Abstract

In this paper, I describe and analyze a novel pattern of secondary stress in Tohono O'odham. Tohono O'odham (formerly known as Papago) assigns primary stress to the first syllable in content words (Hale 1959, Saxton 1963, Hill and Zepeda 1992). Fieldwork by the author on Tohono O'odham shows that a word-final secondary stress is disallowed in monomorphemic words, but is allowed in polymorphemic words. This descriptive generalization holds regardless of the morphological composition or the derivational history of the word. This appears to be a novel stress pattern in the world's languages; no similar pattern appears in either Halle and Vergnaud (1987) or Hayes (1995), two important typological works on metrical systems.

Optimality Theory (McCarthy and Prince 1993, Prince and Smolensky 1993) ranks constraints in a single hierarchy that evaluates both derived and underived words without a serial derivation. O'odham secondary stress is accounted for in this way by proposing the Morpheme-to-Stress Principle, a constraint requiring that each morpheme be stressed. This is true, as long as rhythmic considerations against clashes and lapses are respected. The Morpheme-to-Stress Principle provides an Optimality Theoretic account of this interesting metrical asymmetry between derived and underived words in Tohono O'odham, and offers an account of other types of morphological stress systems.

0. Introduction

Tohono O'odham (also known as Papago) is a Uto-Aztecan language spoken in southern Arizona and Sonora, Mexico. There are approximately 11,000 speakers. Fieldwork by the author on Tohono O'odham reveals that secondary stress is determined by the morphological complexity of the form. Primary stress has been described as word-initial. The focus of this paper is to describe and analyze the morphophonological principles that determine secondary stress in Tohono. Odd-numbered nonfinal syllables are assigned secondary stress. However, odd-numbered final syllables only receive stress in morphologically complex words. Monomorphemic words are never stressed on odd-numbered final syllables. The relevant generalization is that a final secondary stress is only permitted in words that are morphologically complex. 1 This generalization is independent of morphological bracketing; the polymorphemic data shows that final stress occurs regardless of whether the form consists of a root and prefix, root and suffix, or some other particular morphological shape. This is illustrated in (1):

(1) The asymmetric distribution of final secondary stress

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1 Thanks to Mike Hammond, Ofelia Zepeda, Jane Hill, Amy Fountain, Karin Michelson, students in my classes at University of Pittsburgh and San José State University, especially Dorothy Berney and Camille Yeh, and the anonymous reviewers, all of whom gave significant comments on written versions. This material has benefited from various presentations at the University of Arizona, WCCFL at University of California, Irvine, University of Pittsburgh, State University of New York at Buffalo, California State Univeristy at Fresno, and University of California, Berkeley. Fieldwork was funded by the University of Arizona Graduate College and the Phillips Fund of the American Philosophical Society. Many special thanks to my language consultants, Felicia Alvarez and George José. All errors are my own.

1 It also must be the case that the word is without epenthetic vowels, facts treated in Fitzgerald (1997a).
a. Monomorphemic words - no final stress
   ?á:sú:ga:š 'sugar (Sp)'

b. Polymorphemic words - final stress allowed
   pá-pa:ño 'ducks (Sp)'
   pí:šos-gà 'having a pear tree (Sp)'
   hi:-him-àd 'will be walking, plural'

In this paper, I argue that Tohono O'odham is a language with binary syllabic trochees starting at the left edge. I propose that the stress pattern of polymorphemic forms is generated by a constraint that requires all morphemes to be associated with at least one stressed syllable. This constraint, the Morpheme-to-Stress Principle, is satisfied when a morpheme is stressed at least once. As a result, degenerate feet are permitted, but only in those words with complex morphology.

The asymmetry between underived and derived words is an interesting one, and this particular type of asymmetry does not appear to have been previously described for any language in the literature on stress systems (for example, Halle and Vergnaud 1987 and Hayes 1995). The analysis presented here is couched in the framework of Optimality Theory (McCarthy and Prince 1993, 1995; Prince and Smolensky 1993), which uses a hierarchy of universal constraints and parallel evaluation of possible outputs. Variation between languages is accounted for by differences in constraint rankings. Section three explores the nature and universality of the Morpheme-to-Stress Principle. This section presents some additional motivation for the cognitive motivation of this constraint, and also includes cross-linguistic support showing that this constraint exerts varying influence in other languages.

The organization of this paper is as follows. The first section presents the data, illustrating the general pattern of stress in Tohono O'odham with simple and complex forms. Section Two proposes an analysis of this data using rhythmic constraints plus the proposed Morpheme-to-Stress Principle. These constraints are interleaved to account for the generalizations of both underived and derived words. In Section Three, I present additional motivation for the Morpheme-to-Stress Principle. The final section summarizes the descriptive and theoretical points made in this paper.

1. Description of the general stress pattern

   The set of data in (2) shows the distribution of stress in monomorphemic forms. Words consisting of one to three syllables surface with only an initial primary stress. Words consisting of four syllables also surface with an initial primary stress, but also have a secondary stress on the third syllable.\(^3\)

\(^2\) However, for a different approach within Optimality Theory that uses levels and ordering in Optimality Theory, see, for example, Orgun (1995) and Yu (1998).

\(^3\) Fitzgerald (1999a) discusses the methods used in collecting the stress. All data in this paper was collected by fieldwork by the author.
(2) Stress patterns in monomorphemic words

a. Words consisting of one syllable:
   čú: meaning 'extinguishing a fire'
   kó: meaning 'sleeping'
   gá:t meaning 'gun'
   kí: meaning 'house'
   ó:t meaning 'dripping, leaking'
   mí: meaning 'running'
   ó:n meaning 'salt'
  :j:n meaning 'smoking'
   ní:k meaning 'speaking'
   hí:m meaning 'walking'
   pá:n meaning 'making bread (SP, pán)'
   pa:n meaning 'priest (SP, pádre)'

b. Words consisting of two syllables:
   ti:lai meaning 'roadrunner'
   ci:kan meaning 'working'
   ha:ku: meaning 'lima bean'
   wa:lon meaning 'washing'
   wo:lon meaning 'sweeping'
   wa:ka meaning 'ditch'
   wi:kó meaning 'great grandparent'
   ci:wí meaning 'playing'
   ha:wá meaning 'cow'
   si: meaning 'syrup'
   wa:la meaning 'dancing (SP, from bailár)'
   pi:ba meaning 'pipe (SP, from pípa)'
   pa:lo meaning 'duck (SP, from páto)'
   ta:lo meaning 'shawl (SP, from chál)'
   tu:lo meaning 'dress (SP, from túnico)'
   pi:bs meaning 'pear(SP, from péra)'
   řa:ba meaning 'lamp (SP, from lámpara)'

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4 Tohono O'odham words are written in a phonemic transcription using IPA symbols; [ 알아] is a postalveolar lateral flap, [ 알아] and [ 알아] are apicoalveolar, [ 알아] is a palatal nasal and vowel length is indicated with a [ 알아]. Note the representation of the alveopalatal affricates with [ 알아] and [ 알아]. Stress is transcribed with an acute accent for primary stress and a grave accent for secondary stress. Finally, I am omitting the proclitics (such as the reflexive and stative markers) for the purpose of clarity.

5 (SP) indicates Spanish loanwords. These are given with their counterparts in Spanish in (2).
piπlo 'pick (the tool) (SP, from pígo)'
c. Words consisting of three syllables: πí̆̃
muπlo 'musician (SP, from músico)'
maπina 'car (SP, from machína)'
sĭ̃̃ñma 'cemetery (SP, from cementério)'
laπŭ̃ la 'sugar (SP, from azúcar)'
wῐ̃ 'calf (SP becérro)'
d. Words consisting of four syllables: ιπῐ̃
paπoπha 'Pascola dancer (SP, from Pascual)'
pῐ̃do 'pepper (SP, from pimiénta)'

In (2), we see that the first syllable of the word, regardless of the size of that word, receives stress. We also see that the only words that receive a secondary stress are forms that are quadrisyllabic, as in (2d).6

The forms in (3) show various shapes of polymorphemic words in Tohono O'odham. These words show that morphologically complex words surface with stress on all odd syllables. The words below represent possible morpheme combinations; both native and loan roots are given with suffixes, and roots are given with and without the reduplicative prefix that marks number. Stress is iterative in (3), with all odd-numbered syllables receiving stress, even word-finally.7

(3) Stress patterns in polymorphemic words
a. Words consisting of one syllable: ιπ
čú-č̣ 'putting out fire, plural'
kó-ḳ 'sleeping, plural'
gá-g̣t 'guns'
pán-t 'making bread (SP)'
paθ-c̣ 'turned into bread (SP)'

b. Words consisting of two syllables: ιπῐ̃
čímai-t ‘making tortillas’
hí-him 'walking, plural'
čí-č̣pkan 'working, plural'
wá-pkon 'washing, plural'
wó-pson 'sweeping, plural'
hím-a 'the object walked on'

6 Monomorphemic native words are never larger than two syllables, and the words in (2) that consist of three or four syllables are borrowings. Monomorphemic words larger than four syllables are never attested. The four syllable pattern is especially underrepresented, with the two forms in (2d) reflecting the only roots of such size. This size restriction reflects words found in Mathiot (1973), as well as speakers' attempts to recollect consciously such words.

7 One additional comment on the data in (3) is necessary. Reduplicated words may show either vowel length alternations or syncope when compared with their unreduplicated counterparts. See Fitzgerald (1999b) for an analysis of these facts.
hím-ad  'will be walking'
ñón-mad  'adding salt'
pípí-po  'picks (the tool) (SP)'
pah-cul  'to turn into bread (SP)'
c. Words consisting of three syllables:
ñúkud-à  'the object taken care of'
cíkpan-dâm  'worker'
hí-him-àd  'will be walking, plural'
mí-mílu-à  'the objected ran on, plural'
wá[pkon-dâm  'ones who wash'
jí-jin-à  'the smoked objects'
jí:j-kul-dâm  'one with a smoking instrument'
tá-táaï  'roadrunners'
wá-paikà  'ditches'
álkok-aâl  'will be speaking, plural'
há-hawuú  'lima beans'
hauvaú-oâ  'to have cattle'
pádo- gà  'having a duck (SP)'
pípíos-gà  'having a pear tree (SP)'
pí-pibà  'pipes (SP)'
ásugàâ-t  'making sugar (SP)'
píguo-kàm  'one with a pick (SP)'
mú-misígò  'musicians (SP)'
wi-psíbo  'calves (SP)'
sí-sminjúú  'cemeteries (SP)'
tá-tábo  'shawls (SP)'
tuúko[kam  'one with a dress (SP)'
d. Words consisting of four syllables:
hí-hidóø-a  'the cooked objects'
híhidóø-id  'to cook something for someone, plural'
kofíliakam  'one owning a pig'
hí-hidóø-a  'the act of cooking several kinds of dishes for a meal'
cípan-ad-ma  'to appear to be working'
cípos-ií-ad  'will be branding'
cílus-ií-ok  'finish feeding oneself'
daálaí-kul-dâm  'somebody owning a chair'
cíwi-kul-dâm  'someone with a toy'
The words in (3) range from in size from one to six syllables and all receive primary stress on the initial syllable. All subsequent odd-numbered syllables receive a secondary stress, even if these are word-final syllables. This wrinkle in the pattern means that polymorphemic words differ from monomorphemic words by allowing a final secondary stress. The contrast can be seen by comparing (2c) to (3c).

The distribution of these stress patterns in (2) and (3) is predictable on the basis of the morphological complexity of the word. It is not the case that particular morphemes get stressed word finally, nor that only suffixed words allow a final secondary stress. Rather, any word with more than one morpheme will stress a final odd numbered syllable. The relevance of position is reinforced by comparing words like háiwaŋ-ga-kam 'one owning a cow' with há-haiwaŋ-ga-kam 'one owning cows', where the prefixes –ga and –kam are stressed only when they appear in odd-numbered syllables.

Two additional comments need to be made. First, the generalization about how stress behaves in Tohono O'odham is related to the presence of morphemes, not related to bracketing or other facts. This is particular true if we look at a form like pásugà-t 'making sugar (SP)', which
contrasts with the absence of stress in its related monomorphemic form, \( \text{Tásugä} \) 'sugar (SP)'. Second, any trisyllabic or quadrisyllabic forms that reduplicate also display syncope. These forms would be interesting test cases for our analysis, but do not exist. There does seem to be a strong preference for syncope to apply to the second syllable of reduplicated words, but these facts are beyond the scope of the analysis here (see Fitzgerald 1999b for an analysis).

Now let us characterize the descriptive points made by the data. First, primary stress is always on the first syllable of the word. Second, secondary stress falls on subsequent odd-numbered nonfinal syllables. Third, final odd-numbered syllables are assigned secondary stress only if the word is polymorphemic; such syllables are unstressed in monomorphemic words. 8

2. The Morpheme-to-Stress Principle as an Analysis of O'odham Stress

The analysis starts by accounting for monomorphemic forms. This account then motivates the Morpheme-to-Stress Principle to account for polymorphemic forms. Rhythmic constraints are also introduced to prevent stress clashes and lapses.

The basic facts for monomorphemic words indicate a left-to-right trochaic system. Feet are syllabic (quantity-insensitive) and must be binary. This type of analysis is straightforwardly handled under Optimality Theory. Three metrical constraints, FootForm, FootBinarity and Parse-\[\neg\], will do much of the work. These three constraints are given below.

\[
\begin{align*}
(4) & \quad \text{FootForm (abbreviated FtFm)} \\
& \quad \text{Heads are on the left edge of the foot.}
\end{align*}
\]

\[
\begin{align*}
(5) & \quad \text{FootBinarity (abbreviated FtBin)} \\
& \quad \text{Feet are analyzable as binary on the syllabic level.}\footnote{9}
\end{align*}
\]

\[
\begin{align*}
(6) & \quad \text{Parse-\[\neg\] (abbreviated Parse)} \\
& \quad \text{Syllables must be parsed into feet.}
\end{align*}
\]

The ranking of FootBinarity \( \succ \) Parse-\[\neg\] is required to prohibit degenerate feet in trisyllabic words. Such words have an unparsed syllable, which violates Parse-\[\neg\] and motivates it as ranked below FootBinarity. For the moment, we will rank FootForm above FootBinarity. This ranking is supported by the trochaic nature of O'odham word prosody: initial stress, quantity-insensitive, preference for stress on odd syllables (all three shown here). Other arguments for a trochaic foot have been made on the basis of sentence prosody and word order (Fitzgerald 1994) and the meter of traditional songs (Fitzgerald 1998). A subsequent tableau will show that a lower ranking of this constraint makes incorrect predictions.

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8 There is a small set of borrowings that do act differently from native roots. These are nonnative words that occur with noninitial long vowels. (Native words and most other nonnative words never have noninitial long vowels.) There are approximately 150 of these loanwords in Mathiot (1973), so they constitute only a small portion of the vocabulary. Representative examples appear in (i):

(i) Borrowings with noninitial long vowels

\[
\begin{align*}
\text{mif\textdia{a}j\textdia{n}} & \quad \text{‘white man, American (SP, from americ\textdia{á}n)’} \\
\text{kawhi} & \quad \text{‘coffee (SP, from caf\textdia{é})’} \\
\text{pal\textdia{ö}ma} & \quad \text{‘dove (SP, from pal\textdia{óm}a)’} \\
\text{ma\textdia{ö}ja} & \quad \text{‘Maria (SP, from María)’}
\end{align*}
\]

Speakers vary in how they stress these words (J. Hill, p.c.).

9 The fact that stress falls on alternating odd syllables indicates that the stress system of O'odham is not quantity sensitive. This means that the constraint on foot binarity should evaluate feet in terms of syllables rather than moras.
The tableau in (7) shows how these two constraints evaluate a simple disyllabic word to predict initial stress. 10

(7) Evaluation of /taÍai/ 'roadrunner'

<table>
<thead>
<tr>
<th></th>
<th>FtFm</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>pa.([ táÍai])</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ([ taÍai])</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ([taÍaÍ])</td>
<td></td>
<td><em>!</em></td>
<td></td>
</tr>
<tr>
<td>d. [taÍai]</td>
<td></td>
<td></td>
<td><em>!</em></td>
</tr>
</tbody>
</table>

Candidate (7a) satisfies all three constraints. The other three candidates all violate one of the constraints, which means that (7a) is the optimal candidate for this set of possible outputs. (7b) has an iambic stress pattern, which violates FootForm. (7c) stresses both syllables, which means the form has two degenerate feet. This incurs two violations of FootBinarity for (7c). The output in (7d) does not stress any syllables. Because there are no feet at all in this form, (7d) vacuously satisfies FootForm and FootBinarity. However, (7d) incurs two fatal violations on Parse-

Tableau (7) does not motivate any ranking arguments, but tableau (8) does. It provides the critical motivation for the ranking of FootBinarity above Parse-

For the trisyllabic form, the optimal candidate is (8a), which fails to foot the final syllable, but does have only binary feet. (8b) fails on FootBinarity, since the output surfaces with a degenerate foot. (If the rankings between FootBinarity and Parse were reversed, (8b) would instead be the optimal output.) Finally, (8c) has not footed any of its syllables and so its three violations on Parse-

Furthermore, as long as FootBinarity is not violated, this ranking predicts the presence of secondary stresses. The tableau in (9) demonstrates this; (9a) has two binary feet, which produces secondary stress, while the underparsed syllables in (9b) lead to its nonoptimal status.

(9) Evaluation of /pimiando/ 'pepper'

<table>
<thead>
<tr>
<th></th>
<th>FtFm</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>pa.([(piñi)(año)])</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ([piñi)ando]</td>
<td><em>!</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10In tableaux, parentheses indicate feet; square brackets indicate morphemes.
As it now stands, the hierarchy nicely predicts monomorphemic words, but runs into problems with some of the polymorphemic words. Any polymorphemic word that consists of an odd-number of syllables should surface with a final stress. Words like (pa$³lo)-($³a) show that polymorphemic words always have secondary stresses, even if this means there are degenerate feet. Otherwise, the unattested output would result in an unstressed morpheme, as in *(pa$³lo)-³a. In fact, this is true of all polymorphemic words with an odd number of syllables, regardless of the morphological structure (prefixes versus suffixes versus both). However, the high-ranking of FootBinarity does not allow the presence of degenerate feet. Under Optimality Theory, constraints are violated only to satisfy some higher ranked constraint. This means that something must outrank FootBinarity to force stress on all morphemes, even at the cost of allowing a degenerate foot.

However, it cannot be that all prefixes and suffixes get stressed; witness the stress patterns of words like or hi-$³hidíøø$-a ‘the cooked objects’ or ?ásugàl-$mad$ ‘adding sugar’. Rather, the generalization is that all morphemes must get stressed, but that the satisfaction of this constraint cannot override the basic rhythmic constraints, thus producing alternating stress.

First let us turn to the formulation of a constraint that forces all morphemes to be stressed, the Morpheme-to-Stress Principle. This proposed constraint must dominate FootBinarity, so that morphemes will be stressed even if that results in degenerate feet. A higher ranking of FootBinarity would negate the effect of the Morpheme-to-Stress Principle. The proposed constraint is formalized in (10).

\[(10) \text{The Morpheme-to-Stress Principle (abbreviated: MSP)}\]
\[\text{For every Morpheme X, if X is a morpheme then X is stressed.}\]

The Morpheme-to-Stress Principle requires each morpheme to be in a stressed syllable, where stress levels correspond with being prominent on a grid. The constraint is violated when a morpheme does not fall in a stressed syllable at all, or when a morpheme is in a stressed syllable. In addition, the relationship between the morpheme and the stress is a unique mapping, such that a stressed syllable can only be mapped to one morpheme in satisfying the Morpheme-to-Stress Principle.

This constraint will be prevented from stressing every morpheme where this would cause stress clash. The anti-clash constraint in (11) must outrank the Morpheme-to-Stress Principle. In fact, *Clash appears to be undominated in this dialect of Tohono O’odham. Additional evidence for this claim is found in Fitzgerald (1997b, 1997c, 1998), where it is shown that clash is avoided in the clitic group and in song meter. Other languages have also been argued to disprefer stress clashes (Prince 1983, Hayes 1984, Hammond 1988, Kager 1989, etc.). A constraint banning stress clash, *Clash, has also been invoked in more recent work, for example, Kager (1994), Green and Kenstowicz (1995) and Kenstowicz (1995). As there are no words with stress clash in Tohono O’odham, the language must have the following undominated constraint banning stress clash, undominated because there is no evidence it can be violated:

\[(11) \text{*Clash}\]
\[\text{No adjacent strong beats on the grid.}\]

The additional necessary ranking argument is that the Morpheme-to-Stress Principle ranks above FootBinarity in the hierarchy. This will prefer a candidate with final stress, like (pa$³lo)-(³a) over a candidate that avoids the degenerate foot of a final stress, like *(pa$³lo)-³a. The interaction of *Clash » Morpheme-to-Stress Principle » FootBinarity is shown below in (12) and (13).
(12) Evaluation of /pa-do-la/ 'owning a duck'

<table>
<thead>
<tr>
<th></th>
<th>FtFm</th>
<th>*Clash</th>
<th>MSP</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>/pa-do-la/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pa.([pa][dò])([la])</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ([pa][do])</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ([pa][dò][la])</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The evaluation above shows that (12a) violates FootBinary, but more importantly, (12a) satisfies the higher-ranked Morpheme-to-Stress Principle, as both the root and suffix morphemes are stressed. (12b) is nonoptimal because it violates the Morpheme-to-Stress Principle, while (12c) violates both *Clash and the Morpheme-to-Stress Principle. Below, (13) shows that this also makes the correct predictions when a prefix is involved.

(13) Evaluation of /Red-pa-do/ 'ducks'

<table>
<thead>
<tr>
<th>/Red-pa-do/</th>
<th>FtFm</th>
<th>*Clash</th>
<th>MSP</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>pa.([pá][pa][dò])</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ([pá][pàdo])</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ([pá][pa][dó])</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The tableau in (13) shows that the introduction of the higher ranked *Clash and Morpheme-to-Stress Principle makes the violations of lower ranked FootBinary and Parse-irrelevant. The optimal candidate, (13a), violates only FootBinary. Both morphemes are stressed in (13b), but in such a way as to create a problematic violation on *Clash. (13c) has no degenerate feet, but the violation on the Morpheme-to-Stress Principle proves fatal.

A point shown by tableaux (12) and (13) is that this analysis works independently from morphological bracketing. The generalization about stress does not refer to bracketing; prefixed and suffixed words behave the same way. This argues against an analysis of these facts that might use alignment constraints, like the Indonesian analysis in Cohn and McCarthy (1994), instead of the Morpheme-to-Stress Principle. However, one consequence of using alignment is that it would predict two different types of feet in the metrical system. In Indonesian, the stress foot is trochaic, except in certain words that are claimed (without empirical support) surface with trochaic and iambic feet. This "head reversal" solution would also surface if alignment constraints were adopted to analyze Tohono O'odham stress. Such an analysis faces several problems. The distributional patterns of stress support a trochaic analysis. Primary stress falls on the initial syllable, a pattern characterized by left-headed trochaic feet. Stress alternates on odd syllables, counting from the left edge. Again, odd syllable stress is associated with trochaic, not iambic feet. The system is quantity-insensitive. To use iambic feet, we would have to use the quantity-insensitive iamb. Hayes (1987) argues from a typological perspective that there is a lack of evidence in favor of a quantity-insensitive right-headed foot. There is also additional language-internal evidence in favor of trochaic feet in sentence prosody (Fitzgerald 1994) and song meter (Fitzgerald 1998).

There is an additional consideration. An alignment analysis would invoke bracketing constraints to capture a generalization that can be stated independent from morphological bracketing. Trisyllabic polymorphemic words all have first and third syllable stress, regardless of the morphological composition of the word. The result of this approach would necessitate extremely different metrical analyses for two forms with the identical surface patterns. Under such an analysis, the surface similarities between prefixed and suffixed forms become accidental. In fact, a number of morphologically complex words do not directly align the feet or syllables with morphemes, as in words like (mu[nsi])([lo] 'musicians’ or (c]bo)(s-i[d-ad] 'will be branding'. The
identical behavior of prefixed and suffixed trisyllables thus supports the bracketing-independent constraint, the Morpheme-to-Stress Principle.

Having presented arguments against an alignment treatment of these facts, let us now return to the analysis at hand. There is another trisyllabic form that is particularly important, /ásuqá-t / 'making sugar (SP)'. The consonantal suffix, [t] 'causative' produces a final stress when it is suffixed to a monomorphemic trisyllable. This word provides an interesting contrast with its monomorphemic base, /ášuga/ 'sugar (SP)', which does not have final stress. The absence of a stress on this syllable would mean that the suffix -t 'causative' does not surface in a stressed syllable, and thus would violate the Morpheme-to-Stress Principle, as seen in (14b). How does the Morpheme-to-Stress Principle evaluate candidate (14a), which stresses the final syllable? The relevant cell is marked with a “?” so that we can discuss this issue. Note that if the cell were to indicate a violation, (14b) would be optimal. This would be true unless there were some higher-ranked constraint (not present in tableau (14)) that (14a) satisfied and (14b) did not.

(14) Incomplete evaluation of /ásuqá-t / 'making sugar'

<table>
<thead>
<tr>
<th>/ásuqá-t /</th>
<th>FtFm</th>
<th>*Clash</th>
<th>MSP</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>([] a. ([ášu])gá[t]</td>
<td></td>
<td></td>
<td>?</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>[t])</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The claim here is that candidate (14a) satisfies the Morpheme-to-Stress Principle because the causative suffix is in a stressed syllable. If we interpret the Morpheme-to-Stress Principle to create representations where morphemes are prominent on the grid, and syllables are interpreted as the stress-bearing units in Tohono O’odham, then (14a) should fare better on this constraint than does (14b). There are precedents for allowing different types of elements to be prominent in a grid representation, even in a system with metrical feet. One type of formalism for this is found in Everett and Everett (1984), Everett (1988) and Davis (1989), which address cases where onsets play a role in determining stress placement; another proposal is found in Hayes (1995: Chapter 7).

The analysis here follows work by Hammond (1984/1988), Halle and Vergnaud (1987), and Hayes (1995) in which metrical structures include mechanisms for referring to constituency and prominence. Such structures have been referred to as “bracketed grids” or “arboreal grid”. The representations for Tohono O’odham must include a foot, a head, and a prominence grid. The tableau in (15) reevaluates the relevant O’odham form, where prominence is indicated by an “x”; the layer with bracketed feet is the foot layer (built directly on syllables), while the levels above are the grid layers that indicate prominence. When morphemes are not dominated by a grid entry that is prominent (at a higher level than at least one neighbor), this incurs a violation of the Morpheme-to-Stress Principle.
(15) Evaluation of /?asugal-t/ 'making sugar'

<table>
<thead>
<tr>
<th>/?asugal-t/</th>
<th>FtFm</th>
<th>*Clash</th>
<th>MSP</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(x .) (x )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. [//aBu //aO][t]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(x .)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. [//aBu //aO][t]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This prominence-based interpretation of the Morpheme-to-Stress Principle will not predict incorrect results elsewhere because of the high ranking given to the *Clash constraint. This is shown in tableau (16), which evaluates /?cmai-t/ 'making tortillas'.

(16) Evaluation of disyllabic /?cmai-t/ 'making tortillas'

<table>
<thead>
<tr>
<th>/?cmai-t/</th>
<th>FtFm</th>
<th>*Clash</th>
<th>MSP</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(x .)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. [//o//maI][t]</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. [//o//maI][t]</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stressing the causative suffix –t in (16b) does satisfy the Morpheme-to-Stress Principle, because every morpheme is found in a syllable that is prominent on the grid. However, this representation also means that there is stress clash in the disyllable, which triggers a violation on the higher ranked *Clash. Interpreting the Morpheme-to-Stress Principle as representing prominence on the grid means that we are able to be specific about our metrical representations and to see the effects of rhythmic constraints like *Clash. This proposal also makes use of prominence grids as a structure argued for elsewhere in the literature for languages as diverse as Hindi, Pirahã, Asheninca and others.

*Clash is not the only rhythmic constraint needed for this language. Tohono O'odham also disprefers lapses. Lapses are consecutive sequences of unstressed syllables. Quadrisyllabic forms
that consist of a trisyllabic root plus a suffix show that lapses are avoided. The first and third syllables are stressed in such forms, rather than first and fourth syllables, even though the suffix will be unstressed with penultimate stress. This can be seen in comparing the actual surface form /ásuqàl-mad/ 'adding sugar', with the unattested surface form that stressed all morphemes, *?ásuqàl-màd. The comparison shows that it is more important to avoid two stressless syllables in a row, rather than to stress every morpheme.

Metrical theorists have observed that excessive strings of weak syllables, or lapses, are dispreferred in various rhythmic systems (Prince 1983, Selkirk 1984, Nespor and Vogel 1989, Kager 1994 and Green and Kenstowicz 1995), as in (17). Further below, it will be shown that such a general formulation of *Lapse is inadequate for Tohono O’odham; the appropriate anti-lapse constraint must invoke metrical structure, as stated in (20) below.

(17) *Lapse* WW (TO BE REVISED)
Avoid a sequence of more than one unstressed syllable.

If *Lapse dominates the Morpheme-to-Stress Principle, then this ranking successfully prevents the incorrect stress pattern of first and fourth syllable stress. Tableau (18) shows this, making the prediction that the first and third syllable stress pattern of (18a) is optimal.

(18) Evaluation of /ásuqàl-mad/ 'adding sugar'

<table>
<thead>
<tr>
<th>/ásuqàl-mad/</th>
<th>*Clash</th>
<th>FtFm</th>
<th>*Lapse</th>
<th>MSP</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. (<a href="g%C3%A0l">ásu</a>[mad])</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ([ásu]ga<a href="%5Bmad%5D">l</a></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ([ásu] (ga[l] [mad])</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

However, there is a problem with the *Lapse constraint as it is currently formalized. *Lapse wrongly prohibits two unstressed syllables in the monomorphemic trisyllables. This problematic aspect of *Lapse is illustrated by the evaluation of such a form in (19), where the *Lapse constraint prefers the candidate with final stress, (19b), over the actual form, (19a). This incorrect prediction by the hierarchy is noted below, marked by the “k”.

(19) Evaluation of /musigo/ 'musician (SP)'

<table>
<thead>
<tr>
<th>/musigo/</th>
<th>*Clash</th>
<th>FtFm</th>
<th>*Lapse</th>
<th>MSP</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ([músí]go)</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. (<a href="g%C3%B2">músí</a></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We know that monomorphemic trisyllables never stress the final syllable of the word. Unfortunately, the *Lapse constraint, as formalized above, prohibits all sequences of two unstressed syllables. What is the difference between the monomorphemic and polymorphemic lapses? We must determine why two weak syllables are tolerated in músigo 'musician (SP)', but not /ásuqàl-mad/ 'adding sugar'. The difference between the two forms is not due to a phonetic difference; all

11Note that restating the anti-lapse constraint in terms more like Selkirk (1984), where it bans more than two unstressed syllables, will also not resolve this problem.
unstressed syllables should act the same. Instead the difference is phonological. The two forms have different metrical structure in the attested forms; *(lásu)gal-(mád) has a medial unfooted syllable, while the unfooted syllable in (músì)go does not come before a foot. In both cases, there is an unfooted syllable after a foot. This suggests that the anti-lapse constraint must refer to metrical structure so that it can differentiate between the two types of weak syllable sequences, and that the relevant restriction is stated most generally as the avoidance of an unfooted syllable before a foot. This differentiates between these two cases. Given this argument, the correct anti-lapse constraint for Tohono O’odham appears in (20).12

(20) *Lapse*W(Avoid an unfooted syllable (WEAK) followed by a foot.

As given above, *Lapse does not affect trisyllabic simple words, which are without final stress.13 This is shown in the reevaluation in (21) of the forms from (19), where there is no longer a lapse violation. This is because there are the weak syllables in this example do not occur before a foot boundary.

(21) Evaluation of /musigo/ 'musician (SP)'

<table>
<thead>
<tr>
<th>/musigo/</th>
</tr>
</thead>
<tbody>
<tr>
<td>p.a.([músì]go)</td>
</tr>
<tr>
<td>b.(<a href="g%C3%B2">músì</a>)</td>
</tr>
<tr>
<td>c. [mu(sìgo)]</td>
</tr>
</tbody>
</table>

There is a further positive consequence of this version of *Lapse: it correctly predicts that we must foot the initial syllables of words. This also eliminates the need for an alignment constraint, such as All-Feet-Left or AlignLeft holding over a prosodic word and a foot. This consequence is shown as *Lapse excludes a form like (21c) with a word-initial lapse. Finally, the

---

12 An anonymous reviewer suggests that a better analysis of these facts makes use of All-Feet-Left.

i. All-Feet-Left

Align (Foot, Left, Prosodic Word, Left)

To have an effect in the cases currently under discussion, All-Feet-Left must outrank the Morpheme-to-Stress Principle. This high a ranking means that All-Feet-Left will also outrank Parse[-], to the detriment of words like pímìando ‘pepper’, which require iterative footing:

ii. Evaluation of /pimìando/ with All-Feet-Left:

<table>
<thead>
<tr>
<th>/pimìando/</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.(<a href="a%E2%80%B0ndo">pi‰hì</a>)</td>
</tr>
<tr>
<td>kb.([pi‰hì]ando)</td>
</tr>
</tbody>
</table>

A lower ranking of All-Feet-Left will render it ineffective to predict the correct stress pattern in cases like ì‰bùnì(mád) ‘adding sugar’.

13 The constraint does require the reification of the foot boundary; similar moves are made in Idsardi (1992) and McCarthy and Prince (1993).
contrast between músiqo and lásuqâl-mad also tells us that we need feet, as *Clash and *Lapse
alone cannot account for the data.\(^{14}\)

To demonstrate the accuracy of this constraint hierarchy, (22) shows the evaluation of há-
haiwânt-ga-kâd-ma 'will seem to be owning cows'. The morphological complexity of this form
may seem to present a challenge to the hierarchy, but as (22) shows, the optimal candidate is easily
predicted to be (22a).

(22) Evaluation of /ha-haiwân-ga-kad-ma/ 'will seem to be owning cows'

<table>
<thead>
<tr>
<th>/ha-haiwânt-ga-kad-ma/</th>
<th>*Clash</th>
<th>FtFm</th>
<th>*Lapse</th>
<th>MSP</th>
<th>FtBin</th>
<th>Parse</th>
</tr>
</thead>
<tbody>
<tr>
<td>pa.(<a href="%5Bhai%5D(%5Bw%C3%A2nt%5D%5Bga%5D)(%5Bkad%5D%5Bma%5D)">hâ</a></td>
<td>* !</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| b.([hâ])([haiwânt])([gâ])([kad])([mâ]) | * ! | | * | | * | *
| c.([hâ] [haiwânt])([gâ] [kad])([mâ]) | | | * | | * | *
| d. [ha]([haiwânt])([gâ] [kad])[ma] | | | * | | * | *

The optimal candidate, (22a), satisfies the three highest ranking constraints. Satisfaction of
these three constraints means that the Morpheme-to-Stress Principle is violated twice by (22a).
These violations are too low to make (22a) nonoptimal, because competing candidates all fail on the
higher ranked constraints. (22c) stresses each morpheme, but this creates excessive stress clash.
(22c) stresses all but two morphemes; however, the footing of this form means that there is a
medial syllable that is unfooted and precedes a footed syllable. This constitutes a fatal *Lapse
violation. Finally, (22d) fails to parse the initial and final syllables. Because the initial syllable is
unfooted and occurs before a foot, (22d) violates the high-ranked *Lapse. The tableau in (22) also
shows the way in which rhythmic constraints serve to check the Morpheme-to-Stress Principle.

The wide variety of candidates considered in this section provides support for the
Morpheme-to-Stress Principle, *Clash, and *Lapse. The constraint ranking argued for in this
section is *Clash, FootForm » *Lapse » Morpheme-to-Stress Principle » FootBinarity » Parse-[].

3. Implications of the Morpheme-to-Stress Principle

The Morpheme-to-Stress Principle provides a compelling account of the stress pattern of
Tohono O'odham, where all morphemes equally vie for stress while trying to satisfy rhythmic
and metrical constraints. In this section, I discuss implications of the proposed constraint in terms of
cross-linguistic stress patterns that interact with morphemes. First I look at one particular example,
Diyari, and discuss an analysis that makes use of the Morpheme-to-Stress Principle to account for its
stress patterns. By reranking FootBinarity above the Morpheme-to-Stress Principle, the basic facts
of Diyari follow. This gives us at least one argument that the Morpheme-to-Stress Principle can be
used to account for behavior in additional languages. I then show how this constraint extends to

\(^{14}\)The revised *Lapse constraint also means that FootForm must outrank the Morpheme-to-Stress Principle:
languages in which different morphological stress systems may rank the type of morpheme in stress assignment. I discuss how decomposing the Morpheme-to-Stress Principle into subcomponents can account for different lexical accent systems like Vedic or some Salish languages, where the type of morpheme is a key factor in determining stress patterns.

3.1 Diyari

One example of a system where morphemes get stressed is Diyari, a Pama-Nyungan language of Australia (Austin 1981, Poser 1989, Crowhurst 1994). Like Tohono O’odham, it exhibits a metrical system based on binary syllabic trochees, with a left-to-right directionality. The iterative trochaic pattern is interrupted by the appearance of suffixes, as shown in the data below.

Monomorphemic words have the same pattern of stress in Diyari as in Tohono O’odham: a binary alternation of stress on odd-numbered syllables. The data in (23) show this for monomorphemic words of both even and odd syllables.

(23) Monomorphemic words
   a. Words consisting of one syllable:  
      --
   b. Words consisting of two syllables:  
      káña  'man'
      nánda  'to hit'
   c. Words consisting of three syllables:  
      pínádu  'old man'
      máńkařa  'girl'
      púľuru  'mud'
      káńini  'mother’s mother'
   d. Words consisting of four syllables:  
      wíľapiña  'old woman'
      ŋándawålka  'to close'

The above set of data shows stress on the first and third syllables, as long as stress never falls word-finally. This pattern is found also in polymorphemic words, where both the stems and suffixes have an even-number of syllables, as in (24). It is important to break the words up by size to demonstrate that morphological composition plays an important role in footing and stress patterns. A word that consists of a total number of even syllables will not necessarily be stressed like the words in (23d). The stress contour of the word is dependent upon whether the morphemes are evenly divisible.

(24) Even-syllabic stems + even-syllabic suffixes
   a. káña-wàra  'man-PL'
   b. ŋánda-málí  'to hit-RECIP'
   c. wíľapiña-wàra  'old woman-PL'
   d. ŋándawålka-tàdi  'to close-PASS'
   e. táyì-yàtimàyì  'to eat-OPT'
   f. káña-wàra-ŋündu  'man-PL-ABL'
When morphemes with an odd-number of syllables are introduced, the pattern mutates somewhat. The forms in (25) all have monosyllabic suffixes, which never receive stress. This is true regardless of what precedes or follows such suffixes. In contrast, suffixes with an even number of syllables receive initial stress. This is again regardless of environment or position. If we consider trochees to assign stress to odd syllables, these facts suggest each morpheme restarts the count, as environment or position in the word never determines the stress patterns of suffixes. The data below illustrate the asymmetries between suffixes of even and odd syllable count.

This is particularly clear in (25e), where the form of the shape ss-ss-ss surfaces with a stress pattern markedly different from the odd-numbered pattern seen previously in Diyari. Stress falls on the first and fourth syllables, where the fourth syllable marks the beginning of a new morpheme.

(25) Even-syllabic stems + odd-syllabic suffixes
a. kaŋa-ŋi 'man-LOC'
b. n`anda-yi 'to hit-PART'
c. kaŋa-wàra-ŋu 'man-PL-LOC'
d. n`anda-tàri-yi 'hit-REFL-PRES'
e. kaŋa-ŋi-màta 'man-LOC-IDENT'
f. máda-la-ntu 'hill-CHARAC-PROPRIETIVE'

The pattern of (25e) above, where the disyllabic suffixes take initial stress and the monosyllabic suffixes never get stressed, is repeated in (26-27), where we examine forms with trisyllabic bases. The forms in (26), with odd-numbered stems and even-numbered suffixes, show that even-numbered suffixes always get morpheme-initial stress, while the forms in (27) reinforce the point that monosyllabic suffixes never get stressed.

(26) Odd-syllabic+ even-syllabic suffixes
a. pínadu-wàra 'old man-PL'
b. yákalka-yipa-màli-na 'ask-BEN-RECIPIENT'

(27) Odd-syllabic+ odd-syllabic suffixes
a. pínadu-ŋi 'old man-PL'
b. púļuru-ŋi-màta 'mud-LOC-IDENT'

The pattern of Diyari word stress is as follows. Bases always get stressed on the initial syllable. Secondary stresses are allowed, but never in final position. Monosyllabic suffixes never get stressed. Even-numbered suffixes have the same stress pattern as bases, with stress on the initial syllable.

The Diyari data thus resembles Tohono O’odham in that odd syllables are stressed and final stress is not permitted (for Diyari, morphemes disallow final stress; for O’odham, monomorphemic words disallow final stress). In both languages, initial syllables are stressed, and both languages also permit secondary stresses (for Diyari, these stresses are counted within morphemes, while TO computes these stresses within the word). The two languages also differ in how they treat monosyllabic suffixes, which are stressed in Tohono O’odham in odd-numbered syllables, but never stressed in Diyari. It is important to remember that stress in Diyari is not predictable on whether a non-final syllable is odd or even; morpheme binarity is key.

Diyari’s similarity to Tohono O’odham suggests that it can be accounted for by the same constraints: FootForm, FootBinarity, and the Morpheme-to-Stress Principle. Like Tohono O'odham, FootForm is unviolated in Diyari, suggesting that it is top-ranked. Our interest here is primarily in the interaction between FootBinarity and the Morpheme-to-Stress Principle.
In Diyari, the size of morphemes and morphological complexity plays a crucial role in determining the surface stress pattern. I propose that this is accounted for by the Morpheme-to-Stress Principle, which must be dominated by FootBinarity, as evidenced by the absence of degenerate feet. Unfooted syllables also appear in surface forms, indicated by stress lapses of two and three syllables. This ranking leads to the correct prediction of the trisyllable-disyllable polymorphemic form evaluated in (28).

(28) Evaluation of /pinadu-waraq/

<table>
<thead>
<tr>
<th></th>
<th>FtBin</th>
<th>MSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. (<a href="d%C3%B9">pína</a> <a href="r%C3%A0">wa</a>]</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b. (<a href="d%C3%B9">pína</a> [wàraq])</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>c. (<a href="d%C3%B9">pína</a> [wa]raq)</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>pd. ([pína]du [wàra])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. ([pína]du [wara])</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The top-ranking of FootBinarity means that the optimal output best satisfies the Morpheme-to-Stress Principle. Candidate (28d) does this, as each morpheme gets stressed by virtue of a medial unparsed syllable. The competing forms in (28c) and (28e) fail to stress both morphemes, which excludes them as possible outputs.

We see that this ranking predicts a pattern of *[s@ss] for a trisyllabic base combined with a monosyllabic suffix; in Diyari, such a form has only initial stress, *[s@ss]. We expect an unattested form in which all syllables are parsed into binary feet. Feet are only parsed where both syllables are part of the same morpheme. The problem with *[s@ss] could be that the second foot spans two morphemes (Crowhurst 1994), or it could be that stressing the third syllable changes its value from unstressed to stressed in the course of adding affixes (Poser 1989). Crowhurst (1994) proposes a specific constraint banning feet that cross morphemes. This constraint appears in (29), and is adopted for the sake of expediency as it is not the focus of this analysis:

(29) \[ \text{Tautomorphemic-Foot} \] (abbreviated: \[ \text{TautoFt} \])

\[ *\text{F}[\text{M}[\text{]}] \]

The ranking appears to be indeterminate between Tautomorphemic-Foot and the Morpheme-to-Stress Principle. The competition between (30b) and (30e) demonstrates that Tautomorphemic-Foot must dominate Parse-[] to prevent the fully footed (30b) from being selected as optimal.

\[ \text{---}\]

\[ ^{15}\text{This type of form is also problematic for an alternative analysis that invokes alignment of morpheme edges to feet, as in Crowhurst (1994). Crowhurst shows that alignment constraints alone cannot make the correct prediction, and adopts a constraint that bans feet that span more than one morpheme. That solution is followed here, although there are other plausible alternatives, such as Base Identity and Uniform Exponent (Kenstowicz 1995), or Lexical Conservatism (Steriade 1998). This would prevent the final syllable in a trisyllabic form from ever being stressed, because it would not have the same value it would in the allomorph that appears as an independent word. This type of approach would capture the facts as well as Tautomorphemic Foot.} \]
The above hierarchy correctly selects (30e) as the optimal candidate. Note that the new constraint ranking effectively bans iterative footing where it feet would span morpheme boundaries, as in (30b).

The hierarchy in (31) reassures us on this point, as it takes a more complex input and correctly generates the attested surface form.

The optimal candidate, (31a) has only binary feet. Only one morpheme is not footed, and there are no tautomorphemic feet. (31c) is ruled out by the degenerate foot. Candidate (31f) is excluded by its multiple violations on the Morpheme-to-Stress Principle. TautomorphemicFoot disfavors a number of candidates (31b, 31d-e), which all incur one violation on the Morpheme-to-Stress Principle, as does the optimal (31a).

The focus of the Diyari data is the ranking between FootBinarity, Morpheme-to-Stress Principle and TautomorphemicFoot. The interest is typological. The analysis demonstrates an additional language where the Morpheme-to-Stress Principle plays a decisive role. Diyari is an example of a language where the relevant ranking is: FootBinarity outranks Morpheme-to-Stress Principle.

Other languages exhibit stress patterns that show the influence of the Morpheme-to-Stress Principle. Gooniyandi (Crowhurst 1994, McGregor 1990) is strikingly similar to Diyari, with the exception that some feet do cross morpheme boundaries, where this foots two monosyllabic affixes into a binary foot, but syllables may be skipped to allow a disyllabic affix to equal a single foot. Tunica (Haas 1940, Hammond 1988) also shows effects of a high-ranked Morpheme-to-Stress Principle. While Tunica does not allow iterative footing within the morpheme, it does allow each morpheme to be stressed, provided that there are no degenerate feet. Auca (Saint and Pike 1962, Pike 1964) is a language where every morpheme gets stressed, even if this results in degenerate feet and stress clash (even where clash could be avoided). These various languages give support to the idea that the Morpheme-to-Stress Principle interacts with other constraints to influence stress systems.
3.2 Decomposing the **Morpheme-to-Stress Principle**

There are also a number of cases in the literature where specific types of morphemes require stress. Most frequently, examples in the literature consist of languages that require roots to be stressed. For example, Minkova and Stockwell (1994) show that roots must be stressed in Old English, while Riad (1992) makes a similar claim for some of the Nordic languages. Both works rely on historical data for these claims. Synchronic arguments come from still other languages. Alderete (1999: 58-9) cites Nancowry (Radhakrishnan 1981), Chuckchee (1979), Nisg̱a’a (Shaw 1992), and Tahlitan (Cook 1972) as examples of languages that require roots to be stressed; other constraints interact with root stress requirements to produce varying surface stress patterns. However, there are also languages where affixal stress wins out over root stress. This pattern is seen in systems with lexical accent, such as in the Salish languages or Indo-European languages (the so-called Basic Accentuation Pattern). There are also languages in which prefixes attract stress, such as Chamorro (Chung 1983: 40), Sanskrit (Halle and Vergnaud 1987: 86n6), and Akan (Hayes 1980: 59).

For example, various Salishan languages have been analyzed as lexical accent systems which favor accented suffixes over accented roots in assigning stress. This type of pattern (with variation in different languages) is seen in Spokane (Carlson 1989), Moses-Columbia Salish (or Nxa’amx̱cin; Czaykowska-Higgins 1993) and Montana Salish (Smith 1995). Still other systems may prefer to stress prefixes, as well as other morphemes. The discussion of Indonesian exemplified this type of pattern (Cohn and McCarthy 1994).

For example, Moses-Columbia Salish, also known as Nxa’amx̱cin, (Czaykowska-Higgins 1993) frequently stresses suffixes rather than roots. This suggest that suffixal accent wins out over root accent. Given the lexical nature of the system, certain morphemes are marked as accented in the input, while others are unaccented in the input.

<table>
<thead>
<tr>
<th>(34)</th>
<th>Dominant (D) and recessive (R) accent in Moses-Columbia Salish(^\text{16})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root-Suffix</td>
<td>Surface Form</td>
</tr>
<tr>
<td>a. D-R</td>
<td>kas’k’im’xíknəxʷ</td>
</tr>
<tr>
<td>b. D-D</td>
<td>piqencút</td>
</tr>
<tr>
<td>c. R-R</td>
<td>cakstwás</td>
</tr>
<tr>
<td>d. R-D</td>
<td>xatmscút</td>
</tr>
</tbody>
</table>

Halle and Vergnaud (1987: 85) note that in Vedic words with an "underlyingly accented dominant suffix -in- stress falls on the suffix both when the stem is accented [(35b) below] and when it is not [(35a)]."

<table>
<thead>
<tr>
<th>(35)</th>
<th>Vedic stress (Halle and Vergnaud 1987: 85)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Unaccented</td>
</tr>
<tr>
<td></td>
<td>rath+</td>
</tr>
<tr>
<td>b.</td>
<td>Accented</td>
</tr>
<tr>
<td></td>
<td>mitr+</td>
</tr>
</tbody>
</table>

The different ways that languages may "rank" morphemes with regard to stress assignment suggests that the **Morpheme-to-Stress Principle** is really composed of three parts:

\(^{16}\)The facts are more complicated than this, as there is also what Czaykowska-Higgins refers to as “cyclic” accent, and some surface types do result in accenting the root. We refer the reader to Czaykowska-Higgins (1993) for a complete discussion of these issues; the main purpose here is to sketch out how the proposal made here can account for a language like this.
(36) Decomposition of the Morpheme-to-Stress Principle

Tohono O'odham treats all morphemes the same, so the three types of morphemes provide evidence for a monolithic grouping of the Morpheme-to-Stress Principle. A given stress system may rank the three constraints in (36) together in a block, as O'odham does. It may be that only one constraint is active, suggesting that the Root-to-Stress Principle is highly ranked in a system with only root stress, and its counterparts (36b,c) are too low-ranked to play a role in the language. An advantage to a system like (36), with unconstrained permutations in the rankings, is that there are no "meta-constraints" set down on the relationship between the given morphemes. Recent approaches in Optimality Theory (McCarthy and Prince 1995; Alderete 1996) have argued that root constraints universally outrank affix constraints (as regards faithfulness constraints). However, there is a growing body of literature that argues there is no such meta-ranking, since there are cases where the opposite ranking obtains (i.e., Fitzgerald 2000, Noske 2000). Doing away with the meta-ranking would be the type of approach needed for Tohono O'odham, and the other systems outlined above – Salish, Indo-European – which also fail to provide support for a model in which roots are universally more important than affixes.

Reconfiguring the Morpheme-to-Stress Principle into subsidiary constraints could shift the burden from faithfulness constraints and avoid the imposition of a meta-ranking onto roots and affixes. For example, consider a system where an accented root and an accented suffix combine, the suffix is stressed. If both are unaccented, the suffix is stressed. The tableaux below show how this contrast could be predicted. *Clash is used to prevent secondary stresses in this instance (although other constraints may do this job better, this is not the focus here). The faithfulness constraint that prevents deletion of underlying accent is MaxAccent. The reverse ranking of the Suffix-to-Stress and Root-to-Stress Principles will result in the primacy of root stresses, so that reranking constraints would instead predict as optimal (37c) and (38c).

<table>
<thead>
<tr>
<th>/róot-súf/</th>
<th>*Clash</th>
<th>MaxAccent</th>
<th>Suffix/Stress</th>
<th>Root/Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. róot-súf</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[] b. root-súf</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c. róot-suf</td>
<td></td>
<td>*</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>d. root-suf</td>
<td></td>
<td>* *!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/root-suf/</th>
<th>*Clash</th>
<th>MaxAccent</th>
<th>Suffix/Stress</th>
<th>Root/Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. róot-súf</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[] b. root-súf</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. róot-suf</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. root-suf</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The permutations are possible without imposing a meta-ranking on constraints. We can also, in this instance, eliminate some faithfulness constraints necessary (MaxAccentRoot, MaxAccentSuffix, etc.) in the approach that uses morphologically dispersed constraints for
faithfulness (McCarthy and Prince 1995, Alderete 1999). The facts in these particular languages are fairly complicated, and certainly are not receiving a full treatment here, but this does sketch how the proposed constraint would predict such cases.

3.3 Additional support for the Morpheme-to-Stress Principle

What functional purpose could the Morpheme-to-Stress Principle have in a language, and more generally, in language itself? One answer to this can be in highlighting and making salient the information carried by a given morpheme. By increasing the prominence of morphemes, a language makes more prominent the semantic and syntactic information conveyed by the morphemes. There is certainly robust evidence that many languages require content words to be stressed (i.e., prosodic rooting of Hammond 1984). Stressing a content word is a way of making the information more salient in discourse. This interpretation also makes sense in light of Givón (1979), who argues that grammatical morphology arose as a device for coding syntax. He observes that affixes historically developed from independent words, and that these affix orderings correlate with earlier syntactic orderings. In systems which stress content words, the transition of word into affix is accompanied by stressing grammatical morphemes as a way of preserving their status in discourse. Again, not all morphemes within a word have the same status. As languages change, a hierarchy of morphemic status emerges, where roots are often – but not always – more important than affixes.

There are also psycholinguistic arguments supporting a distinction between morpheme classes, as reviewed in Hawkins and Cutler (1988). For example, decisions on whether an item is a word take longer if the form possesses an actual affix. There also seems to be evidence that subjects determine the morphological structure of a derived word in the process of comprehension. Comprehension of a derived word aids in comprehension of morphologically related words. Recognition of a prefixed word facilitates recognition of its stem. Hawkins and Cutler (1988: 304) state that “even those who wish to argue that complex forms have separate lexical representations (e.g. Butterworth 1983; Segui and Zubizaretta 1985) admit that morphological boundaries are marked in these representations.”

This evidence shows the favored status of roots and stems in terms of processing, but also shows that affixes play a considerable role in psycholinguistic models. There is also a typological asymmetry in favor of suffixed over prefixing languages, which Hall (1988) links up with both the diachronic arguments made in Givón (1979) and processing arguments made in Hawkins and Cutler (1988). These cross-linguistic tendencies suggest a hierarchy of roots over suffixes over prefixes. The approach proposed here encodes these processing and typological tendencies into constraints on the phonological systems of various languages, and does so without requiring an absolute ranking by type of morpheme.

4. Conclusion

This paper has described and accounted for a set of data new to the generative metrical literature. The description in Section 1 gives rise to the following generalizations. Primary stress in Tohono O’odham falls on the initial syllable. Secondary stress falls on all nonfinal odd syllables in monomorphemic words. In polymorphemic words, it falls on all odd syllables.

Three constraints accounted for the basic pattern of stress in the monomorphemic words. The preference for stress on odd syllables (rather than even) shows that the foot is left headed, and the absence of weight effects argues for invoking a syllabic trochee. FootForm guarantees that the foot is headed on the left, and FootBinarity forces feet to consist of two syllables. Because there

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17This approach also reduces, if not eliminates, the need for Anti-Faithfulness and Transderivational Anti-Faithfulness, which is proposed in Alderete (1999) as a way of addressing accent systems which favor suffix over root in a version of Optimality Theory that must adhere to the meta-ranking on root over affix faithfulness.
are no final secondary stresses, it must be that it is more important to avoid degenerate feet than to parse all syllables into feet. This effect follows by ranking Parse-[ ] below FootBinarity.

The asymmetrical distribution of final secondary stresses in simple and complex words leads to the innovative aspect of this analysis, the **Morpheme-to-Stress Principle**. This is a constraint that stresses every morpheme. O’odham also shows rhythmic effects, seen here and in other domains (Fitzgerald 1997a, 1997b). The language never allows stress clash and only rarely tolerates stress lapse. The two rhythmic constraints, *Clash and *Lapse, dominate the **Morpheme-to-Stress Principle**, thereby preventing all morphemes from being stressed by militating against stress patterns with clashes or lapses.

The **Morpheme-to-Stress Principle**, whether monolithic or decomposed into its parts, gives us a constrained formalism to account for the variable morpheme hierarchies in stress systems. The formalism of this constraint also explicitly parallels constraints on weight-based stress systems (the **Weight-to-Stress Principle** and the **Stress-to-Weight Principle**, Prince 1990). This means that the formal system reflects the similarities between weight-based and morphological-based stress systems.

Unlike other researchers in Optimality Theory (i.e., McCarthy and Prince 1995, Alderete 1999), I propose that these tendencies are not translated into strict meta-rankings among types of morphemes, but rather, that ranking permutations are allowed. I suggest that the salience of stressed syllables should act to facilitate the processing of morphemes, and the **Morpheme-to-Stress Principle** is proposed to account for this in Tohono O’odham. Furthermore, if we view this constraint not as a monolithic entity, but one which can hierarchize morpheme types, we expect a much wider range of behavior. Section 3 was devoted to examining the range of evidence that supports these moves and to exploring functional aspects of the **Morpheme-to-Stress Principle**. The account offered here of Tohono O’odham stress accounts not only for the specific behavior of that language, but also leads to a useful way of analyzing morphological stress systems across languages.
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