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Winnebago Accent and Dorsey's Law*

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1. Introduction

Parallelism is the property of Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993a) which distinguishes it from other constraint-based theories of phonology. In Optimality Theory (OT), the candidate set provided by Gen is evaluated *in parallel* with respect to the constraint hierarchy of a given language. This means that best satisfaction with respect to the constraint hierarchy is computed over all the members of the candidate set. Furthermore, parallelism significantly contributes to the restrictiveness of OT. Derivational models permit a wide array of machinery, e.g. repair strategies and restructuring algorithms, which effectively negate fair consequences of other phonological rules. There is no room, however, for such derivational devices in a theory that directly pairs an input with the optimal output.

Acceptance of parallelism on the basis of restrictiveness would be premature, I think, without careful consideration of the set of phenomena used to justify serial derivation as a general property of phonological theory. One phenomenon marshalled in defense of the existence of derivations is the stress-epenthesis interaction found in Winnebago[1] (Miner 1979, 1992, Susman 1943, Hale and White Eagle 1980, Halle and Vergnaud 1987, Hayes 1995). To provide a brief sketch of the problem, Winnebago accent, i.e. stress whose chief acoustic correlate is high pitch, interacts with an epenthesis process referred to as Dorsey's Law[2], resulting in an alternating stress pattern. The regular pattern of accent is exhibited in (1a), where accent falls on the third mora from the beginning of the word. When the epenthetic vowel introduced by Dorsey's Law (DL) supports the second mora from the beginning of the word, one finds an irregular accent pattern where primary accent falls on the fourth mora of the word (1b). Yet when DL inserts a vowel into other positions, one observes the regular accent pattern (1c).

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[1]Winnebago is a Mississippi Valley Siouan language spoken in central Wisconsin and eastern Nebraska. The data presented in this paper are drawn from a wide range of sources which are noted where appropriate.

[2]Wolff (1950) originally used this term to describe certain historical correspondences noted in Dorsey (1885), but see Miner (1979) and Miner (1992) for a series of arguments defending the synchronic status of this process.

(1)	a.	/haracabra/	→	haracábra	'the taste'
	b.	/hikroho/	→	hikò̲rohó	'prepare 2 sg'
	c.	/hirakroho/	→	hirakó̲rohò	'prepare 3 sg'

In sum, the problem that these two phenomena pose for Winnebago grammar is that certain instances of DL-epenthesis accompany an irregular stress pattern *hikòrohó*, while others, e.g. *hirakórohò*, do not.

While previous analyses (Hale and White Eagle 1980, Hayes 1995) of the problem differ in significant ways, both propose rule-ordering accounts of the alternating accent pattern, and in this sense, they can be characterized as strongly derivational. For example, Hale and White Eagle (1980) (HWE) develop an analysis within an early metrical framework where DL follows the foot formation rules. When DL inserts a vowel into an iambic foot, a restructuring algorithm kicks in to repair the bad iamb.

(2) Hale and White Eagle (1980)

UR	/hikroho/	/hirakroho/
Foot Formation	hik (rohó)	hi (rakró) ho
Dorsey's Law	hiko̲ (rohó)	*hi (rako̲ró) ho
Restructuring		hi (rakó) (rohò)
PR	[hikorohó]	[hirakórohò]

Drawing on the work of Hale and White Eagle, Halle and Vergnaud (1987: 178) conclude that, "the domino phenomenon [i.e. Restructuring in HWE's analysis] provides strong evidence for the existence of derivations in phonology: the only possible way to characterize the surface patterns of Winnebago words is as transforms of alternating patterns constructed before the application of Dorsey's Law". The main purpose of this paper is to call into question the claim that Winnebago stress requires a derivational theory of phonology, and further, I wish to show that an Optimality Theoretic approach to the problem has consequences for a wide range of phenomena that have not, as yet, been brought to bear on the analysis of alternating accent.

This paper also makes two claims that are only indirectly related to the issue of parallelism. In section 2, the basic accent patterns are presented and accounted for in an analysis which assumes a moraic trochee, *contra* previous analyses which encode iambic structure in their foot parsing rules. Section 3 is an examination of the epenthesis process itself, focusing mainly on the fact that the epenthetic vowel shares the place specification of the following vowel. This fact is shown to have implications for the prosodic analysis of the CVCV sequence resulting from DL, where this sequence is claimed to be exhaustively parsed as a prosodic unit. In sum, the two main claims of §2 and §3 are that a moraic trochee is operative in Winnebago, and that the CVCV sequences created by DL form a prosodic unit. The positive consequences of these two claims for alternating stress in Winnebago are evaluated in section 4, where I also discuss the implications of the analysis in general for a similar stress pattern in Tübatulabal.

2. Basic Accent Patterns: Data and Analysis

In this section, I will present an analysis of the regular accent pattern without the complicating factor of DL-epenthesis, drawing on the insights of the constraint-based stress theory outlined in Prince and Smolensky (1993) (PS henceforth). I first present the data (§2.1), then I present some arguments supporting the claim that a moraic trochee is operative in Winnebago's stress system (§2.2). In §2.3, I present the analysis, and in §2.4, I consider how this analysis extends to the phonology of medial heavy syllables.

2.1 *Some Data*

Summarizing Miner (1979) and HWE, primary accent regularly falls on the third mora from the beginning of the word, if there is one. Secondary accent[3], lower in pitch, falls on every even (light) syllable following the primarily accented syllable. Accent falls on the final syllable of a word composed of two morae. In (3) and below, "H" denotes a heavy syllable and "L" denotes a light syllable. Also, numbers to the right of the decimal point indicate syllable count.

(3) Basic Accent Patterns (Miner 1979, 1992)

	A. H...		B. LL...	
.1	zíi	'yellow, orange'		
	sgáa	'white'		
.2	ciinák̨	'town'	hiwáx̨	'ask'
	booką́	'knock over'	wajé	'dress (n)'
.3	xjaaną́ne	'yesterday'	hipirák	'belt'
	taanį́žu	'sugar'	waxirí	'squash (v)'
.4	booką́gają́	'obviously knockdown'	haracábra	'the taste'
	taanį́žurà	'the sugar'	hasą̨jéja	'on the far side'
.5	wiirágų̨šgèra	'the stars' HWE 1980 (fn3)	hirawáhazrá	'the license'
			hokiwároké	'swing (n)'

Primary accent falls on the second syllable of all the forms with at least three morae in (3A), for these forms all begin with a heavy (bimoraic) syllable. The trimoraic or greater forms in (3B) have a primary accent on the third (light) syllable from the beginning of the word, consistent with the above description. In the forms with five or more morae, secondary accent is found on the second light syllable following the primarily accented syllable; consider (3.4A) and (3.5A,B). Lastly, in the bimoraic forms, accent falls on the final syllable, also in agreement with the above observations.

[3]Secondary accent apparently hasn't been consistently transcribed. While some previous accounts discuss a distinction between primary and secondary accent, Miner (1979) suggests that secondary accent is not observed in contexts other than on the epenthetic vowel inserted by DL. This empirical issue seems to have been resolved in recent work (Miner 1992, Hayes 1995). See HWE, Miner (1981), and Hayes (1995) for discussion.

2.2 *In Favor of a Trochaic Account*

Any metrical analysis within the framework developed in Hayes (1980 et seq) will posit iterative footing to account for the repeating pattern of accent observed in (3). As a necessary point of departure then, we ask how the rhythm of this foot type is characterized. Is the foot structure that yields the Winnebago accent patterns iambic, i.e. (Weak, Strong), or trochaic (Strong, Weak)? The presence of word-final accent exhibited in (3) seems to motivate an iambic requirement. This is because forms like *hipirák* complicate a trochaic analysis, which would presumably involve the licensing of a final nonbinary foot, or equivalently, a catalectic element. There are, however, three empirical arguments in favor of assuming a trochaic requirement on foot structure. I review them now, before turning to the formal analysis of the Winnebago stress.

One argument against an account which espouses iambic foot type involves reconsidering the observations given above. Primary accent consistently falls on the third mora from the beginning of the word, regardless of how the first two morae are syllabified. Assuming that an initial light syllable is extrametrical (Hale and White Eagle 1980), a form like *hipirák* gets a straightforward iambic parse: ‹hi›(pirák). But the extension of this analysis to forms like *booką́* requires splitting up the initial heavy syllable for the right mora count: ‹bo›(oką́). The null hypothesis would be that foot parsing doesn't violate syllable integrity.

Assuming a moraic trochee (McCarthy and Prince 1986, Hayes 1987) however, leads to a less complicated account of initial extrametricality. Suppose that an initial foot is extrametrical. Thus, in forms like *xjaaną́ne*, the initial heavy syllable will be extrametrical because a heavy syllable is bimoraic, and hence supports a moraic trochee. This form is therefore parsed as follows: ‹xjaa›(ną́ne), with an accent on the third mora as accent is a property of the head of a noninitial trochee. Further, on the trochaic account, a form like *haracábra* will be parsed like so: ‹hara›(cábra). The first two light syllables compose a moraic trochee; this trochee is extrametrical because it is word-initial; and accent falls on the head of the final foot.

The second argument supporting the trochaic analysis involves examining accent patterns in reduplicated Dorsey's Law sequences (i.e. the CVCV output of DL). Such forms bear secondary accent on the first mora (Miner 1979: 29)[4].

(4)	pàrapáras	'wide'
	xàraxára	'in slices or leaves'
	sàrasára	'bald in spots'

The trochaic analysis provides an avenue for a straightforward account of these facts. Accent on the first and third mora is simply a reflection of the initial prominence inherent to trochaic foot structure. Presumably, extrametricality, or 'noninitiality' as it is referred to below, is suspended in reduplicated forms. Secondary accent is thus accounted for by reduplicating the root as a coherent trochee: (pára) —> (pàra)(pára)[5]?

[4]This fact seems to have been overlooked in Miner (1992) and Hayes (1995).

[5]The observed 'suspension of extrametricality' gets a nice account within Correspondence Theory structured in McCarthy and Prince (this volume). Suppose there is a constraint that encourages identity between the base and the reduplicant, and that Red = Base outranks the requirement giving extrametricality effects (see below). Initial stress is thus an 'emergence of the unmarked' effect:

The Stem Shortening process discussed in White Eagle (1982: 309) also supports a trochaic analysis. Here, certain prefixes are shown to induce shortening of stems consisting of a heavy syllable. For example in (5), the verb stem *nįįp* shortens to *nįp* when combined with the person prefixes *ra-* and *ha-*:

(5)	nįįpšąną	'swim 3 sg past'
	ranįp	'swim 2 sg'
	hanįpšąną	'swim 1 sg past'

White Eagle's rule shortens a stem after a prefix consisting of a light syllable[6]: CVV(C) → CV(C) / prefix____. The interpretation of White Eagle's rule on an analysis which assumes a moraic trochee is that the underlying heavy syllable of the stem shortens in order to parse the initial light. Thus, given a choice between parsing the medial heavy without the initial light, as in [ra(nįįp)], or parsing the whole word as a single foot consisting of two light syllables: [(ranįp)], Stem Shortening yields the latter because Winnebago requires exhaustive syllable parsing[7].

Stem Shortening doesn't receive a natural interpretation on the iambic analysis. Standard assumptions governing foot form (McCarthy and Prince 1986, Hayes 1987) permit iambs to be composed of a light syllable followed by a heavy. Indeed, a body of work has shown that iambic systems favor iambs composed of a light followed by a heavy syllable over feet supported by two light syllables (see for example Prince 1990). Therefore, Stem Shortening looks like a rather unnatural process if one assumes iambic feet. The underlying sequence of syllables /ranįįp/ would be exhaustively parsed by the best iamb, while the surface [ranįp] would support a less favored iamb.

I therefore conclude in favor of an analysis which posits a moraic trochee because it (i) straightforwardly characterizes initial extrametricality, (ii) provides an approach for analyzing the distribution of accent in reduplicated DL-sequences, and (iii) gives a natural interpretation for Stem Shortening. Next, I will develop a system of constraints compatible with the data in (3) and the established moraic trochee requirement on foot form. The violability of said requirement will, however, be motivated, allowing for other types of feet to surface under conditions of duress. For example, disyllabic forms like *wajé* will be given a iambic parse, compelled by the requirement that initial stressed syllables are avoided.

2.3 *Analysis*

I will begin with a rough sketch of the analysis in nontechnical vocabulary. The foot type for Winnebago is a moraic trochee, i.e. a foot supported by two morae, irrespective of their distribution across syllables. Accent is a property of the head of a foot, but not of an initial foot, if this can be avoided. Also, syllables must, in principle, be parsed by feet. That is, if possible, they are organized into well-formed feet. Applying all these restrictions to an input like /haracabra/ yields

initial stress is generally avoided, but in reduplicated DL-sequences, the initial CVCV base is forced by Red = Base to be accented like the final CVCV reduplicant.

[6]White Eagle's rule doesn't make reference to a light syllable in the conditioning environment. I interpret White Eagle's rule in this way because all the cases she gives involve prefixes composed of a single light syllable. Further, reviewing Lipkind (1945) and Susman (1943: 32), all prefixes are monosyllabic, and the light syllable prefixes constitute a strong majority.

[7]See Prince (1990) on trochaic shortening, and Mester (1994) for similar argumentation in defense of a Latin trochee.

[(hara)(cábra)]. Here, all syllables are dominated by feet, all feet dominate exactly two morae, and accent falls on the head of a noninitial trochaic foot. Compare the parse of *haracábra* with that of *xjaanął́ne*: /xjaanął́ne/ —> [(xjaa)(nął́ne)].

Accent placement in forms like *hipirák* is governed by the interaction of the requirement that syllables be parsed and another requirement dictating that feet be binary (bimoraic). The foot binarity requirement is dominated by the former constraint, so the final light syllable is parsed as a subminimal (unary) foot, and accent then falls on the final foot in order to satisfy the noninitial requirement: /hipirak/ → [(hipi)(rák)]. Further, the reason why an initial subminimal foot is not permitted is because there is a constraint which requires that all feet be aligned at the right edge of some word; an initial subminimal foot, as in [(hi)(pírak)], posits a foot two syllables from the right word edge, while the initial foot of [(hipi)(rák)] is 'mis-aligned' by only one syllable; by the principle that the alignment constraint is minimally violated, the latter parse with the final unary foot wins.

Bimoraic forms like *wajé* and *sgáa* will obviously violate at least some of these constraints, but if we say that the requirement locating accent in a noninitial category dominates the trochaic requirement, the satisfaction of this prominent constraint can give the right result. For example, /waje/ → [(wajé)] violates the constraint on foot type, and presumably the noninitial requirement as the first and only foot is accented. Yet when this iambic parse is contrasted with [(wáje)], we see a distinction with respect to syllable noninitiality. The relevant contrast here can be made if the noninitial requirement is given a wider interpretation, specifying an avoidance of an initial prosodic head of any category, i.e. a foot, a syllable, etc. [(wajé)] better satisfies NonInitial than [(wáje)] does, on this interpretation, because the former satisfies NonInitial on the syllable level. Hence, the argument is that the noninitial requirement is higher ranked than the trochaic requirement, giving an iambic parse satisfying syllable noninitiality.

The constraints used in the above sketch, listed in (6) below, are not novel to this paper. Rather, they represent the results from both pre-OT and OT work in Stress Theory. Constraints (6d) and (6c) underlie key work on foot typology (McCarthy and Prince 1986, Hayes 1987, 1995). (6b) underscores much pre-OT work, but McCarthy and Prince (1993b) give the exact meaning I want for syllable parsing, in the Optimality Theoretic approach I follow. (6a) is the OT interpretation of word-initial extrametricality, conceptually analogous to PS's NonFinality. The general meaning of NonInitial given here is responsible for both 'foot extrametricality' and syllable noninitiality effects discussed above. Presumably there is an alignment constraint antagonistic to NonInitial that is responsible for the leftward orientation of primary accent. I ignore this complication for the moment however. Lastly, the interaction of Parse-Syllable and (6e) has been shown to derive a range of directionality effects in McCarthy and Prince (1993c).

(6)	a. NonInitial	Every head (i.e. a foot, a syllable, etc.) is noninitial
	b. Parse Syllable	Syllables are parsed by feet
	c. Foot Type	Moraic trochee, (SW) feet supported by two morae
	d. Foot Binarity	Feet are binary at relevant level (syllable, mora)
	e. Align-R (Ft, Wd)	All feet are aligned at the right edge of some word

Now we are ready to consider the larger body of data from (3), in light of the analysis fleshed out above. First, I will show how the ranked constraints give a unified account of words composed of odd and even number morae. Then we will consider the account of bimoraic words. The results of the constraint-based account

given here will extend to a variety of 'noncore' data (§2.4), and will be shown to provide a basis for explaining the alternating stress patterns in words with DL-sequences (section 4).

Recall that primary accent falls on the third mora from the beginning of the word, regardless of whether the word's total number of morae is odd or even.

(7)	A. Even Number of Morae		B. Odd Number of Morae	
	(2.3A) H L L	xjaanął́ne	(2.2A) H L	ciinął́k
	(2.4B) L L L L	haracábra	(2.3B) L L L	hipirák
			(2.4A) H L L L	bookął́gajął́
			(2.5B) L L L L L	hirawáhazrá

The proposal made here is that all the words composed of three morae or more are parsed into well-formed trochees, with the possibility of a word-final subminimal foot, if necessary. Consider the footings for the above forms, indicated by the bracketings in (8).

(8)	A. Even Number of Morae		B. Odd Number of Morae	
	(H) (L L)	(xjaa)(nął́ne)	(H) (L)	(cii)(nął́k)
	(L L)(L L)	(hara)(cábra)	(L L)(L)	(hipi)(rák)
			(H) (L L)(L)	(boo)(kął́ga)(jął́)
			(L L)(L L)(L)	(hira)(wáhaz)(rá)

The forms with an even number of morae (8A) satisfy all the proposed requirements except Align-R (Ft, Wd): all syllables are parsed into well-formed trochees, and the foot head of the larger prosodic word is noninitial[8]. It's only the cases with an odd number of morae that have a final unary foot (8B). This is governed by the ranking argument that Parse Syllable (Parse-Syll) dominates Foot Binarity (Ft Bin). The result here is that all syllables are parsed, at the expense of positing nonbinary feet.

(9) Parse-Syll dominates Ft Bin

/hipirak/		Parse-Syll	Ft Bin
a.	(hípi) rak	*!	
b.	hi (pírak)	*!	
c. ☞	(hipi)(rák)		*

In (9), a fourth logically possible candidate with a initial unary foot, e.g. *(hi)(pírak), should be ruled out. As mentioned above, this can be explained as a directionality effect within McCarthy and Prince's Theory of Alignment. A high-

[8]It's important to illustrate this last point, as PS's interpretation for NonFinality doesn't derive foot extrametricality effects.

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(i) x              (ii)      x          (ii)   x            Accent
    x*    x              x   x                 x*    x      Foot
    x*x   x  x           x x x x             x x x   x      Syllable
    hára cabra           hara cábra          ha rácab ra
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The grid mark at the Accent level qualifies subordinate grid marks as prosodic heads. NonInitial will therefore favor (ii) over (i) and (iii), as only the representation in (ii) avoids an initial grid mark at both the syllable and foot level.

ranked Parse-Syll with respect to Align-R (Ft, Wd) rules out the possibility of leaving an initial light syllable unparsed (10a). Furthermore, positing a word-final unary foot (10c), instead of an initial one (10b), minimally violates Align-R.

(10) Parse-Syll dominates Align-R

/hipirak/	Parse-Syll	Align-R
a. hi (pírak)	*!	
b. (hi)(pírak)		pirak!
c. ☞ (hipi)(rák)		rak

The two above constraint rankings derive 'catalexis', familiar from Kiparsky (1992), in constraint-domination vocabulary: the ranking where Parse-Syll dominates Ft Bin produces subminimal feet, and the alignment constraint universally quantified over feet posits the unary foot at the end of the word, in order to better right-align all preceding feet.

Next we turn to the bimoraic forms, and their formal treatment. It's the final light syllable that is accented in a form like *wajé*. Both a trochaic parse (11a) and an iambic parse (11b) of the two light syllables will violate NonInitial at the foot level, but the latter moves accent off the initial syllable, hence (11b) minimally violates NonInitial. In the tableau below, an word-initial grid mark incurs an NonInitial violation at the corresponding level.

(11) NonInitial dominates Ft Type

/waje/	NonInitial	Ft Type
a. x x x (wáje)	* *!	
b. x x x ☞ (wajé)	*	*

Thus, the argument that NonInitial dominates Ft Type yields an iambic parse as a way of satisfying syllable noninitiality[9].

Lastly, observe that the high-ranked NonInitial is flagrantly violated in cases like *sgáa*. However, in a framework where constraints are ranked and violable, this does not constitute a problem. It merely evidences the robustness of a claim underlying most work in prosodic representations, namely that lexical categories correspond to prosodic categories (see PS and McCarthy and Prince 1993a on the constraint LX ≈ PR). The only conceivable way of footing *sgáa* is as a heavy syllable. Thus, in spite of the fact that this incurs multiple violations of NonInitial, the requirement that lexical categories correspond to prosodic constituency compels this result.

[9]Given the argument immediately above that Parse-Syll dominates Ft Bin, /waje/ could be paired with [(wa)(jé)], giving a structurally distinct, but phonetically identical result.

Before moving to some additional data, I summarize the results established above in the following table.

(12) Summary of Results from §3.3

Constraint Ranking	Results
a. Parse-Syll » Ft Bin	Subminimal foot in forms with an odd number of mora, e.g. *hipirák*
b. Parse-Syll » Align-R	Final subminimal foot, e.g. *hipirák*, not: [(hi)(pírak)]
c. NonInitial » Ft Type	Noninitial accent in disyllabic forms, e.g. *wajé*
d. LX ≈ PR » NonInitial	Words composed of heavy syllables stressed, e.g. *sgáa*

Many of the above results merely echo recent OT work in Stress Theory. For example, PS: 54 derive the mirror image of the result in (12c) for Southern Paiute, reversing Rhythm Type to satisfy NonFinality. Further, the nonexhaustivity effect derived by the ranking in (12d) is the same as the account in PS: 44 for 'the parsed monosyllable in Latin'. Lastly, the combined result of (12a) and (12b) is an expected consequence of McCarthy and Prince's Theory of Alignment. Next, we complicate the analysis by considering the accentual properties of medial heavy syllables.

2.4 *The Phonology of Medial Heavy Syllables*

There is a body of forms with medial heavy syllables that have not been accounted for yet. I list them here, and discuss their formal properties below.

(13) Forms with medial heavy syllables[10]

a.	L L H L	hit'et'éire
b.	H H L	maacáire
c.	L H L	kiríinạ
d.	L L H L L H L L	hižạkíicạšguniąnạgá
e.	L L L L L H L L	wağịğígišgap'ụ́įžeré

In all the forms but (13c), primary accent falls on the third mora from the beginning of the word, consistent with the pattern observed in §2.1. Note also that all noninitial heavy syllables have an accent, and they are never adjacent to an accented syllable. Let's apply the analysis developed above to these forms.

Assuming a moraic trochee, while this is not its distinguishing trait, we expect heavy syllables to be accented, as bimoraic syllables support this type of foot. Therefore, it is not surprising that the heavy syllables are accented when they directly follow an initial pair of light syllables (13a), or an initial heavy, as in (13b).

[10]Glosses and references top to bottom (M = Miner 1979, S = Susman 1943): 'they speak' M 29, 'they cut a piece off' M 29, 'he returned' S 14, 'nine and' M 25, 'baseball player' M 25.

The less obvious aspect of these forms is the fact that the final lights are unaccented, given the analysis above that final light syllables can support a foot. However, the trait which distinguishes these forms from ones like *bookąągają́* is the fact that the final lights in (13a) and (13b) directly follow an accented heavy syllable, i.e. the syllable head of a foot bearing stress. Following Prince (1983) and Hung (1994)[11], we characterize this difference in terms of head adjacency.

(14) ***Clash** Avoid adjacent syllable heads.

In the context of a form like *hit'et'éire*, given a choice between footing the final light syllable (as its own unary foot), or leaving it unfooted, the latter option is apparently chosen as a way of satisfying *Clash.

(15) *Clash » Parse-Syll

/hit'et'eire/	*Clash	Parse-Syll
a. x x x xx x x (hit'e)(t'éi)(rè)	*!	
b. x x xx x x ☞ (hit'e)(t'éi) re		*

Next consider the effects of *Clash in (13d) and (13e). Let's focus on the final sequence of a heavy syllable followed by two lights. It's the final light and the antepenultimate heavy syllable that are accented here. What we want to say, I think, is that the independently motivated ranking of *Clash above Parse-Syll provides for this result. Leaving the medial light syllable unparsed, and consequently positing a final unary foot, effectively satisfies *Clash.

(16) Analysis of ...H L L][12]

/...nią̨ną̨ga/ (from 13e)	*Clash	Parse-Syll
a. x x x xx ... (nią́)(ną́ga)	*!	
b. x x x x x ☞ ... (nią́) ną (gá)		*

Note that the treatment of these forms will be different than the one of forms like *xjaaną́ne*, which evidences stress on the medial light syllable. Such forms are instances of *Clash violations, but this is motivated by an additional requirement which states that the left edge of the word is aligned with the left edge of its foot head, which is presumably the force behind the leftward orientation of primary accent (§2.1). The latter constraint dominates *Clash, predicting that the final two lights in a word schematized [H L L] will be parsed as a full trochee, aligning the foot head of the word as best it can to the left edge of the word.

[11]Hung accounts for Internal Clash and NonFinality effects with a single constraint, called Rhythm. I am not sure if *Clash and NonInitial can be conflated in a parallel fashion and still give an adequate account of the facts below.

[12]Alternatively, the analysis here could be that a Foot Type reversal is compelled by *Clash.

(17) Analysis of [H L L]: Align-L » *Clash

/xjaaną̨ne/	Align-L (Wd, Ft-head)	*Clash
a. x x x x xx ☞ (xjaa)(ną́ne)	(xjaa)	*
b. x x x x x x (xjaa) ną (né)	(xjaa) ną́	

Lastly, notice that in (13d) the two light syllables flanked by heavies are unaccented. If *Clash was an operative constraint, effectively barring the alignment of syllable heads of feet, we would expect a result like this: any parse of these medial light syllables will posit a syllable head flush with one of the two heavy syllables. Thus, under pressure from *Clash, the two medial lights are left unfooted.

A high-ranked *Clash with respect to Parse-Syll implies that either the medial heavy syllable in (13c) or the two peripheral light syllables will be footed: [ki (rii) ną] or [(ki) rii (ną́)]; assigning head status to the two final syllables yields two adjacent syllable heads: [ki (rii) (ną́)]. Stressing the final light syllable, as in [(ki) rii (ną́)], will satisfy NonInitial at both the foot level and the syllable level as in this case the initial light syllable supports a foot. But medial *rii* is accented here, showing the importance of stressing heavy syllables independently of the Ft Type requirement. Following Prince (1990), we characterize this as a Weight-to-Stress Principle (WSP) effect ("If heavy, then stressed"). WSP thus dominates NonInitial, relativized to the foot level.

(18) WSP » NonInitial

/kiriiną/	WSP	NonInitial
a. (ki) rii (ną́)	*!	
b. ☞ ki (rii) ną		*

Before moving to the next section, I wish to foreground the parallels between the phonology of medial heavy syllables and medial DL-sequences, as this will be relevant to subsequent discussion. A noninitial heavy syllable is always stressed, and so too is a DL-sequence: compare [ki (rii) ną] with [hi (kòro) hó]. Suppressing the distinction between secondary and primary accent, a prosodic analysis which parses both medial *rii* and *koro* as well-formed trochees accounts for the fact that both attract stress in exceptional circumstances. Further, said analysis will provide an avenue for accounting for the final primary accent of *hikòrohó*. The suggested parallel between heavy syllables and DL-sequences is examined in more detail in the next section. While this line of inquiry will take us somewhat outside the area of Winnebago stress, its relevance to the accent system is made explicit in section 4.

To summarize this subsection, the constraint system developed in §2.3 extends rather straightforwardly to the data with medial heavy syllables if we augment the system with two new constraints: *Clash and WSP. These two constraints, and their rankings relative to Parse-Syll and NonInitial, derive the two observations above, namely that all noninitial heavy syllables are stressed, and that no light syllable adjacent to a stressed heavy is stressed.

3. Explaining Dorsey's Law

Dorsey's Law epenthesis (DL-epenthesis) breaks up [voiceless obstruent + sonorant] clusters by inserting a copy of the vowel that directly follows the sonorant. DL-epenthesis applies both root-internally (19a), and across the left edge of the root (19b), (data from Miner 1993; "|" denotes a root edge). However, as pointed out in Miner (1981), DL-epenthesis does not apply across the right edge of the root (19c); instead the root-final obstruent is voiced.

(19)	a.	/hipres/	→	hipe̱rés	'know'
		/krepną/	→	ke̱repą̱́ną	'unit of ten'
	b.	/š|wapox/	→	ša̱wapóx	'you stab'
		/š|ruxruk/	→	šu̱ruxṵ́ruk	'you earn'
	c.	/wąąk|nąkga/	→	wąągnąka	'that man sitting'

As noted in Steriade (1990) and Miner (1993), an account of DL-epenthesis that refers to prosodic representations will involve a two part process in which a morphologically unsponsored vowel is inserted and linked to the Place node of the following vowel.

(20) Dorsey's Law (where C_1 is a voiceless obstruent and C_2 is a sonorant)

a. C_1 C_2 V —>
      |
   Place

b. C_1 V̱ C_2 V
      \ /
   Place

Broken up into component parts, Dorsey's Law amounts to the following pattern:

(21) a. Sonorants never follow voiceless obstruents
b. Where (21a) is potentially violated, an epenthetic vowel is inserted
c. The epenthetic vowel is colored by the quality of the following vowel

Providing an explanation for this pattern of facts involves addressing the following questions. Why does DL break up voiceless obstruent+sonorant clusters? These are fine onset clusters cross-linguistically. Why does DL involve sharing of a Place node, and not epenthesis of a default vowel? Further, why does the epenthetic vowel share the Place features of the *following* vowel?

I address these questions below, giving special attention to the question relating to the direction of feature linking (21c), as this line of inquiry proves most interesting alongside the alternating accent pattern. We begin in §3.1 by examining the phonotactic requirement motivating DL (21a) alongside other restrictions on Winnebago consonant clusters. I suggest a general account of these facts employing the notion of syllable contact, familiar from work in Natural Phonology (Vennemann 1972, Murray and Vennemann 1983) and work out the formal details of the analysis in the appendix. In §3.2, we examine a body of facts relating to the prosodic analysis of DL-sequences, i.e. the CVCV sequences in (20b). The claim

that these sequences are parsed as heavy syllables is shown in §3.3 to provide for a principled account of the direction of feature linking.

3.1 Winnebago CCs

Winnebago admits consonant clusters both word-initially and word-medially. In both environments, a cluster may begin with a voiceless obstruent and end with either a voiced stop or a voiceless fricative (22a). Word-medially, a cluster may also begin with a voiced obstruent and end with a sonorant (22b)[13].

(22) Winnebago biconsonantal clusters[14] (see Susman 1943, and Miner 1993)

a.	C_1	C_2	[sg]	sgáa	'white'
	voiceless	voiced	[xj]	xjaaną́ne	'yesterday'
	obstruent	stop	[cg]	nąįwacgis	'saw (n)'
		C_2	[ps]	psų̨psį́c	'small change'
		voiceless	[pš]	pšoopšóc	'fine'
		fricative	[kš]	kšée	'revenge'
b.	C_1	C_2	[br]	haracábra	'the taste'
	voiced	sonorant	[zr]	hirawáhazrá	'the license'
	obstruent		[gn]	wą́ągnáka	'that man'

Two properties of the clusters given in (22) stand out. First, only when the first member of the cluster is voiceless (22a) is it licensed in both word-initial and word-medial position. Secondly, the possible clusters given above, taken alongside the phonotactic fact of DL (sonorants never follow voiceless obstruents), suggests the following restriction on these clusters: C_2 may not be 'too far above' C_1 in sonority rank. For example, a voiced stop can form a cluster with a resonant, e.g. [br] of *haracábra*. However, the corresponding cluster with a voiceless C_1 is ruled out by DL: *[pr]. Apparently, [b] and [r] are within the relevant sonority distance, while [p] and [r] are not. Furthermore, the cases in (22a) support a cap on sonority rises. The observation here is that when the first member is a voiceless obstruent, the second member can either be a voiced stop or a voiceless fricative—but it cannot be a voiced fricative. In sum, while these clusters may rise with respect to voicing [sg], or continuancy [ps], a rise in both of these features is not possible *[pz]. Consider how this restriction is respected in the following sonority profiles:

[13]Winnebago has the following underlying consonant inventory (Miner 1993):

p	t	c	k	
b		j	g	
	s	š	x	
	z	ž	ğ	
m	n			
	r			
w		y		h

[14]Winnebago does have triconsonantal clusters, but since the restrictions found in biconsonantal clusters also hold of the larger clusters, I ignore them to simplify the discussion.

(23) Sonority Profiles — Sonority Scale[15]

```
  x     x                 x     voiced fricative, sonorant
  x    x x          x     x     voiced oral stop
 x x   x x   x x   x x   x x    voiceless obstruents
*p r   b r   p s   s g   *p z
```

The relative sonority of the members of the grammatical clusters in (23) supports a general restriction against a jump of more than one interval on the given scale. Therefore, by positing such a restriction, we may describe the observed cooccurrence restrictions and at the same time provide a basis for motivating DL-epenthesis. This appeal to generality leads to a heterosyllabic syllabification of these clusters, where the cap on sonority rises is interpreted as a syllable contact effect: clusters may rise in sonority across syllables, e.g. [b.r], but a marked rise in sonority between heterosyllabic consonants is not allowed, e.g. *[p.r]. The formal details of this account are worked out in the appendix.

For the sake of argument, there is further support for an account which assumes a heterosyllabic parse of these clusters and employs the notion of syllable contact. As pointed out above, DL-epenthesis does not apply across the right edge of the root: /wąąklnąkga/ → [wąągnąka] 'that man sitting'; instead the root-final obstruent is voiced[16]. This fact can be given a straightforward account, granted we assume a heterosyllabic parse for the medial cluster [gn], within McCarthy and Prince's Generalized Alignment Theory. Suppose the right edge of every root must be aligned with the right edge of some syllable (as proposed in PS and McCarthy and Prince 1993a), and that this is a highly ranked constraint.

(24) **Align-R (Root, σ)** The right edge of every root must coincide with some right syllable edge.

The voicing of the root-final obstruent can now be seen as the only way of satisfying both the constraint against marked rises in sonority (Syllable Contact) and Align-R. Lack of epenthesis in (25a) and (25c) enables a closed syllable to be aligned with the right edge of the root; further, the voicing of underlying /k/ in (25c) boosts the sonority of the syllable-final consonant, achieving an acceptable sonority profile for the purposes of Syllable Contact.

(25) Nonapplication of Dorsey's Law

/wąąklnąkga/	Syllable Contact	Align-R(Root, σ)	Faith [voice] "No Voicing"
a. wąąk.lnąkga	*!		
b. wąą.kląnąkga		k!	
c. ☞ wąąg.lnąkga			*

Note that if we assume that [gn] of *wąągnąkga* forms a complex onset, the constraints in (25) give the wrong result: both [.gln] and [.kląn] are violations of Align-R, and the Faith violation incurred by introducing the feature [voice] is

[15] I assume a sonority scale that compares with the one employed in Jespersen (1904) (see appendix for comparison). Sonorants are grouped with voiced fricatives because a more stratified hierarchy is not motivated for Winnebago.

[16] Steriade (1990) gives a cyclic account of this fact, which I do not address because it is irrelevant to the point I make here.

enough to rule out (25c), which leaves (25b) as the output form. To summarize, the syllabification that allows the restriction on Winnebago CCs to be treated as a syllable contact phenomenon also leads to a nice account of the failure of DL-epenthesis in this particular morphological environment.

3.2 DL-sequences as Heavy Syllables

Now that we have sketched an account of the phonotactic component of DL, we address the question of why DL-epenthesis involves spreading to the vowel following the sonorant. Why doesn't DL give **hipirés* instead of *hiperés*?

Spreading in autosegmental phonology has been shown to be restricted to various prosodically defined domains (see for example Archangeli and Pulleyblank 1994). Perhaps we can begin to answer the above question by considering how DL-sequences are organized into prosodic structure. To this end, I would like to review some facts presented in Miner (1979) which can help in forming some assumptions related to this issue.

Miner (1979: 26) describes DL-sequences as 'fast-sequences', that is, "the sequences are spoken (and apparently sung) faster than other CVCV sequences." Susman (1943: 9-10) also supports this claim: "[DL-sequences] can be identified by the consonants they contain [...], by the fact that the two vowels are identical, and usually by the fact that the vowels are very short. In most surroundings, [DL-sequences are] intermediate in length between one long and two short syllables". Hence, we can presumably find minimal pairs which differ with respect to the length of a corresponding CVCV sequence:

(26) Hypothetical Minimal Pairs: $(CVCV)_Y > (C\underline{V}CV)_X$ in duration

a.	/...CCV.../	→	$[...(C\underline{V}CV)_X...]$	DL-sequence
b.	/...CVCV.../	→	$[...(CVCV)_Y...]$	Other CVCV sequence

Both vowels internal to DL-sequences should be interpreted as moraic because they are counted in the determination of accent placement and they can both be stressed. (The evidence supporting the bimoraic status of DL sequences is given in §4.1). Therefore, it seems that the only formal way of distinguishing the minimal pairs in (26) with respect to their duration would be to appeal to syllable quantity. Consistent with the CVCV behavior observed in (3), we analyze $(CVCV)_Y$ as a sequence of two light syllables. Hence, the minimal difference between (26a) and (26b) would seem to be that $(CVCV)_X$ is parsed as a unit that is quantitatively less that two light syllables. This structural difference with respect to syllable count is assumed to account for the observed duration contrast and native speaker intuitions of these minimal pairs.

The claim that DL-sequences are less than a sequence of two light syllables is also supported by reduplication facts. To see this, we need to first study reduplication in verbs which do not exhibit DL-epenthesis, and then compare the regular pattern of reduplication with reduplicated DL-sequences.

Winnebago verb stems take three canonical shapes (Susman 1943: 32), exemplified in (27)[17].

(27)	a.	CVV(C)	x'ée	'to drip'
	b.	CVCV(C)	waší	'to dance'
	c.	CVVCV(C)	mąąnį́	'to walk'

These forms are reduplicated by associating the stem-final material to a suffixal template composed of a single syllable (following the work of McCarthy and Prince 1986 et seq).

(28)	a.	x'ée →	x'eex'é	'drop earrings'
	b.	waší →	wašiší	'to dance a bit, stop, and dance again'
	c.	mąąnį́ →	mąąnį́nį́	'to walk a little'

It seems that when a stem consists of a heavy syllable of the form CVVC, the one syllable reduplicant is 'infixed' between the CVV and the stem-final C[18].

(29)	juuk	→	juujúk	'tender'
	zook	→	zoozók	'slippery'

Taken together, (28) and (29) support an analysis where the template for the reduplicant constitutes a single syllable. With this is mind, it is interesting to return to reduplicated DL-sequences.

(30)	xará	→	xàraxára	'in slices or leaves'
	sará	→	sàrasára	'bald in spots'

The entire DL-sequence is repeated in these forms, showing that reduplication respects the integrity of the DL-unit. Parsing DL-sequences as single (heavy) syllables is consistent with the claim above that DL-sequences are less than two syllables. Further, it makes the form of the reduplicant in these cases appear more like the one observed in (28) and (29): a maximally general statement on reduplicant shape would be that it must be a single syllable.

There is one further piece of evidence in favor of the claim that DL-sequences are syllabified as single syllables. Citing Susman (1943: 22), "No two homorganic consonants occur together [in DL-sequences], that is *p-w, c-n, c-r* are not admissible." (See Miner 1979 for a full chart of clusters, with some apparent exceptions). Homorganic consonants are restricted from occurring syllable-internally in lots of languages (see Clements 1990, and references therein). Parsing DL-sequences as single syllables allows for an account of this restriction in UG.

Notice that the analysis so far predicts a rather peculiar state of affairs where nonadjacent consonants in DL-sequences can't be homorganic, while adjacent consonants can because they are heterosyllabic (recall that the clusters examined in §3.1 were analyzed as heterosyllabic). This is in fact true however: Miner (1993: 116) gives examples with [xg], [šj] and [st] clusters. The occurrence of adjacent

[17]Ignoring the distorting effect of stress in these forms, one notes the absence of a stem composed of a light syllable followed by a heavy, which would be expected in an iambic system (Hayes 1995).

[18]McCarthy and Prince (1993: 132) account for a similar pattern of 'infixing' reduplication in Chamorro as an Anchoring violation compelled by No Coda.

homorganic consonants really 'locks' the argument, as this pattern of facts is unexpected if homorganic CCs are outlawed tautomorphemically, or if the restriction against homorganic consonants is "true of the input". To exemplify this last point, an underlying DL-sequence like [cn] will have the same status with respect to the cooccurrence restriction as an underlying [st]. Applying this restriction to the input material will therefore falsely predict *[st].

3.3 Analysis

Above I have supported the rather strong claim that DL-sequences are syllabified as heavy syllables with a range of facts: DL-sequences have a shorter duration than two light syllables, they pattern like single syllables in reduplication, and the pair of consonants internal to DL-sequences are subject to a condition characteristic of syllable-internal consonants. But how does this relate to the treatment of the directionality of spreading in DL-epenthesis? How does the constraint system choose regressive spreading, e.g. *hiperés*, over progressive spreading: **hipirés*? The claim that the DL-sequences are parsed as single syllables gives the following distinct syllabifications for each form: [.hi.perés.] and [.hipi.rés.]. While the sonority profile in both cases flagrantly violates a condition on the sonority profile of syllables, namely Sonority Sequencing, the former case minimally violates a gradient Sonority Sequencing, and thus can be chosen over the latter on principled grounds. Let's work through the analysis step by step.

Why are DL-sequences syllabified as single heavy syllables? Many ideas come to mind. Perhaps syllabification of DL-sequences is 'conservative' and surface syllabification reflects syllable structure restrictions true of the input. An interesting idea, but one which runs counter to the surface-oriented account of syllable structure assumed in this paper. An alternative approach might be to give an Optimality Theoretic interpretation to Selkirk's (1981) notion of Syllable Maximization, like the one given in Zoll (1994). Fleshing this idea out in the context of a form like *keré*, a one syllable parse is better than a two syllable parse because, by Syllable Maximization, parsing minimizes prosodic structure, i.e. the total number of syllables. I think that this is an interesting avenue which should be explored in other contexts, but employing this notion in an account of DL-sequences begs the question why DL effects an increase in the total mora count, e.g. /pra/ —> $[para]_{\mu\mu}$.

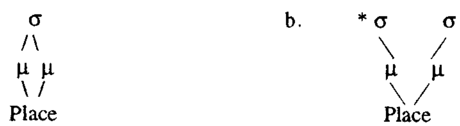
Taking the bimoraic status of DL-sequences into account leads to a comparison with long vowels. In fact, DL-sequences are only distinguished formally from long vowels by the medial sonorant (S) and an additional vowel slot (V): both long vowels and DL-sequences are assumed here to project geminate morae, dominating a single Place node.

(31) a. Long Vowel b. DL-sequence

Now, the pair of morae representing the length of the long vowel in (31a) are always syllabified as a single syllable. Suppose the requirement enforcing this result extends to the case of DL-sequences; suppose that all prosodic categories dominating the same Place node must be contained in the same syllable.

(32) **Syllabify Place (Syll-Place)** All morae dominating the same Place node must be dominated by the same syllable[19].

The constraint in (31) is similar in spirit to Levin's (1985) condition on geminate structures for long vowels. Viewed more generally, Syll-Place is intended to allow (32a) and rule out representations like the one in (32b).

(32) a.


Thus, the formal similarities between the representations for DL-sequences and long vowels permits a unified treatment of their monosyllabicity.

To continue, the prosodic analysis of DL-sequences, constrained by Syll-Place, results in a syllable exhibiting a rather uncommon sonority profile. Employing grid representations again for degrees of sonority rank, the medial sonorant consonant causes a dip in sonority between the two vowel segments.

(33)

Profile for DL-sequence	Sonority Scale
x x	vowels
x x x	voiced fricatives, sonorants
x x x	voiced stops
x x x x	voiceless obstruents
k e̠ r e	

It doesn't matter which vowel in (33) constitutes the peak of the syllable (the fact that both can be stressed suggests that both can form the sonority peak); in either case, the profile in (33) will violate the condition that syllable theorists call Sonority Sequencing.

(34) **Sonority Sequencing (Son Seq)** (from Clements 1990)
Between any member of a syllable and the syllable peak, only sounds of higher sonority rank are permitted.

If the first vowel in (33) is the syllable peak, then the sonorant stands between the second vowel and is of lower sonority rank, hence violating Son Seq. Likewise, if the second vowel forms the peak of the syllable, [r] is of lower rank than the first vowel. Therefore, the claim that DL-sequences are parsed as single heavy syllables is accounted for with a constraint ranking where Syll-Place dominates Son Seq.

[19]Note that Syll-Place, with universal quantification over morae, permits a doubly-linked Place node in heterosyllabic configurations frequently employed as an explanation of nasal Place assimilation (see e.g. Itô and Mester 1993). Linking to an onset consonant will not be relevant to Syll-Place because onsets are not assumed to be dominated by morae.

(35) Syll-Place » Son Seq

/hipres/		Syll-Place	Son Seq
a.	hi.pe̠.res	*!	
b. ☞	hi.pe̠res		*

It's important to note that this is, nothing else being said, an expected result in Optimality Theory. Suppose both Syll-Place and Son Seq reflect phonologically significant generalizations and they are present in every grammar. The null hypothesis is that they are not universally ranked, so we take the null hypothesis. Dorsey's Law in Winnebago creates a situation where the two constraints are in conflict: DL-sequences might be parsed as a single syllable, satisfying Syll-Place at the expense of a Son Seq violation, or they might be parsed as two lights, satisfying Son Seq, but not Syll-Place (because DL involves feature sharing). Winnebago is thus one of those languages where Syll-Place and Son Seq are in conflict and it happens to chose the ranking in (35). The body of evidence given in §3.2 is consistent with such a ranking.

Suppose now that Son Seq can be given a gradient interpretation such that the fall in sonority resulting from the medial [p] in (36a) is a worse violation of Son Seq than the one resulting from the [r] internal to the DL-sequence in (36b). The scalar determination of sonority rank commonly assumed suggests such an interpretation. Assuming the sonority scale given above, the dip in sonority in (36a) will thus incur three violations of Son Seq, while the profile in (36b) with a medial [r] will only incur one violation. *hiperés* is therefore chosen as the output because, by spreading across the sonorant, it minimally violates Son Seq.

(36) Son Seq is gradient

/hipres/	Syll-Place	Son Seq
a. x x x x x x x x x x h i p i̠.res		* *! *
b. x x x x x x x x x x x x ☞ hi.p e̠ r e s		*

I therefore argue for a high-ranked Syll-Place with respect to Son Seq on theoretical grounds. Such a constraint ranking relates the pattern of facts presented in §3.2 to the direction of feature linking: supposing that DL-sequences are monosyllabic predicts spreading across the sonorant as a minimal violation of Son Seq. In the next section, I relate the claim that DL-sequences are parsed as single heavy syllables to their behavior in the stress system.

4. Winnebago Accent and Dorsey's Law

In this section, forms exhibiting DL-epenthesis and alternating accent are presented and explained with the constraint system developed so far. After presenting the data (§4.1), the analysis is given (§4.2), and then summarized (§4.3). Lastly, the implications of the analysis for a similar stress pattern in Tübatulabal are discussed (§4.4).

4.1 Alternating Accent

In the following data, one finds the irregular pattern of accent only in words, of at least four morae, where the epenthetic vowel supports the second mora from the beginning of the word (37B).

(37) Winnebago Accent with Dorsey's Law (Miner 1979, 1992, Hayes 1995)

		A. Regular Accent Pattern		B. Irregular Accent Pattern	
.2		ke̱ré	'leave returning'		
		šo̱róš	'deep'		
.3	a.	ša̱wažók	'you mash'		
		ka̱rahé	'be on the way back'		
	b.	hipe̱rés	'know'		
		gisa̱ną́	'remove'		
.4		ša̱wažókjį	'you mash hard'	hikò̱rohó	'prepare'
		xo̱rojíke	'hollow'	hoša̱wazá	'you are ill'
		hojisá̱ną	'recently'		
		hirupí̱nį	'twist'		
		mąą̱šá̱rac	'you promise'		
		boopé̱res	'sober up'		
.5		hirakó̱rohò	'prepare 2 sg'	wikì̱ripá̱ras	'cockroach'
		waapó̱rohí	'snowball making'	gika̱nąká̱nąp	'shiny'
		yaakó̱rohò	'prepare 1 sg'		

In a form like *xorojíke* or *boopéres*, the epenthetic vowel doesn't support the second mora from the beginning of the word, and one finds the regular accent pattern. In *hikòrohó*, however, the irregular accent pattern correlates with an epenthetic vowel that supports the second mora. In what follows, the alternating accent pattern is explained in an analysis which parses DL-sequences as heavy syllables and posits trochaic foot structure. The regular pattern (37A) is shown to follow from these inherent assumptions. The exceptional pattern (37B) follows from this analysis and our assumptions regarding the phonology of heavy syllables (§2.4). Shorter forms, e.g. (37.2) and (37.3b), are taken as evidence that certain well-formedness constraints are sensitive to the moraic level of prosodic analysis.

4.2 Analysis

As defended above in §2.2, we assume a trochaic requirement. Further, DL-sequences are parsed as heavy syllables (§3.2); hence, they are exhaustively footed as moraic trochees. Putting these two independently motivated assumptions together leads to a prosodic analysis yielding the regular accent pattern when the epenthetic vowel supports the first or third mora from the beginning of the word.

(38)

A. Epenthetic V supports first μ		B. Epenthetic V supports third μ	
(37.3)	(ša̱wa)(zók)	(37.4)	(hoji)(sá̱ną)
(37.4)	(ša̱wa)(zókjį)		(mąą̱)(šá̱rac)
		(37.5)	(hira)(kó̱ro)(hò)
			(waa)(pó̱ro)(hì)

The DL-sequences in these examples form an initial trochee in (38A) and the second foot in (38B). Accent is always assigned to the head of the second foot (and every foot thereafter). And in cases with an odd mora count, e.g. *šawazók*, a final light syllable is parsed as a subminimal foot, in accordance with the assumptions from section 2 (see summary in §2.3).

Next, consider the irregular accent pattern (37B), observed only in forms beginning with a light syllable directly followed by a DL-sequence. In the forms from Miner (1979)[20], the first mora of a DL-sequence receives secondary stress, e.g. *hikòrohó*. By Syll-Place, *koro* is parsed as a heavy syllable. We therefore expect *koro* to participate in the accent system like other heavy syllables; every noninitial heavy syllable is stressed (§2.4); thus we expect DL-sequences to receive stress. Furthermore, we expect the first member of a bimoraic unit to receive stress. Now in heavy syllables composed of long vowels, this moraic division is not visible because long vowels form a single accentual unit. In DL-sequences, however, the medial sonorant effectively separates the two morae, allowing for the rhythmic pattern *kòro.*

Why does the final light in *hikòrohó* receive primary stress, while primary stress falls on the medial heavy in a form like *kiríinq*? Presumably the reason is that *Clash is not violated in the former case. I assume that, at the moraic level, the medial sonorant of [hi (kòro̱)(hó)] legitimizes the second mora as an upbeat (i.e. a weak position), in a fashion that is not available to the second mora of *rii*, hence permitting a subsequent moraic head[21]. One might object to this assumption, pointing out that this fact simply shows that *koro* forms a foot composed of two light syllables, where the second light provides for the footing of the final light without a *Clash violation. On such an analysis, however, we are still left wondering why *koro* is stressed at all, as stress only falls on the second mora when it is parsed as the first member of the second heavy syllable, e.g. *kiríinq*.

To recapitulate, [hi (kòro)(hó)] does not violate *Clash at the moraic level, permitting a final unary foot in this position. Primary stress falls on the final foot in

[20]Again, transcription of secondary stress is inconsistent. It seems that work subsequent to Miner (1979) lost the habit of putting secondary accent on the first vowel of a DL-sequence, perhaps for interesting theoretical reasons.

[21]Also, the analysis must be *koro* is the first foot, because parsing the initial *hi* as a subminimal foot would actually incur a violation of *Clash; the initial mora of *koro* is the head of a foot, and adjacent to the potential mora head of *hi*.

this case because, a high-ranked NonInitial with respect to Align-L (PrWd, Head) (motivated above in §2.4 as an account of the leftward orientation of primary stress), ensures that the foot head of the word will not be the first foot.

(39) Analysis of *hikòrohó*

/hikroho/	NonInitial	Align-L
a. x x x x x x hi (kóro)(hò)	*!	hi
b. x x x x x x ☞ hi (kòro)(hó)		hikoro

The analysis for *hikòrohó* extends to the case of *wikìripára*. Compare (40a) with (40b).

(40) a. (37.4) hi (kòro) (hó)
b. (37.5) wa (kìri) (pára)

The initial DL-sequence *kiri* attracts secondary stress: as a heavy syllable, it must stressed, yet it cannot receive primary stress because it is the initial foot. And the only noninitial foot, *para*, receives primary stress, in accordance with NonInitial.

Lastly, let's turn to forms like *hiperés* and *keré*. Both show, on this analysis, further support for the low-ranked status of Ft Type. Also, they show that both *Clash and NonInitial are sensitive to the moraic level of analysis. Take for example the first case, which is given the following prosodic analysis: [.hi.(.peres.)]. Final stress is thus an effect of the constraint ranking where *Clash dominates Ft Type: stressing the final mora in violation of Ft Type provides an upbeat on the moraic level, escaping the *Clash violation of the trochaic parse.

(41) *Clash » Ft Type (*Clash applied to moraic heads)

/hipres/	*Clash	Ft Type
a. x x σ x x x μ hi.péres	* *!	
b. x x σ x x x μ ☞ hi.perés	*	*

Furthermore, consideration of bimoraic forms like *keré*, which on this analysis are monosyllabic, calls for an application of NonInitial to moraic heads. Thus, just as disyllabic forms like *wajé* required a wider interpretation including syllable targets, *keré* requires moraic sensitivity.

(42) NonInitial » Ft Type (NonInitial applied to moraic level)

/kre/	NonInitial	Ft Type
a. x σ x x μ (kére)	* *!	
b. x σ x x μ ☞ (keré)	*	*

Just as *sgáa* violates NonInitial at the prosodic foot and syllable levels, so too does either parse of *keré* because it must be parsed as a heavy syllable by the undominated Syll-Place. Given a choice, however, between accenting the first mora with a trochaic parse (42a), or accenting the second mora as an iamb, the latter is chosen by the independently motivated ranking where NonInitial » Ft Type. Also, the argument in (42) further motivates moraic sensitivity, employed immediately above in the meaning of *Clash.

4.3 Summary of Results

To summarize, the analysis of alternating accent in Winnebago follows from the set of assumptions motivated in sections 2 and 3. The regular pattern is straightforwardly explained as a consequence of the prosodic analysis of DL-sequences as moraic trochees. When the DL-sequence forms the first or second foot, accent falls on the third mora. Now, the exceptional accent pattern only correlates with a DL-sequence which is directly preceded by an initial light syllable. In an analysis where DL-sequences are prosodized as heavy syllables, we expect them to attract stress just like long vowels do. But they cannot bear primary stress, as stress on the initial foot is avoided. Primary stress therefore falls on a noninitial foot following the DL-sequence; review the tableau in (39). Lastly, the rightward orientation of accent in shorter forms, e.g. *hiperés* and *keré*, motivates an interpretation of certain constraints that is sensitive to the mora level.

One might ask at this point, why the behavior of syllables containing epenthetic vowels found in Winnebago is so poorly attested cross-linguistically. After all, the monosyllabicity of DL-sequences is accounted for with the simple ranking argument that Syll-Place dominates Son Seq. Why don't a whole host of languages have the same ranking and consequently exhibit similar behavior? The answer to this question has to do with the complete formal account of DL-epenthesis. Recall from section 3 that DL involves epenthesis of a particular kind. Consonant clusters that violate Syllable Contact are 'saved' by epenthesis, and this epenthesis involves linking to a following vowel. It is the doubly-linked Place node that creates a situation where Son Seq and Syll-Place are in conflict. Epenthesis of a default vowel doesn't involve double-linking, rendering Syll-Place inapplicable. Therefore, the constraint ranking yielding a monosyllable [CVCV] will not only rank Syll-Place above Son Seq; a second ranking argument is required, favoring linking to a following vowel over insertion of an unmarked vowel. These two ranking arguments also must correlate with a constraint ranking that gives epenthesis in the first place, e.g. Parse dominates Fill (PS). In summary, we only expect monosyllabic [CVCV] units in a language with the following constraint ranking.

(43) Monosyllabic [CVCV]

a. Parse » Fill
b. Ranking favoring feature linking over default vowel epenthesis (see appendix for discussion)
c. Syll-Place » Son Seq

Before concluding this paper, I want to examine an exceptional stress pattern in Tübatulabal which supports a constraint ranking like the one in (43). This study is thus intended to show that, while such a ranking is rather specific, it is not unattested outside the phonology of Winnebago.

4.4 Alternating Stress in Tübatulabal [22,23]

An irregular stress pattern correlates with forms containing [CV$_i$ ˀ V$_i$] sequences in Tübatulabal that can be compared with exceptional pattern found in Winnebago. I will flesh out this comparison by first presenting the regular stress pattern through the lens of a contemporary metrical analysis (namely the one given in Hayes 1995, but see also Wheeler 1979, Hayes 1980, Gutmann 1982, Crowhurst 1991). Then we turn to the irregular stress pattern, which will be interpreted as a consequence of the syllabification of Tübatulabal [CV$_i$ ˀ V$_i$] sequences as heavy syllables, on a par with the above analysis of DL-sequences.

Gutmann: 61 gives a nice summary of Voegelin's (1935) description of the canonical stress pattern:

(44) The final vowel of a word is always stressed.[...]
[L]ong vowels are always stressed, and [...] a short vowel is stressed when two syllables to the left of a stress (either the final stress, a long stressed vowel, or another short stressed vowel).

Consider how the description in (44) extends to the data below.

(45) Tübatulabal Stress (see Gutmann for various data sources)

	A. Initial Stress	B. Stress on Second vowel	C. Final H L L
.2	H L háawál 'the wood-rat'		
.3	L L L číŋiyál 'the red thistle'	L H L haníílá 'the house (obj)'	H L L náawišúl 'the pine-nut pole'
.4	L L H L úwiláanát 'he is fixing it for him'	L L L L witánhatál 'the Tejon Indians'	
.5/7		L H L L L wašáagáhajá 'it might flame up'	L L L L H L L wítaŋhátaláabacú 'away from the Tejon Indians'

[22] I am grateful to John McCarthy for pointing out the relevance of the following data to me.
[23] Tübatulabal is a Northern Uto-Aztecan language (that was) spoken in Southern California.

Initial stress in (45A) is accounted for by stressing every long vowel (45.2) and every even short vowel counting back from the final stress (45.3) or the medial long vowel in (45.4). Stress on the second vowel from the beginning of the word in (45B) is described in the same way: by stressing the every long vowel and/or every even numbered short vowel from the final stressed vowel. The interest of the forms in (45C) is the stressings in the final sequence ...H L L]. The medial light syllable is skipped and both the heavy and final light syllables are stressed.

The analysis of these facts in Hayes (1995) (simplified slightly) is indicated by the bracketings in (46). Final stress is a consequence of applying End Rule Right (Prince 1983) before foot construction, effectively footing the final (light) syllable. Leftward footing from the final syllable with moraic trochees yields stress on every long vowel (interpreted as bimoraic) and stress on every even syllable left of a stressed syllable. Lastly, Hayes' analysis explains why the first of the two light syllables following a heavy is unstressed in a word-final sequence ...H L L].

(46) Hayes (1995)

	A. Exhaustive Footing	B. Initial L Unparsed	C. Penultimate L Unparsed
.2	(H) (L) háawál		
.3	(LL)(L) číŋiyál	L(H)(L) haníílá	(H) L (L) náawišúl
.4	(LL)(H)(L) úwiláanát	L(L L)(L) witánhatál	
.5/7		L (H)(LL)(L) wašáagáhajá	(LL)(LL)(H)L(L) wítaŋhátaláabacú

Initial stress in (46A) is derived from exhaustive leftward footing from the footed final syllable. The initial syllables in (46B) are unstressed because trochees are aligned to the right on Hayes' analysis, leaving the unpaired initial light syllable unparsed. And lastly, the medial light syllable of the [...H <u>L</u> L] sequences in (46C) cannot form a trochee with the preceding heavy or the final footed light syllables, and thus they are left unparsed.

Alongside the above data, consider the following forms:

(47) a. kúˀujubíl (*kuˀújubíl) 'the little one'
b. ugúˀum (*úguˀum) 'it got word out'

Voegelin (1935: 76) accounts for these apparently exceptional forms by stipulating that the initial [C V$_i$ ˀ V$_i$] sequences form a single unit: "[T]wo short vowels of the same phoneme which are kept separated by a glottal stop are treated in alternation of stress as a single accentual unit". What Voegelin appears to be proposing is that a form like *kúˀujubíl* should receive a prosodic analysis more like (46.3C), rather than the superficially similar (46.4B).

(48) a. [(kúˀu)ju(bíl)] b. [wi (tánha)(tál)] c. [(náa)wi(šúl)]

The initial *kúʔu* is analyzed as a unit in (48a), leaving the medial light syllable unparsed, on a par with (48c). Now, *kúʔu* in Voegelin's grammar is derived by a process that can be compared with Dorsey's Law: /V_i:ʔ / —> [V_i ʔ V_i][24]. Both types of epenthesis insert a vowel that shares the place specification of a local vowel. The CV_iCV_i sequences resulting from DL have been shown to be subject to the requirement which syllabifies long vowels as single syllables (Syll-Place of §3.3); supposing that the CV_iCV_i sequences resulting from Echo Vowel epenthesis in Tübatulabal are subject to this same constraint gives formal expression to Voegelin's proposed analysis in (48a). Initial *kúʔu* is syllabified as a heavy syllable, which on Hayes' analysis supports a trochee, and (48a) is thus treated on a par with (48c).

To continue from (47b), *ugúʔum* is the only case in the language where the final vowel is unstressed. However, on the analysis proposed here, the final CV_iCV_iC *gúʔum* will also be syllabified as a single heavy syllable because the two vowels dominate the same Place node. This gives [u.(.gúʔum.)], with a stress on the head of the final syllable, also consistent with Hayes' trochaic analysis. To conclude, the exceptional stress pattern is explained as a context where a formal property of Tübatulabal syllables, i.e. their geminate structure constrained by Syll-Place, interacts systematically with the principles of stress assignment.

5. Conclusion

In this paper, I have advanced two claims specific to Winnebago phonology, and taken together, they provided a basis for explaining the alternating accent problem. Considered more generally however, the analysis presented in this paper reads like an extended argument in defense of parallelism, the distinguishing property of OT.

The first claim was that trochaic feet are active in the stress system. This assumption was shown to straightforwardly characterize initial extrametricality, provide an avenue for accounting for initial stress in reduplicated DL-sequences, give a natural interpretation for Stem Shortening, and lastly, it was also shown to be consistent with the canonical patterns for verb stems. The second claim, made in a rather different context, was that DL-sequences are syllabified as heavy syllables. This hypothesis was shown to account for the shorter duration of DL-units, their behavior in reduplication, and the fact that the pair of consonants in DL-sequences is subject to a condition characteristic of syllable-internal consonants. Further, the proposed monosyllabicity of DL-sequences was given as an important premise in the account of the fact that DL involves spreading to a following vowel.

The hypothesized trochaic requirement and monosyllabic DL-unit were finally shown to have positive consequences for the alternating accent pattern. Here, the interaction between stress and epenthesis was explained as an interaction between a formal property of DL-sequences and the constraint system restricting the position of stress. Epenthetic vowels where shown to participate in the stress system in that they were prosodized like morphologically sponsored vowels. And where epenthetic vowels entered into an exceptional accent pattern, this surface irregularity was shown to be entirely predictable, given the two main claims of the analysis.

[24] It seems that Voegelin's rule is motivated when the long vowel is followed by a syllable-final glottal stop, making this kind of epenthesis appear syllable-structure related.

The theoretical significance of the general approach taken here is that the assumptions inherent to the analysis were given formal expression in a constraint-based theory where underlying representations are paired directly with their surface forms. Thus, the general conclusion is that a coherent explanation of a thorny problem can be expressed in a constraint-based system that espouses parallelism. And this conclusion in turn leads to a negative one, namely that the stress-epenthesis interaction exhibited in Winnebago should not be used to justify serial derivation as a necessary tenet in phonological explanation. If the Optimality Theoretic analysis given here is successful, such a claim is invalid.

Appendix

The two facts presented in §3.1 concerning the position and relative sonority of Winnebago consonants clusters presents an interesting puzzle. Some clusters, namely those in (22a), are found in both word-initial and word-internal contexts. This fact suggests that the conditions licensing these clusters express language particular restrictions on onsets to Winnebago syllables (Miner 1993). The logic here runs something like this. Suppose initial CCs must form an onset. Word-medial CCs can form onsets, and indeed there is cross-linguistic support for onset maximization (Clements and Keyser 1983). In the interest of subjecting the restrictions outlined in (22a) to a single unit, we interpret these CCs as onsets. The puzzle then involves relating the claim that these CCs form complex onsets to the observed restrictions on sonority rises within these clusters.

Relative sonority and sonority distance have been shown to play a role in describing onset clusters, yet it is conventionally stated as a sonority distance minimum (see Clements 1990). For example, [pr] and [fl] are fine onsets in English, but onset clusters like [bz] or [ps] are excluded by the assumed sonority distance minimum. Therefore, syllabifying Winnebago CCs as complex onsets leads to a rather parochial application of the sonority distance maximum mentioned above.

I would like, therefore, to propose a different syllabification for the clusters in (22) which will allow for an interpretation of the cap on sonority rises as an effect of the Syllable Contact Law (see Murray and Vennemann 1983). The Syllable Contact Law is a generalization that applies to adjacent consonants in different syllables and characterizes the tendency for the syllable-final consonant to be greater in sonority than the syllable-initial consonant. For example, this generalization is said to help explain why in French the medial cluster [tr] forms a complex onset, e.g. *pa.tri* 'country', while [rt] is heterosyllabic: *par.ti* 'left'. Syllabifying [tr] in two different syllables creates an unacceptable rise in sonority across syllables by the Syllable Contact Law. Returning to the clusters in (22), Winnebago CCs do rise in sonority, but the observation in (23) is that this rise is no more than one interval on the given sonority scale. Supposing Winnebago has a general ban on complex onsets, these clusters will enter into a syllable contact configuration. Then, a language particular interpretation of the Syllable Contact Law will give the desired results. Let's work through the analysis step by step.

The heterosyllabic parse of the clusters is governed by the argument that *Complex dominates –Cod (from PS: 87).

(49) a. ***Complex**
No more than one C or V may associate to any syllable position node (i.e. Onset, Nucleus, Coda nodes).
b. **–Cod**
Syllables must **not** have a coda.

(50) *Complex » -Cod

/XC CY/		*Complex	-Cod
a.	X.CCY	*!	
b. ☞	XC.CY		*

I propose the following language particular meaning of the Syllable Contact Law for Winnebago.

(51) **Syllable Contact (Syll-Cont)** $C_1 < C_2$ by no more than one sonority interval[25], where C_1 and C_2 are adjacent, and C_1 is syllable-final and C_2 is syllable-initial.

Now we can see how DL-epenthesis is motivated for an input like /XprY/. Medial [pr] is given a heterosyllabic parse, and is therefore subject to Syll-Cont. Dorsey's Law is thus the language particular strategy used in this case as a way of satisfying Syll-Cont.

(52) Syll-Cont motivates Dorsey's Law

/XprV/	Syll-Cont	Dorsey's Law
a. x x x x x x x x X p.r V	*!	
b. x x x xx x xx x x xx ☞ Xp V rV		*

Dorsey's Law renders the output in (52b) exempt from Syll-Cont because the consonants are no longer adjacent. Thus, whatever penalties that accompany Dorsey's Law are subjugated to the syllable contact requirement. DL-epenthesis will apparently incur multiple Faith violations as a morphologically unsponsored vowels in inserted and linked to the following vowel. The issue of which

[25] The sonority scale employed here compares with the one developed in Jespersen (1904):

Jespersenian Sonority Scale	Winnebago Sonority Scale
1. (a) voiceless stops, (b) voiceless fricatives	1. voiceless obstruents
2. voiced stops	2. voiced stops
3. voiced fricatives	3. voiced fricatives, sonorants (3-5)
4. (a) voiced nasals, (b) voiced laterals	4. vowels (6-8)
5. voiced r-sounds	
6. voiced high vowels	
7. voiced mid vowels	
8. voiced low vowels	

constraints exactly are violated will be important to the formal distinction between DL-epenthesis and epenthesis of a default vowel. The crucial representational difference would seem to be that (on PS's account of) default vowel epenthesis does not involve domination of Place features (but see Smolensky 1993). At this point, I will assume that DL-epenthesis violates both PS's $Fill_{Seg}$ and Fill-Link familiar from Itô, Mester, and Padgett (to appear), and that default vowel epenthesis doesn't violate the latter. It's therefore the nonprominence of the Fill-Link constraint which gives linking to a local vowel.

I need to recapitulate and foreground one of the less trivial aspects of the analysis. The restrictions on possible CCs follow from two requirements, the ban on complex onsets, and Syllable Contact. The constraint *Complex requires the members of a cluster to be at adjacent syllable edges, and Syll-Cont describes the restrictions in (22). Now, if the analysis given here is right, Syll-Cont must apply to both word-medial and word-initial clusters. Considering the word-initial CC in *keré*, *Complex dictates that [.k.re.] is a better syllable parse than [.kre.]. The way Syll-Cont is formulated, however, [k] must be syllable-final in order for the syllable contact requirement to apply. We want Syll-Cont to apply here because DL applies here: [keré]. Therefore, it seems that in order to maintain a general account of *[pr], like the one offered by Syll-Cont, we suppose that initial CCs do not form complex onsets, rather they form syllable contact CCs in the same way medial CCs do. Suppose, for example, that Winnebago licenses a silent vowel word-initially that can form a syllable with a voiceless obstruent: [Vk.re][26]. Syll-Cont applies here as [k.r] is analyzed as a syllable contact cluster, hence motivating the application of Dorsey's Law. The important point is that the restrictions on Winnebago CCs are treated as a syllable contact phenomenon in an analysis which appeals to principles with cross-linguistic support. This motivates, I claim, an analysis where word-initial CCs are treated as syllable contact clusters.

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[26] Steriade (1982) and Itô (1982) motivate similar licensing strategies at word edges.

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