UNIVERSITY OF ROCHESTER WORKING PAPERS IN THE LANGUAGE SCIENCES – VOL. 2, NO. 1 (SPRING, 2001)

Crosswhite, K. M. (2001). Predicting syllabicity and moraicity in Dihovo Macedonian. In J. S. Magnuson and K. M. Crosswhite (Eds.), *University of Rochester Working Papers in the Language Sciences, 2 (1),* 1-22.

PREDICTING SYLLABICITY AND MORAICITY IN DIHOVO MACEDONIAN

Katherine Crosswhite
crosswhi@ling.rochester.edu
University of Rochester

1. Introduction

The Macedonian dialect of the village of Dihovo, located about 8 km. west of Bitola, was the topic of a detailed description and structural analysis by Groen (1977), based on original fieldwork in Dihovo.[1] This dialect has a number of interesting prosodic characteristics that provide an insight into the nature of the inter-relationships between different prosodic levels, specifically, those of sonority, syllabicity, and moraicity. For example, the typical antepenultimate-syllable stress placement seen in a number of Macedonian dialects has given rise to an antepenultimate-mora stress placement pattern in Dihovo (Crosswhite 2001). Furthermore, this dialect possesses two segments, /i/ and /r/, which can both surface either as syllabic or non-syllabic. Although the syllabicity of these segments is predictable, the conditioning factors that result in a syllabic parse are different for the two phonemes. Specifically, there are circumstances under which /r/ will surface as a non-syllabic segment, but /i/ will not; in other words, /i/ is more resistant to a non-syllabic parse than /r/ is. Additionally, moraic distribution in Dihovo is also predictable, but only /i/ (and not /r/) contributes weight when parsed as a non-syllabic segment in coda position. In this paper, I provide a formal analysis of the predictable moraicity and syllabicity of Dihovo. Based on this analysis, I claim that moraicity and syllabicity are autonomous prosodic concepts, which can be subject to independent sonority restrictions. That is, it is possible for a segment to be sonorous enough to surface as syllabic, but not sonorous enough to surface as moraic, and vice versa. The formal analysis I present is based on the Optimality-Theoretic mechanism of prominence alignment (Prince and Smolensky 1993), under which minimum sonority requirements are imposed on prosody by interleaving some appropriate constraint between the members of an inherently-ranked constraint family that is specific to some level of prosody. I claim that this formalism correctly accounts for the Dihovo data by allowing multiple sonority requirements to be imposed for one and the same level of prosody; this results, for example, when more than one constraint is interleaved with respect to a single prominence-alignment family. In other words, the prominence-alignment approach to predicting syllabicity and moraicity allows us to formulate the idea that some segments are possible syllable peaks under *condition x* (such as adjacent to a consonant), but an impossible syllable peak under *condition y* (such as in hiatus).

2. Syllabicity and Moraicity in Dihovo Macedonian

Dihovo is a language with an underlying contrast between /i/ and /j/ (cf. [íl^{j}jada] ‘thousand’ and [nál^{j}iat] ‘they cast (metal)’). The occurrence of underlying /j/ is not predictable: I assume,

[1] The name Dihovo is pronounced [dío].

following Hyman (1985), Hayes (1989), and Rosenthall (1994) that in languages such as this, a phonemic vowel-glide contrast is encoded featurally: underlying /j/ is lexically specified [-syllabic] (or, alternatively, [+consonantal]), while an underlying vowel is not. However, putting aside the single case of phonemic /j/, syllabicity in Dihovo is predictable. The possible syllable peaks of Dihovo include the five underlying vowels (/i,u,e,o,a/) and /r/.[2] However, it is not the case that all six of these syllable peaks are equally good; in fact, two of these syllable peaks, /i/ and /r/, can also surface as syllable margins under the appropriate conditions, whereas the remaining four never do. In the remainder of this section, I demonstrate how these limitations on the syllabicity of /i/ and /r/ can be accounted for through constraint interaction in a framework using inherently-ranked prominence alignment constraints.

Syllabic /r/: In Dihovo, neither obstruents nor nasals can be syllabic, but vowels and /r/ can be.[3] Examples of syllabic /r/ are provided below. Note that syllabic /r/ is completely identical to the Dihovo vowels in its ability to bear stress, which regularly falls on the syllable containing the third mora from the end of the word.

(1) Syllabic /r/ in Dihovo

dzr̩tsalo	'spectacles'	dr̩tʃa	'bad weather'
vr̩f	'top'	vr̩o	'the top'
r̩ʃ	'rye'	bakr̩danik	'maize porridge'
popr̩skaʃe	'it rained'	tvr̩dogláets	'stubborn'
závr̩ʃi	'to finish'	zámr̩zni	'to freeze'

Other consonants, such as nasals and obstruents, cannot be syllabic. I propose that the strategy used in Dihovo to enact this sonority cutoff is the tolerance for marked syllable margins. Dihovo, like most Slavic languages, allows a wide range of consonant clusters, in both onset and coda positions. For example, nasal clusters are fairly common, as in the forms [mnóʒi] 'many', [knótʃok] 'thin', [mléko] 'milk', [fnúk] 'grandson', etc. Similarly, obstruents clusters are at least as common, as in forms like [tvr̩t] 'hard', [zgr̩mi] 'to thunder' (perf.), [tkáj] 'to weave', [kvátʃi] 'to brood', [vzémi] 'in the ground], [ʒdrébe] 'foal', [ptsójsa] 'to die' (of animals), etc. These are precisely the forms that would not be expected if nasals and obstruents could be syllabic segments—otherwise, we would expect to find forms like *[m̩noʒi] or *[k̩vatʃi], etc. (It may be useful to compare, for example, the two forms [r̩ka] 'snore' and [tkáj] 'weave', but *[rká].) To enact this pattern in Dihovo, I start off with the following inherently-ranked constraint family, taken with minor modifications from Prince and Smolensky's analysis of predictable syllabicity in Imdlawn Tashlhiyt Berber (P&S 1993):

[2] Groen (1977) also reports a marginal sixth Dihovo vowel, /ə/, which occurs in only a handful of forms.

[3] Note that although syllabic /r/ is allowed in Dihovo, syllabic /l/ never occurs. This could be an accidental gap, or it could indicate that rhotics are slightly more sonorous than laterals, and therefore that these two types of segments occupy distinct positions with respect to a sonority hierarchy. Although I do not have adequate evidence from Dihovo to decide between these options, I choose to adopt the second (that /r/ is more sonorous than /l/), since this will provide a more general, less arbitrary analysis.

(2) *P/X Constraint Family on Syllable Peaks

*P/Obs. » *P/Nasal » *P/Lateral » *P/Rhotic » *P/High » *P/Mid » *P/Low

This type of constraint family is referred to in P&S '93 as a prominence alignment family, and is derived by computing a cross-product between two different types of prosodic prominence. In this case, the two types of prominence that are crossed are sonority (segmental prominence) and syllabicity. The basic idea embodied in such a family is that prominence of type 1 should co-occur with prominence of type 2, or conversely that lack of prominence type 1 should co-occur with lack of prominence type 2. For example, a constraint like *P/Obs. requires that no obstruent be parsed as a syllable peak. The fact that *P/Obs. is ranked at the very top of this constraint hierarchy encodes the idea that obstruents make the very worst sort of syllabic segment. In contrast, the fact that *P/Low is at the very bottom of this hierarchy encodes the idea that low vowels make quite good syllable peaks. As illustrated above, /r/ is the least sonorous segment in Dihovo that can be a syllable peak, and all segments that are more sonorous than /r/ are also syllabic. We can therefore say that *P/Rhotic establishes the sonority cutoff for Dihovo syllabicity. This result is easily derived by simply ranking a constraint against complex syllable margins, *Complex, between the constraints *P/Lateral ("Laterals are not syllable peaks") and *P/Rhotic. This ranking is demonstrated below for actually occurring Dihovo forms. Note that all of the *P/X constraints referring to vowels have been encapsulated (P&S 1993) into a single tableau column marked *P/[any V], due to space considerations.

(3) *P/Lateral » *Complex » *P/Rhotic

/mnoʒi/ 'many'	***P/Obst.**	***P/Nas.**	***P/Lat.**	***Complex**	***P/Rhot.**	***P/[any V]**
☞ [mnóʒi]				*		*
[m̩noʒi]		*!				
[mn̩oʒi]		*!				

/tkaj/ 'to weave'	***P/Obst.**	***P/Nas.**	***P/Lat.**	***Complex**	***P/Rhot.**	***P/[any V]**
☞ [tkáj]				*		*
[t̬kaj]	*!					
[tk̬aj]	*!					

	***P/Obst.**	***P/Nas.**	***P/Lat.**	***Complex**	***P/Rhot.**	***P/[any V]**
/rka/ 'to snore'						
☞ [r̬ka]					*	
[rká]				*!		*

The first two forms shown in the tableaux above ([mnóʒi] and [tkáj]) illustrate that it is preferable to have a complex syllable margin than to have a syllabic nasal or obstruent. (Forms illustrating the same result for laterals are unavailable, see fn. 3.) However, as shown in the third form ([r̬ka]), it is preferable to have a syllabic rhotic than a complex margin. In other words, the inherent ranking of the *P/X constraints based on the relative sonority of the segments referred

to in the constraints makes it possible to encode that fact that a moderately sonorous segment, like /r/, can be parsed as a syllable peak to avoid a complex syllable margin, while less sonorous segments like /m,n,t,k/ *etc.* cannot: That is, although /r/ is not the best possible syllable peak, Dihovo considers it to be less marked than a complex syllable margin.

Restrictions on Syllabic /r/: It should be noted, however, that there are some restriction on the occurrence of syllabic /r/. It cannot occur, for example, if this would cause a hiatus. In other words, syllabic /r/ will never be found adjacent to a vowel.[4] This restriction can be captured by ranking *Hiatus ("No vowel hiatus") above *Complex. (Note that in the following tableau, only the relevant portion of the *P/X family is shown.)

(4) *Hiatus » *Complex

/bakrdanik/ 'maize porridge'	***Hiatus**	***Complex**	***P/Rhotic**	***P/[any V]**
☞ [ba.kr̩.da.nik]			*	
[bák.rda.nik]		*!		

/krasen/ 'beautiful'	***Hiatus**	***Complex**	***P/Rhotic**	***P/[any V]**
☞ [krá.sen]		*		
[kr̩.a.sen]	*!		*	

/barde/ 'water jug'	***Hiatus**	***Complex**	***P/Rhotic**	***P/[any V]**
☞ [bár.de]				
[ba.rde]		*!		
[ba.r̩.de]	*!		*	

As illustrated by the latter two forms above, a candidate with a syllabic /r/ adjacent to a vowel is always less optimal than a candidate with /r/ parsed as part of a complex syllable margin: In forms like [krásen] 'beautiful', a syllabic /r/ would make the following /a/ onsetless, and in forms like [bárde] 'water jug', a syllabic /r/ would itself be onsetless.[5] As illustrated by the first form, [bakr̩danik] 'maize porridge', an /r/ that occurs between consonants will always be parsed as a syllabic /r/: In this context, *Hiatus can have no effect, so the optimal form is chosen by *Complex and *P/Rhotic.

It is also important to note, however, that syllabic /r/ is not limited to occurring between consonants. For example, it also occurs in a number of forms in absolute word-initial position: [r̩ʃ] 'rye', [r̩ka] 'snore', [r̩gʲa] 'rust', etc. The analysis already provided correctly generates these forms, since word-initial onsetless /r/ does not, in and of itself, constitute a hiatus. This is consonant with Casali's (1996) claim that the constraint *Hiatus cannot be subsumed by the constraint Onset ("Syllables must have onsets").

[4] Exceptions to this generalization occur in affixed forms where an /r/ occurs immediately adjacent to the affix boundary, such as [vr̩-o] 'the top', and [zá-rgʲa] 'begin to rust'. In both cases, the syllabic /r/ occurs at a morpheme boundary: c f. [vr̩f] 'top', [r̩gʲa] 'rust'.

[5] The form [bár.de] also illustrates that *P/Rhotic must outrank NoCoda ("Syllables do not have codas").

In summary, then, although /r/ classes with /i,u,e,o,a/ as a possible Dihovo syllable peak, it must also be separable from this group because it is not a possible syllable peak in hiatus contexts. Use of an entire family of *P/X constraints makes this sort of multiple sonority cutoff possible, since the *P/Rhotic constraint can be manipulated to the exclusion of the *P/High, *P/Mid, and *P/Low constraints.

Other Types of Hiatus: As illustrated in (4), hiatus between a vowel and a syllabic /r/ is not allowed. However, hiatus between two vowels is allowed: [kré.ok] 'tender', [grá.o] 'the beans', [ar.ná.utin] 'Albanian', [pó.ubaf] 'more beautiful', [múabet] 'talk', etc. The analysis already presented does not account for this pattern of data: By ranking *Hiatus above *P/Rhotic, we must simultaneously rank *Hiatus above all the other *P/X constraints for segments more sonorous than /r/. In other words, by transitivity of ranking, if *Hiatus » *P/Rhotic, then *Hiatus » *P/High, *P/Mid, *P/Low. These rankings would (incorrectly) predict that hiatus strings will never occur; instead, one member of the potential hiatus must be parsed as a syllable margin, presumably surfacing as a glide. However, this pattern of behavior is actually only observed for /r/. This difference in the behavior of rhotic vs. vocalic hiatus strings can be accounted for using constraints on possible syllable margins. This type of constraint is formulated in P&S 1993 as the *M/X constraint family. The (slightly modified) version of this family necessary for Dihovo is illustrated below:

(5) *M/X Constraints on Syllable Margins

*M/Low » *M/Mid » *M/High » *M/Rhotic » *M/Lateral » *M/Nasal » *M/Obs.

Here, a constraint like *M/Low encodes the idea that low vocoids make bad syllable margins. The fact that *M/Low is ranked at the top of this hierarchy expresses the idea that low vowels are, in fact, the worst possible syllable margins. Similarly, the fact that *M/Obs. is ranked at the bottom of the hierarchy expresses the idea that obstruents are the best possible syllable margins.

In a sequence of the type V + /r/ or /r/ + V, hiatus can always be avoided by parsing the liquid as a syllable margin. Parsing the /r/ as a syllable margin will violate the constraint *M/Rhotic ("Rhotics are not syllable margins"), but avoids hiatus. In a V + V hiatus, parsing one of the vowels as a syllable margin will always break a fairly high-ranking *M/X constraint. By ranking some of these *M/X constraints above *Hiatus, and other below it, the correct results are generated. Specifically, *Hiatus must outrank both *M/Rhotic ("Rhotics are not syllable margins") and *P/Rhotic ("Rhotics are not syllable peaks"). Both of these dominations are necessary: if *M/Rhotic outranked *Hiatus, at least some hiatus sequences involving a rhotic would in fact surface; if *P/Rhotic outranked *Hiatus, syllabic /r/ in general would not be permitted.[6] However, the rankings needed to account for the behavior of /r/ in Dihovo do not extend to the other syllable peaks. That is, although the constraints *P/High, *P/Mid, and *P/Low are crucially dominated by *Hiatus, the corresponding *M/X constraints are not. This

[6] Recall that *Hiatus outranks *P/Rhotic due to transitivity of ranking: If *P/Rhotic were promoted above *Hiatus, it would come to stand in a position that also dominated *Complex, predicting the incorrect output forms in forms like those illustrated in (3).

allows vocalic hiatus sequences to surface. The ranking of these constraints is shown below to a first approximation (which will be subject to further adjustment concerning the vowel /i/):

(6) Ranking of *Hiatus (First Approximation)

*M/Lo » *M/Mid » *M/Hi *P/Obs. *P/Nas. » *P/Liq.	» *Hiatus »	*M/Rhot. » *M/Liq. » *M/Obs. *P/Rhot. » *P/Hi » *P/Mid » *P/Lo

This is illustrated for two sample forms below, one containing a possible rhotic hiatus, and the other a possible vocalic hiatus. Note that all the *M/X constraint referring to vowels have been encapsulated into *M/[any V] for these tableaux. The exact ranking of these encapsulated constraints will be discussed in more detail later; these tableaux are presented at this time to demonstrate how the *M/X family accounts for the different behavior of /r/ on the one hand, and the vowels on the other. (The symbol [̯] indicates a non-syllabic vowel.)

(7) The Role of *M/X Constraints in Rhotic vs. Vocalic Hiatus Sequences

/barde/ ‘water jug’	***M/[any V]**	***Hiatus**	***Complex**	***M/Rhotic**	***P/Rhotic**
☞ [bár.de]				*	
[ba.rde]			*!	*	
[ba.r̯.de]		*!			*
/muabet/ ‘talk’	***M/[any V]**	***Hiatus**	***Complex**	***M/Rhotic**	***P/Rhotic**
☞ [mú.a.bet]		*			
[múa̯.bet]	*!				

As illustrated, the constraint *Hiatus must outrank the constraint *M/Rhotic, since the desire to avoid hiatus is strong enough to cause violation of this constraint. Howver, the fact that *Hiatus is in turn dominated by the *M/X constraints referring to vowels makes it possible for vocalic hiatus to occur.

The fact that rhotics are the only segments whose *M/X and *P/X constraints are both crucially dominated by *Hiatus means that rhotic hiatus is the only type of hiatus that is completely avoided in Dihovo. In other words, the fact that both *M/Rhotic and *P/Rhotic are crucially dominated makes /r/ both a possible syllable peak, and a possible syllable margin: The exact choice between these two syllabic roles for any given /r/ is determined through the interaction of other constraints.

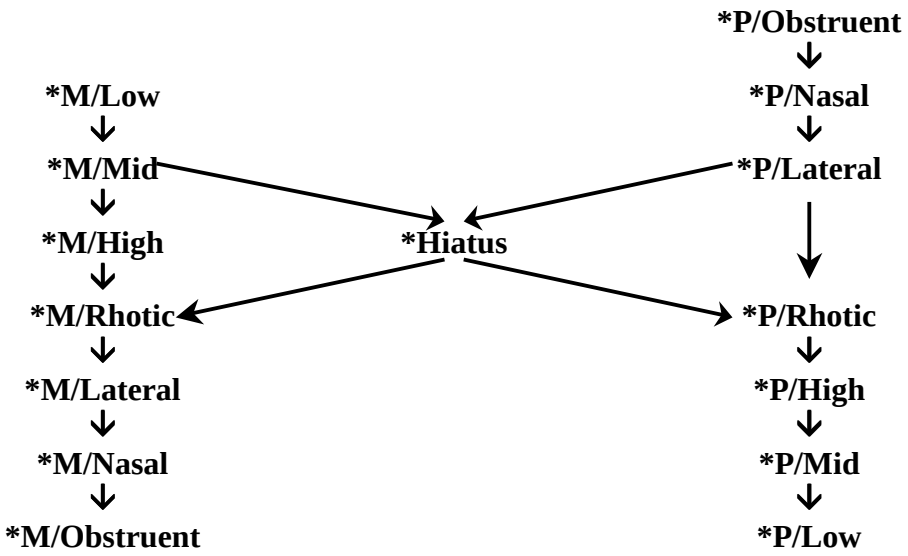
Optional Glide Formation: The prominence alignment analysis of Dihovo syllabicity provided above is further supported by the behavior of the vowel /i/. In vowel hiatus situations involving the vowel /i/ as the second member, that vowel can be parsed as a non-syllabic segment in order to avoid hiatus. However, this is optional, generating doublet forms of the type illustrated below.

(8) Optional Glide Formation

ná.i.gram	náj.gram	'I play'
krá.iʃ.kʲa	krájʃ.kʲa	'ends, extremities'
lʲé.ko.it	lʲé.kojt	'medicinal'
lʲe.ko.i.ta	lʲe.kój.ta	'the medicinal' (f.)
bó.i.te	bój.te	'the colors'
ó.da.i	ó.daj	'rooms'
bó.i	bój	'colors'
mó.i	mój	'my' (pl.)

Note that glide formation is not possible with the high vowel /u/: [arná.utin] cannot be realized as *[arnáwtin], for example. In general, Dihovo does not have the glide /w/. I assume that whatever constraint it is that rules out /w/ as a general phoneme of Dihovo (call it *w) also rules out optional glide formation from underlying /u/. With this caveat in mind, optional glide formation for /i/ can be derived by adjusting the ranking of the *M/X constraints that refer to vowels. Recall that these constraints were previously 'encapsulated' into a single tableau column—now they must be separated and given separate rankings. Specifically, the one lowest constraint of this group, *M/High, must be freely rankable with respect to *Hiatus, while the other two (*M/Mid and *M/Low) invariably dominate *Hiatus. This means that the following rankings would hold in Dihovo:

(9) Ranking of *Hiatus (Final)



As illustrated, the ranking of the *P/X constraints and *Hiatus is total: every constraint in that subset is ranked with respect to every other in that subset. However, the ranking of the *M/X constraints and *Hiatus is partial: there is no ranking specified between *Hiatus and *M/High. However, *Hiatus is ranked with respect to every other member of the *M/X family. Following

Anttila (1995), I assume that partial orders of constraints are always resolved into total orders prior to constraint evaluation. In a grammar where precisely two constraints are not ranked with respect to one another, this will produce two possible total orders, resulting in two possible (i.e., optional) grammars. This is illustrated in the tableaux below. Note that only the violations for the segment(s) in questions are shown (i.e., for the underlying /i/ of /naigram/, for instance).

(10) Variable Ranking of *Hiatus , *M/High

Ranking 1:

/naigram/ 'I play'	*M/Low	*M/Mid	*Hiatus	*M/Hi	*M/Rhot.	*P/Rhot.
☞ [náj.gram]				*		
[ná.i.gram]]			*!			

/muabet/ 'talk'	*M/Low	*M/Mid	*Hiatus	*M/Hi	*M/Rhot.	*P/Rhot.
☞ [mú.a.bet]			*			
[mú̯a.bet]	*!					

/barde/ 'water jug'	*M/Low	*M/Mid	*Hiatus	*M/Hi	*M/Rhot.	*P/Rhot.
☞ [bár.de]					*	
[bá.ɾ.de]			*!			

Ranking 2:

/naigram/ 'I play'	*M/Low	*M/Mid	*M/Hi	*Hiatus	*M/Rhot.	*P/Rhot.
[náj.gram]			*!			
☞ [ná.i.gram]]				*		

/muabet/ 'talk'	*M/Low	*M/Mid	*M/Hi	*Hiatus	*M/Rhot.	*P/Rhot.
☞ [mú.a.bet]				*		
[mú̯a.bet]	*!					

/barde/ 'water jub'	*M/Low	*M/Mid	*M/Hi	*Hiatus	*M/Rhot.	*P/Rhot.
☞ [bár.de]					*	
[bá.ɾ.de]				*!		

As illustrated above, a form with a hiatus involving /i/ has two acceptable surface forms. Under ranking 1, where *Hiatus outranks *M/High, the underlying /i/ surfaces as a glide. Under ranking 2, the hiatus is tolerated in order to avoid parsing a vowel as a syllable margin. However, for other types of potential hiatus strings, such as those involving non-/i/ vowels only (cf. [múabet]) or those with a rhotic (cf. [bárde]), this variability in ranking does not produce optional surface forms. Instead, non-[i] vocalic hiatus is (*ceteris paribus*[7]) tolerated because

[7] It should be noted, however, that there are several other strategies for avoiding hiatus that are not directly related to the present discussion. All such processes are optional, and apply only to certain types of hiatus. For example, certain types of hiatus are subject to optional glide insertion (ex: /oe/ > [oje], /ia/ > [ija]), while others are subject to

both *M/Low and *M/Mid always outrank *Hiatus. Similarly, rhotic hiatus is not tolerated because *Hiatus always outranks *M/Rhotic.

Summary of Dihovo Syllabicity: In summary, although it is possible to simply list the possible syllable peaks of Dihovo (i.e., /i,u,e,o,a,r/), this does not give a full picture of Dihovo syllabicity. Instead, it is more accurate to note that /u,e,o,a/ are obligatory syllable peaks (syllabic in all contexts), and that /i/ and /r/ are optional syllable peaks (syllabic in some contexts only). Furthermore, it must additionally be noted that the optional syllable peak /i/ is more resistant to being parsed as a syllable margin than the less sonorous /r/ is. This state of affairs can be summarized by the following table, which represents the minimum sonority requirements for syllabicity under different contexts in Dihovo:

(11) Dihovo Sonority Requirements on Syllabicity (summary)

A segment that is…	***must be…***	***…to be syllabic.***
not in hiatus position	at least as sonorous as /r/	
in hiatus position (ranking 2)	at least as sonorous as /i/	
in hiatus position (ranking 1)	at least as sonorous as /e,o/	

This tripartite sonority cutoff for syllabicity is easily derived under the prominence alignment approach by allowing three different points at which some constraint, specifically either *Complex or *Hiatus, can crucially dominate some subset of either the *M/X or *P/X constraint families. The fact that *Complex dominates the subset of *P/X constraints from *P/Rhotic to *P/Low accounts for the fact that the segments /r/ through /a/ constitute the general (non-hiatus) set of syllabic segments. The fact that *Hiatus dominates the subset of *M/X constraints beginning with *M/Rhotic and ending with *M/Obstruent accounts for the fact that no consonant, rhotic to obstruent, can be syllabic in hiatus position. Finally, the fact that *M/High is optionally included in the subset of *M/X constraints crucially dominated by *Hiatus accounts for the option of having an even more stringent sonority cutoff in hiatus sequences involving /i/. The fact that these different sonority cutoffs are specific to various contexts (like hiatus position) derives from the fact that the interleaved constraints only apply in certain contexts: *Hiatus can only be active in determining syllabicity in a potential hiatus string; for example. This situation is summarized in the following table. Constraints that are interleaved into a constraint family to produce a cutoff point are shown in bold.

optional coalescence ([oa] > [oː], /ea/ > [eː]). The hiatus sequences exemplified in the main text as examples of V + V hiatus surfacing without repair are not subject to any of these additional strategies.

(12) Deriving Dihovo Sonority Cutoffs

Context	Ranking	Result
General	… *P/Lateral » ***Complex** » *P/Rhotic …	Any segment equal in sonority to /r/, or of higher sonority, will be parsed as syllabic; Complex syllable margins are more marked than syllabic rhotics and vocoids, but more marked than syllabic liquids, nasals, and obstruents in Dihovo.
Hiatus (Ranking 2)	… *M/High » ***Hiatus** » *M/Rhotic …	Any segment that is more sonorous than /r/ can be syllabic in hiatus position; Non-syllabic /i,u,e,o,a/ are more marked than hiatus under this ranking, but non-syllabic /r,l,n,m…/ are less marked.
Hiatus (Ranking 1)	… *M/Mid » ***Hiatus** » *M/High » *M/Rhotic …	Any segment that is more sonorous than /i/ can be syllabic in hiatus position; Non-syllabic /e,o,a/[8] are more marked than hiatus under this ranking, but non-syllabic /i,r,l,n,m…/ are less marked.

3. Moraicity in Dihovo

In the preceding section, I have considered the predictable syllabicity of Dihovo Macedonian. However, moraicity is also predictable in this language. The moraicity of various segments can be investigated via examination of stress placement: In this language, the location of stress is determined in a mora-counting fashion in which stress falls on the syllable containing the third mora from the end of the word (Crosswhite 2001). As illustrated below, all syllabic elements are moraic, as are coda glides.

[8] Recall that [w] does not occur in general in Dihovo, or in most other dialects of Macedonian. As noted above, if we assume, following standard Optimality-Theoretic practice, that this aspect of the Dihovo phoneme inventory is due to an undominated constraint *w, we do not need a separate account of why underlying /u/ is not subject to optional glide formation.

(13) Moraic Segments in Dihovo As Indicated By Stress Placement

a. All Syllable Peaks Are Moraic

ízoral	'he ploughed'	izórala	'she ploughed'
préfṛli	'throw over' (perf.)	prefṛl^{j}uva	"throw over' (imp.)
bakṛ́danik	'maize porridge'	klukódṛvets	'woodpecker'

b. 2nd Half of Long Vowels Are Moraic

arámiː	'thieves	aramíːte	'the thieves'
gológlaː	'bareheaded' (f.)	krastáːta	'the crusty' (f.)

c. Coda Glides Are Moraic

blúdoj	'platters'	bludójte	'the platters'
ʃúrej	'wife's brothers'	ʃuréjte	'the wife's brothers'
rázboj	'looms'	razbójte	'the looms'
gológlaj	'bareheaded' (pl.)	gologlájte	'the bareheaded' (pl.)

d. Other Codas Are Nonmoraic

[fár.mer.ki]	*[far.mér.ki]	'blue jeans'
[pó.jar.no]	*[po.jár.no]	'best'
[mrá.zul^{j}.tsi]	*[mra.zúl^{j}.tsi]	'icicles'
[kó.pan.ka]	*[ko.pán.ka]	'zinc trough'
[má.ga.tʃin]	*[ma.gá.tʃin]	'warehouse'

As illustrated by the forms in (13a), all syllable peaks are moraic, including syllabic /r/. In particular, note the forms [bakṛ́danik] 'maize porridge' and [klukódṛvets] 'woodpecker'. In [bakṛ́danik], a syllabic /r/ occurs in the position three moras from the end of the word and, as expected, bears stress. Stressed /r/ is in fact not uncommon in Dihovo; and forms such as [bakṛ́danik] furthermore illustrate that stressed /r/ is fully parallel to any other stressed syllable peak in the language—for example, this form is rather long, possessing no less than three other vowels that could serve as potential resting places for stress; the /r/ nonetheless receives the stress, indicating the stressed /r/ is just as "stressable" as a vowel in Dihovo. Similarly, the form [klukódṛvets] shows that syllabic /r/ is not only stressable, but is also moraic even when syllabic but unstressed. In this form, the syllabic /r/ crucially must be moraic in order to explain why stress falls on the [o] rather than the [u]. The forms in (13b) illustrate that the second half of a long vowel also contributes weight. It should be noted, however, that Dihovo does not have an underlying contrast between long and short vowels: Surface long vowels result from the optional coalescence of two adjacent underlying vowels across a morpheme boundary (e.g. /arami-/ 'thief' + /-i/ 'pl.', cf. [arámia] 'thief' (sg.)). The forms in (13c) show that glides in coda position also contribute weight. For example, in the forms [gológlaj] and [gologlájte], the coda glide must crucially be moraic to account for stress placement on the penultimate rather than antepenultimate syllable. Furthermore, note that the coda glides provided in (13c) do not result from optional glide formation. Recall that Dihovo has an underlying contrast between /j/ and /i/;

all the forms listed in (13c) have underlying /j/ that just happens to surface in coda position.[9] To summarize Dihovo moraic distribution up to this point: Dihovo syllabic /r/ is moraic, and furthermore, heavy (bimoraic) syllables are allowed. However, as indicated by the forms in (13d), the second mora position of a heavy syllable is under a more stringent sonority restriction than the first mora position is. As illustrated in (13d), non-vocalic segments that occur in coda position are not moraic. In particular, coda /r/ does not contribute to syllable weight. For example, in a form like [fármerki] 'blue jeans', stress falls on the third *vowel* from the end of the word, despite the fact that two coda rhotics intervene between this vowel and the end of the word. If these coda rhotics were moraic, we would expect the unattested accentuation *[farmérki].

An Excursus: Coda Glides vs. Diphthongs: Before continuing with an analysis of Dihovo moraicity, I would like to take a moment to discuss the proper description of the moraic, post-vocalic glides from (13c) just discussed. In particular, some readers may wonder how we can be certain that the post-vocalic moraic glides in (13c) and the post-vocalic nonmoraic consonants in (13d) are truly in the same syllabic position. Is it not possible, for example, that the glides of (13c) are simply the second halves of diphthongs, while the consonants in (13d) are true codas? My response to this objection is twofold:

The first, and most important, point to be considered is of a general theoretical nature. To wit: Even if the V + /j/ sequences in (13c) were diphthongs rather than V + coda, this does not diminish the importance of the Dihovo data. The interesting thing about Dihovo is that the sonority cutoff imposed on general syllabicity is less stringent than the sonority cutoff imposed by general moraicity: Although /r/ can be syllabic in a general (non-hiatus) context, it cannot be moraic outside of the syllable peak position. To put it another way: Whatever the syllabic role associated with the glide in V + /j/ is, we must either explain why /r/ cannot occur in exactly that same position, or explain why can occur in exactly that same position without being moraic. Deciding on a label to describe this position is a somewhat academic matter; the important point is that there is a minimum sonority requirement imposed on this structure, and that /j/ meets and while /r/ doesn't. To illustrate this point even further—even if we assume that V + /j/ is a diphthong, we are still left to explain why Dihovo allows /j/ as the second half of a diphthong, but not /r/. This point is especially important when we realize that rhotic diphthongs are in fact attested in languages like North American English.

The second point I raise is more language-specific: Since the glides in (13c) are underlyingly /j/ (i.e., not the result of optional glide formation from underlying /i/), calling the V + /j/ sequences

[9] The phonemicity of the glides in these examples can easily be ascertained by noting, as Groen (1977:19-22) does, that underlying glides *always* surface as glides, whereas optionality between [i] and [j] is only noted for underlying /i/. That is, formation of a glide from underlying /i/ is optional, and there is no parallel phenomenon of "optional glide vocalization." Therefore, the impossibility of *[blúdoi], *[ʃúrei], *[rázboi], *[gológlai], etc., indicates that these forms should be phonemicized with /j/. In contrast, the optionality seen in forms like /naigram/, which can surface as either [náigram] or [nájgram], indicates that these forms should be phonemicized with /i/. Note that underlying glides do not vocalize even when they are in the antepenultimate mora position, i.e., in the position where stress woul normally be expected to fall. When an underlying /j/ is in such a position, stress falls on the preceding vowel. This contrasts markedly with the behavior of underlying /i/, which always receives stress when found in the antepenultimate mora position. For example, compare [aírlia] 'happy', with an underlying /i/ in antepenultimate mora position vs. [bájratsi] 'banners', with an underlying /j/ in the antepenultimate mora position.

in (13c) "diphthongs" requires either defining the term diphthong to include V + non-syllabic coda /j/, or assuming that the underlying glides have vocalized. Although sequences of V + coda /j/ (or coda /w/) are sometimes referred to as diphthongs (cf. Rosenthall 1994), such a usage of the term in the present context is clearly obfuscatory. Furthermore, the idea that the glides in these sequences have vocalized is belied by Groen's (1977) extremely detailed description of Dihovo. Groen scrupulously distinguishes between syllabic and non-syllabic pronunciations for high front vocoids in Dihovo. Indeed, the fact that he so meticulously describes the phenomenon of optional glide formation (pp. 19-22) clearly indicates that Groen could distinguish syllabic vs. non-syllabic pronunciations for high front vocoids in Dihovo; otherwise variant forms like [náigram] and [nájgram] would have been completely overlooked. The same point can be made by examining Groen's arguments (p. 18-19) for considering /i/ and /j/ to be phonemic: the fact that he was able to distinguish near-minimal pairs like [nálʲiat] 'the cast (metal)' and [ílʲjada] 'one-thousand' once again indicates that Groen's choice to transcribe either /i/ or /j/ in a given form was quite carefully considered. Therefore, given Groen's explicit claim (cf. p. 20) that the glides in forms such as those in (13c) are not and cannot be pronounced syllabically, the glide vocalization hypothesis must be ruled out.

Therefore, based on both the general theoretical and language-specific considerations, I will continue to call the moraic, post-vocalic glides in forms such as those in (13c) codas.

Predicting Moraicity in Dihovo: What we have seen in the preceding paragraphs is that moraicity in Dihovo is entirely predictable, and furthermore, that there are two sets of possible moraic segments in Dihovo: In syllable peak position, vowels and /r/ are moraic; outside of syllable peak position, only vocoids (i.e., vowels or glides) are moraic. In this section, I will present a formal analysis for determining moraic distribution in Dihovo.

In the preceding section, the *P/X and *M/X constraint families were used to predict syllabicity. Recall that the *M/X and *P/X families refer specifically to the idea of syllabicity: "M" refers to syllable margin position, while "P" refers to syllable peak position. This is due to the fact that the *P/X and *M/X constraint families are constructed by crossing the syllabic prominence scale (peak > margin) with the sonority scale. However, this idea of crossing different types of prominence to produce inherently-ranked prominence alignment families is not limited to syllabic positions. As put forward in P&S '93, this mechanism can apply to any types of prosodic prominence taken two at a time. For example, prominence alignment can also be applied to moraicity by crossing a moraic prominence scale (moraicity > nonmoraicity) and the sonority scale: The more sonorous a segment is, the more likely it is to be moraic; the less sonorous it is, the less likely it is to be moraic. This basic idea has already been applied in the realm of vowels to derive the fact that certain low-sonority vowels (like [ə]) tend to resist lengthening (Kenstowicz 1994), or conversely the fact that high-sonority vowels might be excluded from occurring in ultra-short nonmoraic syllables (Crosswhite 1999). The constraint families that have been used in these cases are basically as follow:

(14) Constraints on Moraicity

*Moraic/ə » *Moraic/High » *Moraic/Mid » *Moraic/Low

*Nonmoraic/Low » *Nonmoraic/Mid » *Nonmoraic/High » *Nonmoraic/ə

However, these constraint families can easily be extended to apply to consonants as well as vowels, in which case they become entirely parallel to the *M/X and *P/X constraint families already introduced. I propose that the completely predictable nature of Dihovo moraic distribution is derived via interaction between the *Moraic/X constraint family and the constraint MoraicCoda:

(15) MoraicCoda: Any consonant parsed in coda position must be associated with a unique mora in the output.

If left to reach its full expression, the MoraicCoda constraint would cause all coda consonants in Dihovo to affect stress placement in the manner already observed for coda /j/. However, the MoraicCoda constraint can be barred from overgenerating moraic codas in Dihovo by interleaving it with the members of the *Moraic/X constraint family.

(16) The Dihovo *Moraic/X Family

*Mor./Obs. » *Mor./Nasal » *Mor./Lat. » *Mor./Rhot. » **MoraicCoda** » *Mor./High » …

By ranking MoraicCoda above *Moraic/High, high vocoids that are parsed in coda position will surface as moraic: Since *Moraic/High is the lower-ranking constraint, it is the one that is easier to violate. However, since MoraicCoda ranks below *Moraic/Rhotic, an /r/ parsed in coda position will not surface as moraic: It is more important to satisfy *Moraic/Rhotic than it is to provide a mora for a coda consonant. This is illustrated in the following tableaux. Note that I am assuming that the constraint *Moraic/High applies equally well to all [+high] vocoids, including both [+syllabic] vowels like /i/ and [-syllabic] glides like /j/. Here, the symbol ∅ indicates lack of a mora.

(17) Coda Glides vs. Coda Liquids

/tkaj/ ‘weave’	***Mor/Nas.**	***Mor/Liq.**	***Mor/Rhot.**	**MoraicCoda**	***Mor/High**
☞ [tkaj] | μ					*
[tkaj] | ∅				*!	

/tsar/ ‘czar’					
☞ [tsar] | ∅				*	
[tsar] | μ			*!		

Here, the ranking of MoraicCoda between *Moraic/Rhotic and *Moraic/High guarantees precisely the right result: codas that are less sonorous than /j/ will not surface as moraic. The same result illustrated above for the coda rhotic in [tsár] will also obtain for coda nasals and obstruents, explaining why coda /j/ is the only coda consonant that surfaces as moraic in Dihovo.

However, one snag with this analysis is that it incorrectly predicts that syllable peaks will be nonmoraic. That is, the *Moraic/X constraint family basically tries to prohibit the occurrence of moras; the only reason coda /j/ surfaces as moraic is that there is an additional constraint, MoraicCoda, which applies pressure in favor of moraicity. Since MoraicCoda does not apply to syllabic segments, there must be some other constraint that applies pressure in favor of moraicity for syllable peaks. I suggest that there is in fact a third prominence alignment constraint family that provides this pressure, and which subsumes MoraicCoda. Specifically, assuming that syllable peaks are more prominent[10] than syllable codas, and that codas are more prominent than onsets, the following prominence alignment scale results from crossing the syllabic prominence scale (nucleus > coda > onset) with the moraicity scale (moraicity > nonmoraicity).

(18) MoraicPeak » MoraicCoda » MoraicOnset

A constraint like MoraicPeak requires that all segments parsed into a syllable nucleus position be associated with (unique) moras. The fact that MoraicPeak outranks MoraicCoda means that it is more important for nuclei to be moraic than for codas to be moraic. Furthermore, the fact that MoraicOnset is the lowest ranking of these three constraints indicates that it is not very important at all for onsets to be moraic. If any of these three constraints were to be outranked by the constraint *Struc-μ ("Avoid moraic structure"), segments associated with the named syllable position would never be moraic. This produces four possible output patterns:

(19) Predicted Patterns for Moraic Distribution

1. *Struc-μ » MoraicPeak » MoraicCoda » MoraicOnset:	No segments are moraic.
2. MoraicPeak » *Struc-μ » MoraicCoda » MoraicOnset:	Only nuclei are moraic.
3. MoraicPeak » MoraicCoda » *Struc-μ » MoraicOnset:	Nuclei and codas are moraic.
4. MoraicPeak » MoraicCoda » MoraicOnset » *Struc-μ:	All segments are moraic.

Since option (4) are quite rare, if not completely unattested, it may be the case that the ranking *Struc-μ » MoraicOnset is universal. Since moraic codas are an option in Dihovo, ranking (3) is the appropriate one for this language; the application of MoraicCoda, as already noted, will be limited by the application of *Moraic/X constraints. This ranking is illustrated by the following three tableaux, illustrating underlying /r/ as it surfaces in three different syllabic positions: onset, nucleus, and coda. Note that only the relevant *Moraic/X constraints are included due to space considerations, and only violations for the segment under consideration (i.e., the /r/) are shown due to considerations of clarity:

[10] Here, I use the term "prominent" to refer to relative amplitude and duration, and not to refer to salience. I take salience to be a perceptual concept, referring to the relative probability that a listener will devote attention to a given sound. I do not rule out the possibility that a shorter, quieter consonant in onset position might be more salient than a longer, louder consonant in coda position. Furthermore, I do not rule out the possibility that domain-initial fortition could apply an opposite pressure in the grammar.

(20) Deriving the (Non-)Moraic Status of Dihovo /r/

/rak/ ‘cancer’	**Moraic Nuc**	***Mor/ Rhot**	**Moraic Coda**	***Mor./ High**	***Struc-μ**	**Moraic Ons**
☞ [r á k] | ∅						*
[r á k] | μ		*!			*	

/tsar/ ‘czar’	**Moraic Nuc**	***Mor/ Rhot**	**Moraic Coda**	***Mor./ High**	***Struc-μ**	**Moraic Ons**
☞ [tsár] | ∅			*			
[tsár] | μ		*!			*	

/rʃ/ ‘rye’	**Moraic Nuc**	***Mor/ Rhot**	**Moraic Coda**	***Mor./ High**	***Struc-μ**	**Moraic Ons**
☞ [r̝ʃ] | μ		*			*	
[r̝ʃ] | ∅	*!					

As illustrated in these three tableaux, /r/ in Dihovo is correctly predicted under this analysis to surface as moraic only in syllabic position. As illustrated in the first tableau by the form [rák] ‘cancer’, /r/ could surface as moraic in onset position only if MoraicOnset were to outrank both *Moraic/Rhotic and *Struc-μ, the latter of which is a ranking which may be universally unattested. The form [tsár] in the second tableau shows that a coda /r/ also surfaces as nonmoraic, due to the fact that *Moraic/Rhotic outranks MoraicCoda. That is, under this ranking, it is more important to avoid a moraic /r/ (of any type) than it is to provide moras for coda consonants. Finally, the form [r̝ʃ] in the third tableau shows that syllabic /r/ does, in fact, surface as moraic. Notice, however, that this is due solely to the undominated status of the constraint MoraicPeak, which demands that any syllable peak also be associated with a (unique) mora.

It is important to note that the same constraints and rankings correctly predict that coda glides surface as moraic. To illustrate this point, I provide tableaux below for a forms with high front

vocoids in three different syllabic positions. Again, only violations for the segment under consideration (i.e., the /i/ or /j/) are shown.

(21) Deriving the Moraic Status of Dihovo High Front Vocoids

/juk/ 'south'	**Moraic Nuc**	***Mor/ Rhot**	**Moraic Coda**	***Mor./ High**	***Struc-μ**	**Moraic Ons**
☞ [j ú k] | ∅						*
[j ú k] | μ				*!	*	

/raj/ 'paradise'	**Moraic Nuc**	***Mor/ Rhot**	**Moraic Coda**	***Mor./ High**	***Struc-μ**	**Moraic Ons**
☞ [r á j] | μ				*	*	
[r á j] | ∅			*!			

/is/ 'same'	**Moraic Nuc**	***Mor/ Rhot**	**Moraic Coda**	***Mor./ High**	***Struc-μ**	**Moraic Ons**
☞ [í s] | μ				*	*	
[í s] | ∅	*!					

Comparing between these tableaux and the previous three for /r/, we see that onset /j/ surfaces as nonmoraic for the same reasons that onset /r/ surfaces as nonmoraic; syllabic /i/ surfaces as moraic for the same reasons that syllabic /r/ surfaces as moraic. The key difference is that coda /j/ surfaces as moraic while coda /r/ does not. This difference is due to the fact that MoraicCoda outranks *Moraic/High, but is in turn outranked by *Moraic/Rhotic. In other words, /j/ is sonorous enough to be moraic in coda position, but /r/ is not. However, the high rank of MoraicPeak obviates sonority-based comparisons for moraicity in syllable peak position, by requiring that any segment that is syllabic must also be moraic. In other words, we can say that /r/ is not generally sonorous enough to be moraic in Dihovo, but the fact that it is independently sonorous enough to be syllabic in the same language motivates a moraic parse for this segment in syllable peak position only.

4. Conclusions: Results of Prominence Alignment

The analysis of predictable syllabicity and moraicity in Dihovo presented here crucially relies on the idea of prominence alignment, which produces inherently ranked constraint families that explicitly refer to preferred and dispreferred types of combinations for any two types of prosodic prominence. In summary, the basic logic behind the approach explicated above is as follows: Prominent elements (such as syllabicity, moraicity, and sonority) should co-occur in a mutually reinforcing way; combinations of low prominence elements at one level of the prosodic hierarchy with high prominence elements at some other level are dispreferred. All possible types of prominence (syllabic, moraic, segmental, and others) can serve as the basis for prominence alignment constraints of this sort. In this section, I will discuss some of the further-reaching implications of this formalism.

Autonomy of Prominences: In accounting for syllabicity and moraicity in Dihovo, three different types of prominence alignment constraint were used. These are summarized below:

(22) Prominence Alignment Families in Dihovo

*P/X and *M/X constraint families:
Based on crossing syllabic prominence with sonority.

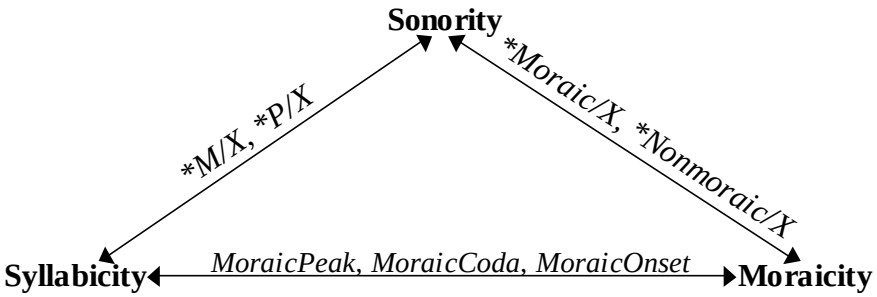
*Moraic/X and *Nonmoraic/X constraint families:
Based on crossing moraic prominence with sonority.

MoraicPosition constraint family:
Based on crossing syllabic prominence with moraic prominence.

Only three constraints in addition to these were necessary in accounting for both moraicity and syllabicity: *Hiatus, *Complex, and *Struc-μ. Although it may seem as though quite a number of constraints were utilized to account for Dihovo syllabicity and moraicity under this approach, the assumption that all *bona fide* Optimality-Theoretic constraints are universal makes this a very economical analysis: Admitting the general class of prominence alignment constraints into the universal constraint set effectively predicts that all three of the prominence alignment families listed in (22) (and others) exist in *every* language, even when they have no role in choosing actual output forms due to constraint domination. Language-specific differences in syllabicity and moraicity are derived wholly through constraint ranking: By interleaving various constraints, such as *Hiatus, *Complex, *Struc-μ, etc. among the members of the prominence alignment families, various subsets of each prominence alignment family can be inactivated via constraint domination. However, the immutable ranking imposed open the members of a given prominence alignment constraint family limits the manner in which inactivation may occur, effectively establishing a means for deriving minimum sonority cutoffs affecting different prosodic positions. Under this approach, the inter-relationships between types of prosody, such as syllabicity and moraicity, can be described as autonomous. That is, the three different constraint families in (22) are completely independent; knowing which members of *P/X are "active" in a given language tells you nothing about which members of *Moraic/X are active in the same language. In fact, the only way that the concepts of moraicity and syllabicity are

directly linked under the prominence alignment approach is due to the existence of the third constraint family, which specifically refers to both concepts simultaneously. This situation can be represented pictorially as follows:

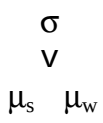
(23) Formal Relations Between Syllabicity, Moraicity, and Sonority



As illustrated, these three types of prominence are formally linked only via prominence alignment constraints. Specifically, moraicity and syllabicity are not causally linked in any way: Under this analysis, syllabicity does not require moraicity except in languages where the constraint MoraicPeak just happens to have a high enough rank to force it. By maintaining the autonomy of all three types of prominence, we are able to establish independent minimum sonority limitations on both moraicity and syllabicity of the type seen in Dihovo. Furthermore, by incorporating a third type of prominence alignment combining syllabicity and moraicity directly, we are able to account for the fact that syllabicity and moraicity do, in most languages, show a very close interrelationship: Syllabic segments are generally moraic, for example.

Predicted Relationships Between Moraicity and Syllabicity: The claim that syllabicity and moraicity are formally independent and autonomous makes certain claims about the possible relationships that may be found between moraicity and syllabicity in the world's languages. Specifically, this claim predicts that there is no *obligatory* relationship between them. This directly contradicts the predictions made in several works by Zec (1994, 1995, 1999). Under Zec's approach, syllabicity is defined as a specific type of moraicity: strong moraicity. That is, the first mora in any syllable is the head of that syllable, and labeled *s* (strong). Any additional moras in the same syllable are labeled *w* (weak). An *s*-labeled mora is then equated with syllabicity:

(24) Strong vs. Weak Moras (Zec 1995)



Under this sort of view, moraicity and syllabicity are not autonomous, and are instead causally linked: syllabicity requires moraicity, because syllabicity is simply a special case of moraicity. Thus, even if distinct and independent sonority cutoffs were imposed on syllabicity and moraicity, certain types of relationships between moraicity and syllabicity would be ruled out simply due to the fact that any syllabic segment must meet both syllabic and moraic requirements. In particular, only the four types of relationships listed below would be possible:

(25) Possible Relationships Between Moraicity and Syllabicity (Zec 1995:113)

a. syllabic set < moraic set < segment inventory	(Lithuanian, Kwakwala, Tiv)
b. syllabic set < moraic set = segment inventory	(Cairene Arabic, English, etc.)
c. syllabic set = moraic set < segment inventory	(Khalkha Mongolian, Gonja, etc.)
d. syllabic set = moraic set = segment inventory	(Imdlawn Tashlhiyt Berber)

An example of an impossible language under this theory would be one in which the set of moraic segments was a subset of the set of syllabic segments (i.e., syllabic set > moraic set < segment inventory), yet this is precisely the situation attested in Dihovo: The set of syllabic segments is a superset of the set of moraic segments since /r/ can be syllabic, but cannot be generally moraic.

In contrast, under the prominence alignment approach, the moraicity of /r/ in syllable peak position is not due to any causal relationship between moraicity and syllabicity. Instead, the moraicity of Dihovo syllabic /r/ is forced by the constraint MoraicPeak. Since any constraint can be deactivated through domination, this analysis predicts that the opposite should also be possible: i.e., if MoraicPeak were ranked a bit lower in the constraint hierarchy, it should be possible for a low-sonority segment like /r/ to be syllabic without being moraic. This prediction is in fact attested by languages where certain low-sonority vowels are arguably nonmoraic. For example, Hyman (1985) convincingly argues that the ultra-short or "reduced" lexical vowels of languages like Chuvash and Mari are nonmoraic.[11] Nonmoraic syllable peaks have also been utilized in the analysis of multiple languages, including Mohawk (Piggot 1998), Tohono O'odham (Hill and Zepeda 1991), English (Hammond 1997), and Russian (Crosswhite 1999).

For example, Piggot (1998) discusses the case of Mohawk (Michelson 1988, 1989), where /e/ is arguably nonmoraic (or, in Piggott's terms, *weightless*) and repels stress. In addition, according to Piggot's (1998) analysis, Mohawk uses trochaic feet that are preferentially uneven (Heavy-Light as opposed to Light-Light). To achieve the desired uneven foot form, stressed vowels undergo lengthening if they are in an open syllable ([CV́.CV] > [CV́ː.CV]). However, this sort of lengthening does not occur if the weak member of the foot is a syllable containing the weightless vowel /e/. For example, the form *wakeras* surfaces as *[wá.ke]ras* instead of **[wáː.ke]ras*. Piggot accounts for this fact by noting that if /e/ is nonmoraic as argued, the foot [wá.ke] is already uneven, and lengthening is therefore unnecessary.

Another convincing case for nonmoraic syllable peaks can be made for the Austronesian language Au (Scorza 1985). In this language, the vowels [ʌ] and [i̇] repel stress: In general, stress falls on the initial syllable of the word, unless this syllable contains the vowel [ʌ] or the vowel [i̇]. In this case, stress falls on the first non-[ʌ,i̇] vowel of the word. If a word only contains [ʌ] or [i̇] vowels, stress falls on the first syllable. At first glance, we might (incorrectly) suppose that Au [ʌ,i̇] are monomoraic and that all the other vowels of Au are bimoraic, thus explaining the stress-repelling qualities of [ʌ,i̇] moraically without recourse to nonmoraicity.

[11] It should be noted, however, that Hyman does not chooses to use the term "weight unit" instead of "mora". Also note that the language Mari is referred to in Hyman (1985) as "Cheremis," which is in fact the ethnonym used by the Chuvash to refer to the Mari.

However, Au also possesses a phonemic distinction between [a] and [aː].[12] Since the short vowel [a] does not show the stress repelling characteristic, a monomoraic analysis for [ʌ,ɨ] will not explain their stress-repelling behavior (or wrongly predicts the same behavior for [a]). The nonmoraic analysis can easily account for these facts, however: Au [ʌ,ɨ] are nonmoraic, [aː] is bimoraic, and the remaining vowels are monomoraic ([a, i, u, o]).

Summary: In this paper, I have presented an Optimality-Theoretic analysis of a language in which it is impossible to simply define a set of possible syllable peaks or possible syllable margins. Instead, certain segments can function as either syllable peaks or syllable margins, in a predictable fashion. Furthermore, within the set of segments that can possibly serve as syllable peaks, distinction must be made between better and worse peaks. Likewise, distinctions must be made between better and worse syllable margins. The formal mechanism for encoding these preferences in grammar is prominence alignment (P&S '93). The data examined from Dihovo are especially interesting because they demonstrate that moraicity and syllabicity are autonomous: Dihovo /r/ is sonorous enough to be syllabic, but is not sonorous enough to be moraic. The fact that the grammar of Dihovo has different sonority cutoffs for these two categories means that we must be able to refer explicitly to both moraicity and syllabicity. The autonomy thus afforded syllabicity and moraicity in turn suggests that the oft-observed link between moraicity and syllabicity is epiphenomenal, not causal. In particular, the fact that Dihovo underlying /j/ can be moraic in coda position without vocalizing, and that Dihovo underlying /i/ can undergo optional glide formation without becoming nonmoraic demonstrate that a moraic structure cannot unambiguously be used to represent syllabicity distinctions. On this basis, I propose that the general (although not universal) link between moraicity and syllabicity be encoded in terms of violable Optimality-Theoretic constraints, and not through a theory of phonological representations.

[12] According to Scorza, [aː] is realized in the Eastern dialect simply as a long vowel, while in the central dialect it is realized as an interrupted vowels: [aˀa]

References

Anttila, Arto. 1995. *Deriving variation from grammar: A study of Finnish genitives.* Ms., Stanford University.

Casali, Roderic. 1996. *Resolving Hiatus*. Ph.D. Dissertation, UCLA.

Crosswhite, Katherine. 1999. *Vowel Reduction in Optimality Theory*. Ph.D. Dissertation, UCLA.

Crosswhite, Katherine. 2001. *Stress Placement in Dihovo Macedonian.* Ms., U. of Rochester.

Groen, B. M. 1977. *A Structural Description of the Macedonian Dialect of Dihovo*. Lisse: Peter de Ridder Press.

Hammond, Michael. 1997. "Vowel Quantity and Syllabification in English," *Language*, vol. 73 no. 1, 1-17.

Hayes, Bruce. 1989. "Compensatory lengthening in moraic phonology," *Linguistic Inquiry*, vol. 20.

Hill, Jane and Ofelia Zepeda. 1992. "Derived words in Tohono O'odham," *International Journal of American Linguistics,* 58. 355-404.

Inkelas, Sharon. *The consequences of Optimization for Underspecification*. Ms., UC Berkeley.

Hyman, Larry. 1985. *A Theory of Phonological Weight*. Dordrecht: Foris.

Kenstowicz, M. 1994. *Sonority-Driven Stress*. Ms., MIT.

Piggot G. 1998 'Foot Form and the Parsing of Weightless Syllables," Paper presented at the *34th Annual Meeting of the Chicago Linguistics Society,* Sat. Apr. 18 1998.

Prince, Alan and Paul Smolensky. 1993. *Optimality Theory: constraint interaction in generative grammar*. To appear from MIT Press. TR-2, Rutgers University Cognitive Science Center.

Rosenthall, Sam. 1994. *Vowel/Glide Alternation in a Theory of Constraint Interaction*. Ph.D. dissertation, U. of Massachusetts, Amherst.

Zec, Draga. 1994. *Sonority Constraints on Prosodic Structure*. New York: Garland.

Zec, Draga. 1995. "Sonority constraints on syllable structure," *Phonology 12*: 85-129.

Zec, Draga. 1999. "Multiple sonority thresholds," in Holloway King and Sekerina (Eds.), *[Formal] Approaches to [Slavic] Linguistics: The Philadelphia Meeting*. 382-413. Ann Arbor: Michigan Slavic Publications.

Katherine Crosswhite
University of Rochester
Center for Language Sciences
514 Lattimore Hall
Rochester, NY 14620 USA

crosswhi@ling.rochester.edu
http://www.ling.rochester.edu/people/cross

UNIVERSITY OF ROCHESTER WORKING PAPERS IN THE LANGUAGE SCIENCES – VOL. 2, NO. 1 (SPRING, 2001)

James S. Magnuson and Katherine M. Crosswhite, Editors
Joyce Mary McDonough, Series Editor