹. This is puzzling. Why should that be the case? Does the restriction arise on phonological or morphological grounds, or both? If AL is not productive in nouns for morphological reasons, then that constitutes evidence that AL may be a lexical phenomenon.

Heath states that for most verbs, complicating factors prevent AL from operating in such a striking factor. Below are listed some conditions that block AL.

AL is either blocked or rendered opaque word-finally or under two conditions that are relevant here. The first condition is a vowel preceding an underlying geminate consonant. A light vowel is blocked from lengthening and a long vowel is shortened in that environment. The second condition is that AL does not lengthen light vowels that are adjacent to syllables with heavy vowels. In fact, a heavy vowel starts the count over again for the application of AL. However, there are exceptions to this rule, as well: when

¹⁰ Heath dubbed S&V's "telic" and "atelic" forms "punctual" and "durative," respectively.

¹¹ S&V's example (18) (p.90) is a noun.

the long vowel is in the first syllable of a suffix, and the preceding stem-final short vowel is otherwise eligible for AL, the rule can apply.

(21) /ʔanaŋi-wi:ti-t/ 'he is crying' (V:106) → [ʔanaŋi:-wi:di-t]

Heath uses these observations to formulate an iterative rule that lengthens every light vowel in a word, from left to right. The alternating effect is due to the restriction against a derived length appearing adjacent to either an underlying or another derived long vowel. His rule is summarized in (22).

(22) Alternating Length (Heath (1981, p. 198)

Lengthen any short vowel, going left to right within a word, if:

- a) it is not word-final, or it is word-final after ungeminated *h* or *ʔ*.
- b) neither adjacent syllable has a long vowel (except for a long vowel in the first syllable of a following suffix).
- and* c) for certain lexically marked verbs like /ppiʃa-/, it is not the first syllable of the stem.

Condition (b), Heath claims, prevents the rule from applying to successive short vowels. Condition (c) prevents the rule from applying to the stem-initial vowels of the irregular verbs that show unexpected lengthening of the second (rather than the first) vowel. The rule will automatically apply to the second stem vowel of such stems.¹² Considering that Heath has a rule of V-reduce that deletes or shortens word-final vowels, Condition (a) is not necessary.

Heath conjectures that historically AL reflected alternating stress rules. Probably stressed vowels in open syllables were automatically phonetically lengthened;

¹² For example the first syllable in the unreduplicated atelic form is not lengthened, e.g., /ppiʃa-/ 'to go out' → *ppiʃa:-* and *ʔi:ppiʃa:-*.

synchronically, however, lengthening has become the only residue of this ancient stress rule.

Thus far, Heath's AL rule has accounted for most of S&V's examples in their vowel length chart in Table 1. He claims that his analysis is superior to those preceding him, particularly in accounting for the alternations seen in examples (S&V#44) and (S&V#48) in S&V's chart. S&V proposed that in these opaque cases, ?-deletion occurs with subsequent contraction of vowel clusters. Quite appropriately, Heath considers these rules ad hoc, and instead proposes an analysis involving syncope and postconsonantal or preconsonantal (not intervocalic) ?-deletion. Heath's rules of syncope and ?-deletion are given in (23) and (24), respectively:

(23) Syncope Rule (Heath 1981, p. 201)

A short vowel is deleted if:

- a) it is flanked by ungeminated consonants; either the following consonant is ? or *h* or the preceding consonant is ?.
- b) adjacent syllables, all within the stem, have long vowels.

(24) ?-Deletion (Heath 1981, p. 209)

Simple ? or geminate ?? is normally deleted after a nonsyllabic (except *y*) when followed by a vowel; simple ? (but not ??) is deleted when it follows a vowel and precedes certain nonsyllabics (stops and affricates, *y*, in some cases *l*).

The derivations for (S&V#48) and (S&V#44) follow in (25) (Heath 1981, p. 199):

(25)	a.	?u?u?a-	b.	?o?oli-	base form (presuffixal)
		?u:fu?a:-		?o:?oli:-	AL
		?u:ʃ?a:-		?o:?li:-	syncope
		?u:ʃa:-		?o:li:	?-deletion

Note that syncope follows AL, which provides the long vowels needed in Condition (b) of Heath's AL rule in (22). Note also that in (25a) the glottal that deletes is an onset whereas in (25b) it is a coda.

Finally, to account for geminates blocking the process of AL to a preceding vowel, Heath proposes a rule, called 'V-Short Rule':

- (26) *V-Short Rule* (Heath 1981, p. 210)
 A long vowel is shortened before a geminate cluster, and in a lexically sporadic fashion before other clusters.

This rule shortens a vowel that has already been lengthened by AL, when in the proper environment.

An advantage of Heath's analysis is that it does not resort to S&V's abstract representations for UR (their capital letters in the vowel chart in Table 1), but, instead has a normal phonetically plausible underlying representation, as did McCawley (1969). Heath, utilizing the insights of McCawley (1969), acquires greater descriptive adequacy than McCawley for the process of AL, including the problematic opaque cases. The path remains to take Heath's insights and put them into a more formal framework. We now turn to Benki (1996).

3.2.4 Benki (1996). Benki attempts an interactive analysis of Stress and AL in Tūbatulabal within an OT framework. The majority of the criticism of his analysis will be directed to the framework he uses, OT, rather than Benki's particular work.

Benki states that stress and AL in Tūbatulabal are independent phenomena. He assumes a bi-level account: the weight-foot level and the stress-foot level. These levels are sometimes called "domains." The two levels are necessitated by the fact that the

vowels lengthened by AL (which is at the weight-foot level) are subject to lengthening under Stress (which is at the stress-foot level).

Benki says that headship of the foot is expressed by weight (defined by vowel length) at the weight-foot level, and by stress at the stress-foot level. He posits two constraints, HEAD-TO-STRESS (HTS) and HEAD-TO-WEIGHT (HTW). HTS says that “heads of feet are stressed” (p. 9) and HTW says that “the head of a foot is heavier than the weaker member of the foot.” (p. 16) A grammar that defines headship by vowel length will rank HTW above HTS; a grammar that defines headship by stress has the opposite ranking. The two levels of Tübatulabal rank these constraints differently.

There are a couple of other differences between the two levels that are worth noting. The first is that the two levels have different rankings for the alignment constraints, and second, that geminates are defined by being underlyingly moraic. Benki assumes this moraic geminate representation to account for the non-occurrence of long vowels to the left of geminates (via a ban on tri-moraic syllables). Yet these moras that are linked to consonants at the weight-foot level are invisible to the constraints that apply at the stress-foot level.

Benki’s levels are entirely ad hoc. He gives us no reason to expect that UG gives us a bi-level architecture such that these phenomena fall naturally into these two levels. Furthermore, having different rank orderings in ad hoc, sequential levels basically amounts to an abandonment of OT’s basic principles.

Benki does not attempt to account for the blocking of AL to the light vowels in syllables to the left of underlying long vowels before geminates (CVCV̄:C.CV). It is difficult to see how this could be done in his framework, or in any OT grammar. This

blocking is rendered opaque by the neutralization of vowel length to the left of a geminate. Because Benki accounts for this blocking by a clash-avoidance constraint, and because all of his constraints are defined on the output representations, he cannot account for (S&V#21).

Benki also does not account for the examples where contraction has rendered the application of AL opaque, e.g. (S&V #45, #47, #48). Nor can OT account for these examples without resorting to even more complex and ad hoc mechanisms.

In general, each of the constraint rankings that Benki posits for each level are complex statements involving nine constraints for the weight-foot level and 11 constraints for the stress-foot level. Aside from a series of ad hoc assumptions, these accounts are unwieldy and implausible. It is not Benki's fault, however. Each of these statements relies on the application of tools and methods that is standard for OT practice.

3.2.5 Alderete, J., J. Beckman, L. Benua, A. Gnanadesikan, J. McCarthy, and S. Urbanczyk (1996). Alderete et. al. address AL in Tūbatulabal in the context of “fixed segmentalism” during Reduplication. Within an OT framework, they provide an analysis for determining which consonants will appear in the reduplicant during Reduplication. Those consonants are the glottal in initial position and the nasal optionally in coda position (hence the term “fixed segmentalism” as it is always and only these consonants). Their analysis accomplishes this by ranking markedness of place-of-articulation, e.g., it is more marked (hence less optimal) to have a labial place than to have a coronal place, over faithfulness constraints. These place-of-articulation constraints dominate faithfulness constraints governing the relation between the base and the reduplicant, i.e.,

constraints that would otherwise restrict deletion or epenthesis to base material in the reduplicant.

Alderete et. al. argue that “the occurrence and distribution of a nasal coda in the Tübatulabal reduplicant follows from precisely the same constraint interaction that yields the initial glottal stop: domination of MAX_{BR} (faithful copying of the base into the reduplicant) by the Place markedness hierarchy”(p. 18). They claim that their analysis solves an ordering paradox that arises with serial-derivational analyses of the same facts: the nasal is copyable because it assimilates to the following stop, but it cannot assimilate until it has copied. Serialism, they contend, demands that either copying or assimilation take place first, but neither order yields the correct result. Alderete et. al. assert that the issue never arises in their theory, because the well-formedness of copying and assimilation are evaluated together, in parallel.

On the contrary, a proper account of serialism shows that there is no ordering paradox whatsoever. The issue is not if there is copying and then assimilation, or vice versa. The claim here (see Section 3.2.6) is that the nasal copies during Reduplication and is subsequently deleted. There is no assimilation and hence no ordering paradox.

Secondarily, they address the interplay among vowel quantity and stop voicing in reduplicated forms. As they describe it, when the root-initial stop is alternating (i.e., voiceless in initial position, voiced otherwise), the vowel reduplicant is long, and if the root-initial stop is non-alternating, the vowel of the reduplicant is short. Also, stops which alternate in voicing permit copying of a nasal, but non-alternating stops prevent nasal copying. The distinction Alderete et. al. make is that when a root begins with an alternating stop, its reduplicant must be a heavy syllable, with either a long vowel or, if

possible, a coda nasal. But when a root begins with a non-alternating stop, its reduplicant must be a light syllable, with a short vowel and no coda nasal.

The main problem with Alderete et. al's analysis is that they do not treat AL as a general phonological process that occurs throughout the word, on alternating odd syllables, if possible. Their analysis proceeds as if lengthening (or not lengthening) is an isolated phenomenon happening only to the reduplicant, dependent totally on the base stem's initial consonant. The authors ignore the fact that the process occurs on non-reduplicated words, as well. Additionally, they argue that a nasal adds to the reduplicant's syllable being heavy. Had they addressed Stress in their analysis, they would have seen that a VN sequence does not necessarily draw Stress. However, they do not make a connection of weight to stress or vice versa. Alderete et. al., as with any OT analysis, by focusing on outputs cannot handle any of the intertwined, multiple opacities that we see in S&V, e.g., (#44, #48). Alderete et. al only look at the clear cases of Reduplication in Tübatulabal, ignoring complicated cases.

We now turn to the Three-Dimensional Analysis of AL adopted in this dissertation. As we shall see, its modular approach is well-suited to Tübatulabal.

3.2.6 A Three-Dimensional Analysis of AL in Tübabulabal. An adequate account of AL should recognize that it is basically a metrical phenomenon. I propose that the grammar of Tübatulabal creates a metrical plane in the lexicon that assigns a Line 1 asterisk to the vowels that eventually become lengthened under AL. This approach must account for at least the following three generalizations:

1) Except for cases where AL is blocked, every odd vowel from the left edge of the word or from a heavy vowel is lengthened. This is accomplished by a set of rules that

assign metrical prominence to these vowels, followed by a rule that lengthens all vowels with metrical prominence.

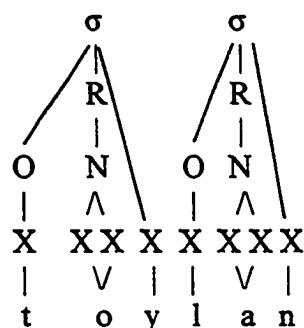
2) Vowels that appear to the left of a geminated non-vocoid are always short. Tübatulabal has underlying long vowels (S&V's "heavy" vowels) that appear to the left of geminates and appear short on the surface. The AL rules, however, honor this underlying length. My approach to this problem is two-fold. It revolves around the representation of geminates and addresses restrictions on the number of segments that may occur in the rime of the Tübatulabal syllable.

3) A nasal consonant which is not the onset of a syllable may appear after a long vowel in the stems of words (as may other consonants), but not in the reduplicated portion of a word. I propose that this generalization is accomplished by allowing syllables to have appendices, along with a constraint that any segment in an appendix must be voiced and may not be part of a geminate.

Let us start with the second point. Pending more research into this matter, I tentatively propose that Tübatulabal conforms to a well-formedness constraint allowing two segments in the rime. Syllables may have appendices, but there are restrictions on what may appear in the rime: no voiced segments may appear there, nor may the first half of a geminate. This is admittedly rather ad hoc, and further elucidation of this constraint awaits further research.

S&V's example of //to:yla:-n// → [to:yla:n] (S&V#4) would be represented as follows:

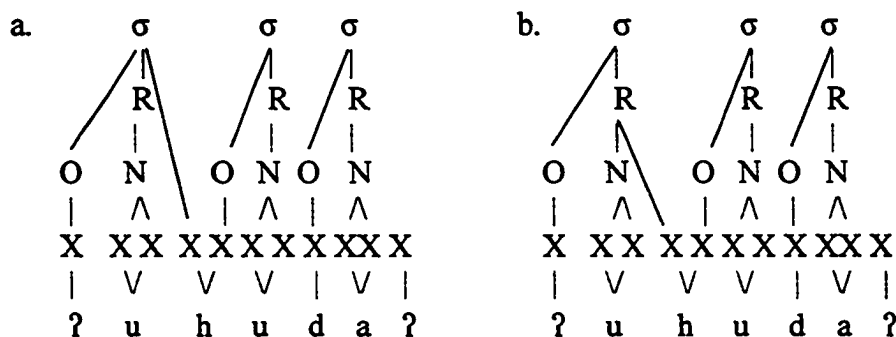
(27) /to:yla:-n/ → [to:yla:n] ‘to teach him’ (S&V#4)



Allowing only two segments in the rime, filled by the long vowel, leaves as a singleton consonant following the vowel as an appendix of the syllable.

Now, let us turn to example (28) with an underlying long vowel followed by an underlying consonantal geminate. (28a) depicts the first half of the geminate as an appendix to the syllable. (28b) portrays the first half of the geminate in the rime.

(28) /hhu:da:/ → [ʔuhhu:da] ‘for the sun to be up’ (S&V#22)



The representation of (28a) violates the constraint against allowing the first half of a geminate in the appendix. (28b) violates the constraint against more than two segments in the rime.

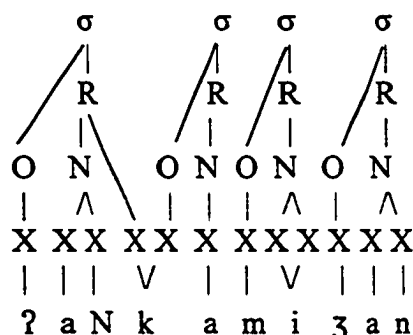
I sketch a possible analysis to these facts here; a more detailed analysis awaits further research. Within an approach along the lines of Calabrese’s theory of Dynamic Phonology (2002), either of the representations in (28) is in need of repair. The output of

the repair rules will yield an evaluation set, and the member of that set chosen to surface is the one with a short vowel and the first half of the geminate in the rime.

Recall that AL fails to lengthen a vowel in the reduplicant before the nasal when the nasal is part of the reduplicated material. The rule that creates the reduplicated material, sketched below, does not carry over a syllable's appendix. This accounts for the failure of a long vowel to precede a tautosyllabic nasal to appear in the reduplicant.

Recall further that a nasal in the reduplicant is deleted if it precedes a geminate, root-initial consonant, as in (S&V#16). The representation in (29) depicts the representation of the nasal preceding a geminate consonant.

(29) /kkami:ʒa-n/ → [ʔakkami:ʒan] 'to catch it for him' (S&V#16)



This is a tentative analysis, but basically in a DP analysis the geminate will trigger the deletion of the nasal: only two segments may be in the rime.¹³ Thus, intervocalic underlying geminates trigger both shortening of long vowels *and* the deletion of nasals in the reduplicant.

A theory employing the notion of the mora seems to offer some utility here. If

¹³ Notice that Tübatulabal and Tseshaht both represent nasals as the right sister of a branching nucleus.

geminated segments are encoded with a mora in underlying representation, then the restriction on long vowels before geminates could be seen as a bimoraic restriction on rimes. Furthermore, if nasals in the coda are assigned moras, then the failure of AL to lengthen vowels in the reduplicant before a tautosyllabic nasal may receive a similar analysis. However, this approach encounters at least the following two problems: first, the moras assigned to geminates is now visible to the stress processes. Second, it would be strange to assign a mora status to a nasal in the reduplicant, but not to a nasal in the root, which can follow a long vowel in the same syllable.

Turning now to the basic AL process, a good candidate for coding the length assigned by AL is a metrical marker. Within metrical theory, this would have to be an asterisk on Line 1. The historical remnant of the old stress in Tūbatulabal is now a metrical plane in the lexicon, up to Line 1. A simple set of rules assigns asterisks to Line 1 on a metrical plane to just those vowels that end up getting lengthened by AL. Then a set of rules apply to the segments on the timing tier, using information on the metrical tier. These rules accomplish the various deletions and coalescences sketched in both the S&V (1939) and Heath (1981) papers. One of these rules is the lengthening rule that simply lengthens all vowels having an asterisk on Line 1. The goal in this section is to lay out how the theory works in general, and then to specifically examine the cases of opacity presented by S&V in Section 3.2.6.1.

Let us look at two hypothetical odd-syllable Tūbatulabal word examples, the first of which has no underlying long vowels and the second having one underlying long vowel.

The UR for both examples is (30a and 30b):

(35)

ICC * *) * *) * *) * * (* *) * *) * *) Line 0
 a. CVCVCVCVCVCVCV b. CVCV:CVCVCVCVCV

Note that in (35b), to fulfill the rule: ICC:L = $\emptyset \rightarrow$) / x x _ (left to right), the right parenthesis must start in at the first uninterrupted asterisk grouping.

Finally, the Headedness parameter accounts for prominence of the first element of each constituent.

(36) *Headedness Parameter*

Project the {left/right}-most element of each constituent
 (onto the next higher line of the grid)

Tübatulabal chooses to project the left-most element of each constituent onto the next higher line of the grid, which is Line 1.

(37)

Head * * * * * * Line 1
 * *) * *) * *) * * (* *) * *) * *) Line 0
 a. CVCVCVCVCVCVCV b. CVCV:CVCVCVCVCV

Now the lengthening rule applies to any short vowel with an asterisk on Line 1.

(38)

 * * * * * * Line 1
 * *) * *) * *) * * (* *) * *) * *) Line 0
 a. CV:CVCV:CVCV:CVCV b. CVCV:CVCV:CVCV:CV

An advantage of this theory is that it reflects Heath's (1981) hypothesis about historical stress origins directly.

We saw in (28b) that the representation consisting of a long vowel before a geminate is in need of repair. The reason for the repair, I claim, is that the grammar of Tübatulabal allows only two segments in the rime, and (28b) has three segments in the rime. The repair operation that I propose is to delete the second half of a vowel before

geminates. This is a common rule, which we know occurs, because underlyingly long, i.e., heavy, vowels get cut back.

We now turn to those opacity cases that are so problematic for previous theories, those involving syncope and deletion, to see how the 3-D Metrical Theory handles them.

3.2.6.1 *Syncope and Deletion in the 3-D Metrical Theory*. Raimy's (2000) theory of reduplication (see Chapter 1), provides a potential analysis to AL and Stress in Tūbatulabal. Recall that jump links (loops) in representations can be added either by readjustment rules or directly by morphemes. Loops are defined by specifying which segments they anchor to. ANCHOR 1 specifies the *start* segment and ANCHOR 2 specifies the *end* segment of an added precedence relationship. Linearization is a process that converts phonological forms into representations that are wholly asymmetrical.

We shall concentrate solely on the AL aspect for now. (39) lays out the AL analysis, with examples using this analysis following.

(39) Analysis of AL within the 3-D Metrical Theory

I. In MORPHOLOGY:

- 1) Reduplicate and Linearize
- 2) Build AL Metrical Structure
- 3) Add Jump Link (Loop)

II. Out of the MORPHOLOGY and into the PHONOLOGY:

- 1) Linearize again
- 2) Lengthen Line 1 Vowels (only in open syllables)

Let us begin with (S&V#31) $yə:wɑ:n \sim ə:yʔəwɑ:n$ from $/yəʔəwɑ:/$ 'to hold it for him'. The first step following (39) is to reduplicate and linearize, getting (40):

- (40) a. $yəʔəwɑ:n$ b. $əyəʔəwɑ:n$

Next, the metrical structure is built using the parameter setting from (31), , i.e.,


(Project: L, ICC: L, Head: L), yielding (41):

- (41)
- | | | | | |
|-----|-----|-----|-----|--------|
| * | * | * | * | Line 1 |
| **) | (** | **) | **) | Line 0 |
- a. yəʔəwa:n b. əyəʔəwa:n

The jump link in Tūbatulabal, responsible for the syncope and deletion, begins on the consonant preceding the Vʔ sequence, and ending on the vowel immediately following the ʔ.

(42) *Tūbatulabal Jump Link (Loop 1)*

#_ X X _%
 | | | |
 C V ʔ V

- (43)
- | | | | | |
|-----|-----|-----|-----|--------|
| * | * | * | * | Line 1 |
| **) | (** | **) | **) | Line 0 |
- a. yəʔ əwa:n b. əyəʔ əwa:n
- 

At this point in the analysis of (39), we leave the Morphology and move into the Phonology, and we linearize again. The metrical structure is retained, however. (44a) keeps its asterisk on Line 1 from the first syllable /yə-/. In (44b), however, both participating vowels in the jump link loop have no asterisk on Line 1, thus accounting for the lack of an asterisk on the second syllable (-yə-/.

- (44)
- | | | | | |
|----|-----|-----|-----|--------|
| * | * | * | * | Line 1 |
| *) | (** | **) | **) | Line 0 |
- a. y ə w a:n b. ə y ə w a:n

And, finally, to complete the AL analysis, we lengthen the vowels on Line 1, yielding (45):

prominent than other stressed vowels, and that a terminology referring to main stress merely serves as a convenient point of departure in describing the rhythmical pattern.

Alternation of stress in general is oriented from the main stress. Counting backwards from the main stress, every second mora is stressed where possible (V: 76).

(50)	a.	tʃiɲiyál	'the red thistle'	(V 75)
	b.	witáɲhatal	'the Tejon Indians'	(V 75)
	c.	witáɲhatalá:baɰú	'away from the Tejon Indians'	(V 75)
	d.	yilahó:lá	'to go along happy'	(S&V 90)
	e.	ʔá:-yá: an-it	'3 rd is singing'	(V 113)
	f.	ʔuyúʔum	'it got word out'	(V 76)
	g.	waʔánt	'the acorns'	(V 77)

In a sequence of short vowels, the alternating stress is uninterrupted, e.g., (50a and 50b). Long vowels are always stressed and the left edge of the long vowel acts as a new edge for alternating stress to continue, e.g., (50c and 50d). (50) reveals that Tübatulabal allows both final and initial stress. (50e) shows that under certain conditions, the language does not mind stress clash. Tübatulabal allows stress clash under two conditions: first, underlying long (heavy) vowels in adjacent syllables may appear stressed on the surface; second, the iterative, left-to-right Stress-Assignment rule may assign stress to a short vowel in a syllable immediately to the right of an underlying long vowel. Generally, consonants do not count as heavy for stress as can be seen by (50c). Two identical short vowels separated by glottal stop within the same morpheme act as a single long vowel ($[...V_iʔV_i...]_{MCAT}$) as in (50f), not *ʔuyúʔum. When vowels around the glottal stop are from different morphemes, they act as belonging to two short vowels, ($[...V_i]_{MCAT}ʔV_i...$, or $[...V_iʔ]_{MCAT}V_i...$) as in (50g).

Recall that the distinction assumed here between the glottal stop in (50f) vs. (50g) is that the former is represented as $V:ʔ]_{\sigma}$ in UR (S&V, p. 92). As a matter of phonetic interpretation, it comes out as $[VʔV]$. (50g), on the other hand, is represented underlyingly as a bisyllabic $VʔV$ sequence, behaving like two light syllables. This latter glottal is subject to syncope and deletion, as in (S&V#45, #47 and #48).

A long, hence stressed, vowel preceding a stressed vowel (long or short) becomes 'rearticulated' (V 59), as in (51):

- | | | | | |
|------|----|-------------------|---------------------|---------|
| (51) | a. | <u>ká:</u> adúl | 'the clay pot' | (V: 59) |
| | b. | el <u>é:</u> egát | 'he is looking out' | (V: 57) |

Phonetically, a rearticulated long vowel consists of the long vowel itself, a brief hiatus, and a short vowel of the same quality of the long vowel. The absence of a glottal stop between the rearticulated vowel indicates that there is no syllable break. For the most part, rearticulation occurs for long vowels preceding word-final stress as shown in (51), and not before word-internal stress as in (52)¹⁴:

- | | | |
|------|-----------------------|--|
| (52) | <u>má:</u> láwinát | 'he is waving his hand at him' (V 101) |
| | * <u>má:</u> aláwinát | |

The exceptions to this are some cases of rearticulation in the reduplicant.

Neither S&V (1939), McCawley (1969) nor Alderete et. al. (1996) address Stress in their papers. We, therefore turn to Heath (1981), Crowhurst (1990), Hayes (1995) and Benki (1996). We turn to a 3-D analysis in Section 3.3.5.

¹⁴ Voegelin (1935) transcribed Rearticulation. Later papers omitted this transcription because of its predictability. For clarification purposes, Rearticulation will be shown throughout the remainder of this chapter.

The focus of Crowhurst's paper is to argue that Initial Reduplication must precede Stress-Assignment and that nasals are moraic for the former process and lose their moraicity for the latter. She points to (55) as evidence. It shows that initial reduplicated prefixes containing short vowels behave entirely regularly in the alternating stress pattern. Crowhurst argues that if Initial Reduplication follows stress, there are two possible results: either stress does not reapply, in which case no reduplicated prefix should have stress, or stress applies again after reduplication, in which case reduplication creates a new domain for stress assignment. In this case, every reduplicated prefix should have stress.

- (55) a. ʔá-nab-át '3rd is throwing it' b. ʔu-púsk '3rd blew it'
 c. ʔé-wekéʔ '3rd crawled' d. ʔu-kús '3rd honked'

Forms like (55a and 55c), in which a reduplicated prefix has stress, rules out the first possibility. Forms like (55b and 55d), in which a reduplicated prefix is not stressed rule out the second possibility. Crowhurst concludes that whether a prefix is stressed or not is predictable only if reduplicated prefixes are present when alternating stress is assigned.

Crowhurst's evidence for coda nasals being moraic before Stress-Assignment is that during Initial Reduplication, nasals are not copied after a long vowel in the reduplicant, but are copied after a short vowel. She stipulates that the reduplicant may be comprised only of moraic material, and she argues that Tübatulabal has a bimoraic syllabic limit and that the nasal is not copied after a long vowel because the moraic limit has been met by the vowel. As we have seen, Crowhurst must delete the moraic nasal to account for the stress facts.

Crowhurst's iambic, right-to-left metrical analysis of Tūbatulabal ignores AL entirely, nor does she look into the role of gemination during reduplication or stress. Her analysis of nasal reduplication is, therefore, stipulative and ad hoc.

3.3.3 *Hayes (1995)*. Hayes analyzes Tūbatulabal within his version of metrical stress theory. According to Hayes, "the central claim of the theory is that stress is the linguistic manifestation of rhythmic structure, and that the special phonological properties of stress can be explicated on this basis" (p. 1).

Before turning to Hayes' analysis of stress in Tūbatulabal, I will give some theoretical background. First of all, it is a parametric theory, which regards a rule system as a particular choice from a limited list of options, or parameters. Types of parameters include direction of parsing, e.g., left-to-right/right-to-left; iterativity, e.g., foot construction is iterative/once only, and so on. By setting all the relevant parameters, one derives a stress rule.

The type of representation Hayes adopts is called "bracketed grids". The bracketing gives metrical tree-like information (where nodes of the tree would be labeled *s* (strong) and *w* (weak) to mark relative prominence) incorporated instead into the structure of the grid. Bracketed grids include brackets at all layers of the grid to indicate the constituency that would appear in a metrical tree. Hayes adopts Halle and Vergnaud's (1987) grid representation as indicated in (56) for the English phrase 'Mississippi mud'. The X's indicate stressed syllables, and the periods indicate stressless syllables. In the grids that result, all pairs of brackets enclose just one grid mark.

(56) (x)
 (x) (x)
 (x .)(x .) (x)
 Mississippi mud

The final definition we give is Hayes' metrical End Rule.

- (57) *End Rule (Left/Right)* (Hayes 1995, p. 61)
- a. Create a new metrical constituent of maximal size at the top of the existing structure.
 - b. Place the grid mark forming the head of this constituent in the (leftmost/rightmost) available position.

Hayes criticizes Crowhurst's (1990) right-to-left iamb approach to stress in Tübatulabal on two counts. First, he argues that an iambic analysis allows degenerate feet, which Hayes' claims should be avoided if further parsing could create a proper foot. He argues that Tübatulabal words ending in /...⁻~/¹⁷ would result in the final syllable wrongly skipped over to create a proper foot headed by the penult. Second, light syllables occurring word-initially and to the right of a heavy syllable can be stressed under the alternating count. Under an iambic analysis, such syllables would form degenerate feet in weak position, which Hayes proposes to exclude entirely.

Following Kager (1989), Hayes analyzes Tübatulabal using moraic trochees. The crucial idea, he claims, is to place the main stress in final position prior to foot construction, so that there will be top-down stressing. Since the only degenerate foot is in strong position, this will circumvent the problems with weak degenerate feet faced by the iambic analysis.

Hayes offers a Tübatulabal derivation within Metrical Stress Theory (p. 264) in

(59). First he presents the stress rule in (58).

- (58) Tübatulabal Stress
- | | |
|----------------------------|---|
| a. Word Layer Construction | End Rule Right |
| b. Foot Construction | Form moraic trochees from right to left.
Degenerate feet are allowed in strong position. |

¹⁷ ‘-’ indicates a heavy, hence stressed syllable; ‘~’ a light, hence stressless syllable.

Hayes explains that the final main stress created in top-down mode forces a degenerate foot underneath it and also licenses this foot by placing it in strong position.

(59) a. 'he is looking out' (V 57)	b. 'you may cross it' (V 116)
$\begin{array}{c} (\quad x) \\ \underline{\quad} \quad \underline{\quad} \\ \text{ele:git} \end{array}$	$\begin{array}{c} (\quad \quad \quad x) \text{ Word Layer Construction} \\ \underline{\quad} \quad \underline{\quad} \quad \underline{\quad} \quad \underline{\quad} \\ \text{hatda:wahabi} \end{array}$
$\begin{array}{c} (\quad x) \\ \underline{\quad} \quad \underline{(x)} \\ \text{ele:git} \end{array}$	$\begin{array}{c} (\quad \quad \quad x) \text{ Foot Construction} \\ \underline{\quad} \quad \underline{\quad} \quad \underline{(x)} \text{ (first iteration)} \\ \text{hatda:wahabi} \end{array}$
$\begin{array}{c} (\quad x) \\ \underline{(x)(x)} \\ \text{elè:git} \end{array}$	$\begin{array}{c} (\quad \quad \quad x) \text{ Foot Construction} \\ \underline{(x)(x \quad .)(x)} \text{ (remaining iterations)} \\ \text{hatdà:wàhabí} \end{array}$

As discussed above, V (75) points out that the main stress is not acoustically more prominent than other stressed vowels. Hayes' theory, therefore, forces him to make stipulations that do not flow from the data. In particular, his crucial parameter 'End Rule Right' is a stipulation, not arising from the facts of the language. We turn now to Benki's (1996) analysis of stress.

3.3.4 *Benki (1996)*. Benki acknowledges that the foot type of Tūbatulabal is unclear as to whether it is iambic or trochaic. On the one hand, the ubiquitous final stress suggests a word-final right-headed foot consisting of an iamb. However, the right-to-left pattern results in initial stress for odd-numbered sequences of light syllables suggesting a trochaic parse. Benki chooses the trochaic foot parsing of Tūbatulabal. He argues that the word-final stress should be treated as the primary word stress assigned by an undominated alignment constraint, and not by the regular rhythm of the language. As

with Hayes (1995), Benki is making an unwarranted assumption about main stress in the language, therefore, his alignment constraint is stipulative.

Benki claims that the presence of stress is forced by HTS, a constraint requiring the marking of foot heads by phonetic stress. Headship itself is obtained by foot form constraints. Separating stress from foot headship is done because an independent level of foot organization, the weight-foot level (used for AL), uses a different strategy of marking headship. HTS is ranked above HTW in the stress-foot level and the reverse ranking is in the weight-foot level.

As noted above in the discussion of Benki's AL analysis, his levels are entirely ad hoc. Furthermore, having different rank orderings in ad hoc, sequential levels basically amounts to an abandonment of OT's basic principles.

3.3.5 *Three-Dimensional Phonology* (Idsardi 1992). Idsardi (1992, p. 22) investigates two possibilities for parentheses insertion in Tübatulabal stress. (60) gives the Stress Projection Parameter for Tübatulabal. Idsardi maintains that constituents are clearly being constructed right-to-left, indicating right-to-left Stress-Assignment, but questions whether the parentheses are projected right or left for long vowels.

- (60) Project a line 0 element for each syllable head
Project the {left/right?} boundary of [...VV] syllables.

We shall investigate stress in Tübatulabal using different directions for the directionality parameter in (60). Idsardi (1992) uses an even-numbered syllable example from Tübatulabal to present the two different analyses: *tá:háwilá:p* 'in the summer'. Both analyses go from right-to-left in the word, but Analysis 1 projects right parentheses whereas Analysis 2 projects left parentheses. The two possibilities are in (61).

(61)	Analysis 1	Project:R	Edge:LLR	ICC:R	Head:R
	Analysis 2	Project:L	Edge:LLR	ICC:R	Head:L

Idsardi comments that the clue to figuring out which of these two analyses is correct comes in considering a span of syllables HLLH. He gives two derivations in (62).

Idsardi argues that in Analysis 1, applying Project:R to HLLH leaves a span of three marks: H)LLH). Since single elements do not constitute enough material to form a constituent, the ICC groups these three marks into only one binary constituent, plus a left-over mark, H)L(LH). The left-over mark is not in any constituent, and thus does not gain stress. This parsing produces one stress too few in these words.

In Analysis 2, Project:L also leaves a span of three marks, (HLL(H. However, Idsardi claims that this time the rightmost parenthesis will cause the “left-over” mark to form a constituent by itself.

(62)	<i>Analysis 1</i>	<i>Analysis 2</i>	
Project	x) x x x) ta:hawila:p H L L H	(x x x(x ta:hawila:p H L L H	Line 0
ICC	x) x (x x) ta:hawila:p	(x (x x(x ta:hawila:p	Line 0
Head	x x x) x (x x)	x x x (x (x x(x	Line 1 Line 0
	*tá:hawilá:p	tá:háwilá:p	

The crucial difference is the nature of the three mark span. In Analysis 1, this span is LLH, and the left-over mark is an L syllable, which does not provide its own constituent. In Analysis 2, the span is HLL, and the left-over mark is an H syllable, which provides its own parenthesis, (H(LL(H. Because of this, only Analysis 2 produces the correct stress patterns for Tūbatulabal.

Within the 3-D Metrical theory, the output of the AL tier in Tübatulabal is the input string of a timing tier (the Stress plane), which is orthogonal to the syllabic and featural tier.

The parameter setting that applies to the Stress plane is Analysis 2 in (61), restated in (63) for convenience.

(63) Project:L Edge:LLR ICC:R Head:L

3.3.5.1 *A Three-Dimensional Metrical Analysis of Stress with S&V's Opacity Cases.* I

concur with V and Idsardi (1982) that stress in Tübatulabal is iambic. (64) illustrates a hypothetical even-numbered syllable input and its two corresponding outputs.

(64) /σ σ σ σ σ σ/
 a. [(σσ')(σσ')(σσ')]
 b. *[(σσ)(σσ)(σσ)]

(64a) is what occurs in Tübatulabal. Looking back to the Stress examples in (50) confirms that descriptively Stress in Tübatulabal appears iambic: the even-numbered syllable examples reveal the right-headedness of the stress.

Let us move on to the opacity cases we discussed above. We apply the stress parameter, (63), to each of the AL output examples in Section 3.2.6.1, beginning with (45) (S&V#31), which will be our input in (65) below.

(65) * * * * * Line 0
 a. y ə:w a:n b. ə:y ə wa:n

To this input, Project:L applies to yield:

(66) (* (* (* * (* Line 0
 a. y ə:w a:n b. ə:y ə wa:n

Neither Edge:LLR nor ICC:R applies to this derivation, so all that is left is for Head:L to place an asterisk on the leftmost asterisk of each constituent onto Line 1. Each syllable on Line 1 receives stress, resulting (correctly) in [yé:wá:n] and [é:yəwá:n].

- (67)
- | | |
|---|--|
| <p style="margin-left: 40px;">* *</p> <p style="margin-left: 20px;">(* (*</p> <p>a. y é:w á:n</p> | <p style="margin-left: 40px;">* *</p> <p style="margin-left: 20px;">(* * (*</p> <p>b. é:y ə wá:n</p> |
| | <p>Line 1</p> <p>Line 0</p> |

Next is (S&V#48), previously analyzed in the 3-D Metrical AL analysis as (46):

- (68)
- | | |
|--|---|
| <p style="margin-left: 40px;">* *</p> <p>a. ʃ u: ʔan</p> | <p style="margin-left: 40px;">* *</p> <p>b. u:ʃ a:n</p> |
| | <p>Line 0</p> |

We apply Project:L, Edge:LLR (69a only), ICC:R (n/a) and Head:L to get:

- (69)
- | | |
|---|---|
| <p style="margin-left: 40px;">* *</p> <p style="margin-left: 20px;">(* (*</p> <p>a. ʃ ú: ʔá n</p> | <p style="margin-left: 40px;">* *</p> <p style="margin-left: 20px;">(* (*</p> <p>b. ú:ʃ á:n</p> |
| | <p>Line 1</p> <p>Line 0</p> |

Our last example from Section 3.2.6 is (S&V#46). The output from (49) is the input in (70).

- (70)
- | | |
|--|---------------|
| <p style="margin-left: 40px;">* * *</p> <p>ʔ o: ʔ o w í: n</p> | <p>Line 0</p> |
|--|---------------|

Project:L and Head:L are all that can apply resulting in:

- (71)
- | | |
|--|-----------------------------|
| <p style="margin-left: 40px;">* *</p> <p style="margin-left: 20px;">(* * (*</p> <p>ʔ ó: ʔ o w í: n</p> | <p>Line 1</p> <p>Line 0</p> |
|--|-----------------------------|

This three-dimensional modular approach to the stress system of Tūbatulabal accounts for the facts, without the overwhelming constraints that we see in the OT approach. Furthermore, by rejecting the prosodic hierarchy representation that is

embraced by OT and other theories, stress is allowed to be separated from syllabic structure in its representation.

3.4 AI and Stress Combined. The focus of this section is to look at analyses that integrate AL and Stress: those of Heath (1991), and Benki (1996), and the 3-D-Metrical Theory adopted here.

3.4.1 Heath (1981). Essentially Heath reformulates Voegelin's (1935) phonological rules using generative phonological methods that includes linear ordering. He points out, as did McCawley (1969), that S&V's (1939) paper appears to be an anticipation of generative phonology in its use of abstract formulae and rules linking them to surface forms. Each of the processes that we have examined, AL and stress assignment, are themselves ordered rules in the phonology of Tūbatulabal. Heath's rule ordering for Tūbatulabal has the rule of AL applying first followed by the syncope and deletion rules. Next come the vowel shortening rules, and, finally, the stress rules.

If we were discussing a lexical phonology framework, AL would be in the lexical phonology and Stress-Assignment the post-lexical phonology, since the former rule applies prior to word-formation. Stress occurs rather late in the phonology.

Heath's analysis of Tūbatulabal falls out neatly in an ordered fashion. Heath uses the tools of generative phonology simply to achieve descriptive adequacy—which in itself is no small task in the face of these very complicated phenomena.

3.4.2 Benki (1996). Benki's trochaic OT analysis of Tūbatulabal is problematic in several respects. First, he needs a separate level of prosody to establish alternate lengthening from stress. Within an OT framework, this would require a two-level

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approach, e.g., McCarthy (1997). It is difficult to reconcile this with a theory whose crucial reliance is on parallel processing.

Benki establishes that syllables are parsed into trochaic feet during stress. He chooses a trochaic rather than an iambic analysis of stress based upon the assumption of word-final stress. Benki stipulates that the final syllable is not part of the rhythmic pattern of the language, but is reacting to an alignment constraint establishing main stress in the word. Voegelin (1935) claims, however, that there is no word-final main stress in Tübatulabal.

Moving away from specific criticisms of Benki's analysis, let us go on to a general critique of any possible OT analysis of the Tübatulabal facts. To get the syncope and deletion facts, you need both to have designated which vowels are targeted for AL, *and* to have prevented them from having achieved that length, because underlying length blocks syncope and deletion. OT's phonetically based analysis is incapable of handling any of the intertwined, multiple opacities, e.g., (S&V#44), *o:lin* vs. *o:li:n*. AL is rendered opaque by syncope and deletion, because syncope and deletion makes vowels lengthened by AL adjacent. OT's parallel processing is incapable of handling a process that must feed into another.

By assuming that all "action" is markedness-driven, OT cannot account for apparent failures of syncope and deletion, e.g., (the telic forms of (S&V#45 and #46)). In these cases, the vowel to the left of the glottal stop is long by virtue of AL, *not* by virtue of underlying length.

Finally, OT cannot handle "historical baggage." AL is a remnant of a Proto-Uto-Aztecan stress rule. It should be handled straight-forwardly, as was done in the 3-D-

Metrical Analysis. OT would have to try to find a markedness base for it, which it cannot do without stipulation.

3.4.3 *A Three-Dimensional Analysis of AL and Stress in Tübatulabal*. The theory has three interacting modules: two metrical planes, one each for AL and Stress, and a module for the segmental rules. The whole system works with a simple set of rules and a minimal set of assumptions (the parameter settings). There are three components: the Morphological component, the Lexical Phonology component and the PostLexical and phonetic interpretation component. All the AL things occur in the morphological component, possibly in the lexicon. The various processes occurring here are Reduplication, building the metrical structure, lengthening, nasal deletion in the reduplicant (possibly), and syncope and deletion. The output of the above is a timing tier with orthogonal syllabic and featural tiers. Stress applies to this timing tier. Most likely we are still in the word grammar, since there does not seem to be any evidence of clitics that affect stress. Finally, we have the application of phonetic rules, such as consonantal gemination after short vowels, rearticulation and glottalization. In (36) above, a partial analysis, through AL was given. In (72), the total 3-D-Metrical Analysis is outlined.

(72) Analysis of AL and Stress within the 3-D Metrical Theory

I. Morphological component:

- 1) Reduplicate and Linearize
- 2) Build AL Metrical Structure
- 3) Add Jump Link

II. Lexical Phonology component:

- 1) Linearize again
- 2) Lengthen Line 1 Vowels (only in open syllables)
- 3) Build the Stress plane

III. PostLexical and Phonetic Interpretation component:

The 3-D Metrical analysis of Tübatulabal satisfactorily accounts for the data. Many of the insights gleaned about the language arise from the architectural representation, i.e., a segmental representation. Length is not equivalent to “weight” in this theory. The restriction limiting the rime of the syllable to just two segments is a restriction that any phonological theory of Tübatulabal must require somehow (in moraic theory, it is a bimoraic restriction). Claiming that long vowels, nasals and certain types of glottal stop occupy the second segment of the nucleus provides insights into the behavior of AL and Stress. Specifically, the structural representation accounts for a broad generalization: nasal deletion or vowel shortening before a geminate consonant follows from this structural representation. Moraic theory is unable to do the same without ad hoc stipulations.

The 3-D Metrical analysis is a serial theory accounting nicely for the fact that in Tübatulabal, certain processes must feed upon one another. In particular, its serial approach, combined with its modular metrical approach accounts for the cases of opacity seen in S&V’s vowel lengthening chart in Table 1. A parallel-processing theory, e.g., OT, is incapable of handling opacity, particularly being so phonetically grounded.

Finally, what makes the 3-D Metrical theory unique is its modular approach of different metrical tiers and its orthogonal planes, one of which contains the segmental rules, and one which includes a syllabic tier. Previous metrical theories, e.g., Hayes (1995), encoded syllabic information directly onto its grids.

Chapter Four: CONCLUSION

It has been the purpose of this dissertation to give a detailed description and analysis of a range of challenging phenomena in the phonologies of Tseshaht and Tūbatulabal. Providing a descriptively adequate account of these facts is in itself sufficient, but being able to contribute to furthering our knowledge on issues of a general phonological nature is a higher objective.

It has been shown that a segmental representation of Tseshaht and Tūbatulabal accounts for the facts, whereas a moraic representation cannot, without great difficulty. A standard moraic analysis of the vowel shortening phenomena in Tūbatulabal would posit geminates as underlyingly moraic. The shortening of a vowel before a consonantal geminate would be due to a constraint against having more than two moras in a syllable. Furthermore, the behavior of geminates in Tūbatulabal provides evidence for a double-root structural representation (Selkirk 1990) versus the single-root moraic representation (Hayes 1989). The latter representation would entail serious difficulties in accounting for the stress facts, however, because Stress-Assignment is blind to geminates. If geminates were inherently moraic, we would be hard-pressed to explain why geminates do not draw stress in the language. And in Tseshaht, a segmental representation of nasals, specifically as occupying the right sister of a branching nucleus, offers insights into the parallel distribution of variable vowels and nasals in Tseshaht.

A parallel-processing theory, such as OT (Prince and Smolensky 1993), has been shown to be insufficient for accounting for opacity in Tūbatulabal. A serial approach, utilizing the insights of Dynamic Phonology (based on Calabrese, 2002) and Three-

Dimensional Phonology (Halle and Idsardi (1995), Idsardi (1992), Halle and Vergnaud (1987)), provide a descriptively adequate account of the multiply opaque phenomena in these languages without the need to invoke ad hoc theoretical innovations. OT does not offer this advantage.

The Three-Dimensional Metrical Theory is modular in two respects. First it is modular in that it has a morphological, phonological and phonetic component, each with its own set of serial rules. Second, the Three-Dimensional Metrical theory is modular by consisting of different metrical tiers and orthogonal planes. Syllables are not the stress-bearing unit in this theory. Instead, syllables are a plane radiating from the timing tier, whose purpose is to organize segments. Languages may differ in terms of whether syllable heads are the stress-bearing units, or vowels are. The metrical grid is a device for calculating relative prominence. The mechanisms that build appropriate representations of stress are parameterized rules and constraints. Metrical rules apply successively in a derivation. The constraints that block the application of metrical rules in specified configurations prevent the application of metrical rules that would generate universal or language-particular disfavored configurations.

Dynamic Phonology (Calabrese 2002) is the other serial theory that looks promising, and when paired with the Three-Dimensional Metrical Theory goes a long way in accounting for the phenomena in Tübatulabal and Tseshaht. The advantage of DP is that it can go beyond Stress-Assignment and address questions of markedness. The theory's basic assumption is that premium value is assigned, either by UG or language-specifically, to a language. Once a language has been assigned premium values, and

markedness statements have been listed, the repairs necessary to achieve the most convergent form fall out naturally.

As with many things, the deeper one looks, the more questions arise. Although this dissertation goes far towards an explanatory analysis of several phonological issues, much remains for future research.

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