[corrected 10 Oct 1995]

Cyclicity as Correspondence

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6 October 1995
Derivational Residue in Phonology, Tilburg

In Uighur, /a/ raises to [i] in a morpheme-final open syllable, even in some cases when that syllable is closed on the surface due to another rule, Syncope of a high vowel between like consonants (Orgun 1994).

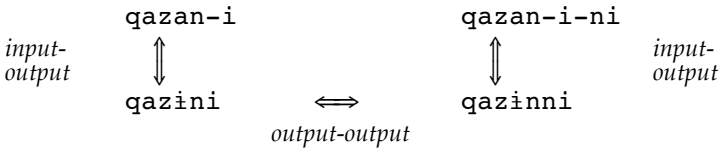
(1)	a.	qazan			'pot'
	b.	qazan-ni	→	qazanni	'pot-ACCUSATIVE'
	c.	qazan-i	→	qazini	'pot-POSSESSIVE'
	d.	qazan-i-ni	→	qazinni	'pot-POSSESSIVE-ACCUSATIVE'

To explain (1d), a cyclic analysis appeals to an intermediate stage where the relevant syllable is open.

(2)	a.	MORPHOLOGY 1	*suffixation*	qazan-i
	b.	Phonology	*Raising*	qazini
	c.	MORPHOLOGY 2	*suffixation*	qazini-ni
	d.	Phonology	*Syncope*	qazinni

Thus (1c) is a stage in the derivation of (1d) (and not of (1b)). But (1c) also exists as a surface form, so a different analysis of (1d) is possible: there are no intermediate stages, but the grammar can impose **correspondence** requirements on morphologically related words (e.g. McCarthy and Prince 1994, 1995; Benua 1995; McCarthy 1995; cf. Burzio 1994). In this approach, we find vowel raising in *qazinni* not because it has been **derived** from *qazini*, but because it is **related** to it.

(3)



In this approach, Uighur has an **output-output correspondence** on the feature [high]; I return below to certain questions raised by this claim.

This reformulation of cyclicity, essentially as analogy, is necessary in a **parallel model** of phonology, and is motivated to the extent that strict parallelism is motivated (e.g. Prince and Smolensky 1993). But are there more specific reasons to **prefer** correspondence over cyclicity? I show that in Kashaya correspondence makes possible a superior account of relations between **underlying and surface vowel length**, and its effect on the **location of stress**. In brief, if both phenomena are attributed to stages in a derivation, the rules must be complex and ad hoc; but if stress is influenced by correspondence, vowel length can be accounted for by means of simple and well-motivated surface constraints.

Kashaya Feet

Kashaya builds iambs from left to right. No secondary stresses; iterativity is shown by **Iambic Lengthening** (=IL). The main (only) stress is normally on the first foot. The root is shown in bold; note the vowel length alternations in the suffixes.

(4)	a.	**kel**-mul-ad-uced--u	
		→ (kél)(mula:)(duce:)(du)	'keep peering around'
	b.	**mo**-mul-ad-uced--u	
		→ (momú:)(ladu:)(cedu)	'keep running around'

A word-final vowel (4b) never undergoes IL; final long vowels are avoided, but more to the point every verb-final suffix, and potentially others preceding it, permit no IL of their vowels. **Non-lengthening suffixes** uniformly occur to the right of those which permit IL, so the domain of IL is a substring at the right side of the word. The double hyphen (--) indicates the beginning of the non-lengthening domain.

(5) a. **mo**-mac-ed--ela
→ (momá:)(cede)(la) 'I keep running in there'
b. **ṡi**--pʰila
→ (ṡipʰí)(la) 'if [it] happens'
c. **hoṭʰ**-ala--ṡuw-em
→ (hoṭʰá:)(laṡu)(wem) 'it would warm [us] up'
d. **mo**-mac-ed--eti
→ (momá:)(cede)(ti) 'although he kept running in there'

In lexical phonology (e.g. Kiparsky 1982), the derivation requires **several stages**: first the lengthening suffixes are added to the root; then IL applies; and then the non-lengthening suffixes are added (Buckley 1994a). After the second round of morphology, IL does not reapply.

(6) a.	*MORPHOLOGY 1*	mo + mac	mo + mac + ed
b.	*Phonology (with IL)*	(moma:) <c>	(moma:) (ce) <d>
c.	*MORPHOLOGY 2*	(moma:) c + eti	(moma:) (ce) d + ela
d.	*Phonology (no IL)*	(momá:) (ceti)	(momá:) (cede) (la)

This crucially refers to an **intermediate representation**, but work in Optimality Theory has placed that approach in doubt; much to be gained if ordered rules are replaced with constraints on surface representations (cf. Prince and Smolensky 1991, 1993). An example is the need for provisional final-consonant extrametricality in (6b), to permit IL in intermediate *momac*; cf. Buckley (1995a,b).

If we cannot appeal to *momaced* as an **intermediate** representation, we must refer to it as a **substring** of the surface representation within which IL occurs. Below, within $\{\ldots\}_1$ IL occurs, within $\{\ldots\}_2$ it does not.

(7) a. *Input with domains* {momaced}$_1${ela}$_2$
b. *Output with feet* (momá:)(cede)(la)

I will show that this difference can be attributed to the interaction of constraints on (i) the weight of the strong branch of an iamb, and (ii) the maintenance of underlying vowel length.

First, we must generate the foot structure on which IL is based. In a surface analysis, there is no notion of directionality; instead, we must refer to the **alignment of feet** (McCarthy and Prince 1993). As Crowhurst and Hewitt (1995) show, the precise manner in which a directionally based generalization such as 'left-to-right foot construction' translates into the alignment framework depends on whether degenerate feet are permitted. Below (34) I show that it is **right** alignment that must be used; this means that degenerate feet must be permitted, as supported by the existence of monomoraic words (e.g. *cá* 'stay!').

While I give here only single-word examples, Kashaya stress is assigned to the phrase (see Buckley 1995c for analysis). The following two constraints generate the **basic foot structure**.

(8)	ALIGNR	Align(Ft, R; PhonPhr, R)
	PARSESYL	Every syllable must be parsed by a foot.

In order to get the effect of **iterative footing** it is necessary to rank PARSESYL over ALIGNR (McCarthy and Prince 1993). I assume the undominated constraint FTFORM(Iamb).

(9)

keladucedu	PARSESYL	ALIGNR
a. ☞ (kelá:) (duce:) (du)		*, ***
b. ke (ladú:) (cedu)	*!	**
c. keladu (cedú)	*!**	

As mentioned, using ALIGNR to achieve the effect of left-to-right footing requires that we permit **degenerate feet**. In languages that avoid such feet, FTBIN is responsible (Prince and Smolensky 1993; cf. McCarthy and Prince 1993: 91). I assume that universally no foot is larger than two syllables.

(10) FTBIN A foot is binary under moraic or syllabic analysis.

Since, however, degenerate feet are **necessary** for ALIGNR in Kashaya, PARSESYL » FTBIN.

(11)

keladucedu	PARSESYL	FTBIN
a. ☞ (kelá:) (duce:) (du)		*
b. (kelá:) (duce:) du	*!	

The basic **effect of IL** is to achieve a perfect or canonical iamb, which consists of a light (and unstressed) syllable followed by a heavy (and possibly stressed) syllable (cf. Hayes 1985, 1995).

(12) ASYM In a branching iamb, the strong branch must be heavy.

ASYM is ranked lower than ALIGNR; cf. (17b,d). Notice in (13) that the **location of feet** is determined by PARSESYL and ALIGNR, while ASYM secondarily determines the **internal composition** of those feet.

(13)

keladucedu	PARSESYL	ALIGNR	ASYM
a. (kelá) (duce) (du)		*, ***	*!*
b. (kelá:) (duce) (du)		*, ***	*!
c. ☞ (kelá:) (duce:) (du)		*, ***	
d. (kelá:) (du) (cedu)		**, ***!	*
e. (kelá:) ducedu	*!**	***	

IL must be prevented in the non-lengthening domain (cf. Urbanczyk 1995: 512, McCarthy 1995: 43).

(14) Q-IDENT The quantity of each input segment must be identical to its output quantity.

The **difference between lengthening and non-lengthening suffixes** is quite simply a matter of which constraint wins: ASYM or Q-IDENT. Since the winner differs across the two domains, there must be a different constraint ranking in those domains. Following Buckley (1995a,b), I assume the existence of **C[onstraint]-domains** to which constraints can be particularized.

(15) { root + lengthening suffixes }$_1$ { non-lengthening suffixes }$_2$

Two C-domains require two **domain-specific constraints**. Q-IDENT{1}, which evaluates only segments in the lengthening domain C1, is ranked below ASYM; while Q-IDENT{2}, for the non-lengthening domain C2, dominates ASYM to prevent IL.

(16) Q-IDENT{2} » ASYM » Q-IDENT{1}

The UR, with domains labeled, is shown in the upper left corner of the tableau.

(17)

{kelala}$_1${pʰila}$_2$	Q-IDENT{2}	ALIGNR	ASYM	Q-IDENT{1}
a. (kelá) (lapʰi) (la)		*, ***	**!	
b. ☞ (kelá:) (lapʰi) (la)		*, ***	*	*
c. (kelá:) (lapʰi:) (la)	*!			*
d. (kelá:) (la) (pʰi) (la)		*, **, **!*		

Although in (17c) iambic structure is perfectly satisfied, it happens at the expense of preservation of underlying vowel length in the suffix *-pʰila*, subject to high-ranking Q-IDENT{2}. In (b), iambic structure is met only within the domain where low-ranked Q-IDENT{1} is violated, making it optimal.

Not only is Q-IDENT{1} low-ranked relative to ASYM, in fact it never plays any role in choosing candidates. Any form that Q-IDENT{1} might favor is ruled out by ALIGNR, which dominates ASYM and therefore necessarily Q-IDENT{1}. (Every long vowel leads to a new foot and adds violations of ALIGNR.) As noted by Buckley (1995a), an alternative to the view that a constraint such as Q-IDENT exists in two domain-specific forms is that there is only one constraint, but (in this case) it is ignored in C1. The important point is that violations within C1 never matter, whether this is treated as low ranking of a domain-particularized constraint, or by completely ignoring the violations.

Extrametricality

The **word-initial syllable** is regularly excluded from foot structure — is **extrametrical** — when the verb root is two or more syllables in length. (The roots seen so far, in (4) and (5), are one syllable long.)

(18) a. **libut**-ad--u
→ (butá:)(du) 'keep whistling'

b. **šiwey**-ibic-ed--em
→ <ši>(weyí:)(bice:)(dem) 'when new growth starts'

c. **bimucid**-uced--u
→ <bi>(mucí:)(duce:)(du) 'used to eat'

Many verbs in Kashaya take a **monosyllabic prefix**; here extrametricality occurs regardless of root length.

(19) a. du-**ḵil**-iċ--i
→ <du>(ḵilí:)(ċi) 'point at yourself!'

b. cʰi-**ʔdic**-mac-adad--u
→ <cʰiʔ>(dícʰ)(maca:)(dadu) 'pick up while going in'

c. do-**hqoṭol**-iċ-ed--a-em
→ <doh>(qoṭó:)(liċe:)(dam) 'couldn't get around'

To account for the lack of extrametricality in unprefixed monosyllabic roots, lexical phonology can apply a rule of Syllable Extrametricality **after prefixation but before suffixation**; the Non-Exhaustiveness Condition prevents an entire domain from being extrametrical, so only stems (root plus possible prefix) of at least two syllables will undergo the rule (Buckley 1994b).

(20)

ROOT, PREFIX	libut	du-ḵil	kel
Extrametricality	but	<du>ḵil	— (*<kel>)
SUFFIXATION	but-ad-u	<du>ḵil-iċ-i	kel-ad-u
Footing	(butá:)(du)	<du>(ḵilí:)(ċi)	(kelá:)(du)

Once again, the lexical phonology analysis relies crucially on an intermediate stage. In this case that stage is different from the one required for IL in (6), which does include many suffixes.

In OT, the equivalent of Syllable Extrametricality is a constraint which **prevents a syllable from being footed**. Below is one possible formulation. As shown in (22), NONINITIAL » PARSESYL.

(21) NONINITIAL Align(Ft, L; Syl, R).

(22)

{libutad}$_1${u}$_2$	NONINITIAL	PARSESYL	ALIGNR
a. (libú:) (tadu)	*!		**
b. ☞ li (butá:) (du)		*	*
c. li (bú) (tadu)		*	**!

Of course, NONINITIAL is **always violated in words with a root restricted to the first syllable**. Without intermediate representations, however, we cannot appeal to the Non-Exhaustiveness Condition. Rather, a constraint prevents the complete non-footing of the root.

(23) FT-ROOT The root must be dominated by a foot. (The root must overlap with a foot.)

Intuition: the **morphological head of the word** is too important to be excluded from higher prosodic structure (see Buckley 1995c for more discussion).

(24)

{**kel**ad}$_1${u}$_2$	FT-ROOT	NONINITIAL
a. ☞ (kelá:) (du)		*
b. ke (ladú)	*!	

In the interpretation of this constraint, only a syllable which is **headed** by material in the root satisfies the requirement of inclusion in the next higher level of prosodic structure, the foot. For example, the presence of the root /l/ in the foot in (24b) is insufficient to permit non-footing of /ke/.

When the **root is at least disyllabic**, FT-ROOT and NONINITIAL can both be satisfied.

(25)

{**libut**ad}$_1${u}$_2$	FT-ROOT	NONINITIAL	PARSESYL	ALIGNR
a. (libú:) (tadu)		*!		**
b. ☞ li (butá:) (du)			*	*
c. li (bú) (tadu)			*	**!
d. libu (tadú)	*!		**	

When a monosyllabic root is **preceded by a prefix**, the two constraints FT-ROOT and NONINITIAL are again both satisfied in the optimal candidate: it is the word-initial prefix which is excluded from foot structure, and the root itself is free to be footed. While the lexical phonology analysis illustrated in (20) makes use of the prefix and root as an intermediate constituent in accounting for when Syllable Extrametricality can apply, the constraint analysis refers directly to the root alone, in the form of the constraint FT-ROOT; the role of the prefix simply falls out from the nature of the constraints and the morphology.

Foot Flipping

A remarkable indication of the pressure in Kashaya for iambic rhythm is found in the process that Buckley (1994a,b) calls **Foot Flipping**. When the leftmost (visible) sequence of the word is CvvCv, the vowel lengths in the two syllables are 'flipped' or reversed, resulting in the perfect iamb CvCvv.

(26)

a.	**di:ċ**-aq^{w}-iċ--i	→	(diċa:)(qoċí)	'take a message out!'
b.	**ġa:**-cid--u	→	(ġaci:)(dú)	'keep leaving'
c.	**miku:ṭ**-ad--e:	→	<mi>(kuṭa:)(dé:)	'keep humming'
d.	**mu-bo:ḳ**-ibic--ʔ	→	<mo>(boḳi:)(bíʔ)	'start to rise'

In addition to the flipping of vowel lengths, notice that the **stress falls on the second foot**, rather than on the first one as is normally the case in Kashaya.

CvvCvC — where the last consonant is in the coda — **does not undergo Flipping**. The reason: the maximal syllable in Kashaya is CvC, and Flipping would result in *CvvC.

(27)

a. **di:ċ--i?ba**
→ (di:)(ċíʔ)(ba) 'cause to bring a message out'

b. **ġa:-muċ--ba**
→ (ġa:)(múċ)(ba) 'after leaving each other'

c. **miku:ṭ--e:**
→ <mi>(ku:)(ṭé:) 'be humming'

d. **kilu:ca-:qa-w**
→ <ki>(lu:)(cá:)(qaw) 'a lock'

In this case the stress also falls on the second foot in the word; we will see that the **shift in stress** that occurs in conjunction with Foot Flipping can be accounted for in the same manner as that found in (27).

A related phenomenon is found with **Closed-Syllable Shortening**. Notice in (28) that the first foot is again skipped for stress, even though on the surface it does not contain a long vowel.

(28)

a.	**di:ċ**-waċ--a-emu	→	(diċ)(waċá)(mu)	'what they say (is)'
b.	da-**li:t**-qa--w	→	<da>(lit^{h})(qáw)	'let wave with the hand'

What all three cases of stress shift have in common is a **long vowel** that seems to start out at the beginning of the foot that is skipped; only in (27) does it surface there. Buckley (1994a,b) proposes a serial

analysis whereby a rule of Foot Extrametricality applies to any foot **beginning** with Cvv, thereby uniting Cvv and (underlying) CvvCv and CvvC. This requires temporary creation of the **ill-formed 'anti-iamb'** CvvCv, which persists until Foot Extrametricality applies, after which a literal rule of Foot Flipping simply reverses the vowel lengths to create a true iamb. Henceforth I use « » for an extrametrical foot.

(29)				
i.	*Foot Construction*	(dí:) (ċah) (qaw)	(dí: ċa) (qo ċi)
ii.	*Foot Extrametricality*	«di:» (ċáh) (qaw)	«di: ċa» (qo ċí)
iii.	*Foot Flipping*	—	«di ċa:» (qo ċí)

Similarly, the **ill-formed superheavy** CvvC must be temporarily permitted until Foot Extrametricality applies, after which it undergoes Shortening (cf. Buckley 1991).

(30)				
i.	*Foot Construction*	(di:ċ) (waċa) (mu)	<da> (li:t^h) (qaw)
ii.	*Foot Extrametricality*	«di:ċ» (waċa) (mu	<da> «li:t^h» (qaw)
iii.	*Shortening*	«diċ» (waċá) (mu)	<da> «lit^h» (qáw)

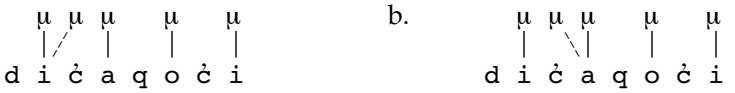
In addition to the ad hoc nature of Foot Flipping and the temporary creation of ill-formed structures, Foot Extrametricality also requires the **dubious generalization** "begins with Cvv", to cover Cvv (27), CvvCv (26), and CvvC (28).

A more principled analysis is possible using constraints. The change does not need to be analyzed as 'flipping' per se, whereby the mora moves from one syllable to another. Rather, it can be seen as **underlying indeterminacy** in the association of the mora, which is resolved by metrical and syllabic well-formedness; that is, one mora's **association is underspecified** (cf. Kiparsky 1992).

(31) a. *root morpheme* b. *with suffixes*

There are two basic **surface realizations possible**: leftward or rightward linking to a vowel.

(32) a. b.



The choice between these forms is made by ALIGNR, which **prefers branching feet at the left edge**. (A raised period [·] indicates a floating mora in the UR; a colon [:] indicates a linked mora.)

(33)

{di·ċaqoċ}$_1${i}$_2$	Q-IDENT{2}	ALIGNR	ASYM
a. (di:) (ċaqo:) (ċi)		*, **!*	
b. ☞ (diċa:) (qoċi)		**	*
c. (diċa:) (qoċi:)	*!	**	

The next example shows clearly that **rightward alignment** is necessary in Kashaya, since (34a,b) are identical in all respects except for the location of vowel length and foot boundaries.

(34)

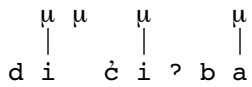
{miku·ṭad}$_1${e:}$_2$	NONINITIAL	PARSESYL	ALIGNR
a. mi (ku:) (ṭadé:)		*	**!
b. ☞ mi (kuṭa:) (dé:)		*	*
c. (miku:) (ṭadé:)	*!		**

The major success of the constraint-based analysis is that the **same constraint** needed to determine foot structure in simple cases — namely, ALIGNR — serves as the motivation for Foot Flipping. The fact that the lexical phonology analysis requires the ad hoc rule of Foot Flipping to accomplish the same task constitutes a strong argument in favor of the constraint-based approach.

Phonologically blocked Flipping

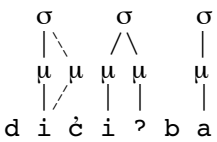
As seen in (27), vowel length surfaces in the root, i.e. there is **no Flipping**, when the rightward potential docking site of the floating mora is a **heavy syllable**. Below is a relevant input representation.

(35)

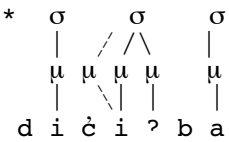


The first of these consonants /ʔb/ must syllabify as a coda, where it must bear a mora itself. That makes a total of two moras in the syllable, with **no room for the floating mora**.

(36) a.



b.



(37) BIMORA A maximum of two moras is permitted in a syllable.

To avoid a bimoraic syllable, but maintain the long vowel, the coda would have to be eliminated from the syllable, either by **deleting the consonant** (*diċi:ba*) or by **inserting a vowel** so the consonant can syllabify as an onset (*diċi:ʔiba*). Neither of these candidates wins, due to the following constraints.

(38) MAX Every input segment must correspond to an output segment. (Do not delete.)
DEP Every output segment must correspond to an input segment. (Do not insert.)

MAX and DEP are fundamental faithfulness constraints on segments, which resist changes to the basic underlying string; see McCarthy and Prince (1995).

(39)

{**di·ċi**ʔ}$_1${ba}$_2$	BIMORA	MAX	DEP	ALIGNR
a. ☞ (di:) (ċiʔ) (ba)				*,**
b. (diċi:ʔ) (ba)	*!			*
c. (diċi:) (ba)		*!		*
d. (diċi:) (ʔiba)			*!	**

Reshuffling of mora–segment linkings (e.g. vocalic mora links to coda) is prevented as follows.

(40) MORA-IDENT The features linked to a mora in the input are identical to those in the output.

See Buckley (1995c) for discussion of further constraints which prevent other rearrangements of the moraic structure, e.g. MAX(μ) and LINEARITY.

Morphologically blocked Flipping

In addition to its ad hoc nature, the serial lexical phonology analysis in (29) treats IL and Foot Flipping as independent rules, and it is a complete coincidence that the **domains of the two rules are identical**. For example, notice that the suffix *-mela* resists IL (41a) as well as Foot Flipping (b).

(41) a. **baṭi**--mela → <ba>(ṭimé)(la) '[we] camped'
*<ba>(ṭimé:)(la)

b. **ġa·**--mela → «ġa:»(melá) 'I left'
*«ġame:»(lá)

Formally, this shared restriction on IL and Foot Flipping is easy enough to state, by assigning both rules to the same lexical level (cf. Buckley 1994a). But this move provides no explanation as to **why** this correlation should obtain, and it is predicted that a similar language might have the same rules in different levels. This prediction is dubious, since both processes result in the same perfect iamb.

In the OT analysis, the **high-ranking status of Q-IDENT{2}** accounts for both facts: IL and Foot Flipping both introduce a long vowel, and Q-IDENT{2} ensures that this not occur in C2.

(42)

{**ḍa·**}$_1${mela}$_2$	Q-IDENT{2}	ALIGNR	ASYM
a. ☞ (ḍa:) (melá)		**	*
b. (ḍame:) (lá)	*!	*	

The explanation of the correlation is transparent in the constraint-based analysis: in both cases, creation of a long vowel in C2 is blocked by Q-IDENT. The special status of C2 is stipulated for a **single constraint**, which by itself accounts for the lack of **both processes**. Such an explanation is not possible in the ordered-rule approach, and this fact constitutes a powerful argument against it.

Closed-Syllable Shortening

The analysis developed so far also accounts quite easily for Closed-Syllable Shortening (28). The following input has a **cluster of two consonants**, /ċw/, following the root vowel.

(43)

```
      μ μ     μ   μ   μ
      |       |   |   |
    d i ċ w a ċ a m u
```

In this context, the floating mora has not just two places to link, in the ways seen above, but it can also, as shown in (44c), **serve as the mora for the coda consonant** /ċ/.

(44) a.

```
      μ μ   μ   μ   μ
      |/    |   |   |
    d i ċ w a ċ a m u        =   *(di:ċ)(waċa)(mu)
```

b.

```
      μ  μ  μ   μ   μ
      |   \ |   |   |
    d i ċ w a ċ a m u        =   *(diċ)(wa:)(ċamu)
```

c.

```
      μ μ   μ   μ   μ
      | ¦   |   |   |
    d i ċ w a ċ a m u        =    (diċ)(waċa)(mu)
```

The form in (44a) is ruled out by BIMORA, just as illustrated in (39b). The linking to the following vowel in (44b), by contrast, is well-formed syllabically. But it is **not as well aligned** as (44c), where the floating mora links to the coda consonant and pre-empts Weight-by-Position.

(45)

{**di·ċ**waċ}$_1${amu}$_2$	BIMORA	ALIGNR	ASYM
a. (di:ċ) (waċa) (mu)	*!	*, ***	*
b. (diċ) (wa:) (ċamu)		**, ***!	*
c. ☞ (diċ) (waċa) (mu)		*, ***	*

This derivation captures a reasonable intuitive interpretation of Closed-Syllable Shortening, that the coda consonant 'steals' the second mora of a long vowel. The only quirk in Kashaya is that the mora in question was never actually linked to the vowel.

Elision

Within C1, adjacent vowels /V_iV_j/ become long [V_i:] by **Elision** (in C2 the result is short [V_i], by Q-IDENT; cf. (28a)). This occurs where Flipping is not possible, whether phonologically (46) or morphologically (47).

(46) a. **mo**-ibic--ʔ → «mo:»(bíʔ) 'run away'
b. **ca**-ad--uʔba → «ca:»(dúʔ)(ba) 'could fly'
c. **puhṭi**-aqac--ʔ → <puh>«ṭi:»(qáʔ) 'go up alone'

(47) a. **mo**-aq--ela → «mo:»(qalá) 'I'm running'
b. **mo**-ad--eti → «mo:»(detí) 'even though [it] was running'
c. cʰi-**de**-ad--u → <cʰi>«de:»(dú) 'carry along'

The two adjacent vowels are, however, a common **source of Foot Flipping**.

(48) a. **mo**-aloqʷ-iċ--i
→ «molo:»(qoċí) 'run up out here!'
b. **do**-ibic--i
→ «dobi:»(cí) 'raise your hand!'
c. **yehe**-ala-meċ--tʰu-ʔ
→ <ye>«hela:»(méʔ)(tʰuʔ) 'don't drag yourself down!'

Using an ordered-rule framework, Buckley (1994a,b) has to assume that even in cases of Flipping, the **intermediate step** exists in which the two vowels are syllabified together, and then the length is flipped.

(49)	*Underlying form*	moaloqoċi	cahnoaduċi
i.	*Elision and Footing*	(mo:lo)(qoċi)	<cah>(no:du)(ċi)
ii.	*Foot Extrametricality*	«mo:lo»(qoċi)	<cah>«no:du»(ċi)
iii.	*Foot Flipping*	«molo:»(qoċí)	<cah>«nodu:»(ċí)

This **intermediate CvvCv foot is necessary to trigger** both Foot Extrametricality and Foot Flipping. Similarly, **intermediate superheavy CvvC** is required for forms with Closed-Syllable Shortening (cf. (28)), though in this case the only need is to trigger Foot Extrametricality.

(50) a. **mo**-aq--mela
→ «mo:h»(melá)
→ «moh»(melá) 'I ran through there'

b. **pʰila**-aċ--me-ʔ
→ <pʰi>«la:ċ»(méʔ)
→ <pʰi>«laċ»(méʔ) 'come here! (pl)'

The **floating-mora analysis** extends easily to these cases, and **obviates the intermediate steps**. Assume that loss of the second vowel is accomplished by constraints dominating MORA-IDENT (40), including ONSET (e.g. Prince and Smolensky 1993) and NODIPH (e.g. Rosenthall 1994).

(51)
```
  μ μ   μ   μ   μ
  | ǂ   |   |   |
m o a l o q o ċ i
```

The second mora is prohibited from remaining linked to its own features, and **behaves identically to an underlyingly floating mora**, as in (31b). The two output possibilities are precisely those outlined in (32).

(52)

{moala}$_1${qoċi}$_2$	ALIGNR	ASYM
a. (mo:) (laqo:) (ċi)	*, **!*	
b. ☞ (mola:) (qoċi)	**	*

In a sense, it is a root like ***di·ċ-*** which is like ***mo-aq-***, rather than vice versa: there is no long vowel in the underlying form of ***di·ċ-***, simply a short vowel and a floating mora, just as in ***ca-ad-*** there is a short root vowel plus a mora provided by the suffix. Once again the constraint-based analysis makes possible a simpler and more elegant account of the alternations.

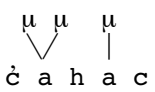
True Long Vowels

While it appears to be a fact about Kashaya that verb roots normally do not have underlying long vowels — i.e. vowel features linked to two moras — there are nevertheless a few cases of apparent **underlying long vowels**, and these are non-alternating and fail to undergo Foot Flipping.

(53) **ċa:hac**-id--em → «ċa:»(hací:)(dem) 'when he marries'
ma:ku-c-ibic--ʔ → «ma:»(kucí:)(biʔ) 'start to grow deaf'
ʔaca:ċ-am-at-ad--u → <ʔa>«ca:»(ċamá:)(tadu) 'embryo start to develop (pl)'

I treat these roots as **prespecified in the underlying representation** with long vowels (cf. Kiparsky 1991), and use the colon [**:**] in the inputs in (53) as an indication of this analysis.

(54)



This underlying linking is all that is necessary to account for the lack of Flipping. MORA-IDENT (40) prevents movement of the second mora of the long vowel into the following syllable.

(55)

{**ċa:hac**id}$_1${em}$_2$	MORA-IDENT	ALIGNR	ASYM
a. ☞ (ċa:) (hací:) (dem)		*, ***	
b. (ċaha:) (cidém)	*!	**	

MORA-IDENT must look not at whether the **content** of the features linked to the mora is the same, but whether the same **linkings** to the mora are maintained. This means that movement from one /a/ to another is prohibited.

Correspondence of Stresses

The constraint-based analysis elegantly unifies the accounts of IL and Foot Flipping. Now we must deal with the similarity in stress patterns between the flipped and non-flipped words. Recall the general pattern according to which an **initial Cvv foot is skipped** in choosing the main stress of the word — i.e. it is extrametrical (56). The initial foot dominating the same root is extrametrical even when it is not of the shape Cvv, e.g. **even when it is flipped or shortened** (57).

(56) a. **di·ċ--i**ʔba → «di:»(ċíʔ)(ba) 'could tell'
b. **di·ċ--ela** → «di:»(ċelá) 'I tell'
c. **di·ċ--i** → «di:»(ċí) 'tell!'

(57) a. **di·ċ**-aqʷ-iċ--i → «diċa:»(qoċí) 'take a message out!'
b. **di·ċ**-id--a-em → «diċi:»(dám) 'told about'
c. **di·ċ**-waċ--a-emu → «diċ»(waċá)(mu) 'what they say (is)'
d. **di·ċ**-maq--o → «diċ»(maqó) 'bring the message in!'

Contrast this with the situation of a root with **no (underlying) long vowel in the first syllable**, and therefore no skipping of the first foot.

(58) a. **kel--i**ʔba → (kelíʔ)(ba) 'could peer'
b. **kel--ela** → (kelé)(la) 'I peer'
c. **kel--i** → (kelí) 'peer!'

(59) a. **kel**-adad--u → (kelá:)(dadu) 'look at while riding'
b. **kel**-ma--w → (kél)(maw) 'peer down at'

The forms in (59a) and (57a) have identical syllable structures, but different stresses. In (57) underlying vowel length has been shifted or eliminated, but the resulting foot is skipped just like Cvv in (56).

A framework tied to surface constraints **cannot refer to intermediate levels** as was done in the lexical phonology analysis illustrated in (29), but as we saw that analysis has numerous problems anyway. First let us **account for the case of a simple Cvv foot**. Such a foot, when the first one in the domain, is skipped for stress. For present purposes, this can be accomplished by the following constraint.

(60) SKIPFT Do not stress an initial CVV foot.

The formal consequence is exclusion of the foot from line 2 constituency. It is not possible to have a constraint which says not to stress **any** Cvv foot, since the effect is not iterative; cf. *<ki>lu:cá:qaw* 'a lock'.

SKIPFT must **dominate two basic constraints** on metrical structure.

(61) PARSEFT Incorporate a line 1 constituent (a foot) into a line 2 constituent.
ALIGNHD Align the head of the phrase with the left edge of the phrase.

Under this analysis, the location of stress in a phrase (here, just one word) beginning with surface Cvv (modulo syllable extrametricality) is **due to SKIPFT** and the floating mora linking leftward (56). Every word that undergoes Flipping or Shortening is related to a word where neither occurs, and where shift is motivated transparently on the surface by Cvv. This fact is illustrated for the root *di·ċ* in (56) and (57). Whereas in many words shift is directly due to SKIPFT, in words that lack initial Cvv (thanks to Flipping or Shortening), the shift follows not from the surface form but from **output-output correspondence** with words that do have Cvv.

(62) a.
```
    (   x)
 (x) (.  x)
 di: ċe lá
```
by SKIPFT

b.
```
     (   x)
 (.  x)(.  x)
 di ċa: qo ċí
```
by correspondence with (a)

c.
```
      (   x   )
 (x) (.  x)(x)
 diċ wa ċá mu
```

Specifically, the **location of the metrical head** of the word must remain consistent across instantiations of a root or stem.

(63) STRESS-IDENT^{O} If the first foot is stressed in one word, it must be stressed in related words.

The superscript 'O' indicates that the constraint is on outputs, rather than the default form of correspondence, which relates the input and output. In the following tableau, **related output forms are evaluated together**, so that the winning candidate is actually a set of forms, rather than a single form.

(64)

Candidate Sets	STRESS-ID^{O}	SKIPFT	PARSEFT
a. ☞ (kelá:) (dadu) (kelí?) (ba)			
b. «kela:» (dadú) «keli?» (bá)			*! *
c. (kelá:) (dadu) «keli?» (bá)	*!		*

(65)

Candidate Sets	STRESS-ID^{O}	SKIPFT	PARSEFT
a. (diċá:) (qoċi) (dí:) (ċi?) (ba)		*!	
b. ☞ «diċa:» (qoċí) «di:» (ċí?) (ba)			* *
c. (diċá:) (qoċi) «di:» (ċí?) (ba)	*!		 *

In (64), perfect satisfaction of all three constraints is possible. In (65), the two highest ranked (STRESS-IDENT^{O} and SKIPFT) can be satisfied, so there is no necessary ranking between them, only that both dominate PARSEFT. The winning candidate set obeys SKIPFT in the word where that constraint matters, and patterns the second word after the first (in order to obey STRESS-IDENT^{O}).

The two words of each pair illustrate **the only types of cases that exist**: any other word based on the same root will fall into one of the same two categories, i.e. where the underlying length is preserved in the root and where it is not. So the same reasoning applies to the entire derivational and inflectional paradigm: based on a subset of the words that require SKIPFT, all related words also show the same effect.

Relatedness

An obvious question is what will serve as the 'related form' on which the output-output correspondence is based. One clear generalization in Kashaya is that the property of skipping the first foot (i.e. line 2 constituent alignment) is unfailingly **shared for all instantiations of a particular root**. Thus there is no need to decide among different words with the same root: all produce the same result, illustrated in (65).

But correspondence goes beyond that. Because of **Elision**, a particular root may or may not have a long vowel to undergo flipping, depending on which suffix immediately follows it. Take *mo-* 'run'. If a consonant follows, it patterns like *kel-* in (64), with **no foot skipping**.

(66) a. **mo**-mul--i → (momú:)(li) 'run around!'
b. **mo**-ht-mul--ʔ → (móh)(timuľ) 'ran around (pl)'

If a vowel follows, however, Elision yields an extra mora, and the complex stem patterns like *di·ċ-* (65), i.e. the **first foot is uniformly skipped**, with or without flipping.

(67) a. **mo**-ibic--ba → «mo:»(bíċ)(ba) 'after running away'
b. **mo**-ibic--i → «mobi:»(cí) 'run away!'

In determining relatedness, then, more than just 'same root' is relevant. Minimally, we must be able to take account of the first suffix as well.

I suggest that the reason that stress is skipped in «*mobi:*»(*cí*) — i.e. it obeys STRESS-IDENT^{O} relative to «*mo:*»(*bíċ*)(*ba*) in (67a) rather than, say, relative to (*momú:*)(*li*) in (66a) — is **degree of relatedness**. The verb ***mo-ibic--i*** shares with ***mo-ibic--ba*** not just its root, but also the complex stem that results from the addition of the suffix *-ibic*.

(68) a. [[[mo] mul] i] } *root shared*
↕
b. [[[mo] ibic] i] } *root and suffix shared*
↕ ↕
c. [[[mo] ibic] ba]

While (68a,b) share the suffix *-i*, relatedness is **mediated by morphological constituency**: as can be seen, *mo-* and *-i* are not a single constituent, while *mo-* and *-ibic* are.

Identity, then, is enforced **most strongly** for words which share the **most morphological constituency**. By the same principle, we might expect the second suffix to play a role as well. For example, (69a) ought to correspond to (69b) in preference to (67a) or (b). But in fact it **can simultaneously correspond perfectly** to the line 2 alignment of all these words.

(69) a. **mo**-ibic-ed--u → «mobi:»(cedú) 'to run away'
b. **mo**-ibic-ed-uced--u → «mobi:»(cedú:)(cedu) 'to keep running away'

For the relevant property — skipping of the first foot — the presence of additional suffixes makes no difference. What really matters is that **one class** of related words, exemplified by (67a), **requires foot skipping independent of correspondence**, and the other related classes are able to correspond with it. Similarly, in a case such as *di·ċ-* (65), **constituency beyond the root is irrelevant**: perfect correspondence of foot-skipping is possible for all words with this root, regardless of suffixes.

This approach extends to the Uighur data given above in (1) and repeated below.

(70) a. qazan 'pot'
b. qazan-ni → qazanni 'pot-ACCUSATIVE'
c. qazan-i → qazini 'pot-POSSESSIVE'
d. qazan-i-ni → qazinni 'pot-POSSESSIVE-ACCUSATIVE'

The form in (70d), like Kashaya foot-skipping, is an example of **overapplication** as found also in reduplication (e.g. McCarthy and Prince 1995) and truncation (Benua 1995).

What is relevant is that (d) shares the constituent [[*qazan*]*i*] with (c); and (c) has the surface structure necessary to trigger Raising. But note the **asymmetry** in correspondence relationship.

(71) The [+high] in *qazini* forces the [+high] in *qazinni* (from *qazan-i-ni*).

(72) The [+high] in *qazini* does **not** force a [+high] in *qazan*.

Thus while *qazini* affects the form that contains it (71), it does not affect the form that it contains (72).

(73)

	qazan		qazan-i		qazan-i-ni
input-output	⇕		⇕		⇕
	qazan	⇒	qazini	⇒	qazinni
		output-output		*output-output*	

This asymmetry is easily captured by the **temporal metaphor** of the cyclic approach; creation of the inner constituent precedes creation of the larger one (or nontemporally, the larger constituent draws properties from the inner one). In the correspondence approach the generalization is that when **one output form is a subconstituent of another**, it imposes its phonological properties on the larger form, rather than vice versa. It remains to be seen whether this fact can be derived from some more general principle. (In the Kashaya case, there is no proper inclusion; there are simply related words which **share** the same subconstituent. In this case the influence among related forms can be treated as symmetric.)

A **functional perspective**: Note the **incoherence of establishing the superset as the 'basic' form** to be imitated by the subset: there is in principle an infinite number of superset words which might serve as the basis of correspondence, with potentially contradictory requirements, while the subset word is unique (for each level of constituency). (These statements hold of the synchronic grammar; diachronic analogy, sporadic by nature, can of course work in the opposite direction.)

A **preliminary analysis** of the Uighur alternations includes the following constraints.

(74)

a.	*CiC	No high vowel between identical consonants.
b.	*a]	No low vowel in a morpheme-final open syllable.
		(Dominated by a constraint against word-final [i] to prevent raising there.)

The forms in (70) all obey these constraints. The noteworthy fact is overapplication of *a], due to an output-output correspondence on vowel height features, call it HEIGHT-IDENT^{O}. By the principle of **greatest shared constituency**, it is the **largest** subset word which has the determinative influence on the superset word. Thus *qazan-i-ni* imitates *qazan-i* rather than *qazan*. This same principle is relevant to the following data as well, which introduce a complication.

(75)

a.	bala			'child'
b.	bala-lar	→	balılar	'child-PLURAL'
c.	bala-lar-i	→	balları	'child-PLURAL-POSS'

In (75c) the **raised vowel also syncopates**, while in (b) it **does not** (cf. Orgun 1995 for Uighur, McCarthy 1993 for similar Arabic data). These facts can be handled in the present framework by interpreting HEIGHT-IDENT in terms of **distantial faithfulness**, proposed by Kirchner (1995) to account for vowel shifts. In essence, [a] can correspond to [ı], and [ı] to Ø, but the correspondence [a] to Ø is too distant.

(76)

	bala		bala-lar		bala-lar-i
input-output	⇕		⇕		⇕
	bala	⇒	balılar	⇒	balları
		output-output		*output-output*	

The correspondence [a] to Ø is permitted between input and output (as in *balları*), but not between outputs. This suggests HEIGHT-IDENT^{O} » *CiC » HEIGHT-IDENT^{IO}. In *balılar* the constraint *CiC would prefer *ballar*, but correspondence with the surface [a] in *bala*, subject to distantial faithfulness, prevents complete loss of the vowel.

Conclusion

I have argued in some detail that an analysis with surface constraints captures the formal similarities between phenomena in Kashaya such as Iambic Lengthening and Foot Flipping in ways not available to an analysis reliant on intermediate steps — namely, the interaction of constraints such as ALIGNR, ASYM, and Q-IDENT. To provide a full accounting of the facts, two enrichments to the theory are necessary: **constraint domains**, which permit substrings to be subject to different constraint rankings; and **output-output correspondences**, which permit the optimal form of one word to be determined in part by reference to the output form of another word.

While for cases such as Uighur an account of cyclicity effects is possible by reference to either intermediate or surface forms, for Kashaya only output-output correspondence works. Thus **correspondence handles both types of data**, and makes intermediate stages unnecessary. The Kashaya data provide an example where the object of correspondence is in a sense not a complete surface form: but since the relevant criterion of correspondence is **relatedness**, this type of morphology is not problematic. The property which must be shared is determined by some aspect of the phonological representation of another surface form which is morphologically **related** — not necessarily **included**, although the latter is a subtype of relatedness which, as in the case of Uighur, can also be analyzed within this framework.

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