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Stress-Epenthesis Interactions
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1. Introduction[1]

In many languages, stress assignment appears to ignore inserted vowels, giving rise to opaque stress patterns. This fact has provided strong arguments for multi-level derivations, which account for the apparent invisibility of epenthetic vowels by inserting them after stress is assigned. Because this approach requires multiple levels of derivation, stress-epenthesis interactions are potential problems for a framework that allows reference to only two levels, input and output. However, as Alderete (1995b, 1999a) has argued, even strictly parallel versions of Optimality Theory can account for the invisibility of inserted vowels by means of constraints requiring elements in prosodic constituents to have correspondents in underlying representation.

In this paper I argue that the correspondence approach to stress-epenthesis interactions actually provides a better match with the wide array of stress-epenthesis interactions than the multi-level approach. The general argument of the paper is that disruption of normal stress patterns by epenthetic material is caused by one of two factors: avoidance of epenthetic material in prominent positions, and maximization of paradigmatic contrasts. I discuss stress-epenthesis interactions in four languages. In Selayarese loanwords, the main stress foot is constructed to avoid inclusion of epenthetic vowels anywhere in the foot, while in North Kyungsang Korean loanwords and in Winnebago native vocabulary, epenthetic vowels are avoided in the head position of a foot. Iraqi Arabic illustrates a different motivation for the apparent invisibility of inserted vowels, the maximization of contrast between stems of different grammatical types.

2. Selayarese Loanwords

In Selayarese, one of the Makassar languages of South Sulawesi, Indonesia, the very general pattern of penultimate stress may be disrupted by the presence of epenthetic vowels. This disruption has been accounted for in a serial derivation by ordering epenthesis after stress assignment (Mithun and Basri 1986), and in strictly parallel OT by means of a constraint banning epenthetic material from the head foot of a prosodic word (Alderete 1995b, 1999a). In terms of empirical coverage of native vocabulary, these two approaches are equivalent. However, data from loan phonology provides a wider range of stress-epenthesis interactions, and I argue below that only the strictly parallel approach can account successfully for the stress in borrowed words.

I begin by reviewing stress-epenthesis patterns in native vocabulary. Stress is normally penultimate in monomorphemic words, regardless of syllable structure:

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(1) Normal penultimate stress

a. sahála	'sea cucumber'
b. palóla	'eggplant'
c. balíkaʔ	'arm'
d. sampúlo	'ten'
e. barámbaŋ	'chest'
f. kalihára	'ant'
g. kalumánti	'big black ant'
h. búlaŋ	'moon, month'
i. tímbo	'grow'
j. góntiŋ	'scissors'

This stress pattern can be analyzed as preference for a bisyllabic, trochaic foot at the right edge of the word. The bisyllabic nature of the foot is consistent with the minimal word size; all major category words consist of at least two syllables.

The exceptions to penultimate stress are of two kinds. First, several suffixal clitics fall outside the stress domain; these are argued by Selkirk (1999), Basri, Broselow, Finer (1999), and Basri, Broselow, Finer, and Selkirk (1997) to be outside the prosodic word. Second, there are a number of monomorphemic words with antepenultimate stress, which have been analyzed as containing a final epenthetic vowel (Mithun and Basri 1986, Piggott 1995, Basri, Broselow, Finer, and Selkirk 1997):

(3) Monomorphemes with antepenultimate stress

surface	root	
a. sáhala	/sahal/	'profit'
b. lámbere	/lamber/	'long'
c. bótoro	/botor/	'gamble'
d. sússulu	/sussul/	'burn'
e. páʔrisi	/páʔris/	'painful'
f. maŋkásara	/maŋkasar/	'Makassar'
g. kasíssili	/kasissil/	'mosquito'
h. barúasa	/baruas/	'cookie'
i. hállasa	/hallas/	'suffer'

Comparison of (1a) *sahála* 'sea cucumber' and (3a) *sáhala* 'profit' reveals that stress cannot be entirely predicted from surface structure. However, all morphemes with antepenultimate stress share certain properties. First, all end in a vowel which is preceded by either /*r*/, /*l*/, or /*s*/, none of which is an acceptable coda in this language. The vowel following /*r,l,s*/ is identical to the preceding vowel, suggesting the final vowel reflects a process of insertion of a copy of the nearest vowel to allow stem-final /*r,l,s*/ to be syllabified as an onset. This analysis is confirmed by the fact that final vowels of stems with antepenultimate stress disappear before a vowel-initial suffix (4a,b), in contrast with other final vowels, as in (4c,d):

(4) Disappearance of epenthetic vowel

a. lámbere	lambéraŋ	/lamber+aŋ/	'long/longer'
b. hállasa	hallási	/hallas+i/	'suffer/make suffer'
c. lóhe	lohéaŋ	/lohe+aŋ/	'many/more'
d. rúppa	ruppái	/ruppa+i/	'face/confront'

In a serial approach, stress is assigned to the penultimate syllable before the final vowel is inserted. In a parallel approach, the constraint HEADDEP (Alderete 1995b, 1999a) prevents the main stress foot from containing epenthetic material. This means that in a word like *lámbere*, from underlying */lamber/*, the bisyllabic trochaic stress foot is built on the first two vowels, leaving the final vowel unfooted: {*lámbe}rE*. (Here and in the following discussion, inserted vowels are shown in upper case.)

These two analyses do equally well in accounting for forms with final epenthetic vowels. The more interesting cases, however, involve medial epenthesis, which we can see in the adaptation of loanwords that do not conform to Selayarese phonotactic constraints. Most loans into Selayarese are from Bahasa Indonesia (BI), the lingua franca of the region. In general, the stress of the BI forms is ignored, with loans stressed on their penultimate syllable. However, as the forms below illustrate, BI forms with final /*r,l,s*/ undergo epenthesis and are stressed on their antepenultimate syllables, just like native vocabulary (Basri 1997).[2]

(5) Loans with final epenthesis: σ'σE

a. bótolO	'bottle'	BI: bótol
b. sénterE	'flashlight'	BI: sénter
c. kálasA	'class'	BI: kəlás
d. bérasA	'rice'	BI: bərás
e. kábalA	'cable'	BI: kábal
f. kábarA	'news'	BI: kábar
g. kíkirI	'metal file'	BI: kíkir

This confirms the invisibility of final epenthetic vowels for the purposes of stress. In contrast, however, epenthetic vowels in penultimate position must be visible; in fact, they themselves bear stress:

(6) Loans with medial epenthesis: σE'σ

karÁtu	'card'	BI: kártu
surÚga	'heaven'	BI: súrga
bakÁri	proper name	BI: bákri
burÚhaŋ	proper name	BI: búrhan
ramÁli	proper name	BI: rámli

Quadrisyllabic words further complicate matters. As in native vocabulary, stress is penultimate when the two final syllables are underlying, and antepenultimate in forms with a final epenthetic vowel:

(7) Quadrisyllabic Loans:

a. σEσ'σ, Eσσ'σ

samAsúddiŋ	proper name	BI: syamsúddin
pArajúriʔ	'soldier'	BI: prajúrit

b. σ'σσE

balábasA	'ruler'	BI: bələbás

[2]See Broselow 2000 for discussion of forms ending in consonants other than /*r,l,s*/.

However, when both the last and the third-from-last vowel are epenthetic, stress falls on the penultimate syllable:

(8) Quadrisyllabic Loans: σEσ'E

solOdérE	'weld'	BI: sólder
korOnélE	'corner kick (in soccer)'	BI: kórnel
karAtísI	'ticket'	BI: kárcis
tarApálA	'tarpaulin'	BI: térpal
tapAsérE	'interpretation'	BI: tápsir

The generalization, then, is that only in final position does an epenthetic vowel disrupt the normal penultimate stress pattern, yielding antepenultimate stress. However, when the final epenthetic vowel is accompanied by another epenthetic vowel two syllables to its left, the final vowel must count in the stress computation.

This pattern is problematic for the serial analysis. We can easily derive the discrepancy between final and medial epenthesis in trisyllabic forms by assuming that word-final consonants are extraprosodic, and not syllabified until late in the derivation. Medial /*r,l,s*/ will be syllabified before stress is assigned, while final /*r,l,s*/ may remain in limbo until some later point in the derivation, as illustrated in (9):

(9) Serial analysis:

	a. /sahal/	b. /kartu/
Final extrametricality:	saha (l)	---
Syllabification, epenthesis:	sa.ha (l)	ka.rA.tu
Stress assignment:	{sá.ha}(l)	ka.{rÁ.tu}
Loss of extrametricality;		
Syllabification, epenthesis:	{sá.ha.} lA	ka.{rÁ.tu}

The invisibility of epenthetic vowels following stem-final consonants then follows from the invisibility of stem-final consonants. However, this approach predicts the wrong output for forms with both final and medial epenthesis:

(10)

	a. /solder/	b. /balabas/
Final extrametricality:	solde(r)	balaba(s)
Syllabification, epenthesis:	so.lO.de (r)	
Stress assignment:	so.{lÓ.de} (r)	ba{lába}(s)
Loss of extrametricality;		
Syllabification, epenthesis:	*so.{lÓ.de.}rE (solO{dé.rE})	ba{lába}sA

Form (10a) receives antepenultimate stress, rather than the actual penultimate stress. To derive the correct stress, we would need a stress readjustment rule converting the antepenultimate stress of (10a) to the correct penultimate stress. But such a rule would need to leave stress on forms like (10b) intact. Since the metrical structure of (10a) and (10b) is equivalent at the point this rule would

apply, the rule would need to be non-Markovian, distinguishing underlying from inserted vowels.

This distinction is of course at the heart of the strictly parallel approach. In this approach, stress feet are constructed (where possible) on underlying vowels only. The inclusion of epenthetic vowels in the stress foot (in either head or nonhead position, as in *ka{rÁtu}* 'card' or *solO{dérE}* 'weld') occurs only when it is impossible to construct a bisyllabic foot that does not contain an epenthetic vowel. The following constraints derive this pattern:

(12) Selayarese Stress Constraints

a. FT BIN(σ), FT TROC: Feet are bisyllabic and trochaic. These constraints are ranked so high as never to be violated.

b. HEAD-DEP (Alderete 1999):Every vowel contained in a prosodic head in S_2 has a correspondent in S_1 (i.e., vowels in prominent foot must not be epenthetic).[3]

c. ALIGN-R (PWD, FT) The right edge of the prosodic word should be aligned with the right edge of a foot..

Constraints (12a,c) enforce the normal penultimate stress pattern. Ranking HEAD-DEP over ALIGN-R will choose antepenultimate stress for trisyllables with final epenthesis, where the stress foot includes only lexical vowels. But for forms with medial epenthesis, there is no possible parse into bisyllabic feet, and therefore the best that can be done is to satisfy the requirement that the foot be right-aligned, yielding penultimate stress, as in (15):

(13) /sahala/ 'sea cucumber' σσ'σ	FTBIN, FTTROCH	HEAD DEP	ALIGN-R (PWD, FT)
☞a. sa {hála}			
b. {sáha}la			*!
(14) /sahal/ 'profit' σ'σE			
a. sa {hálA}		*!	
☞b. {sáha}lA			*
(15) /kartu/ 'card' σE'σ			
☞ a. ka {rÁtu}		*	

[3]Alderete's proposed constraint is more (probably too) general, banning any epenthetic material from the prosodic head. Nothing hinges on this distinction here.

b. {kárA}tu		*	*!

In quadrisyllabic forms, the principle is the same–the ideal parse constructs a bisyllabic trochaic foot aligned with the right edge of the word, but if the final vowel is epenthetic, the alignment requirement is overridden, moving the stress foot one syllable leftward. (Below I show only parses containing a single stress foot; for a full treatment of possible outputs, see Broselow 2000).

(16) /kalihara/ 'ant' σσσ'σ	FT BIN, TROCH	HEAD DEP	ALIGN-R (PWD, FT)
a. {káli} hara			*!*
b. ka {líha} ra			*!
☞c. kali {hára}			
(17) /maŋkasar/ 'Makassar' σσ'σE			
a. {máŋka} sarA			**!
☞b. maŋ {kása} rA			*
c. {maŋka} {sárA}		*!	

Where both the final and the antepenultimate vowels are epenthetic, it is impossible to construct a bisyllabic foot that does not contain an epenthetic vowel, which makes HEADDEP irrelevant and the alignment constraint decisive:

(18) /solder/ 'weld' σEσ'E	FT BIN, TROCH	HEAD DEP	ALIGN-R (PWD, FT)
b. {sólO}derE		*	*!*
c. so {lÓde} rE		*	*!
☞d. solO {dérE}		*	

Thus, the strictly parallel analysis predicts that an epenthetic vowel disrupts the normal construction of a bisyllabic foot aligned with the right edge only when it is possible, by shifting the foot over, to construct a foot containing only underlying vowels. The serial account, on the other hand, has difficulty in accounting for why a final epenthetic vowel is invisible when preceded by two underlying vowels, but visible when preceded by an antepenultimate epenthetic vowel.

The serial analysis might be saved by employing the Domino Condition (Halle and Vergnaud 1987), which directs that when material is inserted into a foot, that foot and all feet to its right/left

are destroyed (moving toward the edge from which feet are constructed, or with which feet are aligned). Stress is then reassigned on the liberated portions of the word, including the inserted material in the computation. In Selayarese, this means that epenthetic vowels to the right of the penultimate underlying vowel should cause a reversion to default stress. Hayes (1995) points out empirical problems with the Domino Condition, but two conceptual problems should also be noted. First, assuming feet are constructed on syllables, this analysis would require us to allow /*r,l,s*/ in forms like /*solder*/ to be syllabified in coda at some level. Second, where the Domino Condition stipulates the connection between the direction of foot destruction and edge orientation of foot construction, this edge orientation falls out of the ranking HEAD-DEP>>ALIGN. Furthermore, we will see in the next section a similar case of stress-epenthesis interactions for which the Domino Condition makes the wrong predictions.[4]

3. North Kyungsang Korean Loanwords

A second example of stress-epenthesis interaction in loanwords is provided by borrowings into North Kyungsang Korean discussed by Kenstowicz and Sohn (2000). Kenstowicz and Sohn report that this dialect of Korean (henceforth, NKS Korean) is characterized by a pitch accent system in which each word must have at least one pitch peak. There are some subregularities in the pitch accent system: words with a long vowel in the first syllable generally have a HH pattern, and words longer than three syllables most often have penultimate accent. But to a large extent, the native language accent pattern is lexically determined, as illustrated by the following contrasts:

(19) North Kyungsang Native Accent

a. HH

hárépi	‘grandfather’

b. HL

kámani	‘rice bag’
káci	‘kind’

c. LH

kurúma	‘cart’
kací	‘eggplant’

Like longer native forms, loans generally have penultimate accent (20a), though there is some evidence of a preference for accenting a final heavy over a penultimate light syllable (20b):

(20) Loan Accent

a. penultimate accent

kʰítʰa	‘guitar’
ameríkʰa	‘America’
kʰellipʰonía	‘California’

b. final accent

[4]Another possible argument for the serial analysis of epenthesis is provided by Piggott (1995), who notes, following Mithun and Basri (1986) that while underlying stressed vowels in open syllables are lengthened, presumably to satisfy a bimoraic minimum requirement, epenthetic vowels fail to lengthen. However, Basri (1999) provides an analysis of these facts in a parallel framework. See the Appendix for fuller discussion of this issue.

kʰepinét 'cabinet'

Because NKS Korean borrows freely from English, with its complex syllable structure, these borrowings exhibit a good deal of epenthesis, of a wider range than we can see in Selayarese. While both languages exhibit a preference for penultimate stress as the default pattern, they contrast in interesting ways with respect to the behavior of forms with epenthetic vowels. In NKS Korean loanwords, final epenthetic vowels appear to be visible, in contrast with such vowels in Selayarese:

(21) σσE, EσE

tʰenísU	'tennis'
te.í.tʰU	'date'
ma.ú.sU	'mouse'
ma.í.kʰU	'mike'
kUrásU	'glass'
kUllápU	'glove'

In contrast, however, epenthetic vowels in penultimate position, which take the stress in Selayarese, are generally not accented in NKS Korean. When the two final vowels are epenthetic, accent falls on the antepenult, while a word with a single epenthetic vowel in penultimate position takes accent on its final syllable:[5]

(22) a. σ'EE

tʰósUtʰU	'toast'
pésUtʰu	'best'
réphUtʰU	'left'
tʰéksUtʰU	'text'
kípʰUtʰU	'gift'
pʰásUtʰU	'first'

b. σEσ'

metʰUró	‘metro’
nigUró	'negro'
kʰontʰUról	'control'

Thus, while both Selayarese and NKS Korean exhibit disruption of the generally preferred penultimate stress pattern in the presence of epenthetic vowels, the disruptions are of a different type. In Selayarese, disruption is associated with final but not penultimate epenthetic vowels, while in NKS Korean it is penultimate epenthesis that is disruptive. We can account for these differences by assuming that while Selayarese avoids incorporating an epenthetic vowel into any position in the main stress foot, NKS Korean simply avoids allowing an epenthetic vowel in the prominent (accented) position. Thus, while HEAD-DEP ranks relatively low in NKS Korean, the following constraint is highly ranked:

[5]K&S note that some forms (pakÚna 'Wagner', rarÚko 'largo') do have accent on a penultimate epenthetic syllable; they speculate that these are older forms in which the inserted vowel has been reinterpreted as underlying.

(23) HEADSYLL-DEP: Every segment contained in the head of a foot in S_2 has a correspondent in S_1. (epenthetic vowels cannot be the head of a foot).

In Selayarese, the ranking HEAD-DEP >> ALIGN-R accounts for the leftward shift of stress in forms with final epenthesis. In NKS Korean, ALIGN-R dominates HEAD-DEP, giving penultimate accent so long as this accent does not fall on an epenthetic vowel:

(24) /tʰenis/	HEADSYLL-DEP	ALIGN-R (PWD, FT)	FTBIN	HEAD-DEP
☞a. tʰe{nísU}				*
b.{tʰéni} sU		*!		
c. tʰeni {sÚ}	*!		*	*
d. tʰe {ní}sU		*!	*	
e. {tʰé}ni sU		**!	*	

However, accent does shift leftward when both final and penultimate vowels are epenthetic, due to high-ranking HEADSYLL-DEP:

(25) /tʰostʰ/	HEADSYLL-DEP	ALIGN-R (PWD, FT)	FTBIN	HEAD-DEP
a. tʰo{sÚtʰU}	*!			*
☞b.{tʰósU}tʰU		*		
c. tʰosU{tʰÚ}	*!		*	*
d. tʰo{sÚ}tʰU	*!	*	*	*
e. {tʰó}sUtʰU		**!	*	

When only the medial vowel is epenthetic, the best parse is a (nonbinary) right-aligned foot:

(26) /metʰtro/	HEADSYLL-DEP	ALIGN-R (PWD, FT)	FTBIN	HEAD-DEP
a. me{tʰÚro}	*!			*
b.{métʰU}ro		*!		*
☞c. metʰU{ró}			*	
d. me{tʰÚ}ro	*!	*	*	*
e. {mé}tʰUro		**!	*	

It is difficult to see how these facts could be accounted for in a serial framework. Assuming (based on forms like *kʰɪtʰa* 'guitar' and *amerikʰa* 'America') that penultimate accent is preferred, forms like *tʰenísU* 'tennis' indicate that epenthetic vowels, even final ones, should be present when stress is assigned. But if that is the case, we would expect penultimate stress in forms like *tʰósUtʰU* 'toast' and *metʰUró* 'metro'. Note that the Domino Condition is useless here, since that condition predicts that insertion of material to the right of the penultimate underlying vowel should cause destruction of foot structure. Reassignment of accent to the liberated material, including the inserted vowel(s), should yield default penultimate accent. But in NKS Korean, insertion of a vowel into an existing foot ({*metʰro*}, {*tʰostʰ*}) yields either antepenultimate or final accent.

In contrast, the parallel approach (with correspondence constraints) not only accounts for the data, but also provides insight into the similarities and differences between NKS Korean and Selayarese loanword adaptation. Selayarese and NKS Korean are alike in avoiding epenthetic vowels in prosodically prominent positions, even at the cost of sacrificing alignment of the main foot with the right edge of the word. They differ, however, in their definitions of prominent position (anywhere in the head foot vs. the prominent position in a foot). They differ as well in the relative rankings of FTBIN and ALIGN-R; Selayarese is unyielding in its requirement that feet be bisyllabic, while NKS Korean is willing to sacrifice binarity for the sake of right-alignment.

Another respect in which the two languages differ is the extent to which the rankings of the relevant constraints are motivated by the native vocabulary. In Selayarese, the native vocabulary,

while providing evidence for epenthesis in a much smaller range of cases, still motivates the rankings necessary to handle the loanword data. NKS Korean native vocabulary, in contrast, provides no obvious evidence for high ranking of HEADSYLL-DEP, suggesting that this is an instance of the emergence of the unmarked. We now turn to another case illustrating the role of HEADSYLL-DEP, this time in native vocabulary.

3. Winnebago

The problem of stress-epenthesis interactions in the Siouan language Winnebago has received a great deal of attention (e.g., Miner 1979, 1981, 1989, Hale and White Eagle 1980, Hale 1985, Halle and Vergnaud 1987, Steriade 1990, Hayes 1995, Halle and Idsardi 1995, Alderete 1995). Because a number of researchers have provided analyses in a serial framework, it is important to determine whether these facts can be accounted for in a framework with only two levels. I argue that Winnebago, like NKS Korean, illustrates avoidance of foot heads containing epenthetic nuclei. Authorities differ on whether Winnebago should be considered to employ a stress system or a pitch accent system; I will assume that Winnebago employs a system of accent, with the position of the accent determined by metrical foot structure.

The facts of Winnebago accent are complex. Below I indicate only primary accent. (Nasalization, which is irrelevant to the analysis, is also not indicated.) In words with only light syllables, the accent falls on the third syllable and every other syllable thereafter (except in bisyllables, which have accent on their rightmost syllable). In forms beginning with a heavy syllable, accent falls on the second syllable, and on subsequent even-numbered syllables:

(27) a. All light

waʤé	'dress'
hotaxí	'expose to smoke'
haraʧ́ábra	'the taste'
hokiwároké	'swing (n.)'

b. Initial heavy

maatáʧ́	'promise (1sg.)'
waakítʔe	'speak to (1sg.)'
waipéresgá	'linen'

I will assume, following Miner 1979, 1981, 1989 and Hayes 1995, that syllables are grouped into iambic feet, with accent falling on each syllable following a foot. The following constraints derive the patterns in (28):

(28) a. FTBIN(MORA), FT=IAMBIC
b. ALIGN-L (PWD, FOOT): Align left edge of Prosodic Word with left edge of a foot.
c. POSTACCENTING: The syllable to the right of a foot should be accented.
d. *ACCENT: vowels should not be accented (no accented vowels unless required to satisfy constraints).

3.1. Accent and Epenthesis

Winnebago has an epenthesis process known as Dorsey's Law by which a vowel is inserted between a voiceless obstruent and a following sonorant consonant. The inserted vowel is a copy of the following vowel. These inserted vowels may be associated with disruption of the normal accent patterns, as illustrated by comparison of quadrisyllabic forms with and without inserted vowels:

(29) LLLL words
a. no epenthesis: {σσ}{σ'σ}

haraʧ́ábra	'the taste'

b. normal accent: Eσσ'σ, σσE'σ, EσE'σ

kEreʤúsep	'Black Hawk'
hanipʃ́Ána	'I swam (declar.)'
kEreʃ́kÉreʃ	'colorful'

c. disrupted accent: σEσσ'

hikOrohó	'prepare, dress (3sg.)'

As the forms above illustrate, an epenthetic vowel disrupts accent when it occurs in the second syllable from the left (though only in words longer than three syllables). In contrast, epenthetic vowels in odd-numbered syllables are associated with normal accent. These patterns can be accounted for by assuming that HEADSYLL-DEP plays a leading role in Winnebago, as in the adaptation of NKS Korean loanwords. Normally, an iambic foot is formed at the left edge of the word, with accent falling on the syllable following this foot (that is, the third syllable). Thus, alignment of the foot with the left word edge places an accent on the third syllable. But the normal accent pattern is disrupted just when the syllable that should be the head of a foot is epenthetic. In this case, the ranking HEADSYLL-DEP >> ALIGN-L will shift the iambic foot one syllable to the right, choosing the parse *hi{kOro}hó* 'prepare, dress (3sg.)' over the well-aligned **{hikO}{róho}*, for

example. The following tableaux illustrate the array of LLLL word types:

(30) LLLL, no epenthesis /haraʧabra/ σσσ'σ 'the taste'	FTBIN, FTIAMB	HEADSYLL-DEP	ALIGN-L (PWD, FT)	POST ACCENT
☞a. {hara}{ʧábra}				
b. ha{raʧa}brá			*!	

(31) LLLL, normal accent /kreʃkreʃ/ EσE'σ 'colorful'	FTBIN, FTIAMB	HEADSYLL-DEP	ALIGN-L (PWD, FT)	POST ACCENT
☞a. {kEreʃ}{kÉreʃ}				
b. kE{reʃkE}réʃ		*!	*	

(32) LLLL, disrupted accent /hikroho/ σEσσ' 'prepare'	FTBIN, FTIAMB	HEADSYLL-DEP	ALIGN-L (PWD, FT)	POST ACCENT
a. {hikO}{róho}		*!		
☞ b. hi{kOro}hó			*	

We next consider trisyllabic words. As illustrated below, accent is never disrupted in trisyllabic forms, even when the epenthetic vowel is the second in the word:

(33) LLL words
a. no epenthesis: {σσ}σ'
hotaxí 'expose to smoke'
b. normal accent: Eσσ', σEσ'
ʃUruʃgé 'you (sg.) untie it'
hokEwé 'enter'

We can account for forms like *hokEwé* by assuming two additional constraints. I have argued that in Winnebago, accent falls on the syllable following each foot. A more familiar pattern, however, is one in which accent falls directly on the head syllable, which suggests that the universal constraint set must also contain a constraint assigning accent to the head of a foot. In Winnebago, this constraint will be is normally masked by higher ranked POSTACCENT, which assigns accent to the syllable following the foot, and OCP, which forbids retention of adjacent accents. But in forms with an epenthetic second syllable, the foot is shifted one syllable to the right. Because there will be no syllable following this foot to receive the accent, HEADSYLLACCENT can be satisfied. Thus, trisyllabic forms will receive accent on their final syllable either by accent on the post-foot syllable, or accent on the head syllable of the foot:

(34) Stress/Accent Constraints (Final Version)

a. FTBIN(MORA), FT=IAMBIC

b. HEADSYLL-DEP: Every segment in the head of a foot in S_2 has a correspondent in S_1.

c. ALIGN-L (PWD, FOOT): Align left edge of Prosodic Word with left edge of a foot.

d. OCP(ACCENT): Adjacent syllables may not be accented.

e. POSTACCENTING: The syllable to the right of a foot should be accented.

f. HEADSYLLACCENT: The head of a foot should be accented.

g. *ACCENT: vowels should not be accented (prevents extraneous accents).

(35) /hotaxi/ 'expose to smoke' σσσ'	FTBIN, FTIAMB	HEADSYL L-DEP	ALIGN-L	OCP	POST ACCENT	HEADSYLL ACCENT
☞ a. {hota}xí						*
b. ho{taxí}			*!			
(36) /ʃruʃge/ 'you (sg) untie it' Eσσ'	FTBIN, FTIAMB	HEADSYL L-DEP	ALIGN-L	OCP	POST ACCENT	HEADSYLL ACCENT
☞a. {ʃUru}ʃgé						*
b. ʃU{ruʃgé}			*!			
(37) /hokwe/ 'enter' σEσ'	FTBIN, FTIAMB	HEADSYL L-DEP	ALIGN-L	OCP	POST ACCENT	HEADSYLL ACCENT
a. {hokE}wé		*!				*
☞b. ho{kEwé}			*			

These constraints account equally well for words of more than four syllables. Normally, accent falls on the third and following odd-numbered syllables, but again, accent is disrupted by an epenthetic vowel in an even-numbered syllable:

(38) Longer words

a. no epenthesis

hokiwároké 'swing (n.)'

b. normal accent

hirakÓrohó 'prepare, dress (2sg.)'

hirakÓrohónirá 'the fact that you do not dress'

c. disrupted accent

wakIripÁras 'flat bug'

wakIripÓropÓro 'spherical bug'

harakíʃUruʤíkʃAná 'pull taut (2sg. declar.)'

Longer forms containing odd numbered syllables could conceivably be parsed in different ways; for example, the accent pattern of (39) is consistent with footing (39a), in which a final stray syllable, or (39b), with medial stray syllable. The constraint ranking proposed here chooses (39b), since this satisfies both PostAccent and HeadSyllAccent. The same footing is possible for (40), since it does not require creating a foot which has an epenthetic vowel as its righthand (head) element. However, forms like (41) in which the second syllable is epenthetic require the shifting of feet to the right:

(39) no epenthesis /hokiwaroke/ 'swing (n)' σσσ'σσ'	FTBIN, FTIAMB, PARSE-2	HEADSYLL DEP	ALIGN-L	OCP	POST ACCENT	HEADSYLL ACCENT
a. {hoki}{wáro}ké						**!
☞b. {hoki}wá{roké}						*
c. ho{kiwa}{róke}			*!			**
(40) normal accent /hirakroho/ 'prepare' σσE'σσ'						
a. {hira}{kÓro}hó						**!
☞b.{hira} kÓ{rohó}						*
c. hi {rakO}{róho}		*!	*			**
(41) disrupted accent /wakripras/ 'flat bug' σEσE'σ						
a. {wakI}{rípA}rás		**!				**
b. {wakI} rí {pÁrás}		*!				*
☞c. wa {kIri}{pÁras}			*			**

The constraint set developed for light syllables will account equally well for accent-epenthesis interactions in words containing heavy syllables. Accent falls on a syllable following an initial heavy syllable, whether that syllable is underlying or epenthetic. Thus, in light-syllabled forms, an epenthetic vowel in the second position disrupts the normal accent pattern (compare *hara***ʧ***ábra* 'the taste' with no epenthesis and *hikOrohó* 'prepare, dress (3sg.)' with second vowel epenthetic). In contrast, forms like (42a) and (42b) have the same accent pattern:

(42) a. {haa}kí{tujík} 'I pull it taut (plain)'
b. {waa}pÓ{rohí} 'snowball making'
c. {waa}{pÓro}{pÓro} 'snowball'

This follows if the initial heavy syllable itself constitutes a foot, which then causes the following syllable to be postaccented.[6]

3.2. Previous Analyses of Epenthesis-Accent Interactions

In the analysis proposed above, the disruption of normal accent by epenthesis in an even-numbered syllable stems from the high rank of HEADSYLL-DEP, which disallows feet of the form {σE}. Thus, although the normal footing is {σσ}{σσ} (as in *{hara}{tfábra}* 'the taste'), the sequence σEσσ will be footed as σ{Eσ}σ (as in *hi{kOro}hó* 'prepare'), because an epenthetic vowel cannot be the head (rightmost) syllable of a foot.[7]

Alternative analyses derive the impossibility of creating a foot of the form {σE} in different ways. The analysis of Halle and Idsardi (1995) posits a constraint requiring an epenthetic syllable to coincide with a left metrical constituent boundary. Like HEADSYLL-DEP, this constraint rules out feet of the form {σE}. But while the HEADSYLL-DEP analysis relates this prohibition to universal constraints against epenthetic material in prominent positions, the analysis using a left-coincidence constraint does not.

Other analyses rely on the assignment of somewhat unorthodox syllable structures to σE sequences. Thus, to prevent the formation of {σE} feet, Hayes (1995) argues that there is a level prior to footing at which a sequence like /*kro*/ in /*hikroho*/ ⇒ *hikOrohó* would constitute a single syllable. To account for the position of accent on the syllable following this sequence, he assumes further that a sequence like /*kro*/ constitutes a heavy syllable, with both the vocalic nucleus and the onset sonorant consonant bearing a mora. These sequences then pattern with other heavy syllables in taking accent on the syllable following them. However, since a structure like *kOro* patterns with two light syllables with respect to his tone shift rule, he must assume that this sequence is transformed into two light syllables by the point at which tone shift applies. Similarly, Alderete (1995a), though working within a strictly parallel framework, argues that a sequence like *kOro* constitutes a single heavy syllable in the output, though it is presumably realized phonetically as two syllables. Note that this approach cannot be extended to Selayarese, in which treating *solOdérE* as a bisyllabic form would have disastrous results.

All these analyses are designed to to an epenthetic vowel to form a foot with a following rather than a preceding vowel. In the analysis proposed here, this follows from high ranking of HEADSYLL-DEP, which bans epenthetic vowels from the right (head) syllable of a foot.

4. Iraqi Arabic

I now turn to a case of disruption of normal stress by an inserted vowel that does not lend itself to the sort of account outlined above. I will suggest that the source of the disruption of stress is due to morphological factors rather than to the presence of epenthetic vowels.

The relevant fact is the apparent invisibility of epenthetic vowels to stress assignment in Iraqi Arabic. Stress is quite regular in this dialect. As shown below, stress falls on the final syllable if that syllable consists of a long vowel followed by a consonant; on the penultimate syllable if the penultimate is heavy (containing a long vowel or closed by a consonant); and otherwise on the antepenultimate syllable:

---

[6]Forms with noninitial heavy syllables are discussed in the Appendix.

[7]The constraint LAPSE-2, which prevents a sequence of two unfooted syllables (Alderete 1999b) will rule out hkO{roho}.

(43) Iraqi Arabic stress:
a. final syllable: kitáab ‘book’
b. heavy penult: sallátha 'her basket', ʕiráaqi 'Iraqi'
c. antepenult: ʃárika 'company', ʕáalami 'world', mumáθθila 'actress'

This regular pattern is disrupted, however, in the presence of epenthetic vowels: in *kitábIt* 'I wrote/ you (2 sg. m.) wrote' the suffix consists of /t/, but a vowel is inserted to prevent a complex coda. (This dialect allows only one consonant in coda and in onset, except in word-initial position, where complex onsets are possible). Stress falls on a light penultimate syllable, in contrast to *ʃárika*, which has identical surface syllable structure and the expected antepenultimate stress.

Forms like *kitábit* 'I wrote/ you (m. sg.) wrote' are actually anomalous in another respect as well. Comparison of the full perfect tense paradigm reveals that the final vowel of a CVCVC verb stem is normally deleted when a vowel follows the stem, as in the 3rd person singular feminine and 3rd person plural forms::

(44) 'write (perfect)'

kítab	'3 sg. m.'	/kitab/
kítbat	'3 sg. f.'	/kitab+at/
kítbaw	'3 pl.'	/kitab+aw/
kitábit	'2 sg. m.'	/kitab+t/
kitábti	'2 sg. f.'	/kitab+ti/
kitábtu	'2 pl.'	/kitab+tu/
kitábit	'1 sg.'	/kitab+t/
kitábna	'1 pl.'	/kitab+na/

Thus, the *kitábit* forms are opaque with respect to both stress and syncope. In a serial analysis, this opacity can be accounted for by ordering stress and syncope rules before epenthesis:

(45) Serial analysis (Broselow 1982):

	a. /kitab+at/	b. /kitab+t/
syncope:	kitbat	---
syllabification:	kit.bat.	ki.tab.t
stress assignment:	kít.bat	ki.táb.t
epenthesis:	---	ki.táb.It
resyll:	---	ki.tá.bIt
	[kítbat] 'she wrote'	[kitábit] 'I wrote/ you (sg. m.) wrote'

In this analysis, the stem actually contains a heavy penult at the point at which stress is assigned. The anomalous stress in the 1st person singular and the 2nd person masculine singular follows from the fact that these forms are the only ones to take a suffix consisting of a single consonant.

It is more difficult to see how the stress disruption in these forms could be treated within a strictly parallel framework. Note that this pattern is crucially different from those we have considered earlier. In Selayarese, NKS Korean, and Winnebago, when the normal patterns of foot construction would place epenthetic material in prominent positions, feet were shifted to include only underlying vowels. But in this case, the expected stress pattern *{*kíta}bIt* would involve a foot that does not contain any epenthetic material (according to the normal assumption that stress in this

language involves a bisyllabic trochee). Therefore, neither HEAD-DEP nor HEADSYLL-DEP should prevent assignment of the foot structure found in *ʃárika* to the form *kitábIt*. These facts, therefore, seem to favor the serial analysis.

However, while the serial account is appealing, this account does not extend to other verb types, in which we see anomalies that do not receive an intuitively satisfying phonological explanation. I will argue, therefore, that the stress disruption in forms like *kitábIt* is due not to the presence of an epenthetic vowel but instead to a more general phenomenon. In this dialect (as in many of the colloquial Arabic dialects), the base of suffixation in 3rd person perfective verb forms is always distinct from 1st and 2nd person verb bases.[8] To see this, a survey of different verb stem shapes in the perfective is instructive. We begin with triconsonantal verbs, which in their unsuffixed form are bisyllabic:

(46) Triconsonantal Verbs

	a. 'write'	b. 'telephone'	c. 'change'
3rd	kítab, kítbat, kítbaw	xáabar, xáabrat, xáabraw	báddal, bádlat, bádlaw
2nd	kitábit, kitábti, kitábtu	xaabárit, xaabárti, xaabártu	baddálit, baddálti, baddáltu
1st	kitábit, kitábna	xaabárit, xaabárna	baddálit, baddálna

The 3rd person forms all have stress on the initial stem syllable, while the others have stress on their second syllable. The phonological analysis of these facts derives these differences from the suffix shape: [+3p] suffixes are zero, or vowel-initial *(+at, aw)*, while [-3p] suffixes are (at least underlyingly) consonant-initial (*+t, +ti, +tu, +t, +na*).

The phonological analysis is no doubt a good explanation of how the differences between these verb bases arose, but does not necessarily provide the best account of the synchronic facts. Consider the so-called final weak verbs, which historically have a glide as their final radical:

(47) Final Weak Verbs

	'forget'	
3rd	nísa, nísat, nísaw	(+∅, +at, +aw)
2nd	niséet, niséeti, niséetu	(+t, +ti, +tu)
1st	niséet, niséena	(+t, +na)

Brame (1970) has argued for a synchronic analysis in which the final glide is still present. The glide is deleted word-finally (yielding *nisa* from /*nisaj*/); before a consonant, the vowel-glide sequence undergoes coalescence to create a long mid vowel with the backness of the glide (yielding *niseet* 'I/you m. forgot' from /*nisaj+t*/). But this account leads us to expect verbs in which we find [*oo*] before the suffix, since there is no reason to exclude the possibility of verbs ending in /*w*/. The fact that all final weak verbs take [*ee*] before a suffix suggests that this vowel has been re-analyzed as a stem extender, rather than as the result of a general phonological process. In our terms, the function of this stem extender is to ensure that a distinction is maintained between the [+3] stems, which receive stress on their initial syllable, and the [-3] stems, which are stressed on the extender.

Also problematic for the phonological analysis are the geminate (or doubled) verbs:

[8]Many years ago, Bob Harms suggested a similar functional analysis in a class which I sat in on at the University of Texas at Austin. (As I recall, I argued against it.)

(48) Geminate Verbs

	‘send’	
3rd	dázz, dázzat, dázzaw	(+∅, +at, +aw)
2nd	dazzéet, dazzéeti, dazzéetu	(+t, +ti, +tu)
1st	dazzéet, dazzéena	(+t, +na)

In these verbs, as in the final weak verbs, [*ee*] appears before the [-3] suffixes. We could ascribe the appearance of [*ee*] to the presence of a final glide, assuming underlying /*dazzaj*/ (parallel to *baddal* 'change'). However, we would then expect the third person masculine singular (the unsuffixed form) to surface as **dazza,* by the same rule that deletes the final glide in *nisa* 'he forgot'. On the other hand, if we assume that the stem is either /*dazz*/ or /*dazaz*/ (with metathesis), we have no explanation for the appearance of [*ee*] before consonant-initial stems. While syllable structure constraints would indeed prevent the faithful realization of inputs like /*dazz+t*/, /*dazz+ti*/, we would expect these forms to be made pronounceable via more widespread processes of epenthesis or degemination:

(49) a. /dazz+t/ ⇒ dazzeet ‘I/you m.sg. sent’
expected form: *dázzit via epenthesis (cf. /kitab+t/ ⇒ kitabit 'I/you m.sg. wrote')

b. /dazz+ti/ ⇒ dazzeeti ‘you f. sent’
expected form: *dázti via degemination (cf. /baddal+at/ ⇒ badlat ‘you f.sg. changed’)

Thus, there is no obvious phonological account of the appearance of [*ee*] in geminate verbs.

Another problematic case involves so-called hollow verbs, which historically had a glide as their middle radical:

(50) Hollow verbs

	‘see’	
3rd	ʃáaf, ʃáafat, ʃáafaw	(+∅, +at, +aw)
2nd	ʃífit, ʃífti, ʃíftu	(+t, +ti, +tu)
1st	ʃífit, ʃífna	(+t, +na)

In these verbs, the stem is monosyllabic, leaving no room for a stress difference between [+3] and [-3] stems. However, the two sets of stems are nevertheless distinct, with [+3] stems containing a long low vowel and the [-3] stems containing a short high vowel. Thus, assuming a single stem for all persons, we need to explain the realization of /*ʃáaf+ti*/ as *ʃífti* ‘you f. saw’, rather than **ʃáafti*. There is no clear phonological reason for shortening the stem vowel in this context since CVVC is tolerated in this language (Broselow, Chen, and Huffman 1997); cf. *xáabrat* ‘she telephoned'.[9]

The array of facts above do not lend themselves to a single phonological analysis. However, we can describe them as an effect of morphological distinctness. In each verb type, we see a contrast between the base of suffixation in [+3] and [-3] forms. For bisyllabic stems, the [+3] base consists of either a stressed followed by an unstressed syllable, or a single stressed syllable, while [-3] bases have stress on their second syllable. Monosyllabic bases are of two types: final weak verbs and geminate verbs add a second syllable ([*ee*]) in [-3] forms, and this syllable bears stress; hollow verbs

[9]Brame (1970) proposes an analysis for the counterpart verbs in Modern Standard Arabic whereby underlying /*ʃajaf+ti*/ is transformed first to *ʃajf+ti*, with subsequent vowel-glide coalescence.

are monosyllabic in both [+3] and [-3] forms, but the single stressed vowel changes its quality in [-3] forms. We can assume a constraint enforcing nonidentity between [+3] and [-3] bases (reminiscent of Alderete's (1999b) antifaithfulness constraints):

(51) [-3] Contrast:
A base bearing a nonthird person ([-3]) suffix must be distinct from the unmarked [+3] base in the identity of the stressed vowel.

This constraint compares the of a [-3] suffix to the nonsuffixed 3rd person masculine singular. Hollow verbs satisfy this constraint by changing the quality of the stressed vowel, while the other verb types satisfy it by means of locating stress on a different vowel. We can now view the exceptional stress in *kitábIt* 'I/you m. wrote' as a result not of stress-epenthesis interactions, but of the desire to maximize contrast between the [+3] and [-3] forms:

(52) /kitab+at/ 'wrote, 3 f. sg.'	*Complex Coda	[-3]Contrast (base for comparison: kítab)	Stress Constraints	Syncope
a. kítabat				*!
☞b. kítbat				
c. kitábat			*!	

(53) /kitab+t/ 'wrote, 1 sg./2 m. sg.'	*Complex Coda	[-3]Contrast (base for comparison: kítab)	Stress Constraints	Syncope
a. kítabIt		*!		
b. kítbIt		*!		
☞c. kitábIt			*	

This is by no means a full account of Arabic stress and epenthesis (see Broselow 1992, Piggott 1995, Kiparsky 1999 for discussion of a broader range of data). But it does at least suggest an approach to the complex morphology of perfect stems.

5. Conclusion

An examination of the interaction of stress and epenthesis reveals a rich and complex array of facts, with epenthetic vowels sometimes patterning with underlying vowels, and sometimes disrupting the normal stress patterns, and both patterns sometimes coexisting within a single language. I have argued that Alderete's basic insight, that languages tend to avoid placing epenthetic material in prosodically prominent positions, allows us to account for many cases of apparently exceptional stress. Other cases may be accounted for by principles of maximization of morphological contrast. Based on the data here, it appears that a serial account of these facts is

neither necessary nor desirable.

Appendix: **Residual Issues**

1. Selayarese

Though Selayarese does not have contrastive vowel length, vowels in open syllables show an increase in length under stress (Basri 1999). In (54), we see that while underlying vowels lengthen before a possessive suffix, epenthetic vowels do not; the epenthetic vowel in (54b) is followed by a geminate consonant (the phonetic realization of a glottal stop followed by a voiceless consonant):

(54) a. /sahala+ku/ ⇒ sahalá:ku 'my sea cucumber'
b./sahal+ku/ ⇒ sahalÁkku 'my profit'

Stress falls on the epenthetic vowel in (54b), in violation of HEAD-DEP, because the alternative footing, in which the first two syllables constitute the main stress foot, would violate constraints against leaving a sequence of two syllable unparsed (see Broselow 2000 for a complete analysis).

Piggott (1995) argues that the failure of epenthetic vowels to lengthen under stress is evidence that these vowels are not present when the lengthening rule applies, supporting a serial analysis of epenthesis. However, an alternative analysis of these data has been proposed by Basri (1999). Basri argues that glottal stop insertion is preferred to vowel lengthening (NOLONGV >> DEPC) as a means of satisfying the requirement that stressed syllables be bimoraic. But glottal stop insertion is blocked in vowel-final stems by a higher-ranked alignment constraint requiring the right edge of the stem to coincide with the right edge of a syllable boundary (ALIGN-R(STEM,SYLLABLE)). In forms such as *sahalá:-ku* 'my sea cucumber,' the alignment of stem-final [a] would be destroyed by insertion of glottal stop. But in *sahalÁ-kku* 'my profit,' the right edge alignment constraint will be violated no matter whether the bimoraic condition is satisfied by vowel lengthening or by glottal stop insertion, because the rightmost stem segment, [l], is not a possible coda. Therefore, the preferred option of glottal stop insertion is chosen. (Basri does not discuss why stressed vowels within a morpheme are lengthened; presumably, glottal stop insertion would be blocked by high ranked CONTIGUITY.)

The addition of possessive suffixes provides the only environment in which epenthetic vowels can receive stress in native vocabulary, because these are the only consonant-initial suffixes that fall within the stress domain (see Basri, Broselow, Finer, and Selkirk 1997, 2000). But the loanword data present a wider range of epenthesis sites. Epenthetic vowels within a stem (as in *karÁtu* 'card') are not followed by a glottal stop/geminate, but do in fact lengthen under stress, just like underlying vowels. This is consistent with Basri's account, but problematic for Piggott's.

In fact, it is arguable whether the gemination/glottal stop insertion seen before possessive suffixes is best analyzed as an effect of adding weight under stress, rather than a property peculiar to the possessive suffixes themselves (as Sirk (1988) shows, most South Sulawesi languages have two sets of possessive suffixes, -CV and -CCV, with the alternation frequently dependent on morphological rather than phonological factors). But in either case, the failure of vowels before possessive suffixes to lengthen does not provide a compelling argument for a serial analysis.

2. Winnebago

This section addresses some residual issues regarding Winnebago accent placement. Noninitial heavy syllables in Winnebago bear accent, so we find forms like *kiríina* 'returned', in contrast to forms like *hotaxí*. We can account for this by assuming that two additional constraints are active in Winnebago accent placement: a constraint requiring heavy syllables to bear accent (the

accentual counterpart of WEIGHT TO STRESS), and a constraint forbidding accent on the initial syllable (arguably, the same constraint that accounts for the low pitch on Japanese initial syllables). The ranking illustrated below will derive the correct accentual patterns:

(55) /hooʧagra/ 'the Winnebago'	NOINITIAL ACCENT	OCP	HEAVYHEAD ACCENT	POST ACCENT	HEAD ACCENT
☞a. {hoo}{ʧágra}			*		**
b. {hóo}{ʧágra}	*!	*			*
c. {hoo}{ʧagrá}			*	*!	*
(56) /kiriina/ 'returned'					
a. {kirii} ná			*!		*
b. {kiríi}ná		*!			
☞c. {kiríi}na				*	

Remaining problems include binary/ternary alternations illustrated by the contrast below, in which stress falls in (57a) on the third and sixth syllables, but in (57b) on the third and fifth:

(5) a. hokiwároroké 'swing (v. intrans.)'
b. hakirúʤikgáʤa 'after he pulls taut'

Following Hale (1985), I assume that these forms differ in their morphological structure, and that footing is sensitive to morphological constituency. Similarly, Hale argues that in the following form demonstrates the necessity of incorporating reference to morphological structure in the analysis:

(58) hirat'át'aʃAnakʃÁna 'you are talking'
predicted form: *{hira}{t'át'a}{ʃÁna}{kʃÁna} (accent on 5th syllable)
Hale (1985): 2 metrical domains, {hira}{t'át'a} and {ʃÁna}{kʃÁna}

The problem of binary/ternary alternations illustrated above is of course independent of the question of whether stress/epenthesis interactions are best handled by serial or parallel accounts.

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