Version of September 2, 2014. To appear in *The Morphosyntax-Phonology Connection*, ed. Vera Gribanova and Stephanie Shih. Oxford University Press.

Global Effects in Kashaya Prosodic Structure

EUGENE BUCKLEY

UNIVERSITY OF PENNSYLVANIA

In Kashaya there is a stark difference in the patterning of vowel length according to the morpheme in which the vowel is located. The verb root and a large set of inner suffixes undergo various lengthenings and shifts in length, whereas another large set of suffixes, located outside the first set, does not participate in any of these alternations. Buckley (1994a) posits five lexical levels for Kashaya, but with minimal changes these can be reduced to two strata matching the more typical grammar in Lexical Phonology (Kiparsky 1982) or the Stem and Word in Stratal Optimality Theory (Kiparsky 2000, Bermúdez-Otero 2011); these labels then identify the two sets of suffixes. In this paper I explore the complex interaction between the changes to vowel length and the morphological affiliation of the morphemes in question, with special reference to an apparent global effect across the two lexical strata.[1]

---

[1] I am grateful to the participants at the conference for their insightful comments, as well as to the anonymous reviewers for their careful suggestions, including pointers to several references that now are included in the discussion; any errors are of course my own. The interlinear glosses use the following abbrevations: ABS absolutive, AUR aural evidential, CAUS causative, CONC concessive, COND conditional, DFNC defunctive (action by people long dead), DS different subject (switch reference), DUR durative, FUT future, IMP imperative, INCEP inceptive, LOC locative, MAND mandatory (occurrence independent of the agent's will), MVMT movement, NEG negative, NFV non-final verb (in clause), OBJ objective, PERF performative (action by the speaker), PL plural, PST past, REFL reflexive, REM remote past, RESP responsive (said in reaction to a statement or occurrence), SIM simultaneous, SS same subject (switch reference), VIS visual evidential. The

The paper is organized as follows. Sections 1 and 2 describe the complex but regular stress pattern of Kashaya, including its effect on vowel length and its interactions with morphological structure. Section 3 demonstrates the problem of generating the right Stem form on the basis of the first following Word suffix, and considers ordered solutions that rely on special intermediate representations, in approaches ranging from constraint-based Optimality Theory to the stepwise rules and spell-out of Distributed Morphology. Section 4 presents two quite different approaches to the global effect in Optimality Theory. Section 5 summarizes the issues that arise in the different perspectives. Although I present several possible analyses in diverse theoretical approaches, my goal is not to argue that only one of them is plausible. Instead, I seek to show in a variety of frameworks what steps might be necessary in order to accommodate the complex pattern of Kashaya foot structure and vowel length. Ultimately the ordered-rule or Stratal approaches succeed only if a rather marked intermediate representation is permitted, whereas the more global approaches in OT succeed only with additional machinery added to the classic models.

1. An overview of Kashaya stress

Kashaya is a member of the Pomoan family, spoken in northern California (Oswalt 1961, Buckley 1994a). It has a very complex but almost entirely regular metrical system that can place the stress on any of the first five syllables of a word, depending on the length of the root and the distribution of closed syllables and long vowels. Since the main discussion in this paper revolves around certain features of the metrical system, I first give an overview of the various components. Although Kashaya stress is often placed on phrases of more than one word (Buckley & Gluckman 2012), the question of interest here is relevant mainly within long words, and phrasal stress will be addressed only briefly. The data in this paper are from Oswalt (1961, 1964, 2005).

---

terms largely follow Oswalt (1961). The retroflex symbol [ʈ] is here used for an apico-alveolar stop, generally notated <ṭ> in the literature on Kashaya.

Metrical structure in Kashaya is iambic, constructed from left to right in a stepwise approach (Buckley 1994b) or aligned to the left in a constraint-based theory (Buckley 1997). As expected under this basic pattern, stress falls on the first syllable if it is heavy, otherwise on the second. Since morphological bracketing plays an important role, roots of all complex words are shown in boldface, and square brackets mark two domains that are also crucial, the Stem and Word, to be discussed more thoroughly below.[2] Within the Stem domain (the inner brackets), any vowel that heads a foot and occurs in an open syllable undergoes Iambic Lengthening.

(1) a. [[**mo**-mul-itʃʼ-ed] u]

[[run-around-REFL-DUR] ABS]

(mo mú:) (li tʃʼe:) du

'run in circles'

b. [[**tʃad**-utʃed] un]

[[look-DUR] SS.SIM]

(tʃa dú:) (tʃe dun)

'while looking'

c. [[**kel**-mul-ad-utʃed] u]

[[peer-around-DUR-DUR] ABS]

(kél) (mu la:) (du tʃe:) du

'keep peering around'

Since there is no explicit evidence for degenerate feet except when required for the main stress (illustrated below), they are assumed in these representations only in that special case. Nonprimary stresses are motivated more by lengthening than by audible prominences, so secondary stresses are not transcribed here.

---

[2] In a few forms, a clitic such as negative /tʰin/ is included in an example; this is placed outside the Word brackets.

1.1. Syllable extrametricality

A central fact about Kashaya stress is that the first syllable is extrametrical by default (Buckley 1994a,b); this special status is marked by ‹ › here. Extrametricality is blocked when the second syllable of the word is suffixal, as in the examples just presented. But in most words of the language, either the root is at least two syllables in length, or the first syllable is an instrumental prefix and followed by a root of one or more syllables. As a result, the vowels that undergo Iambic Lengthening are shifted one syllable to the right, and the stress occurs on a heavy second syllable, otherwise on the third syllable.

(2) a. [[ʧa-**qʰam**-ala-w-ibiʧ] ʔ]

[[by.knife-cut-down-MVMT-INCEP] ABS]

‹ʧa› (qʰa má:) (la wi:) (biʔ)

‘start to cut downward’

b. [[**qaʔʧ’aʈ**-ad-uʧed] u]

[[cry-DUR-DUR] ABS]

‹qaʔ› (ʧ’a ʈá:) (du ʧe:) du

‘used to cry and cry’

c. [[**qaʔʧ’aʈ**] ʔkʰe] tʰin

[[cry] FUT] NEG

‹qaʔ› (ʧ’áʈ’) (kʰe tʰin)

‘shouldn’t cry’

More formally, syllable extrametricality occurs in disyllabic or prefixed roots, but is blocked for monosyllabic unprefixed roots.

1.2. Stress shift

Left-edge extrametricality is unusual in the world’s languages, although clearly attested in some cases (Buckley 2009, Kager 2012). What makes Kashaya additionally noteworthy is the presence

of stress shift onto the second foot in the representation, which I treat as foot extrametricality (Buckley 1994b, 1997), marked here by the notation « ».[3]

The most straightforward instantiation of stress shift in Kashaya occurs when the leftmost syllable of the word is Cv: — that is, a nonbranching foot containing a long vowel. This length can be underlying or derived by elision of two adjacent vowels.

(3) a. [[**di:ʧ'**-id] ba]

[[say-DUR] SS.PST]

«di:» (ʧ'ín') ba

'after having said'

b. [[**wa**-ad] uʔba-em]

[[walk-DUR] COND-RESP]

«wa:» (dúʔ) (bem)

'could walk away'

c. [**ʧu:se**-to-ʔna]

[uncle-OBJ-LOC]

«ʧu:» (se tóʔ) na

'at our uncle's house'

The last word is not marked for the Stem because it belongs to a morphological category in which it is more difficult to diagnose that constituent.

As with syllable extrametricality, this foot extrametricality yields stress on the second or third syllable of the word, depending on weight. But the two phenomena cannot be collapsed, because they are independent and often cooccur. A word that is eligible for syllable extrametricality due to the position of the root often has a long vowel in the next syllable — a Cv:

---

[3] Foot extrametricality as a phenomenon has been questioned by some authors (e.g., McCarthy 2003) and is not crucial to the present analysis; it would also be possible to treat it as a shift in the accent onto the following foot at a late stage of the derivation.

foot that is initial modulo syllable extrametricality — and in that case the two displacements are additive. In other words, extrametricality is cumulative when the root is disyllabic or prefixed.

(4) a. [[du-**ʔya:q**-ad-qa] ba]

[[by.finger-think-DUR-CAUS] SS.PST]

‹duʔ› «ya:» (qán') (qa ba)

'after thinking about it'

b. [[**bane**-aduʧ-qa] :li]

[[put-far-CAUS] DS.PST]

‹ba› «ne:» (dúʧʰ) (qa:) li

'when (they) sent it off in the distance'

c. [[**šula:m**] iʔba]

[[be.sick] COND]

‹šu› «la:» (máʔ) ba

'would get sick'

In these examples, the third syllable of the word receives the stress because it is heavy. When that syllable is light, we find a further pattern that is of special interest in this paper, to which I now turn.

1.3. Foot Flipping

The application of Iambic Lengthening to the sequence CvCv results in a "perfect iamb" (CvCv:), and this is a common sequence of syllables in Kashaya as well as many other iambic languages (Hayes 1995). A more unusual aspect of Kashaya is that an initial sequence of the shape Cv:Cv is "flipped" with respect to syllable weight to produce the same CvCv: found in other contexts. Although this change, named Foot Flipping by Buckley (1994b), is not syllabically distinct from a CvCv that has undergone Iambic Lengthening, it does remain prosodically distinct, because the flipped foot is subject to the same stress shift found for Cv: that is not eligible for Flipping (for various reasons discussed below); in other words, the entire flipped foot behaves as extrametrical.

(5) a. [[**t’e:t**-ibiʧ] ba]

[[stand-up] SS.PST]

«t’e ti:» (bíʧˀ) ba

‘having stood up’

b. [[**ʧa**-ad-uʧed] u]

[[fly-along-DUR] ABS]

«ʧa du:» (ʧe dú)

‘flies along’

c. [[**di:ʧˀ**-id-uwad-uʧed] u]

[[say-DUR-DUR-DUR] ABS]

«di ʧˀi:» (du wá:) (du ʧe:) du

‘he used to tell (this story)’

As with the simple stress shift that applies to Cv:, Foot Flipping combines freely with syllable extrametricality. Consequently, accent falls on the fourth or fifth syllable, depending on weight.

(6) a. [[**loq’o:ʧ**-ad-uwad] u]

[[move.noisily-along-DUR] ABS]

‹lo› «q’o ʧa:» (du wá:) du

‘make noise by moving around’

b. [[si-**de**-aʧˀ-iyiʧˀ] in]

[[by.water-move-along.PL-DUR.PL] SS.SIM]

‹si› «de ʧˀi:» (yi ʧˀín)

‘while they were sailing along’

c. [[**muna:ʧ**-id] iʔba]

[[be.shy-DUR] COND]

‹mu› «na ʧi:» (dúʔ) ba

‘would be shy’

In summary, several regular processes combine in Kashaya to produce a system of considerable intricacy, in which stress falls on any of the first five syllables depending on the length of the root, the presence of a prefix, and the distribution of closed syllables and long vowels. In the next section, I discuss the role of the Stem constituent within the Word, and how this further complicates the system by affecting the potential application of Foot Flipping.

2. Level ordering

The fundamental structure of a Kashaya verb can be illustrated by the following example.

(7) [[[**t'e:t**]$_{\text{ROOT}}$ ibiʧ]$_{\text{STEM}}$ ba]$_{\text{WORD}}$

The length of the root is crucial to the realization of syllable extrametricality, as shown above. But we have not yet covered the nature of the Stem suffixes and the Word suffixes.[4] The crucial fact is that Iambic Lengthening and Foot Flipping apply only to members of the Stem class, and never to the Word class. Before pursuing this point further, however, I make a digression into the content of these two classes.

The Stem level suffixes can be compared to Level 1 in Lexical Phonology (Kiparsky 1982). A Kashaya verb may contain many such suffixes, but often none. They are classified by Oswalt (1961) in various categories that include adverbial meanings (directionals), aspect (inceptive, durative, distributive), and valence (reflexive, reciprocal, causative). All are optional for verbs in general, although as a lexical property, for example, some verbs obligatorily occur with a durative suffix.

The Word level (or Level 2) suffixes always follow whatever Stem suffixes are present in the verb. This class mainly consists of a large group of suffixes, exactly one of which must be present in every verb. This slot covers several types of function, including mood (imperative,

---

[4] The instrumental prefixes in the verb are tightly bound to the root, and can be considered part of a Base to which the Stem suffixes actually attach; see Buckley (1994a). The only other prefixes to a verb root are irregular plurals on a small number of roots, which are even more tightly bound and probably lexically listed.

conditional), evidentials (visual, aural, circumstantial, hearsay), switch reference (same or different subject plus temporal sequence), and the absolutive (used as a perfective verb, an infinitive, or other derivative nouns and adjectives). A few other suffixes can precede or follow this obligatory slot: examples are negation, remote past, relative clause markers, and the "responsive" for an utterance made in reaction to what someone else has said.[5]

It should be clear from these descriptions that there is not an obvious means of attributing the difference between the Stem and Word suffixes to another notion such as derivational or inflectional functions. It should be possible, however, to define a position in an elaborated set of functional projections at which one shifts from Stem to Word: nodes such as aspect and causative would appear below this position, but mood and evidential would appear above it. In an approach such as Distributed Morphology (Halle & Marantz 1993), the phonological operations of Iambic Lengthening and Foot Flipping would apply in cycles of Vocabulary Insertion until the relevant point is reached, after which those processes no longer apply.

As discussed below, this point is tangential to the question of how the application of these processes to the Stem suffixes is affected by the nature of the first (and possibly only) occurring Word suffix. In particular, that Word suffix does not participate in Foot Flipping, but it does affect the syllable structure of the Stem suffixes and determines whether these eligible suffixes actually undergo Flipping.

2.2. No word-level Lengthening

We have already seen many examples of Stem suffixes that undergo Lengthening and Flipping, but the words chosen have not been of the right structure to demonstrate that Word suffixes

---

[5] A reviewer wonders whether the special influence of Word suffixes on Stem-level phonology in Kashaya is somehow due to the obligatory Word slot. The main difficulty with this idea is that the leftmost Word suffix – the one that influences the Stem phonology – is not necessarily from the obligatory class, so the relevant base to which the obligatory suffix apples is not quite the Stem but potentially includes several preceding Word suffixes.

definitely resist these changes to vowel length. The following examples show a vowel belonging to a Word suffix that heads a foot in an open syllable, but remains short.

(8) a. [[**mo**-maʧ-ed] ela]

[[run-in-DUR] PERF.IPFV]

(mo má:)(ʧe de) la * (mo má:)(ʧe de:) la

'I keep running in there'

b. [[**hoʈʰ**-ala] s'uw-em]

[[warm-INCEP] MAND-RESP]

(ho ʈʰá:) (la s'u) (wem) * (ho ʈʰá:) (la s'u:) (wem)

'it would warm (us) up'

c. [[**s'i**-yiʧ'] ʔʧid-tʰi-mi-ya-em]

[[do-DUR.PL] DFNC-NEG-REM-VIS-RESP]

(s'i yíʔ) (ʧíʔ) (tʰi mi) (yam) * (s'i yíʔ) (ʧíʔ) (tʰi mi:) (yam)

'they never used to do (that)'

This generalization is true even if the vowel in the Word suffix is the nucleus of the main-stress syllable, with or without the effect of syllable extrametricality.

(9) a. [[**s'i**] pʰila]

[[do] DS.FUT]

(s'i pʰí) la * (s'i pʰí:) la

'if it happens'

b. [[**bawil**] ela]

[[put.in.container] PERF.IPFV]

‹ba› (wi lé) la * ‹ba› (wi lé:) la

'I am putting (it) in'

c. [[ʧa-**hke**] wi-ya-e:]

[[by.sitting-block] 1.OBJ-VIS-NFV]

‹ʧah› (ke wí) (ye:) * ‹ʧah› (ke wí:) (ye:)

‘it blocked me from sitting’

2.3. No word-level Flipping

Foot Flipping occurs only if the entire Cv:Cv target of the process is located in the Stem; otherwise the Cv: remains a nonbranching (and extrametrical) foot.

(10) a. [[**q’a:**] mela]
[[leave.behind] PERF.PFV]
«q’a:» (me lá) * «q’a me:» (lá)
‘I left (it) behind’

b. [[**sima:q**] eti]
[[sleep] CONC]
‹si› «ma:» (qa tí) * ‹si› «ma qa:» (tí)
‘although he’s asleep’

c. [[šo-**ʈ’o**:] tʰi-pʰila]
[[by.pulling-peel] NEG-DS.FUT]
‹šo› «ʈ’o:» (tʰi pʰí) la * ‹šo› «ʈ’o tʰi:» (pʰi lá)
‘if (you) don’t peel it’

These pairs of grammatical and ungrammatical outcomes do not differ in the location of stress, since shift occurs in either case, but they do differ in the distribution of vowel length; the correct forms show that Flipping has not occurred.

The following pairs have the identical string Cv:Cv in the input, but contrast in whether the second vowel is part of a Word or Stem suffix. Only in the latter case does Flipping occur; that is, the Stem-level suffix undergoes Foot Flipping, but not the Word-level suffix under the same syllable configuration, which retains the underlying distribution of vowel length.

(11) a. [[**q’a:**] mela] [[**q’a:**-ʧid] u]
[[leave.behind] PERF.PFV] [[leave.behind-DUR] PERF.PFV]
«q’a:» (me lá) «q’a ʧi:» (dú)
‘I left’ ‘keep leaving’

b.	[[**sima:q**] eti]	[[**sima:q**-ad] u]
	[[sleep] CONC]	[[sleep-DUR] ABS]
	‹si› «ma:» (qa tí)	‹si› «ma qa:» (dú)
	'although he's asleep'	'usually sleep'
c.	[[qa-**ʈ'o:**] wi-ya-e:]	[[qa-**ʈ'o:**-ʧid-uʧed] u]
	[[between.forces-peel] 1.OBJ-VIS-NFV]	[[between.forces-peel-DUR-DUR] ABS]
	‹qa› «ʈ'o:» (wi yé:)	‹qa› «ʈ'o ʧi:» (du ʧé:) du
	'rubbed off my (skin)'	'be peeling with the teeth'

Note that a stressed degenerate foot is permitted when forced by foot extrametricality, so this cannot be what causes avoidance of Flipping in the Word level.

2.3. No Flipping before CVC

We turn now to a phonological condition on Flipping that plays a crucial role in the interaction between Stem and Word. Since Flipping applies to Cv:Cv, it is blocked in Cv:CvC; more generally, if the point of Flipping is to create a perfect iamb, then it could not operate on Cv:CvC unless it simply deleted the vowel length to create CvCvC, but this is not a permitted outcome. This phonological blocking of Flipping is also true fully within the Stem Level, as in (4a,b) above.

But now we come to the crux of the problem. In the following pairs, the first example fails to undergo Flipping due to a CvC syllable; the second example in each case shows that the same root and suffix combination can indeed undergo Flipping if the syllable structure is different.[6]

(12)	a.	[[**q'a:**-ʧid] ba]	[[**q'a:**-ʧid] u]
		[[leave.behind-DUR] SS.PST]	[[leave.behind-DUR] ABS]
		«q'a:» (ʧĩn') ba	«q'a ʧi:» (dú)
		'after leaving'	'keep leaving'

[6] By a regular process, onset /d/ alternates with coda /n'/ in Kashaya (Buckley 1994a).

b.	[[**sima:q**-ad] tʰ-e]	[[**sima:q**-ad] u]
	[[sleep-DUR] NEG-EXPL]	[[sleep-DUR] ABS]
	‹si› «ma:» (qáʔ) tʰe	‹si› «ma qa:» (dú)
	‘can’t sleep’	‘usually sleep’
c.	[[qa-**ʈ’o:**-ʧĩd] tʰu] ʔ	[[qa-**ʈ’o:**-ʧĩd-uʧed] u]
	[[between.forces-peel] NEG.IMP] IMP	[[between.forces-peel-DUR-DUR] ABS]
	‹qa› «ʈ’o:» (ʧĩʔ) (tʰuʔ)	‹qa› «ʈ’o ʧĩ:» (du ʧé:) du
	‘don’t peel (it)!’	‘be peeling with the teeth’

The formal problem here is that the reason the CvC syllable is present and prevents the application of Flipping in the Stem suffix is that the following Word suffix begins with a consonant. That is, Flipping has to apply only within the Stem Level suffixes, but whether CvC exists to block Flipping depends on a Word Level suffix.

This pattern is the seemingly global effect that I wish to address here, and in the following sections I discuss the ways in which various theoretical approaches can, or cannot, handle this phenomenon.

3. Ordering analysis of Lengthening

Let us return for a moment to the simpler case of Iambic Lengthening. In a theory with ordered operations, a straightforward way to analyze the fact that Stem suffixes undergo it and Word suffixes do not is to add all Stem suffixes and apply the rule (a); then add any Word suffixes, but not to apply the rule again (b).

(13) a. [**hoʈʰ**-ala]

(ho ʈʰá:) la

b. [[(hoʈʰá:)la] s’uw-em]

(ho ʈʰá:) (la s’u) (wem)

This approach can be implemented in Lexical Phonology (Buckley 1994a) as well as in any serial theory that permits an intermediate representation of the Stem to which phonological processes apply, including phases in Distributed Morphology (see below).

A complication arises in intermediate representations, however, which is that when the rule applies to the Stem representation, a consonant at the end of the (intermediate) word has to be ignored, or extrasyllabic, in order to permit Lengthening to apply. This is necessary since that final syllable often ends up as open due to the following Word suffix.

(14) a. [**mo**-mul-itʃ'-ed]

(mo mú:) (li tʃ'e:) d′

b. [[**mo**-mul-itʃ'-ed] u]

[[run-around-REFL-DUR] ABS]

(mo mú:) (li tʃ'e:) du 'run in circles'

If the syllable ends up closed because the Word suffix begins with a consonant, it will shorten again independently without making any false predictions about the location of stress.

(15) a. [**mo**-mul-itʃ'-ed]

(mo mú:) (li tʃ'e:) d′

b. [[**mo**-mul-itʃ'-ed] ba]

[[run-around-REFL-DUR] SS.PST]

(mo mú:) (li tʃ'en') ba 'after running in circles'

In this case, look-ahead is not crucial; but Flipping is more complicated. When we see just the Stem with extrasyllabicity, Flipping should apply (a); but we cannot predict whether we will eventually have CvC or Cv (b).

(16) a. [**q'a:** - tʃid]

«q'a tʃi:» d′

b. [[**q'a:**-tʃid] ba] [[**q'a:**-tʃid] u]

«q'a:» (tʃin') ba «q'a tʃi:» (dú)

'after leaving behind' 'keep leaving behind'

Unlike Iambic Lengthening, Flipping cannot be reversed at a later point by shortening the vowel in a closed syllable (b), because this generates the wrong distribution of vowel length, whether or not stress shift also applies (c).

(17) a. [[**q'a:**-ʧid] ba]

«q'a ʧi:» d′ ba

b. «q'a ʧi:n'» ba

c. * «q'a ʧin'» (bá)

* (q'a ʧin') ba

The important analytical question, then, is how to prevent the application of Foot Flipping within the Stem domain or level, on the basis of whether or not a Word level suffix begins with a consonant or a vowel.

3.1. Avoiding look-ahead in Lexical Phonology

Buckley (1994a,b), working in Lexical Phonology, splits the effect of Foot Flipping into two steps by setting up the conditions for Flipping at (the equivalent of) the Stem level, but not completing the operation until the Word level, when the final syllabification is known. The first step under this analysis is to set the stage for Flipping by adjoining a Cv syllable to a preceding (Cv:) foot, creating the anti-iamb (Cv:Cv), which has the opposite internal weight relationship of a usual iamb (CvCv:). This is all that occurs at the Stem level (a). Then, at the Word level, if the existing prosody requires a C to be moved into the preceding syllable, the anti-iamb is destroyed and new foot structure is created, because two heavy syllables cannot occur in one quantity-sensitive foot (b). But if no such resyllabification is necessary, the anti-iamb remains available to undergo the remaining half of the process, which is the actual Flipping of vowel length.

(18) a. [**q'a:** - ʧid]

Basic Footing (q'a:) ʧi d′

CV Adjunction (q'a: ʧi) d′

b. [[**q'a:**-ʧid] ba]

(q'a: ʧi) d ba

«q'a:» (ʧin') ba

c. [[**q'a:**-ʧid] u]

(q'a: ʧi) d u

«q'a ʧi:» du

This two-stage architecture captures the strong Stem vs. Word distinction, and correctly predicts (for example) that all Stem affixes are internal to all Word affixes. In a rule-based implemen-

tation, the rules of Iambic Lengthening and CV Adjunction simply turn off at the end of the Stem level, accounting for the fact that no Word suffixes participate in these processes.

There are, however, significant disadvantages. First, this derivation splits Flipping into two processes, but not because the phenomenon inherently seems to demand it; rather, this strategy is used to achieve the effect of global look-ahead in an otherwise local framework. The use of an otherwise unmotivated structure is essentially diacritic, and undermines the predictions that any theory makes about possible derivations (see Wolf 2011: 119 for discussion and references). Further, the temporary anti-iamb violates the general pattern of Kashaya as well as languages in general (Prince 1991); it seems all the more a trick to get the facts to come out right than an insight. Finally, the analysis makes no connection between Flipping and Lengthening, yet both are fundamentally about changes in vowel length.

3.2. Stratal Optimality Theory

Stratal OT, in various specific forms (Kiparsky 2000, Bermúdez-Otero 2011), is an implementation of the basic Lexical Phonology architecture in a constraint-based framework, with fixed levels in the derivation labeled Stem, Word, and Phrase. The output of level *n* is the input to level *n+1*, but within each level forms are chosen by ranked constraints rather than by ordered rules. Some basic constraints necessary in any OT analysis are listed here; they will figure in other analyses later in the paper as well.

(19) a. IDENT-L The input length of a segment is identical to the output length of the corresponding segment.

b. *CV:CV A syllable containing a long vowel is not followed by a short open syllable.

c. SWP Stress-to-Weight Principle: A stressed syllable is heavy.

d. WSP Weight-to-Stress Principle: A heavy syllable is stressed.

e. $*V{:}C]_{\sigma}$ A long vowel does not occur in a closed syllable.

The constraint *CV:CV, which forces Flipping to occur, is used here for simplicity, but would better be treated as a combination of simpler constraints, including general foot-form constraints such as SWP (which triggers Iambic Lengthening) and WSP (which penalizes long vowels

outside the head of a foot), along with FT-BIN for branching feet and of course FT-FORM(Iambic) which places the head in the right branch of the foot (see Prince 1991, Prince & Smolensky 1993 for general discussion).

Just as Lexical Phonology has different rules in each level, so Stratal OT has different constraint rankings in the Stem and Word levels. For Kashaya, the crucial difference is the place of IDENT-L, since the levels differ most importantly in whether changes to vowel length occur.

(20) a. Stem level: $*V{:}C]_{\sigma}$ >> *CV:CV, SWP >> IDENT-L

b. Word level: $*V{:}C]_{\sigma}$ >> IDENT-L >> *CV:CV, SWP

A particular advantage to a constraint-based approach to Kashaya (see also Section 4.2) is that a single constraint on changes to vowel length, IDENT-L, controls the domain of Iambic Lengthening and Foot Flipping, as well as the creation of long vowels by Elision (Buckley 1994a, 1997), thereby unifying the three phenomena in a way that is not possible in a rule-based approach.

Following Bermúdez-Otero, I assume that each level is internally global like Classic OT; but under standard assumptions, globality does not extend across levels. Because the account of the Stem and Word difference requires that vowel length changes occur in the Stem level, stratum-internal globality will not remedy the look-ahead problem discussed above. In fact, in this regard Stratal OT is exactly like Lexical Phonology, and still needs some equivalent to CV Adjunction in the Stem level. On top of this, the arbitrary nature of CV Adjunction is harder to manage with constraints than with a processual rule. In particular, if Flipping is actually implemented in the Word level, that means low ranking of IDENT-L; but then we wrongly predict Iambic Lengthening at the Word level. Is there an alternative to CV Adjunction?

A possible solution is to go halfway not in the creation of the iambic foot, but rather in the shift of the mora.[7] Foot Flipping, of course, involves a change from Cv:Cv to the perfect iamb (CvCv:). An intermediate anti-iamb (Cv:Cv) is especially problematic because the right branch is light, whereas Iambic Lengthening, which is highly active in the Stem level of Kashaya, demands a heavy right branch. Suppose that the Stem level output represents a compromise between preserving the length on the first vowel (demanded by faithfulness) and lengthening the second vowel (to yield the preferred heavy foot head). This can be effected by doubly linking the middle mora in the foot to both vowels.

(21)

```
σ   σ
|\  |
μ μ μ
|/ ∴|
V   V
```

Admittedly this (Cv:Cv:) foot, with a double-linked mora, is a rather unusual configuration. Formally, it may require a separate moraic plane to accommodate links between onset consonants and syllables not shown here. At the same time, the Kashaya pattern is also typologically unusual, and this representation seems no more problematic than the anti-iamb. The lack of vowel shortening in the Stem level — i.e. the mora does not simply shift immediately — matches the fact that no other vowel shortening occurs in the Stem level, other than some morphologically determined changes (Buckley 1994a). This suggests two separate constraints, essentially IDENT-LONG >> IDENT-SHORT, similar to the symmetrical pair MAX and DEP applied to moras (McCarthy 2008).

---

[7] For reasons of space, I do not discuss several other possible approaches to moraic representations, such as a floating mora, that raise various problems. This analysis builds on a suggestion by Peter Svenonius at the conference.

In the Word level, the temporary (Cv:Cv:) structure is resolved in favor of a standard (CvCv:) iamb where possible, but if the second syllable becomes closed, the mora remains with the first vowel as (Cv:)(CvC), effectively undoing the Stem level spreading, since long vowels independently shorten in closed syllables. In outline, this derivation recapitulates the CV Adjunction approach, but directly via the moraic structure (the locus of vowel length) rather than foot structure. Of several approaches I have considered, I believe this is the least problematic means of capturing in Stratal OT the technique used by Buckley (1994a,b) to avoid a true look-ahead mechanism. But like the Lexical Phonology approach, it can be considered to employ a diacritic approach as a substitute for an architectural solution.

3.3. Suffix classes in Distributed Morphology

Another theoretical approach that would treat the Stem/Word distinction as a form of ordering is Distributed Morphology (DM; Halle & Marantz 1993). In this theory, the spell-out of morphosyntactic features triggers a cycle of phonological rules, but these rules apply only to those affixes that have already been received their phonological content. A basic question is how to get the Stem/Word distinction in Kashaya. In English, Level 1 or Stem affixation potentially leads to idiosyncratic meaning and pronunciation, and correlates with direct attachment to the root; whereas Level 2 or Word affixation involves attachment to a root that is already affixed (Marantz 1997, Marvin 2003). More generally, in order to capture the distinct behavior of Stem and Word morphology, suppose that suffixes are classified into two groups, Inner and Outer, and that no Inner suffix can be added once an Outer suffix occurs (Marantz 2007). After addition of the first Outer suffix, a cycle of phonological rules applies to the entire domain preceding the Outer suffix; this corresponds to the Stem in the Stratal OT approach and matches the standard spell-out of a phase-head complement (Chomsky 2001, Kaye 1995), as well as the use of cyclic and noncyclic labels in Marvin (2003).

The Outer suffix does not undergo these rules itself, and therefore should not yet be spelled out (i.e., have its phonological content inserted into the representation). Yet the most general aspect of the prosodic shape of the first Outer suffix has to be available, specifically whether a

final C in the preceding Inner suffix can ultimately be syllabified into the next syllable. This problem suggests a special role for the prosodic structure of a phase head during spell-out, and a more subtle interpretation of the relationship between vocabulary insertion and relative visibility of spelled-out content to phonological rules.

One potential solution would be to spell out the phase head that triggers the Stem cycle, but to exempt this content from the application of the rules, other than syllabification. Such a position, however, would significantly undermine the basic purpose of ordered Vocabulary Insertion: once the content has been spelled out, it should be available for phonological rules. To permit insertion for the purposes of syllabification, but then exclude the latest structural node from participation in rules, requires some special status or marking on that node and appears to be quite arbitrary. This gambit would also lead to uncertain predictions about the interaction of phonology and morphology. For example, this idea bears a certain resemblance to the Noninteractive Lexical Phonology of Odden (1993), where all morphology precedes phonology, but the phonological operations are still allocated to levels and apply cyclically to substrings of the representation. This in turn is somewhat like indexed constraints (Section 4.2), since the morphological structure is labeled according to its level, and this labeling determines the application of phonological rules. But the noninteractive model has the disadvantage that no morphological operation can refer to derived or global phonological features, whereas this is attested in allomorph selection (Kiparsky 1996, Wolf 2009, Yu this volume).

3.4. OT with Candidate Chains

We now turn to an ordered spell-out approach that incorporates a degree of globality, namely the Optimal Interleaving of Wolf (2008). First, though, some background. Classic OT has parallel derivations in which candidates can deviate from the input form in many ways at once. A rather different implementation of constraint-based evaluation is OT with Candidate Chains, or OT-CC (McCarthy 2007). In this model, each output candidate is the last step in a CHAIN of forms, with one step in the chain for every faithfulness violation (so that the derivation is gradual); and each step must be harmonically improving (which serves to avoid certain types of unattested patterns).

Because there are many potential steps in a derivation, changes to the representation (i.e., unfaithful mappings between steps) can be extrinsically ordered as in traditional rule-based phonology. OT-CC handles opacity by PRECEDENCE constraints, which stipulate that the constraint violations that lead to the steps in the chain occur in a particular relative order.

(22) a. in PREC(A,B) where A and B are basic Faithfulness constraints,

b. a violation of constraint A has to precede any violation of B in the chain

c. **and** no violation of A can follow a violation of B.

For example, to capture an opaque interaction of vowel apocope and coda devoicing, with /pad/ → [pat] but /pada/ → [pad], we need to choose the chain <pada, pad> without devoicing, and reject <pada, pad, pat>.

(23) a. <pada, pad> violation of MAX-V

b. <pada, pad, pat> violation of MAX-V and then IDENT-VOICE

The constraint PREC(IDENT-VOICE, MAX-V) makes the correct choice because IDENT-VOICE cannot be violated after MAX-V, as it is in (b). The two-clause formulation of the constraint also penalizes (a) for violating MAX-V without a prior violation of IDENT-VOICE, but this effect is overridden by higher-ranked FINAL-C, which forces deletion of the final vowel (McCarthy 2007).

This very brief outline gives us the background to look at a means of integrating the Stem/Word distinction into OT-CC. For this goal we need reference to morphological operations and the class to which each operation belongs. The original form of OT-CC has no account of stratal effects, except possible morpheme-specific rankings or classes of morphemes, such as "Word-level". The Stem vs. Word distinction is a kind of opacity: viewed phonologically, the lack of Lengthening and Flipping in certain suffixes is unexpected. It makes sense, therefore, to analyze the difference as a kind of opacity using PREC constraints, but we have to involve morphology in the PREC constraint in order to do this.

Wolf (2008) proposes a theory of Optimal Interleaving (OI), in which each instance of Vocabulary Insertion occupies a step in the candidate chain. Because OT-CC is serial in

orientation, the derivation is similar to Distributed Morphology, but the choice of optimal derivation is constraint-based. Insertion counts as a faithfulness violation, so PREC can then control ordering of spell-out relative to particular phonological changes. We must refer to a Word class of affixes since there are no strata to serve this purpose.[8]

In Kashaya, the main requirement is to prevent Lengthening and Flipping — i.e., a violation of IDENT-L — from occurring after the spell-out of a Word affix. First consider the simpler case of Lengthening. The constraint PREC(IDENT-L, Insert-Aff_{Word}) penalizes a violation of IDENT-L after the insertion of any affix in the Word class (the spell-out of its phonological content). In other words, once the first Word affix is spelled out, no more changes in vowel length are permitted; this is the same effect as ranking IDENT-L higher in the Word level or domain.

In the chains shown below – one step per line, for clarity – the input has phonological content for the root /mo/ 'run' but abstract featural representations for the suffixes, which also carry diacritics for their Stem or Word class. Each step in the chain permits one unfaithful mapping, whether the spell-out of a suffix or a phonological change.

(24) a. < mo-DIR_{S}-DUR_{S}-PERF_{W},
momatʃ-DUR_{S}-PERF_{W},
momatʃed-PERF_{W},
(moma)tʃed-PERF_{W},
(moma:)tʃed-PERF_{W},
(moma:)tʃedela,
(moma:)(tʃede)la >

b. < mo-DIR_{S}-DUR_{S}-PERF_{W},
momatʃ-DUR_{S}-PERF_{W},
momatʃed-PERF_{W},
(moma)tʃed-PERF_{W},
(moma:)tʃed-PERF_{W},
(moma:)tʃedela,
(moma:)(tʃede)la,
*(moma:)(tʃede:)la >

Of these two possible derivations, chain (a) wins because violation of IDENT-L, i.e. vowel lengthening, occurs after spell-out of the Word suffix *-ela* in (b).

---

[8] Thanks are due to Matt Wolf for help in developing this analysis.

For the analysis of Foot Flipping, we can assume a final extrasyllabic consonant where needed as in the traditional Lexical Phonology and Stratal OT analyses, so that Flipping is able to occur before any Word affix is added. The crucial constraint ranking places the PREC constraint over the *CV:CV that would otherwise cause Flipping, since it outranks IDENT-L, faithfulness to underlying length.

(25) PREC(IDENT-L, Insert-Aff$_{Word}$) >> *CV:CV >> IDENT-L

The precise details on an analysis in OT-CC will depend on how Foot Flipping is implemented. A sudden change from CV:CV to (CVCV:) would involve several faithfulness violations: at least loss of length on the first vowel and addition of length to the second vowel, plus introduction of a new foot if that is interpreted as a separate step (Pruitt 2010). As a result, the process would have to be broken down into several steps, each of which must be harmonically improving. The gradualness requirement of OT-CC essentially brings back the intermediate representation problem addressed by CV Adjunction and mora spreading (Section 3). If an early binary foot can be motivated independent of vowel length – contrary to surface footing in Kashaya – then mora spreading in the change from *(q'a:ʧi)d* to *(q'a:ʧi:)d* would better satisfy Stress-to-Weight by making the head of the foot a long vowel, while subsequent shortening in *(q'aʧi:)d* would satisfy Weight-to-Stress by eliminating a long vowel that is unstressed.

(26) a. < q'a:-DUR$_S$-ABS$_W$,
q'a:ʧi d′-ABS$_W$,
* q'a:ʧid-u >

b. < q'a:-DUR$_S$-ABS$_W$,
q'a:ʧi d′-ABS$_W$,
q'a:ʧi: d′-ABS$_W$,
q'aʧi: d′-ABS$_W$,
q'aʧi:d-u >

The form in (a), without Flipping, fares worse on metrical structure, whereas the Flipping in (b) does not lead to any later problems. Globality comes into play because a sequence with Flipping will be rejected as part of a larger chain that ultimately has a consonant-initial suffix spelled out after it.

(27) a. < q'a:-DUR$_S$-SS.PST$_W$,
q'a:ʧi d′-SS.PST$_W$,
q'a:ʧid-ba,
q'a:ʧin'-ba >

b. < q'a:-DUR$_S$-SS.PST$_W$,
q'a:ʧi d′-SS.PST$_W$,
q'a:ʧi: d′-SS.PST$_W$,
q'aʧi: d′-SS.PST$_W$,
q'aʧi:d-ba,
* q'aʧid-ba,
q'aʧin'-ba >

Derivation (a) is preferred because (b) violates PREC(IDENT-L, Insert-Aff$_{Word}$): a vowel is shortened after /ba/ has been spelled out. This in turn is forced by higher-ranking *V:C]$_\sigma$.

Assume that other details of implementation, including the introduction of foot structure, can be worked out successfully. What remains is that, because of gradualness, the OT-CC analysis appears to require the same sort of half-flipped representation as discussed for Stratal OT in Section 3.2 – and that intermediate representation is quite sufficient to make the Stratal OT analysis come out right. It appears, therefore, that the particular type of globality found in OT-CC does not eliminate the problem that other ordered derivations raise.

4. Global approaches

Both the CV Adjunction and doubly linked mora approaches described above rely on an otherwise unattested and also problematic representation to navigate the relative roles of Stem and Word phonology in determining whether Foot Flipping occurs in a particular word. A DM approach raises the difficulty of accessing the syllable structure of an affix that otherwise does not yet participate in the phonology. In this section, I discuss two approaches that do not rely on intermediate forms or stages, but rather employ either limited or full globality to generate the necessary effect.

4.1. Precompiled prosody

One approach, compatible with Lexical Phonology or Stratal OT, is inspired by Hayes' (1990) work on the way that postlexical conditions can apparently affect lexical derivations. Hayes argues that in some languages, alternations according to syntactic context actually involve lexical

processes. His solution is PRECOMPILATION of two alternate forms in the lexical phonology, indexed for the syntactic context in which they occur; the appropriate form is inserted into the syntax with its phonological form already determined.

A similar formalism might be applied here to capture the Stem and Word interaction. Specifically, the Stem level could generate two outputs that later compete with each other at the Word level, according to the prosody that is present. Since the two forms need to differ in their expectations about prosody, they must reflect an optional presence of final-consonant extra-syllabicity, where in the forms under discussion Foot Flipping will occur only in the presence of that extrasyllabicity (b).

(28) a. [**q'a:** - ʧid] b. [**q'a:** - ʧid]

(q'a:) (ʧid) (q'a ʧi:) d′

This then is a syllabification-focused version of precompilation. At the Word level, the two inputs are treated as stem allomorphs, and the choice follows from the existing constraint ranking: the stem is preferred that has a branching iambic foot (by general metrical constraints) as long as it does not require a change in vowel length by Closed-Syllable Shortening (enforced by $*V{:}C]_{\sigma}$). The subscript number indicates which "allomorph" serves as the input for each candidate. The SWP, or Stress-to-Weight Principle (Prince 1991), is added in the second tableau to prefer the candidate that has Iambic Lengthening – this is Emergence of the Unmarked (McCarthy & Prince 1994), since at the Word level there is no active Lengthening, but the same constraint that causes it at the Stem level would here at the Word level be lower ranked and have only the effect of choosing the right allomorph.

(29)

$_1$/q'a:ʧid/ ~ $_2$/q'aʧi:d/ + /ba/	*V:C]$_\sigma$	IDENT-L	*CV:CV	SWP
☞ a. $_1$(q'a:) (ʧin') ba				
b. $_1$(q'a ʧin') ba		*!		
c. $_2$(q'a ʧi:n') ba	*!			
d. $_2$(q'a ʧin') ba		*!		

(30)

$_1$/q'a:ʧid/ ~ $_2$/q'aʧi:d/ + /u/	*V:C]$_\sigma$	IDENT-L	*CV:CV	SWP
a. $_1$(q'a:) (ʧi du)			*	*!
b. $_1$(q'a ʧi) du		*!		*
☞ c. $_2$(q'a ʧi:) du			*	
d. $_2$(q'a ʧi) du		*!		*

Changes to vowel length are already penalized in the Word level by high-ranking IDENT-L, and so this analysis requires no new assertions about the constraint ranking there; but it does complicate the nature of optimal candidate selection at the Stem level. Nonetheless, the choices are quite restricted: the final C is syllabified or not. Perhaps more choices would be available in a language that permits complex onsets, but Kashaya does not. It might also be related to other types of optionality or variation in the phonology: in particular, Coetzee (2004) proposes that Eval produces not a single optimal candidate but rather a list of candidates ordered by optimality. His model is intended mainly to account for variation, as well as access to relative well-formedness in language processing, but in Kashaya the second-ranked candidate at the Stem level (differing in whether a final consonant is syllabified) would compete with the most optimal as the input to the Word level. This has parallels to the many examples of variation (such as t/d-deletion in English) that are partly determined by phonological context.

This derivation conflicts, at least in spirit, with the claim that outward-looking allomorphy is never phonological: Bobaljik (2000) and Embick (2010) claim that morphosyntactic conditioning is a more restrictive account for attested stem allomorphy, and that phonological conditioning predicts unattested patterns. The choice of stem here is not, strictly speaking, formulated as whether the segment immediately following the stem is a consonant or vowel, but does make reference to the overall phonological well-formedness of the constraints that contain one or the other of the available stem forms. Others, however, argue that the allomorphy claim may be too strong; for example, Deal & Wolf (this volume) make an interesting proposal that weakens the claim in a specific way: outward-looking allomorphy selection can see material within the same cycle, but not in a following cycle. It does not seem that this solution can be applied to Kashaya, however, since the different phonological behaviors of the Stem and Word suffixes would be expected to occur in different cycles.

4.2. Indexed constraints

Look-ahead is an issue in a stepwise, local theory that is restricted in the amount of information that can be seen at a particular stage, but as Kashaya demonstrates this restriction may be too strong. Classic Optimality Theory (Prince & Smolensky 1993) avoids the look-ahead problem because it evaluates the output directly, with surface syllabification present: the form of the Stem, with or without Flipping, is evaluated in a candidate that already contains Word suffixes. But the classic form of the theory, without separate lexical levels, requires some other means of identifying the lengthening suffixes; either a long (essentially arbitrary) list of morphemes that undergo certain changes, or some domain equivalent to the Stem.

Buckley (1996, 1997) proposes an analysis of Kashaya using Constraint Domains: substrings of the output that we can here call Stem and Word, as well as constraints indexed such that they are relevant only to segments located in a specific domain. This has the advantage of capturing the fact that all Stem suffixes are contiguous, followed by all Word suffixes. A more common approach in the literature, however, is to permit indexation of morphemes that are subject to one or more specially ranked constraints (Flack 2007, Jurgec 2010, Mahanta 2012,

Pater 2000, 2009). Although this formalism has often been applied to cases were a few morphemes are exceptions to a general phonological process, the same technique can be used to treat all the Word suffixes as exceptional with respect to the faithfulness constraint IDENT-L. Here, as in cophonologies (Inkelas, et al. 1997), the lengthening property could be randomly distributed among the suffixes, and the generalization about contiguity is potentially a relic of the diachrony of the language with no synchronic formalization. For the sake of familiarity, I use a simple indexation analysis here.

Crucially for Kashaya, the constraint IDENT-L – which in its general version is fairly low-ranked – occurs in a special version, IDENT-L_W, which is violated by any changes to the length of a vowel that belongs to a suffix in the Word class. High ranking ensures that Word suffixes are faithful to underlying length, whereas roots and Stem suffixes are subject only to the general, lower-ranked version (to which the Word suffixes are redundantly subject as well). The essential constraint ranking is similar to the OT-CC analysis, with a substitution for the framework at hand: instead of a PREC constraint that makes reference to IDENT-L and the insertion of Word suffixes, there is a version of IDENT-L that applies only to Word suffixes. In addition, the single global ranking essentially combines the two rankings found at the Stem and Word levels.

(31) a. Global: IDENT-L_W >> *CV:CV >> IDENT-L

b. Interleaving: PREC(IDENT-L, Insert-Aff_{Word}) >> *CV:CV >> IDENT-L

c. Stem level: *CV:CV >> IDENT-L

Word level: IDENT-L >> *CV:CV

(32)

/sima:q-ad-u_W/	IDENT-L_W	*CV:CV	IDENT-L
a. ‹si› «ma:» (qa dú)		*!	
☞ b. ‹si› «ma qa:» (dú)			**

/sima:q-eti$_W$/	IDENT-L$_W$	*CV:CV	IDENT-L
☞ c. ‹si› «ma:» (qa tí)		*	
d. ‹si› «ma qa:» (tí)	*!		**

This specially marked constraint prevents changes in length (though not changes in segmental features) within the Word suffix *-eti*, but allows Flipping to modify Stem-level *-ad*.

There are other advantages, such as no need for temporary final extrasyllabicity of the stem-final consonant. Most centrally, because the entire form is present in the candidates under evaluation, there is no need to look ahead to whether an eventual following Word suffix will begin with a consonant or a vowel.

(33)

/q'a:-ʧĩd-u$_W$/	IDENT-L$_W$	*CV:CV	IDENT-L
a. «q'a:» (ʧĩ dú)		*!	
☞ b. «q'a ʧĩ:» (dú)			**
/q'a:-ʧĩd-ba$_W$/	IDENT-L$_W$	*CV:CV	IDENT-L
☞ c. «q'a:» (ʧĩn') ba			
d. «q'a ʧĩ:n'» (bá)			*!*
e. «q'a ʧĩn'» (bá)			*!

Because the conditions for Foot Flipping are not met in the presence of a following closed syllable, (c) wins for simple phonological reasons, without any complicated reference to what will happen later in the derivation. One disadvantage of this approach for the analysis of Kashaya is the stipulation of the Word class behavior, which is laid on top of the representation, rather than forming part of architecture as in Lexical Phonology; the robust fact that all such suffixes occur in a contiguous string is also coincidental. A broader problem with the global evaluation is

that there is no inherent account for opacity; this would require extra mechanisms, just like all Classic OT frameworks.

Opacity is a particular problem at the Phrasal level in Kashaya, where accentual feet are often constructed across two words. Although there is considerable variation in the occurrence of these phrases (Buckley & Gluckman 2012), they are clearly distinct from the lexical feet for Iambic Lengthening and Flipping.[9] As pointed out to me by Paul Kiparsky, a global theory appears to predict that Foot Flipping should occur across word boundaries; but there is no Flipping in phrases, just Foot Extrametricality.

(34) a. [**moqʰo:**] [[ʧu-**qʰam**-aʧ˜] wi-y]

[knee] [[with.round-cut-REFL] 1.OBJ-VIS]

‹mo› «qʰo:» (ʧu qʰá) (maʧ˜) (wiy) 'I cut my knees'

*‹mo› «qʰo ʧu:» (qʰa máʧ˜) (wiy)

b. [**ʧuhni:**] [[mo-**bo:k'**-ibiʧ] ʔ]

[bread] [[with.heat-swell-INCEP] ABS]

‹ʧuh› «ni:» (mo bó) (k'i:) (biʔ) 'bread starting to rise'

*‹ʧuh› «ni mo:» (bo k'í:) (biʔ)

The monomorphemic stems such as /moqʰo:/ 'knee' and /ʧuhni:/ 'bread', as well as the prefixes on the following words, otherwise have no cause to be treated as subject to higher-ranked IDENT-L_W, so changes to vowel length there ought to be penalized only by lower-ranked simple IDENT-

[9] Foot Flipping is never affected by the content of a following word, and does not apply across a word boundary: Recall that every verb contains at least one Word suffix, which terminates the domain of Flipping. As a reviewer suggests, one might ask whether it is ever possible for the sort of global interaction found between Stem and Word in Kashaya to occur between Word and Phrase or their equivalent in some other language. Such a pattern is more likely to be predicted in a theory such as DM that does not recognize a sharp distinction between word and sentence structure; but see Shwayder (2014) for discussion of the phonological word in DM.

L. This difficulty can be solved by having a distinction between Lexical and Postlexical components in the grammar, where in the latter component Flipping is ruled out high ranking of IDENT-L in general. This is probably already a necessary enhancement to the architecture of the grammar (e.g., Ito & Mester 2003); but if we abandon the pure one-step format of Classic OT by introducing stages in the representation, it is perhaps a small further step to introduce ordered components to handle Stem vs. Word components, as discussed in Section 3.2.

5. Conclusion

The Kashaya data present a problem of globality or look-ahead that is fairly simple to summarize but more difficult to analyze. Given a structure [[[Root]X]Y], where X and Y belong to different phonological domains, the phonology of X makes partial reference to the content of Y. But that reference has to be limited to the syllable structure that results from addition of Y, rather than the full presence and participation of Y; otherwise a Word suffix will undergo Stem processes. Different theoretical approaches can accommodate these facts, but with various advantages and compromises to the strictest forms of each theory.

A Lexical Phonology analysis of the Kashaya facts captures the difference between Stem and Word patterns, but has difficulty with cross-level effects, since the theory is designed not to permit global interactions. The use of a temporary ill-formed anti-iamb generates the right outcome, but at the cost of dubious intermediate representations and rule types. Stratal OT generalizes much more effectively over several processes that create long vowels in the Stem but not in the Word, but has the same difficulty with cross-level interaction, despite globality within levels. As with Lexical Phonology, an unusual intermediate form — mostly likely in marked moraic structure — can bridge the Stem/Word divide, but casts doubt on the overall analysis.

Distributed Morphology has difficulty accessing outward phonology as required by the Kashaya pattern. It is unclear how the central predictions of the theory might be altered if we permit an affix to reveal its basic prosody and have an effect on syllable structure, without full spell-out and participation in phonological processes. Optimal Interleaving resembles DM in certain important ways, including ordered phonology and morphological spell-out; but because it

has the limited global properties of OT-CC, it can capture the effect of the following suffix via the well-formedness of the entire chain, and "look-ahead" is not a problem. On the other hand, the fundamental property of gradualness seems to require the same kind of intermediate marked moraic structure that raise possible doubts about the Stratal OT analysis.

A limited form of globality can be achieved in Stratal OT by adding new tools. Precompiled pairs of outputs of the Stem level, differing only in the syllabification of the final consonant, are also very limited in their effect, but require an unusual kind of allomorph selection at the Word level. Parallel OT easily handles global interactions, but in its original form has no account of stratal behavior. The addition of Indexed Constraints captures the different behavior of Stem and Word suffixes while maintaining the required globality to access the surface syllable structure, but these indexes are ad hoc. A significant problem with opacity can be solved by adding a distinct postlexical component, although other types of opacity will require different solutions.

In summary, the unusual phenomenon of Foot Flipping presents a surprisingly difficult challenge for a wide range of theoretical approaches. Depending on what compromises one is willing to make, the challenge might not seem especially grave. Although the Kashaya pattern is typologically unusual, it is a pervasive fact of the language and plainly integrated into the grammar. It is therefore indisputable that no theory of the interaction of phonology and morphology in word derivation can be considered empirically adequate if it does not have an account for facts like those presented by Kashaya.

References

Bermúdez-Otero, Ricardo. 2011. Cyclicity. *The Blackwell Companion to Phonology*, vol. 4, 2019-2048.

Bobaljik, Jonathan. 2000. The ins and outs of contextual allomorphy. *University of Maryland Working Papers in Linguistics*, ed. K.K. Grohmann and C. Struijke, vol. 10, pp. 35–71. UMCP.

Buckley, Eugene. 1994. Persistent and cumulative extrametricality in Kashaya. *Natural Language and Linguistic Theory* 12, 423–464.

Buckley, Eugene. 1996. Levels vs. domains: the case of Kashaya vowel length. *Proceedings of the Berkeley Linguistics Society* 22, 36-45.

Buckley, Eugene. 1997. Optimal iambs in Kashaya. *Rivista di Linguistica* 9, 9-52.

Buckley, Eugene. 2009. Locality in metrical phonology. *Phonology* 26, 389-435.

Buckley, Eugene & John Gluckman. 2012. Syntax and prosody in Kashaya phrasal accent. *U. Penn Working Papers in Linguistics* 18, 21-30.

Chomsky, Noam. 2001. Derivation by phase. *Ken Hale: A Life in Language*, ed. M. Kenstowicz, 1-52. MIT Press.

Coetzee, Andries. (2004). What it Means to be a Loser: Non-Optimal Candidates in Optimality Theory. Ph.D. dissertation, University of Massachusetts Amherst. [ROA-687]

Embick, David. 2010. *Localism versus Globalism in Morphology and Phonology*. MIT Press.

Flack, Kathryn. 2007. Templatic morphology and indexed markedness constraints. Linguistic Inquiry 38, 749-758.

Halle, Morris & Alec Marantz. 1993. Distributed morphology and the pieces of inflection. *The View from Building 20*, ed. K. Hale & S.J. Keyser, 111-176. MIT Press.

Hayes, Bruce. 1990. Precompiled phrasal phonology. *The Syntax-Phonology Connection*, ed. S. Inkelas & D. Zec, 85-108. CSLI.

Hayes, Bruce. 1995. *Metrical Stress Theory: Principles and Case Studies*. University of Chicago Press.

Inkelas, Sharon, Orhan C. Orgun & Cheryl Zoll. 1997. The implications of lexical exceptions for the nature of grammar. In Derivations and constraints in phonology, ed. by Iggy Roca, 393–418. Oxford: Clarendon Press.

Ito, Junko & Armin Mester. 2003. Lexical and postlexical phonology in Optimality Theory: evidence from Japanese. *Linguistische Berichte. Sonderheft 11: Resolving Conflicts in Grammars*, ed. Gisbert Fanselow & Caroline Féry. 183-207.

Kager, René. 2001. Rhythmic directionality by positional licensing. Handout of presentation given at HILP-5, University of Potsdam, January 11.

Kager, René. 2012. Stress in windows: Language typology and factorial typology. *Lingua* 122, 1454-1493.

Kaye, Jonathan. 1995. Derivations and Interfaces. *Frontiers of Phonology*, ed. J. Durand & F. Katamba, 289-332. Longman.

Kiparsky, Paul. 1996. Allomorphy or morphophonology? In R. Singh (ed.), Trubetzkoy's Orphan 13-31. Amsterdam: John Benjamins.

Kiparsky, Paul. 1982. Lexical Morphology and Phonology. *Linguistics in the morning calm: selected papers from SICOL-1981* (vol. 1), ed. In-Seok Yang for the Linguistic Society of Korea, 3-91. Seoul: Hanshin Publishing Company.

Kiparsky, Paul. 2000. Opacity and cyclicity. *The Linguistic Review* 17, 351-367.

Mahanta, Shakuntala. 2012. Locality in exceptions and derived environments in vowel harmony. *Natural Language and Linguistic Theory* 30, 1109-1146.

Marantz, Alec. 1997. No Escape from Syntax: Don't Try Morphological Analysis in the Privacy of Your Own Lexicon. *U. Penn Working Papers in Linguistics* 4.2, 201-225.

Marantz, Alec. 2007. Phases and words. *Phases in the theory of grammar*, ed. S.-H. Choe, 191-122. Dong In.

Marvin, Tatjana. 2003. *Topics in the Stress and Syntax of Words*. Dissertation, MIT.

McCarthy, John. 2003. OT constraints are categorical. *Phonology* 20, 75-138.

McCarthy, John. 2007. *Hidden Generalizations: Phonological Opacity in Optimality Theory*. Equinox.

McCarthy, John. 2008. *Doing Optimality Theory: Applying Theory to Data*. Blackwell.

McCarthy, John & Alan Prince. 1994. The emergence of the unmarked: Optimality in Prosodic Morphology. In Mercè Gonzàlez (ed.), *Proceedings of the North East Linguistics Society* 24 (pp. 333-379). Amherst, MA: Graduate Linguistic Student Association.

Odden, David. 1993. Interaction between modules in Lexical Phonology. In S. Hargus and E.M. Kaisse (eds.), Phonetics and Phonology 4: Studies in Lexical Phonology 111--144. San Diego: Academic Press.

Oswalt, Robert L. 1961. *A Kashaya grammar (Southwestern Pomo)*. Dissertation, UC Berkeley.

Oswalt, Robert L. 1964. *Kashaya texts*. University of California Press.

Oswalt, Robert L. 2005. Kashaya dictionary. Manuscript, California Language Archive, University of California, Berkeley.

Pater, Joe. 2000. Non-uniformity in English secondary stress: the role of ranked and lexically specific constraints. *Phonology* 17, 237-274.

Pater, Joe. 2009. Morpheme-specific phonology: Constraint indexation and inconsistency resolution. In: Steve Parker (ed.) *Phonological Argumentation: Essays on Evidence and Motivation*. London: Equinox 123-154.

Prince, Alan. 1991. Quantitative consequences of rhythmic organization. *Parasession on the Syllable in Phonetics and Phonology*, 355-398. Chicago Linguistic Society.

Pruitt, Kathryn. 2010. Serialism and locality in constraint-based metrical parsing. *Phonology* 27, 481-526.

Rice, Keren. 1990. Predicting rule domains in the phrasal phonology. In S. Inkelas & D. Zec (eds.), *The Phonology-Syntax Interface*. CSLI, Stanford and University of Chicago Press, 289-312.

Shwayder, Kobey. 2014. Morphosyntactic structure of phonological words. In J. Kingston, C. Moore-Cantwell, J. Pater & R. Staubs (eds.), *Proceedings of Phonology 2013*. LSA.

Wolf, Matthew. 2008. *Optimal Interleaving: Serial phonology–morphology interaction in a constraint-based model*. Dissertation, UMass Amherst.

Wolf, Matthew. 2009. Local ordering in phonology/morphology interleaving: Evidence for OT-CC. 83rd Linguistic Society of America Annual Meeting, San Francisco, CA.

Wolf, Matthew. 2011. Limits on global rules in Optimality Theory with Candidate Chains. *Phonology* 28, 87-128.

Abstract

The complex patterning of Kashaya stress and vowel length depends on the morpheme in which participating vowels are located. The verb root and Stem suffixes undergo various length alternations, whereas Word suffixes resist them. The special challenge is that whether a Stem vowel participates in these alternations can depend on syllable structure that is partly determined by a following Word suffix. This means that if the relevant rules or constraints apply before addition of Word suffixes, such as in a stratal approach, some kind of look-ahead or globality is required; but if the crucial Word suffix is present when the vowel alternations occur, there must be some mechanism to limit the participation of that suffix. In this paper I explore the complex interaction between the changes to vowel length and the morphological affiliation of the morphemes in question, and consider the challenges that these facts present to a range of rule- and constraint-based theories of how phonology interacts with morphology.

Keywords

stress
vowel length
strata
globality
rules and constraints