Deconstructing Foot Binarity
in
Koniag Alutiiq

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Introduction[9]:

Metrical theory has been concerned with elucidating and restricting the possible forms of feet. As champions of this view we will cite Hayes (1985,1987,1991) and Prince (1985, 1990) from among the multitude of metrical researchers. One of the basic tenets of the restricted-foot view is that there is a basic distinction between iambic and trochaic feet. Hayes (1991) chooses to define his foot-type inventory in these terms (asymmetric iamb, symmetric trochee), while Prince (1990) attempts to build in the distinction through the interaction of a Weight-to-Stress Principle and a Grouping Harmony algorithm. The result for Prince is that a light-heavy iamb has the highest harmonic value of all feet.

A distinct problem for all such researchers has been the existence of Yupik[10]. In all dialects of Yupik (except St. Lawrence Island) an underlying sequence of light-heavy (e.g. a short vowel followed by a long vowel) never groups together as a foot. In contrast however all bisyllabic feet that are created are subject to a variety of processes (vowel lengthening, consonant (de-) gemination) that conspire to produce the canonical light-heavy iambic form. This conundrum has engendered a number of proposals for modifying the theory in various ways to accomodate the facts (e.g. Rice, Hewitt, Kager, Hayes, Halle). All of these accounts required additions of new foot-types to the metrical inventory, or structure-changing operations.

The account offered here, in terms of Optimality Theory (OT) as proposed by Prince & Smolensky (1993), claims that the Yupik pattern can be derived using constraints that are already operative in the theory as long as these constraints are broken apart into their

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[10] The data and generalizations concerning Yupik dialects come from the extensive and detailed work of the various researchers associated with the Alaska Native Language Center. The appropriate references are given throughout the paper. Any misinterpretations, omissions, or absurdities are my responsibility.

Orthography: 'e' = schwa, 'L' = voiceless lateral, 'g,?' = voiced velar fric., 'r,R' = voiced uvular fric., a '**C**'is a fortis C, ':' represents segment length, underlying long vowels are written 'VV' and accent has been placed over the second V of long V's, but is realized over the entire syllable. Syllable boundaries are indicated with '.', foot boundaries with '( )' and prosodic word boundaries with '[ ]' (doubling with phonetic transcription).

component claims regarding metrical structure. The surprising result is that OT converges with recent proposals of Kager (1993) that the iambic-trochaic/asymmetric-symmetric parametric distinction can be eliminated from the grammar entirely. That is to say that there is no Iambicity constraint ranked with respect to a Trochaicity constraint, nor is there an Asymmetric Foot constraint ranked with respect to a Symmetric Foot constraint. Rather these patterns can be generated from the interaction between constraints on foot binarity, head alignment ("Align Head L/R PCat") and Peak Prominence ("the head should be heavier/longer than the non-head") (McCarthy & Prince (1993), Prince & Smolensky (1993)). The OT account supports the view that constraints on foot constituency and headedness are stated separately in the the grammar (e.g. Halle & Vergnaud 1987, Crowhurst 1991 and others). Thus the non-derivational approach of OT provides support for recent proposals made within derivational frameworks regarding the nature of metrical structure.

Specifically this paper proposes that within OT *Foot Binarity* must be deconstructed (atomized) into a family of explicit constraints regarding the prosodic structures dominated by a foot. The *Foot Binarity* (FtBin) constraint as currently stated in OT (P&S93,McC&P93) is: *A foot must be binary at some level of analysis: syllabic or moraic*. I propose here that Foot Binarity must be broken into its component constraints which evaluate binarity at the prosodic levels contained within the foot: *FtBin-Syll*, *FtBin-Mora* and *FtBin-NucMora* (the Nuclear mora of Shaw (1992,1993)).[11] In addition I show that it is necessary to distinguish between two types of binarity violations: minimality (less than two) and maximality (more than two). The result is that the FtBin-family consists of six constraints set to prosodic level and type of deviation: FtBin-$\{\sigma,\mathbb{N},\mu\}^{\{min,max\}}$.

A distinction which plays a crucial role in accounting for quantitative alternations in Koniag/Yupik is the nuclear/non-nuclear mora contrast of Shaw (1992). This distinction allows the structural differentiation of underlying light-heavy syllable sequences from surface/derived light-heavy sequences. An OT account without the nuclear/non-nuclear distinction must either allow FtBin reference to underlying vs. derived distinctions, or it must incorporate level-ordering between the assignment of constituency and the instantiation of iambic weight. As the nuclear/non-nuclear distinction captures these facts without recourse to such measures it constitutes a strong argument in favor of such a distinction.

Organization of the paper:

Although the proposals in this paper can be applied to all of the Yupik dialects, I will

[11] The next logical step would be to state binarity as a separate contraint and then cross it with the various prosodic levels, rather than limiting it to feet alone. Thus binarity becomes a general constraint on constituents, where the constraint is ranked and evaluated at the different levels of the constituent hierarchy. Each constituent node would have a binarity constraint applied to all subordinate levels, e.g. the prosodic word would have binarity assessed at the foot, syllable, nuclear-mora, mora and possibly root-node levels. (Ito & Mester 1992 have proposed that word-level binarity holds for truncations in Japanese.) Whether these constraints express themselves in the structure of a language depends on their ranking with respect to other constraints (particularly those of the Parse-family). However the discussion of Koniag focuses only on binarity at the foot-level.

first present them through the lens of Koniag Alutiiq. Extending the coverage to the other dialects is briefly discussed in section 5. Thus the first four sections of the paper are focused on Koniag. The first section presents the basic data and generalizations regarding the realization of stress and its segmental consequences taken from Leer (1985a,b,c,1989). The second section discusses the placement of foot boundaries and focuses on the decomposition of Foot Binarity. The third section deals with the surface realization of bisyllabic feet, in particular the quantity-affecting processes which result in surface iambicity. The fourth section focuses on the word-initial monosyllabic foot of Koniag and derives the apparently paradoxical behavior of these feet (compared to the bisyllabic feet) from the interaction of a constraint that prefers initial stress in the word (Initial Stress) and a constraint (Recoverμ) which avoids adding an epenthetic moras to the representation. A brief excursion into comparative Yupik is found here as well. The sixth and final section summarizes the results of the preceding sections and gives the full ranking of the various constraints.

1.0 Koniag Alutiiq

The processes that form the core of the quantitative action surrounding stressed syllables are vowel lengthening, consonant gemination, consonant degemination and vowel compression. In addition there are two generalizations which center on an initial closed syllable. However the first process presented here is consonant fortition which is sensitive to foot-initial position. Leer (1985a) shows that consonant fortition is only predictable on the basis of a foot-sized unit. The examples in (1) demonstrate the environments for fortis consonants (bolded and underlined). It is impossible to characterize this range of environments by simply referring to stress or unstressed syllables, rather the generalization is that the initial consonant of a foot is fortis. An important point here is that underlying long vowels always have fortis onset consonants, therefore they always form their own foot.

(1) a. #**C**VC.[**m**é?.**t**a.qán]'if she fetches water'
b. **C**VV(C).[**n**é?.**t**aá.qan] 'if she (always) eats'
c. **C**V(C).CV:[**q**a.yá:.kun]'by boat'
d. **C**V(C).CVC[**q**a.yát.xun]'by boats'

The distribution pattern of fortition clearly argues for foot constituency being assigned on the basis of a bimoraic foot, with only vowels (modulo the initial closed syllables) counting as moras. It is important to note that not all vowel length is underlying - in (1c) the second vowel is long, while the same morpheme shows a short vowel in (1d). (In the phonetic transcriptions I have followed the standard practice of representing underlying long vowels as sequences of short vowels, while underlying short vowels that are long on the surface are represented with a short vowel followed by a colon.) The realization of an underlying short vowel as either long or short is predictable from the foot structure. In (2) and (3) the length of the consonants and vowels depends on foot structure. The morpheme *-nnir-* in (2) alternates between [nir] and [nnir], while in (3) *-kutar-* alternates between [qu.ta], [qu:.ta], and [qu.ta:]. (The syllables that are not footed in (3) are the result of lexical conditions on stress (Leer's "accent-advancement").[12]

(2) /-nnir-/ 'stop V-ing' (Leer(1985a,87))
a. [(a.tún)(nir.túq)] /atu$_r$-nnir-tuq/
b. [(íq)(**L**u.nír).tuq.] /iqlur-nnir-tuq/
c. [(a.kú:)(**t**a.tún)(nix.túq)] /akuta$_q$-tu-nnir-tuq/

(3) /-kuta$_r$-/ 'be going to V'
a. [(**p**i.sú:).qu.(**t**a.qú:).ni] /pi-su$_r$-quta$_r$-quni/
b. [(**m**a.ʔár).su.(**q**u.tá:)(**q**u.ní)] /mangar-su$_r$-quta$_r$-quni/
c. [(át).sar.(**s**u.qú:).ta.(**q**u.ní)] /atsar-su$_r$-quta$_r$-quni/

The examples in (2) and (3) demonstrate two processes: vowel lengthening - an underlyingly short vowel is lengthened when it appears in a stressed open syllable; consonant degemination - an underlying geminate consonant degeminates / shortens when it is preceded by an unstressed syllable. Examples of the converse processes of vowel compression and consonant gemination are given in (4) and (5) respectively. Vowel compression shortens an underlying long vowel in a closed syllable. Consonant gemination occurs when a schwa appears in a stressed open syllable. (Unfortunately there are no pairs in Leer (1985) which unequivocally demonstrate this, however stressed schwas *only* appear in closed syllables.)

(4) vowel compression /-taar-/ (La:90)
a. [**n**éʔ.**t**aá.qan] 'if she (always) eats' /nere-taar-kan/
b. [**n**éʔ.**t**áʔ.**t**u.kút] 'we (always) eat' /nere-taar-tukut/

(5) C gemination
a. [a.ʔá:.yu.tém.máʔ] 'O my God' (vocative) /agayute-ma-ang/
b. [**p**i.súʔ.pe.kén.ní] 'without my hunting' /pi-sur-peke-nii/

The basic generalization to be drawn from (2-5) is that a stressed syllable in Koniag must contain two moras worth of material and can not contain more than that, in addition an unstressed syllable can only contain a single mora's worth of material. (Note that non-geminate coda consonants can count as a mora in a stressed syllable or can count as non-moraic in unstressed syllables (see the final foot in (2c)).

The final generalizations we need to examine have to do with the initial syllable. As can be seen from (1a,b),(2b),(3c) an initial closed syllable always attracts stress and fortition. All accounts have treated this through special stipulations and/or processes. A related generalization is what the Yupik researchers have named "automatic gemination". This gemination occurs

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[12] I have narrowed the focus of this paper to the basic generalizations Leer gives for foot structure in Alutiiq. I have chosen to exclude segmental deletions (denoted by subscripted segments), which are heavily morphologically conditioned; quiescent (voiceless) schwas; lexically assigned stress/foot structure. While undoubtedly the full integration of these patterns into the system proposed here will require adjustments, the basic proposals will remain unaffected, since these additional patterns do not affect the patterns that are covered.

when an initial light open syllable is followed by a syllable containing an underlying long vowel (6b). These initial syllables surface with stress and a following geminate (of the onset of the long vowel) which closes their syllable. So in derivational terms, gemination comes first, creating a closed syllable which attracts stress like any other inital closed syllable.
A schematic summary of all the generalizations is given in (7).

(6) Automatic gemination
  a. [**p**e.Lút] 'leaves' (*[péL.Lút])
  b. [péL.Luí] 'its leaves'

(7) Summary:

poss.F:	#CVC.	Vowel Lengthening:	.CV. --> .CV:.
	.CVV(C).	Con. Gemination:	.Cé.C_i --> .CéC_i.C_i
	.CV(C).CV(C).	Degemination:	.CVC_i.C_iV. --> CV.C_iV
	---------------	Compression:	.CVVC. –> .CVC.
imposs. F:	*.CV(C).CVV(C).	Auto-gemination:	#CV.C_iVV(C). --> #CVC_i.C_iVV(C)
	*.CV. (& medial .CVC.)		

2.0 Optimizing Foot Boundaries

In applying Optimality Theory to the problem of foot boundaries in Koniag it is necessary to define the range of outputs that *Gen'*[13] will submit/generate for evaluation by the ranked constraints. In section 2.1 I outline the constraints I will be assuming operative at high enough levels in the grammar to restrict the outputs that will be compared for elucidating other constraint rankings and interactions. Section 2.2 focuses on Foot Binarity in general and the advantages and implications of breaking it apart into three separate constraints. Section 2.3 then applies the family of Foot Binarity to the placement of feet in Koniag/Yupik. (Please note that throughout this section I am suppressing the distinction between minimality and maximality -type violations as it is not crucial for these patterns. This distinction becomes crucial for the initial closed syllable pattern and is discussed in section 4.)

2.1 Background assumptions

I will assume that for Koniag the *Onset* constraint is part of *Gen'* (this is not strictly true since onsetless syllables appear word-initially, which is to say that *Onset* is highly ranked, but dominated by the constraints *Align-L-Root-L-s* and *Recover-C* (no epenthetic consonants). Thus the set of candidates will only include syllables with onsets. I am also assuming that there is a

[13] Obviously I do not want to claim that these constraints are always part of GEN, rather I am setting up a construct GEN' which contains most of the highly ranked (roughly inviolable) constraints. The action of the analysis centers on lower ranked constraints and GEN' is a convenience to speed us on our way to examining them.

highly ranked constraint against tri-moraic syllables (i.e. *s > 2μ). The final highly ranked constraint that I will assume is *Complex*, which aims at limiting the existence of complex onsets, codas and peaks. (Note *Onset* ? *Complex* in order to generate syllables with long vowels as opposed to short vowel sequences with an onsetless syllable.) There is schwa epenthesis (as well as underlying schwa) in Koniag/Yupik, however it is only used to insure the syllabification of segments and not for the optimization of foot structure (I treat schwa as featurally unspecified and represented by an empty Nulcear mora). Therefore the constraints *Parse-Segment* and *Recover-{i,u,a}* dominate *Recover-Nuclearμ*, which in turn dominates the FootBinarity constraints. For the purposes of this paper I am assuming that *Gen'* does not submit structures which violate any of these constraints and I treat all schwas as underlying.

The possible syllable structures I assume *Gen'* can submit are given in (8). These are the syllable-types proposed by Shaw (1992). The important point for Koniag/Yupik is that closed syllables have two possible representations: either light (8a), or heavy (8b).

(8) Nuclear Moraic Model (Shaw 1992)

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     Light          Heavy              Heavy
a.     s        b.     s          c.     s
      /|\             /|\               / \
     / ℕ \           / ℕ \             /   ℕ
    /  |  \         /  |  \           /   / \
   /   μ   \       /   μ   μ         /   μ   μ
  /    |    \     /    |   |        /     \ /
C      V   (C)   C     V   C       C       V

       ℕ               ℕμ               ℕℕ
     .CVC.           .CVC.            .CVV.
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The output structures produced by *Gen'* and evaluated by the ranked constraints will be notated in the tableaux in the flattened, condensed form given beneath the syllable trees in (8). Syllable nodes are replaced with periods to mark boundaries, segments linked to nuclear moras will be dominated by an 'ℕ', segments linked to non-nuclear moras will be dominated by 'μ' and non-moraic segments will lack dominating symbols.

In addition I assume that all candidate feet satisfy *Prosodic Integrity* which requires the proper bracketing (Nespor & Vogel (1986;7)) of prosodic constituents. This requires that a prosodic constituent of level *n* can only be dominated by a single mother-node ($\geq n+1$), i.e. *n* can not be shared between two dominating constituents.

2.2 Foot-Binarity Deconstructed

The constraint of Foot Binarity as stated in McC&P/P&S 93 is given in (9).

(9) Foot Binarity (FtBin): Feet must be binary under syllabic or moraic analysis. (McC&P;43)

As stated FtBin covers two levels of analysis: syllabic and moraic - producing a range of possible optimal candidates when we evaluate the possible outputs produced by *Gen*. Any foot which is binary at some level will pass the constraint. An implicit assumption in their application of FtBin is that it is a minimality-type constraint, i.e. if the foot is greater than bimoraic it still passes the constraint without violation. However note that the same does not hold true for trisyllabic feet, they are assumed to be out in general. In order to give FtBin more explicit content I will take the position that it is aimed at measuring strict binarity - i.e. any deviation from two will count as a violation. Under this interpretation both a monomoraic foot and a trimoraic foot are classed as violators of FtBin. If FtBin were allowed to cover both syllabic and moraic analyses equally this would not be a desirable result,however if we separate the two levels into separate constraints then we can properly class monomoraic feet at less desirable than trimoraic feet: monomoraic feet violate binarity on both levels, while trimoraic feet are binary on the syllabic level. The tableau given in (10) presents the evaluation of the various foot-types *Gen* would produce in terms of FtBin - exploded and unexploded versions.

(10)

Candidates	FtBS/μ (orig)	FtBμ ? FtBS		FtBS ? FtBμ	
ℕ a. (.Cμμ.)			*	*	
ℕℕ b. (.Cμμ.)			*	*	
ℕ ℕ c. (.Cμ.Cμ.)					
ℕ ℕℕ d. (.Cμ.Cμμ.)		*			*
ℕ ℕ e. (.Cμ.Cμμ.)		*			*
ℕ ℕℕ f. (.Cμμ.Cμμ.)		* *			* *
ℕ ℕ g. (.Cμμ.Cμμ.)		* *			* *
ℕℕ ℕℕ h. (.Cμμ.Cμμ.)		* *			* *
ℕ i. (.Cμ.)	*	*	*	*	*
ℕ ℕ ℕ j. (.Cμ.Cμ.Cμ.)	*	*	*	*	*

Evaluating the foot-type-candidates by the versions of FtBin in (10) only gives us some very broad rankings of groups. In the original unexploded version of FtBin the constraint only distinguishes monomoraic feet (bad) from bisyllabic, or bimoraic feet (good). When we split the two constraints apart and add some teeth to the notion of binarity we get a more articulated ranking of the foot-types. No matter how we rank FtBinμ with respect to FtBinS we get (c)

[CV.CV] as being the optimal foot form - strictly binary on all counts. A breakdown of the rankings of the foot-types is given in (11).

(11) a. FtBinS ? FtBinμ : c ≻ d,e ≻ f,g,h ≻ a,b ≻ i,j
b. FtBinμ ? FtBinS : c ≻ a,b ≻ d,e ≻ i,j ≻ f,g,h

The relative better-formedness rankings in (11) still contain unresolved groups where potential outputs are equally good. A fully articulated ranking of these foot-types can be achieved through distinguishing between Nuclear moras and non-Nuclear moras as proposed in Shaw (1992). In terms of binarity this means an additional level of analysis - FtBin-Nuc, which requires a foot to contain two nuclear moras. Interestingly, when this constraint is added and permuted through the various rankings with respect to the other two binarity constraints the foot-form in (c) still wins through as optimal in all possible rankings, simply because it passes at all levels of analysis.

When the Nucleus is added to the representation, binarity at the moraic level is computed in the following manner: a μ dominated by a Nucleus counts for determining FtBinℕ violations, any μ (nuclear or non-nuclear) counts for determining violations of FtBinμ. This view of binarity relies on a structural interpretation of the nucleus (i.e. a nucleus node within the S), as opposed to a diacritic label, which would completely segregate nuclear moras from non-nuclear moras.

The tableau in (12) presents the constraint scoring of the foot-types against all possible rankings of the constraints. The candidate set in (12) has been limited to syllables which contain at least one nuclear mora. The relative order of light and heavy syllables is not significant, the rankings hold for either order. Also note that a mono-moraic foot would violate all three binarity constraints.

(12)

Candidates	FBμ ?	FBs ?	FBℕ	FBμ ?	FBℕ ?	FBs	FBs ?	FBμ ?	FBℕ
ℕ a. (.Cμμ.)		*	*		*	*	*		*
ℕℕ b. (.Cμμ.)		*				*	*		
☞ ℕ ℕ c. (.Cμ.Cμ.)									
ℕ ℕℕ d. (.Cμ.Cμμ.)	*		*	*	*			*	*
ℕ ℕ e. (.Cμ.Cμμ.)	*			*				*	
ℕ ℕℕ f. (.Cμμ.Cμμ.)	* *		*	* *	*			* *	*
ℕ ℕ g. (.Cμμ.Cμμ.)	* *			* *				* *	
ℕℕ ℕℕ h. (.Cμμ.Cμμ.)	* *		* *	* *	* *			* *	* *

(12)-cont.

Candidates	FBs ?	FBℕ ?	FBμ	FBℕ ?	FBμ ?	FBs	FBℕ ?	FBs ?	FBμ
ℕ a. (.Cμμ.)	*	*		*		*	*	*	
ℕℕ b. (.Cμμ.)	*					*		*	
☞ ℕ ℕ c. (.Cμ.Cμ.)									
ℕ ℕℕ d. (.Cμ.Cμμ.)		*	*	*	*		*		*
ℕ ℕ e. (.Cμ.Cμμ.)			*		*				*
ℕ ℕℕ f. (.Cμμ.Cμμ.)		*	* *	*	* *		*		* *
ℕ ℕ g. (.Cμμ.Cμμ.)			* *		* *				* *
ℕℕ ℕℕ h. (.Cμμ.Cμμ.)		* *	* *	* *	* *		* *		* *

The fact that any ranking of the three foot binarity constraints leads to a CVCV foot as optimal is quite striking. This holds true regardless of the linear order of the syllables in the bisyllabic candidates. It is apparent from this that the FtBin-family of constraints arrives at the same optimization conclusions as the basic syllable structure constraints from McC&P 93, P&S 93, i.e. *Onset*, *Complex*, and *NoCoda* interact to rank the CV syllable as the optimal candidate. *FootBinarity* simply adds that two is better than one.

The theoretical implication of this pattern is that Trochaicity as a separate principle enforcing symmetry does not exist. The preference for symmetry that is observed in trochaic languages (Hayes (1987,1991)) is simply the result of Foot Binarity across three levels (μ,ℕ,s). Given that metrical phonologists have thought of iambicity/trochaicity as a parametric variation the loss of symmetric trochaicity as a constraint calls into question the validity of its counterpart: asymmetric iambicity. Once the symmetric/asymmetric parameter is lost then the only parametric variation we are left with is whether the foot is left or right headed. Following McC&P93b we can class this variation as part of the Align-family of constraints, specifically as Align-L/R-Head-Foot.[14] The choice between iambicity and trochaicity comes down to a choice in whether heads of feet are aligned with the L or R edge of the foot, and how a constraint preferring quantitative asymmetry (Peak-Prom) is ranked with respect to Parse and Recover constraints. Thus OT eliminates iambicity and trochaicity as independent principles and derives the observed rhythmic preferences from the various permutations that can be generated from other independently required constraints: *PeakProm*, *Align-L/R-Head-Foot* and *FtBin(μ,ℕ,s)*.[15]

2.3 Placing Foot Boundaries in Koniag

Setting aside the initial closed syllable pattern, the basic generalization regarding feet in Koniag/Yupik is that a foot is bisyllabic as long as it does not contain a long vowel (and concomitantly all long vowels form a monosyllabic foot). Once we have exploded Foot Binarity into its component constraints this generalization is quite easy to capture. The ranking of constraints that is required is that FtBinℕ dominates FtBinμ/FtBins.

The constraint *Parse-Syllable-to-Foot* enters the picture since unfooted syllables are restricted in Koniag/Yupik. As Parse-s violations are restricted toward the right-edge of the word an Align constraint *"Align-L-Ft-PrWd"* leads to the appearance of L-to-R directionality (McC&P93b). This alignment constraint must be ranked below Parse-s since Parse-s forces numerous violations. An additional high-ranking constraint is *Align-L-Root-L-Foot*, such that the left edge of the root always coincides with the left edge of a foot. This constraint is never

[14] Thus, as noted earlier, OT comes down on the side of derivational approaches which treat the parameters governing headedness and constituency as separate.

[15] The asymmetry that is left unexplained is the relative rarity of Heavy-light trochees ("anti-iambs") and the even scarcer quantity manipulations to instantiate canonical versions of them. However see Kager (1993) for a derivational account of these asymmetries without an underlying iambic/trochaic asymmetry.

violated in Yupik and should be considered part of *Gen'*. I have included it here as it plays a major role in forcing violations of high-ranking constraints later in the paper.

The tableau in (13) examines this ranking through the footing of /qaya^{r}-sina^{q}-a/ 'her big baidarka' (La;118), which surfaces phonetically as [**q**a.yá:.si.**n**á] (final long vowels in open syllables are shortened, see section 3.4). The tableau in (14) demonstrates the need for the *Align-L-Ft-PrWd* constraint by examining the candidates for /iqLu-nnir-tuq/ 'he stoppped lying'(La;87), which would surface as [íq.**L**u.ní?.tuq]. Note that violations of Align-L-Ft-PrWd constraint are counted in terms of syllables.

An assumption that is made throughout this paper is that long vowels and diphthongs are never split by feet into separate constituents. This idea has was formalized as the Syllable Integrity Principle (Prince (1976)) and can be captured in OT for Koniag/Yupik with the Onset and Parse-Segment constraints ranked above the FtBin-constraints. A syllable will not split since that would create an onsetless-syllable, or lead to the underparsing of a vowel.

(13)

Candidates	Align-Root-Ft	FtBinℕ	Parse-S	Align-L-Ft-PrWd
☞ ℕ ℕ ℕ ℕℕ a. [(qa.ya).si.(naa)]			*	* * *
ℕ ℕ ℕ ℕℕ b. [(qa.ya)(si.naa)]		*!		* *
ℕ ℕ ℕ ℕℕ c. [.qa.(ya.si)(naa)]	*!		*	* * *
ℕ ℕ ℕ ℕℕ d. [(qa.ya)(si)(naa)]		*!		* * * * *
ℕ ℕ ℕ ℕℕ e. [(qa.ya).si.naa]			* *!	
f. .qa.ya.si.naa.	*!		* * * *	
ℕ ℕ ℕ ℕℕ g. [(qa)(ya.si)(naa)]		*!		* * * *

(14)

Candidates	Align-Root-Ft	FtBinℕ	ParseS	Align-L-Ft-Wd
☞ ℕ ℕ ℕ ℕ a. [(iq)(Lu.ni?).tuq]		*	*	*
ℕ ℕ ℕ ℕ b. [(iq).Lu.(ni?.tuq)]		*	*	* *!
ℕ ℕ ℕ ℕ c. [(iq).Lu.ni?.tuq]		*	* *! *	

The ranking of FtBinℕ over Parse-S has the effect of forcing the non-parsing of the light syllable [si] since it is sandwiched between the preceding word-initial foot and the following long vowel (13a). If the rankings were reversed then Parse-S could force a violation of FtBinℕ and create a light-heavy foot (the canonical iamb) (13b). So the permutation of these two constraints accounts for both the canonical iambic languages and the non-canonical iambs of Yupik. (Note that the St.Lawrence Island dialect pattern of allowing light-heavy feet can be accounted for using the "canonical iamb" ranking, see section 5.) The constraint Align-L-Foot-PrWd is necessary to rule out the form in (14b). The candidates (14a,b) are tied in all other respects and we must force the placement of the unparsed syllable as far right-ward as possible to arrive at the actual surface form. This Alignment constraint forces that choice since leaving an unparsed syllable closer to the left edge of the prosodic word increases the number of Align violations for following feet.

The ranking of FtBinℕ over Parse-S is crucial, but what about the ranking of FtBinS and FtBinμ? Since monosyllabic feet do exist on the surface in Koniag/Yupik it is necessary to rank FtBinS below Parse-S, i.e. Parse-S can force a violation. (Remember that FtBinℕ ranks above Parse-S and can force the non-parsing of light syllables.) If FtBinμ were ranked above Parse-S we would not be able to generate bisyllabic feet containing a stressed closed syllable (to abstract away from vowel lengthening), as this is obviously not the case FtBinμ must rank below Parse-S as well. This is demonstrated through the tableau in (15) for the form /an-kutar-tua/ 'I'm going to go out' (La;116) [án.**k**u.tá?.**t**uá].

(15) (Align-Root-Foot and FtBinℕ satisfied for all candidates therefore not included.)

Parse-S	?FtBS	FtBμ	Candidates	FtBS	FtBμ	?Parse-S
	*	*	☞ ℕ ℕμ ℕℕ a. [(an)(ku.ta?)(tua)]	*!	*	
*!		*	ℕ ℕμ ℕℕ b. [(an)(ku.ta?).tua.]		*!	*
*! *	*		ℕ ℕμ ℕℕ c. [(an).ku.ta?.(tua)]	*!		* *
*! * *			ℕ ℕμ ℕℕ d. [(an).ku.ta?.tua.]			* * *
*!	* *		ℕ ℕμ ℕℕ e. [(an).ku.(ta?)(tua)]	*! *		*

The tableau in (15) shows that for Koniag FtBinS and FtBinμ are ranked below Parse-S, as it is better to Parse a syllable into a foot even if that foot violates these constraints of binarity. The constraint ranking that is required to generate the optimal forms for the basic generalizations regarding the placement of foot structures in Koniag is given in (16). The crucial ranking is FootBinℕ above Parse-S which forces the underparsing of syllables when they precede a long vowel (and are themselves preceded by a foot).

(16) Align-L-Root-Foot ? FtBinℕ ? Parse-S-to-Ft ? FtBinS / FtBinμ / Align-L-Ft-PrWd

3.0 Recoverability in Bisyllabic Feet

This section discusses the quantitative additions that are made to bisyllabic feet to bring them into a properly asymmetric iambic configuration. In section 3.1 I return to the problem of distinguishing underlying light-heavy sequences from surface light-heavy sequences. In section 3.2 I discuss the processes of vowel lengthening, consonant gemination and consonant degemination. The conclusions reached in this section are that nuclear moras can not be epenthesized for iambic purposes and that the featural filling of the epenthetic (nonnuclear) moras is governed by PeakProminence, NoCoda and Link-V-Nuc ('link a vowel to a nuclear mora'). In section 3.3 the issues surrounding the weight of closed syllables and geminates are examined and section 3.4 examines the vowel shortening patterns observed word-finally and in closed syllables.

3.1 How to allow for surface light-heavy but not underlying light-heavy?

In section 2.3 I claimed that by ranking FtBinℕ above Parse-S we could choose the correct optimal form for the location of foot boundaries with respect to underlying long vowels. However as the reader may recall, one of Leer's generalizations for Koniag (all Alutiiq) is that a short vowel in an open stressed syllable lengthens, and Leer is careful to note that phonetically it is indistinguishable from an underlyingly long vowel in an open syllable (in terms of length). This leaves us with the problem of allowing for one such light-heavy foot but disallowing the other. Putting it graphically we apparently need to allow for (17a) (where '?' denotes an epenthetic element), but we need to disallow (17b).

(17) ☞? ℕ ℕℕ ℕ ℕℕ
a. (Cμ.Cμ?) b. (Cμ.Cμμ)

The problem in (17) boils down to distinguishing between underlying and derived (or more palatably for Optimality theorists non-underlying) length. A bisyllabic foot in Koniag/Yupik cannot contain an underlying long vowel. We could simply state such a constraint, however this would stink of language-specificity and the strongest version of Optimality Theory disallows language specific constraints. Therefore we should avoid such a move in favor of something that might have wider application in the linguistic universe. A broader proposal which relies on the Nuclear/non-Nuclear distinction is that Recoverability (Pulleyblank's term for MPS's *Fill*-family) can be sensitive to this distinction. Specifically my claim is that there is a constraint *Recover Nuclear-μ* (Recℕ) which is highly ranked and prevents the addition of nuclear moras to the representation (except when forced by *ParseSegment* for syllabification purposes). What follows from this is that the epenthetic quantity-unit in Koniag/Yupik is the non-Nuclear mora (subject to *Recover-μ* (Recμ), of course, but lowly ranked). With this distinction then we can rely on the high ranking of FtBinℕ to continue blocking (17b). The foot in (17a) is also blocked by Recℕ, and so the optimal form is in (18). (Note that to ever arrive at (18) we need to rank PeakProm above Recμ.)

(18)
```
☞  ℕ   ℕ
  (Cµ.Cµ µ)
     |   |/
     V   V
```

The constraint Recℕ is preferable to more Yupik-specific possibilities since it can be exploited for grammars that restrict the use of epenthetic vowels, while allowing epenthetic consonants. Of course Yupik does have an epenthetic vowel (schwa), but it does not exploit it for the purposes of meeting *PeakProminence* preferences. Note that Recℕ, as a *Faithfulness* constraint examines the input/output relations in a candidate. However this does not necessarily require that the Nucleus be an underlying constituent, rather the constraint requires that any mora dominated by the Nucleus be part of the input.

In addition there is a more general reason for preferring the Nuclear/non-nuclear distinction here. The Faithfulness constraints of Optimality theory rely on distinguishing underlying from non-underlying material. However all other constraints, such as PeakProminence and Weight-to-Stress do NOT make such distinctions. (In McC&P93 epenthetic material has prosodic phonological status but no morphological status.) In order to capture the foot-behavioral distinction between underlying light-heavy sequences and surface light-heavy sequences (without Nuc/non-Nuc) would require that FootBinarity be sensitive to the distinction between underlying and non-underlying material. This is an undesirable increase in the power of constraints and lends additional support to the Nuclear mora proposals of Shaw (1992,1993).

The result of positing Recℕ and the structure in (18) is that a lengthened short vowel will have a vowel linked to a non-nuclear mora! However note that while the relation of vowels to Nuclear moras is usually inviolable, in Optimality theory such relations are violable. So we must think in terms of a constraint which prefers to associate vowels to Nuclear µ's and then discover what other (higher-ranking) constraint is leading to its violation. Specifically I claim the existence of the constraint in (19). (The LinkVℕ constraint interacts with both PeakProminence and NoCoda, which we turn to in the next section.)

(19) LinkVℕ: vowels should be linked to nuclear moras.

Linking a vowel to a non-nuclear mora has applications outside of Yupik.[16] In Turkish there is a class of roots which end in a long vowel, but pattern with consonant final roots for suffixal allomorphy. Clements & Keyser (1983) proposed an account in C/V terms where these vowels were VC in representation rather than VV. In nuclear/non-nuclear terms these vowels are like the iambically lengthened vowels of Yupik - they are linked to both a nuclear and a non-nuclear mora. This requires that Turkish allomorphy be sensitive to whether roots end in a nuclear of a non-nuclear mora (rather than V vs. C).

An additional case may be found in the Bantu language Chibemba (Hyman 1992) where moraic nasals pattern differently with respect to tone spreading and compensatory vowel lengthening. In Chibemba when a moraic (coda) nasal forms a prenasalized segment with a following stop the preceding vowel lengthens (…CVNd… --> …CV:^{n}d…). However for the

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[16] I would like to thank Larry Hyman and Sharon Inkelas for these suggestions.

spreading of a H tone one mora to the right the nasal does not count as a mora and the tone spreads to the following syllable (…Cá:^{n}da…--> Cá:^{n}dá). Hyman proposes referencing the s/w distinction proposed by Zec (1988) for bimoraic syllables together with featural restrictions on moras, e.g. the TBU for Chibemba is the head mora of a syllable (μ_s) or the non-head (μ_w) if it dominates a [-cons] root node. (This tacitly assumes that HSpread applies before Pre-nasalized stop formation.) Using the nuclear/non-nuclear distinction we can simply say that HSpread targets nuclear moras, while compensatory lengthening is concerned with any empty mora, in this case a non-nuclear one and dispense with ordering relations altogether.

A question this raises for the Koniag/Yupik case is whether the nuclear/non-nuclear distinction might be traded in for featural conditions on moras. The answer is "no" as a lengthened vowel is phonetically/featurally non-distinct from an underlying long vowel or a long vowel derived from two underlying short vowels, e.g. /qaya-kun/ 'by boat' [qa.yá:.kun] as opposed to /qaya-a-kun/ 'by his boat' [qáy.yá:.kun]. In both cases the moras would be linked to the same featural material, so we would not be able to distinguish between a surface lengthened vowel and an underlying long vowel. Without such a distinction we can not account for the differences in footing behavior (within an OT framework).

3.2 PeakProminence and Quantity

The Koniag/Yupik pattern for creating iambic asymmetry basically relies on spreading a vowel or spreading a consonant. (In more derivational thinking we also need to give priority to the interpretation of a coda C as weight-bearing, since closed syllables in stressed position do not trigger any additive processes.) The point is that we need to distinguish between these strategies in a manner which allows vowel spreading (20) to have precedence over consonant gemination. The distinguishing constraint is NoCoda - consonant gemination closes the preceding syllable and therefore NoCoda rules in favor of vowel spreading. A complication arises however when the stressed vowel in Koniag is schwa - in this case consonant gemination takes precedence (21).

(20) vowel spreading (21) consonant gemination

```
(20)                              (21)
        Foot                          Foot              Foot
        /  \                          /  \              /
       s    s                        s     s           s
      /|   /|\                      /|    /|\         /|
     / ℕ  / ℕ \                    / ℕ   / ℕ \       / ℕ
    /  μ /  μ μ                   /  μ  /  μ μ   /   μ
   /   | |  |/                   /   |  |  |  \/     |
  C    V C  V                   C    V  C  e   C     V
```

PeakProminence applies the pressure to add the non-nuclear mora to the representation, however the spreading of segmental material to the added mora follows from **Emptyμ* (22a) and *RecoverC* (22b). These constraints work to force the spreading of underlying material to the added mora. In the case of schwa all we need to do is assume that schwa is the default vowel and as such contains no featural material. Underlying schwa is represented with a bare, empty mora (which must however have linear order relations with other segments in the morpheme). With this representation the gemination pattern follows - there is nothing in the nuclear mora to spread and to spread from its onset consonant would create a contradiction in linear ordering between the onset consonant and the nuclear mora that represents the schwa. The only other possibility in this configuration is to spread the onset of the following syllable. A tentative ranking of constraints is given in (23) - please note that this ranking (specifically the rank-order of NoCoda and LinkVℕ) is revised in the section 4.2.

(22) a. *Emptyμ: Avoid moras unlinked to root-nodes.

b. RecoverC: A consonant in the output should be present in the input.

(23) PeakProm ? Emptyμ ? NoCoda ? LinkVℕ (to be revised)

The interactions/rankings of these constraints are demonstrated in the tableau in (24) and (25). The form in (24) is /qeče?-uq/ 'she's running' (La;103) [**q**e.čé?.?uq] and the form in (25) is /mulu-k^{u}-an/ 'if she takes a long time' (La;87) [**m**u.lú:.kan]. The tableaus in (24) and (25) assume that the higher-ranked constraints of Align-L-Root-Foot and FtBinℕ are met in all candidates (note that FtBinℕ is forcing the foot-wise underparsing of the final syllable).

(24)

Candidates	Recℕ	PeakProm	*Emptyμ	NoCoda	LinkVℕ
☞ ℕ ℕ ℕμ a. [(qe.čé?).?uq.]			**	**	
ℕ ℕ ℕμ b. [(qe.čée).?uq.]	*!		***	*	
ℕ ℕ ℕμ c. [(qe.čée).?uq.]			***!	*	
ℕ ℕ ℕμ d. [(qe.čé).?uq.]		*!	**	*	

(25)

Candidates	RecℕN	PeakProm	*Emptyμ	NoCoda	LinkVℕ
☞ ℕ ℕ ℕμ a. [(mu.lúu).kan.]				*	*
ℕ ℕ ℕμ b. [(mu.lúk).kan.]				**!	
ℕ ℕ ℕμ c. [(mu.lúu).kan.]	*!			*	
ℕ ℕ ℕμ d. [(mu.lú).kan.]		*!		*	

The constraint interaction in (24) and (25) can be summarized as PeakProm forcing the addition of a (non-nuclear) mora and Emptyμ and NoCoda combining to force the vowel to link to this mora, except if the vowel is the unspecified schwa, in which case the dominance relation between Emptyμ and NoCoda results in the gemination of the following onset. The asymmetries between schwa and the other vowels must be captured in some manner - choosing to represent schwa as an empty mora (unspecified vowel) allows us to take advantage of the Fill-family of constraints arrayed against empty structure.

3.3 Degemination and Closed Syllable Weight

One of the striking observations about Yupik for derivationalists has been that coda consonants vary as to whether they count for iambic weight or not. Their presence does not influence the positioning of foot boundaries, but they can bear weight when required to for stress assignment. Short vowels in stressed open syllables lengthen, while the contents of a closed syllable do not vary. This pattern created problems for derivationalists since a homogeneous interpretation of closed syllables throughout a derivation was seen as desirable (e.g. Hayes (1989, 1991), Hewitt (1989, 1992)). Optimality theory does not have such a problem - the interpretation of closed syllables as either light or heavy depends solely on which delivers the best output. If a closed syllable is initial within a bisyllabic foot then it will be interpreted as light (monomoraic), while if it appears in a stressed syllable it will be treated as heavy (bimoraic). Thus in an Optimality account the ambidextrous behavior of coda consonants poses no particular problem.

An additional pattern which Optimality theory covers easily is the degemination of underlying geminate consonants. As noted earlier an underlying geminate C degeminates when preceded by an unstressed syllable. In derivational terms this was viewed as the geminate consonant requiring the second mora of an iamb to associate to. However in OT we can pull apart the various factors and analyze the geminate consonants as having underlying moras (non-nuclear) which may be underparsed to achieve the asymmetry within the foot preferred by Peak-Prominence. Note that if Peak-Prominence were ranked below Parseμ then we would not degeminate the consonant. (Underparsing of the mora leads to degemination since the consonantal root node is still licensed via its onset position and the addition of any new links to the preceding syllable would violate *Structure ('don't add structure').)

The interaction of these constraints is demonstrated in (26) and (27). I have chosen to use abstract representations of the feet as opposed to actual forms in order to eliminate intervening constraints that are not crucial to the topic at hand. The tableau in (26) purports to show the evaluation of geminates within a bisyllabic foot. The tableau in (27) examines the general behavior of closed syllables in a bisyllabic foot as well. In (27) the two constraints that are active are Peak-Prominence and Recover-μ. The latter constraint potentially plays a role since the coda consonants are not underlying geminates and therefore do not have a mora associated with them, so any mora which appears above a non-underlying geminate C must count as a Recover-μ violation.

(26)

<table>
<tr><th>Candidates</th><th>PeakProm</th><th>Parseμ</th></tr>
<tr><td>☞ s s
/ℕ<μ> /ℕ\
| | \ | | |
a. (C μ C μ μ)</td><td></td><td>*</td></tr>
<tr><td>s s
/ℕ \ /ℕ\
| | μ / | |
b. (C μ <\>C μ μ)
\|</td><td>*!</td><td></td></tr>
<tr><td>s s
/ℕ\ /ℕ\
| | | / ||
c. (C μ μ C μμ)
\/</td><td>*!</td><td></td></tr>
</table>

(27)

<table>
<tr><th>Candidates</th><th>Peak-Prominence</th><th>Recoverμ</th></tr>
<tr><td>☞ ℕ ℕμ
a. (.CVC.CVC.)</td><td></td><td>*</td></tr>
<tr><td>ℕμ ℕμ
b. (.CVC.CVC.)</td><td>*!</td><td>* *</td></tr>
<tr><td>ℕ ℕ
c. (.CVC.CVC.)</td><td>*!</td><td></td></tr>
</table>

The tableaux in (26) and (27) demonstrates the ranking of PeakProm above both Parseμ and Recμ. In (26) the underlying geminate consonant is degeminated - demorified and shortened as in (26a) to make the non-peak initial syllable lighter. In (27) PeakProm ranks above Recμ, forcing the addition of a mora to the representation to instantiate the desired head/non-head asymmetry. Thus PeakProm can force both the underparsing of an underlying non-nuclear mora and the addition of a non-underlying non-nuclear mora.

The pattern of consonant degemination raises the possibility of an underlying long vowel shortening under the same circumstances. In point of fact it does not, however the question is what rules out such a possibility? Again, the distinction between nuclear and non-nuclear moras can be called upon to save the day through the constraint: Parse-Nuc ('parse a nucelar mora to a syllable'). In examining the behavior of stressed syllables in disyllabic feet we claimed that a nuclear mora could not be added to satisfy PeakProminence (i.e. RecNuc ? PeakProm). To prevent the underparsing of one of the moras of an underlying long vowel we must rank ParseNuc above PeakProm as well: ParseNuc, RecNuc ? PeakProm .

Given that Parse and Recover are Faithfulness constraints we have to consider the status of the Nucleus with regard to the underlying representation: is it present or not? We know that moras must be present underlyingly given the existence of a long/short contrast in both vowels and consonants. (Note Pulleyblank (1993) shows that moras need to be present even on short vowels for the representation of tone.) To show conclusively that the Nucleus needs to be present in the UR we need to demonstrate a three-way contrast between glides and vowels: non-alternating vowels, non-alternating glides, alternating glide/vowel. In Koniag/Yupik the first two categories of non-alternation exist, however I have not found unequivocal evidence for alternating glide/vowel segments. What evidence there is centers on the behavior of certain post-bases with respect to base-final [te] sequences - certain post-bases in CAY induce an alternation of [te] to [se] to [ye] and optionally to [i] (Reed, et al (1977), Jacobson (1984)).[17]

(27d) /sagte-nga-uq/ 'to spread out-stative-3rd sg.' (Jacobson(1984;510))
[sa?es?auq], [sa?ey?auq], [sa?i?auq]

Pending the resolution of the segmental complexities surrounding base-final [te] (which must be left to future research) we must leave the status of the Nucleus unresolved. The rest of the paper continues to refer to RecNuc and ParseNuc - although these could in many cases be replaced with Recover-μ-Linked-to-V, and Parse-μ-Linked-to-V. Note that it is also possible to state the constraints as Recoverμ-Linked-to-Nucleus and Parse-μ-Linked-to-Nucleus, which would not require that the Nucleus be an underlying constituent. The arguments presented in this paper do not hinge on the Nucleus being in the underlying representation - they only hinge on the existence of a nuclear/non-nuclear distinction.

3.4 Compression

The last quantitative adjustment we need to examine is compression of vowels. Compression (the shortening of a long vowel) comes in two flavors in Alutiiq: (i) closed syllable shortening; (ii) final shortening. These two patterns arise from the interaction of distinct constraints and are discussed in turn below. However before turning to the details of

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[17] To quote Jacobson directly on the stative post-base *-nga*: "…if a monosyllable ending in a fricative precedes *te* [of the base], or if *e* precedes *te*, the *t* changes to *s* or y, and *es/ey* changes to *i* for most speakers."

each pattern it is important to note a very specific property of the compressed/shortened vowels - *they still behave as if they are long in terms of foot structure.*

In a derivational framework this property posed no particular difficulty as foot structure could be assigned first, then quantitative adjustments could occur while maintaining the original boundaries. However in OT it is necessary to explain why these phonetically short vowels are not treated as short. Obviously what is required is that the information that these vowels were long in the input be available, but the only constraints which have this power are in the Faithfulness family, so the governing constraint here must be of the Parse-family, since the nuclear mora of the underlying long vowels must be respected. In order to keep their foot structure (which is observable from fortition) they must still be bi-nuclear. Thus ParseNuc must be forcing a configuration which is interpreted as a long vowel prosodically, while being implemented as short phonetically.

3.4.1 Closed Syllable Shortening

For the shortening of a long vowel in a closed syllable I propose the constraints in (28) (some mentioned previously), where the main action takes place between a constraint which wants the foot to end in a mora (28d:*Align-R-F-μ*) and Parseℕ. The only one which looks at all language specific is (28d), however note that it is from the Align-family and is simply one of the logical possibilities when we have the prosodic categories of foot and mora. The Parse and Recover constraints in (28b,c,e,f) are part of the Faithfulness-family and must be available. Presumably *Link-Cons-to-Nuc is a family of constraints which could be broken into the component phonemes/features, again this relation (or preference for a non-relation) may be violated (cf. Shaw (1992) which proposes that such a constraint is universally unviolated for obstruents).

(28) a. **Tri-moraic Syllables* (*3μσ): Avoid syllables with three (or more) moras: $\sigma \leq 2\mu$

b. *Parse-Nucleus* (Parseℕ): Parse Nuclear mora into a syllable.

c. *Parse-Mora* (Parseμ) : Parse a mora into a syllable.

d. *Align R Ft, R μ* (AlignR-Ft-μ): Align the right edge of a foot with the right edge of a mora (nuclear <u>or</u> non-nuclear).

e. *Recover Path* (RecPath) : A path (assoc. line) present in the output should be present in the input. (≈ *Structure)

f. *Parse Path* (ParsePath) : A path (assoc. line) present in the input should be parsed in the output (= Myers(1993): Parse Assoc. Line).

g. **Link Consonant to Nucleus* (*LinkCℕ): Avoid linking a C to a nuclear mora.

These constraints when ranked with Parse-Segment and LinkVℕ (and its converse *LinkCℕ) into the tableau in (29) produce the correct outcome for those dialects which exhibit closed syllable compression. For those dialects of Yupik which lack compression RecPath would be ranked above AlignR-F-μ. The crucial ranking is between the Align-R-F-μ, Parseℕ and *LinkCℕ; such that the preference to align the right edge of the foot with a mora forces the parsing of the Coda C to the nuclear mora. Any other configuration that obeys the *LinkCℕ underparses a nuclear mora (29b,c), or the coda C itself (29e). The other configurations violate higher ranking constraints disallowing trimoraic syllables (29d), or the Align-R-F-μ constraint itself (29f). (Shared subscripting denotes connecting association lines.)

(29)

Candidates	*3μs	ParseSeg	Align-R-F-μ	Parseℕ	*Link-Cℕ
☞ ℕ$_i$ ℕ$_{j/k}$ a. (CV$_{i/j}$ C$_k$)					*
ℕ$_i$<ℕ$_j$>μ$_k$ b. (CV$_{i/j}$ C$_k$)				*!	
ℕ$_i$<ℕ$_j$>μ$_{j/k}$ c. (CV$_{i/j}$ C$_k$)				*!	
ℕ$_i$ℕ$_j$μ$_k$ d. (CV$_{i/j}$C$_k$)	*!				
ℕ$_i$ℕ$_j$ e. (CV$_{i/j}$) <C>		*!			
ℕ$_i$ℕ$_j$ f. (CV$_{i/j}$ C)			*!		

The output of compression, as given in (29a), is presented in more detail in (29a') below. The reason for associating the vowel root node to both nuclear moras is that diphthongs also undergo compression and all other things being equal the association between underlying vocalic root nodes and underlying moras will be respected. I have no evidence that the underlying associations are disturbed, thus the only change will be the addition of a link between the coda C and the second nuclear mora. My assumption is that the phonetic implementation rules treat this structure as requiring the realization of three segments within the alloted time of two moras.

(29a')

```
           s
          /|
         / ℕ
        /   |\
       /    μ μ
      /     |/ \
   ( C      V   C )
```

An additional point to note is that Align-R-Ft-μ is met in bisyllabic feet as well, since PeakProm induces the addition of a mora at the right-edge of the foot.

3.4.2 Final Shortening

Leer describes final shortening as applying to all word-final long vowels when they are in an open syllable. This is true of underlying long vowels and also of short vowels that would otherwise lengthen foot-finally. So the basic generalization, in light of compression, is that Koniag/Alutiiq does not tolerate long vowels word-finally. If it were the case that underlying long vowel were parsed as short word-finally this pattern would be easily dealt with, however underlying long word-final vowels are still treated, in terms of stress and fortition, as if they were full feet. The patterns are shown in (30).

(30) a. [**k**úm.**l**a.cí:.**w**i.ká] 'my freezer' (La;116)
b. [č̣a.ná:.**x**á] 'he's making it' (La;102)

We could simply state a constraint such as *V:]PrWd, and this constraint would essentially remain unviolated, i.e. be surface true. However such a constraint is really a negative alignment constraint, and following Generalized Alignment we must formulate the constraint in terms of prosodic words and vowels - crucially not moras in this instance. Again, the reason for this is that finally-shortened vowels behave as if they were long for foot structure. So they must still be bi-nuclear, but not bi-vocalic. The appropriate constraint is given in (31), which interacts with FtBinℕ, Parseℕ and ParsePath in the tableau in (32). Note that ParsePath here is in terms of the underlying path/assoc. line that existed between the vowel and the second nuclear mora.

I am also assuming that Recover-Consonant is highly ranked here and such sub-optimal candidates with epenthetic final C's are not included in (32). A second point is that the constraint *Emptyμ, which requires that moras dominate featural material, must be ranked below the constraints that govern final long vowel shortening, which I claim produces an empty mora. So *Emptyμ must be ranked below (31) and since empty moras are not required in any other position this ranking suffices.

(31) *Align-R-PrWord-R-Vowel (*AlignR-W-V): Do not align the right edge of a prosodic word
with the right edge of a vowel.

(32)

<table>
<tr><th>Candidates</th><th>Parseℕ</th><th>FtBinℕ</th><th>*AlignR-PrWd-V</th><th>ParsePath</th></tr>
<tr><td>☞ ℕ
/\
μ μ
|</>
a. (Ca)</td><td></td><td></td><td></td><td>*</td></tr>
<tr><td>ℕ
|\
μ<μ>
|/
b. (Ca)</td><td>*!</td><td>*</td><td>*</td><td>(*)</td></tr>
<tr><td>ℕ
|\
μ μ
|/
c. (Ca)</td><td></td><td></td><td>*!</td><td></td></tr>
</table>

The constraint in (31) is violated whenever a prosodic word ends in a vowel, which is a not infrequent occurence in Koniag/Yupik, but in those cases it is violated as a result of a higher ranking constraint ParseSeg which requires that segments be parsed. In the case of a word-final short vowel the vowel must be parsed and the *AlignR-W-V must be violated. At first this might seem to argue in favor of the *V:]$_{PrWd}$ constraint dismissed earlier, however there are a number of hidden assumptions in such a constraint - the important one here being that one can see the long vowel and both of its moras and judge whether they are final in the prosodic word or not. The ability to scan both nuclear moras at once here makes the constraint non-local in application - one must see both nuclear moras and their attachments to the Root-tier. The Generalized Alignment approach however can examine just the edgemost units and return the proper judgement as to whether the constraint has been violated or not. The strictly local nature of the Align-constraint is preferable even though it is often violated by the optimal output.

The main interest of the compression and shortening pattern is that phonetically short vowels must be treated as still being long (binuclear) within the phonology. OT is forced to allow nuclear moras to be parsed, but unfilled by segmental material in one case, and in the other the nuclear mora is allowed to be associated to what ostensibly would not be a nuclear segment (a consonant).

4.0 The Initial Closed Syllable

The status of the initial closed syllable in Yupik is quite mysterious. Unlike all other closed syllables it is *always* counted as heavy (cf. St.Lawrence Island)- it always forms its own foot. Previous accounts have always had to stipulate this property. In this sense the Optimality account proposed here does a bit better as the constraint that must be added (Initial Stress (33)) is obviously needed in UG, so it costs us nothing to invoke it here. However the other addition that must be made is an adjustment to the computation of FootBinarity violations - specifically we must postulate constraints which distinguish between minimality violations (hypo-binarity) and maximality violations (hyper-binarity). This next step in the deconstruction of foot binarity allows us to rank the maximality constraint above the minimality one which is required to capture the patterns surrounding the initial closed syllable in Yupik.

Section 4.1 focuses on the initial closed syllable and the Max/Min deconstruction of FootBinarity. An additional claim in this section is that Recoverμ assesses two violations for the formation of a geminate consonant - thus supporting the proposal of Shaw (1992) for representing geminate consonants as bimoraic. In section 4.2, following Shaw (1993b), the definition of PeakProminence is explicitly made sensitive to both the nuclear/non-nuclear distinction as well as the presence/absence of featural material. This is crucial for capturing the gemination patterns exhibited in mono-nuclear feet throughout Yupik and forces the revision of the ranking between the NoCoda and the LinkVℕ contraints posited in section 3.2.

4.1.1 The Initial Closed Conundrum

The conundrum of the initial syllable in Yupik lies in comparing the behavior of initial closed syllables (whether underlyingly closed or closed by automatic gemination) with the behavior of initial open syllables (always light). Given that closed syllables in Koniag/Yupik can be treated as either light or heavy (section 3.3) there must be other constraints/preferences which force the heavy interpretation in initial position. However the pressure of these constraints must be weak enough so that it does not trigger vowel lengthening or consonant gemination to create the desired initial-heavy pattern.

I propose that Initial Stress (33) interacts with the FtBin family and Recoverμ to produce the correct pattern. The basic idea is that Koniag/Yupik wants to have initial stress, but not at too high a cost in terms of additions to the prosodic representation. This requires that Recoverμ be ranked above InitialStress. The initial closed syllable foot also violates FtBinℕ which means InitialStress will have to dominate, however such a ranking leads to the wrong results in the case of an initial /#CVCVV…/ sequence and requires the further decomposition of the FtBin family into constraints which evaluate violations in terms of minimality and maximality (34). An algorithm for computing binarity violations is given in (35).

(33) Initial Stress (InitStr): stress the initial syllable: Align-L-PrWd-L-Head

(34) a. FtBin-X^{max}: For the elements of category X (s,ℕ,μ) contained within a foot assess a violation for each element that exceeds 2.

b. FtBin-X^{min}: For the elements of category X (s,ℕ,μ) contained within a foot, assess a violation if the foot contains less than 2 such elements.

(35) Computing binarity without counting: the elements of the category to be evaluated within

the foot are treated as a list, with manipulations consisting of removing a single element and comparing it in terms of identity with the remainder and zero.

For X^{min} violations: remove the first element from the list, if the remainder equals zero/null assess a violation, otherwise assess no violation and stop.

For X^{max} violations: remove the first element from the list, if the remainder equals the first element assess no violation and stop, otherwise assess a violation and repeat the operation on the remainder.

The configurations which must be evaluated by the constraints are given in the tableaux in (36). Again a number of possible structures have been eliminated already - in particular those which violate Align-L-Root-Foot. So the structures which must be examined are those which treat the initial syllable as a bimoraic foot and those which group it into a foot with the following syllable. I am also assuming that consonant gemination is the only possibility for bulking mono-nuclear feet and that this gemination is evaluated as 2 Recμ violations. (The issue of gemination versus vowel spreading is discussed in 4.2 below.) The constraint Parse-s-to-Ft is ranked below InitStress so the non-footing of final syllables does not affect the preference for placing a foot over initial closed syllables.

(36)

Candidates	FBℕ^{max}	FBμ^{min}	PeakProm	Recμ	InitStr	FBℕ^{min}
☞ ℕμ ℕ ℕμ a. [(CVC)(CVC.s) s]				**		*
ℕ ℕμ ℕ ℕμ b. [(CVC.CVC)(s s)]				**	*!	
ℕ ℕ ℕμ c. [(CVC)(CVC.s) s]		*!		*		*
☞ ℕ ℕμ ℕ ℕμ d. [(CV.CVC)(s s)]				**	*	
ℕμ_i μ_iℕ ℕμ e. [(CV)(C_iVC.s) s]				***!		*
ℕ ℕ ℕμ f. [(CV)(CVC.s) s]		*!		**		*
☞ ℕμ_i μ_i ℕℕ ℕ ℕμ g. [(CV)(C_i VV)(s s)]				***		*
ℕ ℕℕ ℕ ℕμ h. [(CV.CVV)(s s)]	*!			*	*	
ℕ ℕℕ ℕ ℕμ f. [(CV)(CVV)(s s)]		*!		*		*

The basic observation that can be made about the initial syllable/foot in Koniag/Yupik is that the initial syllable forms the initial foot as long as no geminate structures are built to create the foot. (The pattern in (36g), that of automatic gemination, would seem to be an immediate counter-example, however it should be kept in mind that FtBinℕ and Align-L-Root-L-Foot are conspiring to force that particular footing.) The three competing forces in the system are: (i) Initial Stress, which wants the first syllable to be its own foot; (ii) FtBinℕ^{min} which wants a foot to contain two nuclear moras and can only be satisfied with an initial light syllable being footed with a peninitial light syllable; (iii) Recoverμ which wants to minimize the number of non-underlying moras. InitialStress causes violations of FtBinℕ^{min}, but Recoverμ constrains these violations to the context of the initial closed syllable, since the addition of gemination to close the initial syllable results in an additional, therefore fatal, Recμ violation.

The other constraints which play a crucial role in (36) are FtBinℕ^{max} and FtBinμ^{min}. FtBinℕ^{max} is necessary to rule out the (CV.CVV) foot in (36h) - this constraint is never violated. If we did not separate minimality violations from maximality violations we could not distinguish the initial closed (36g) from (36h), as the initial closed syllable induces a (minimality) violation of FtBinℕ. An undifferentiated FtBinℕ assesses equal violations to both (36h) and (36g), while we actually need the violation in (36h) to be worse.

An additional point that should be noted here is that right-headed feet are not violated in Koniag/Yupik. Obviously one possiblity to achieve satisfaction of both FtBinℕ^{min} and Initial

Stress would be to build a trochee at the left edge of the word. Therefore it is necessary to rank the constraint regarding right-hand Heads above Initial Stress. This leaves the creation of a mono-syllabic/mono-nuclear foot as the only possibility for satisfying Initial Stress. The head alignment constraint is "Align-R-Foot-R-Head".

4.1.2 Peninitial Schwa

The last configuration we need to examine for the initial foot is when a schwa appears in the peninitial syllable. If the schwa is in a closed syllable (e.g. #CV.CeC.) then it is treated like any other open-closed sequence, however if the second syllable is open then the schwa is deleted (unparsed in OT terms) (e.g. #CV.Ce. --> #CVC. < e >). In Alutiiq the deletion of schwa in an open syllable (that would otherwise bear stress) is limited to the initial foot, however in other Yupik dialects (GCY and Chevak) it is a general process throughout the word (Reed, et al. (1977), Woodbury(1987)). To handle this pattern in Koniag we need to include a constraint (37) against schwa appearing as the Head of the initial foot (Ft`) which is ranked above NoCoda and Parseμ/Parseℕ, allowing the underparsing of the schwa and the formation of a closed syllable.

(37) *Schwa-in-Head-Ft` (*e-Ft`): Avoid having a schwa in head position of the initial foot.

(38)

Candidates	*e-Ft'	NoCoda	Parseμ	FtBinℕ^{min}
☞ ℕμ a. [(CVC)<e>(....]		*	*	*
ℕ ℕμ b. [(CV.Ce)(...]	*!			

There is one additional configuration where (37) could have unwanted effects - when the initial foot contains schwa in a closed syllable. In this case the dominating constraints of Parse-C and Align-L-Root-L-Foot force the maintenance of the schwa and thus the violation of (37).

4.2 Gemination and the Single Syllable Foot

In the discussion of bisyllabic feet we derived the differential realizations of iambic weight via the interaction of NoCoda and *Emptyμ. A striking fact of Central Alaskan Yupik is that this pattern is reversed when the foot in question is mononuclear. An underlyingly mononuclear syllable, which is stranded in derivational terms (due to FtBinℕ) is closed by gemination of the following onset which brings it up to foot-status. (Note that this does not occur in Koniag, which is perfectly happy to leave stranded syllables foot-wise unparsed.) So in the dialects of Yupik where this occurs the constraint Parse-s-to-Ft must be ranked above Recμ and above FtBinℕ^{min} and FtBins^{min}, but crucially below FtBinμ^{min}. So in stranding configurations it is better to add a (non-nuclear)mora and create an additional mononuclear/monosyllabic foot than to leave a syllable unfooted.

(39) FtBinμ^{min} ? Parse-s-to-Ft ? Recμ, FtBinℕ^{min}, FtBins^{min}

Once the non-nuclear mora is added then the question becomes why we geminate instead of lengthening the vowel as we would in a bisyllabic foot. The answer with regard to the mononuclear feet is that the constraint LinkVℕ must be ranked above NoCoda - thus gemination becomes preferable to linking the vowel to the non-nuclear mora. This obviously contradicts the analysis given for the bisyllabic feet and requires a more explicit account of what exactly is the optimal peak for PeakProminence.

An example demonstrating this gemination is in (40). Note that the triggering configuration here is not simply FtBinℕ^{max}, but rather the avoidance of a CVC.CV foot. (I will not attempt to integrate this into the grammar here.) The example (and generalization for CAY) comes from Miyaoka (1985;60). Note that there is final-destressing in CAY (optional in Koniag). The gemination occurs in the penultimate foot; the underlying syllable [ri] can not form a foot with [ten], nor can it form a foot with [tua] (by FtBinℕ^{max}). So instead of remaining unparsed (to a foot) it is subjected to epenthesis and brought up to monosyllabic/mononuclear foot-hood. The basic constraints for this pattern in CAY are given in the tableau in (41).

(40) [(ča.?á:)(tén)(rít)(tua)] 'there is nothing wrong with me'

(41) Central Alaskan Yupik: …)(CV)(CVV)… -->)(CVC$_i$)(C$_i$VV)….

Candidates	FtBinℕ^{max}	FtBinμ^{min}	Parses	*Emptyμ	LinkVℕ	NoCoda
☞ ℕμ$_i$ μ$_i$ ℕℕ a. (CV)(C$_i$VV)						*
ℕμ$_i$ ℕℕ b. (CV$_i$)(CVV)					*!	
ℕμ ℕℕ c. (CV)(CVV)				*!		
ℕ ℕℕ d. (CV CVV)	*!					
ℕ ℕℕ e. (CV)(CVV)		*!				
ℕ ℕℕ f. <CV> (CVV)			*!			

One of the differences between CAY and Koniag/Alutiiq is in where this type of gemination takes place. Recall that Koniag has Parse-s-to-Ft ranked low, so that unfooted syllables may be created and judged optimal in some configurations. As a result, monosyllabic feet (that are mononuclear) are created only at the left-edge of the word - the pattern which is referred to as "automatic gemination". Since Parses can not be supplying the pressure for footing here another constraint, Align-L-Root-L-Ft, is required to force the inclusion of the initial syllable in a foot. When we swap the Align constraint with the Parse constraint in (41) we get the tableau in (42) which produces the correct form as the optimal candidate.

(42) Koniag Automatic Gemination /ulua/ --> [úl.luá] 'it's tongue' (La;87)

Candidates	FtBinℕ^{max}	FtBinμ^{min}	Align-Root-Ft	*Emptyμ	LinkVℕ	NoCoda
☞ ℕμi μi ℕℕ a. [(CV)(CiVV)						*
ℕμi ℕℕ b. [(CVi)(CVV)					*!	
ℕμ ℕℕ c. [(CV)(CVV)				*!		
ℕ ℕℕ d. [(CV CVV)	*!					
ℕ ℕℕ e. [(CV)(CVV)		*!				
ℕ ℕℕ f. [<CV> (CVV)			*!			

The re-ranking of NoCoda and LinkVℕ in (41) and (42) creates a contradiction as it predicts consonant gemination instead of the vowel lengthening observed in bisyllabic feet. In order to reconcile the two patterns it is necessary to exploit the other constraint which distinguishes these configurations - PeakProminence. PeakProm examines the relations between a head and non-head element, and as defined, passes configurations where the head is more prominent (heavier) than the non-head. The adjustments which must be incorporated into PeakProm are those proposed by Shaw (1993b) - prominence is computed via the intersection of the scales of relative prominence in (43).

(43) a. Nucμ ≻ μ : structural prominence
b. V ≻ C : sonority prominence ([-cons] ≻ [+cons])
c. 2 ≻ 1 : quantitative prominence
d. aF ≻ ∅ : substantive prominence

The combination of the scales in (43) gives a fine-grain analysis to the notion of prominence - thus allowing PeakProm to evaluate and rank all candidate feet which share the property of having a basic asymmetry between the head and non-head elements. By employing the prominence scales of (43) PeakProm will choose the candidate foot which is most asymmetrical, i.e. the candidate with the <u>most</u> prominent head and <u>least</u> prominent non-head. A ranking of some syllable-types, from more to less prominent (L-to-R), is given in (44).

```
(44)  ℕℕ   ℕμ   ℕμ   ℕμ   ℕ    ℕ    ℕ    μ
      |/   |/   ||   ||   |    |    |
      V    V    VC   ?C   V    C    ?
```

In terms of the problem at hand, in the bisyllabic foot case PeakProm provides the pressure for lengthening the vowel in preference to the gemination of the consonant - the head is heavier with the vowel linked to the non-nuclear mora, than with the consonant linked there. In the case of mononuclear feet PeakProm simply does not apply - there is no non-head, so the LinkVℕ constraint dominates and forces the violation of NoCoda through gemination. By positing a prominence distinction between nuclear and non-nuclear moras and interpreting PeakProm as choosing the most prominentially asymmetric foot we can capture the difference in behavior between bisyllabic asymmetric feet and mononuclear feet in Yupik.

An important advantage of this approach to prominence is that additional scales of relative prominence can be incorporated into the grammar. A possible example from Zec (1988) would be $K^w ak^w ala$ where glottalized sonorants and non-sonorants do not count for weight while non-glottalized one do. This pattern could be derived via the interaction of two scales:
[+son] ≻ [-son], and [-c.g.] ≻ [+c.g.]. An additional point to note here is that the s/w relation Zec posits for distinguishing tautosyllabic moras does not provide the same fine-grain weight distinctions that the nuclear/non-nuclear relation provides. In particular a long vowel has the same s/w labeling of its moras as does a short vowel in a closed heavy syllable.

Integrating the behavior of the initial closed syllable into the metrical system of Yupik forces us to explicitly distinguish between minimality and maximality violations of the FootBinarity constraints and forces a fine-grain analysis of PeakProminence based upon structural, featural and quantitative scales of prominence. This might appear to be a costly method for incorporating a small generalization in a particular language, however these constraints occur in other systems: reduplication in Nisgha (Shaw (1993b)) requires a fine-grain approach to weight/prominence and minimality/maximality distinction exist in various forms, such as the bimoraic maximum most languages employ for syllables, or the min/max constraints imposed on roots as Bagemihl (1992) proposes for Bella Coola. Thus the constraints added to the grammar here for Yupik are actually part of UG and so there is no "cost" in positing them.

5.0 Comparisons with other dialects

This section very briefly looks at how various dialects differ in the ranking of the constraints associated with the placement of foot boundaries: the FtBin-family, ParseS, Recℕ and Recμ. The crucial shift between dialects in this area is the ranking of ParseS which is bolded in the constraint hierarchies. The structural changes these shifts induce center on how light syllables sandwiched between a preceding foot and a following long vowel (foot) are treated: in Koniag these syllables are left unparsed (indicated by a non-fortis onset)(45a); in CAY they are bulked and parsed as feet (45b); in St.Lawrence Island they are parsed into a bisyllabic foot with the following long vowel (i.e. the canonical iamb case) and when trapped word-finally they are (presumably) bulked and footed as well (45c). Please note that there is final de-stressing in CAY and St. Lawrence Island Yupik and that this obscures the status of the final stranded syllables - they are not stressed and due to final-shortening as well there is no surface evidence for the bulking to foot-hood. (Fortition does not mark the left-edges of feet in these dialects, so its absence does not indicate non-foot-hood as it does in Alutiiq.) I have left the final syllable foot-wise unparsed in St.Lawrence Island as it is not crucial that it be parsed. If evidence can be found to show that it is footed then ParseS will have to dominate FBℕ^{min} in the rank.

(45) a. [(án)ci(**q**uá)] 'I'll go out' (La;84)
b. [(qa.yá:)(píx)(kaá)(ni)] 'in his (another's) future authentic kayak' (J85;31)
c. [(qa.yá:)(pix.kaá)ni] 'in his (another's) future authentic kayak' (J85;27)

Koniag Alutiiq: FBS^{max}/FBℕ^{max} ? Recℕ ? FBμ^{min} ? Recμ ? **ParseS** ? FBℕ^{min}/FBS^{min}/FBμ^{max}

Candidates	s^{max}	ℕ^{max}	Recℕ	μ^{min}	Recμ	Parses	ℕ^{min}	s^{min}	μ^{max}
☞ ℕμ ℕ ℕℕ a.(VC)CV(CVV)					*	*	*	*	
ℕμ ℕ ℕℕ b.(VC)(CVCVV)		*!			*		*	*	*
ℕμ ℕμ ℕℕ c.(VC)(CV)(CVV)					**!		**	**	

Central Alaskan: FBs^{max}/FBℕ^{max} ? Recℕ ? FBμ^{min} ? **Parses** ? Recμ ? FBℕ^{min}/FBs^{min}/FBμ^{max}

Candidates	s^{max}	ℕ^{max}	Rec ℕ	μ^{min}	Parse s	Rec μ	ℕ^{min}	s^{min}	μ^{max}
ℕ ℕμ ℕ ℕℕ ℕ a.(CVCV)CVC(CVV)CV					**!	*		*	*
ℕ ℕμ ℕ ℕℕ ℕ b.(CVCV)(CVCCVV)CV		*!			*	*			**
ℕ ℕμ ℕμ ℕℕ ℕ c.(CVCV)(CVC)(CVV)CV					*!	**	*	**	*
☞ ℕ ℕμ ℕμ ℕℕ ℕμ d.(CVCV)(CVC)(CVV)(CV)						***	**	***	*
ℕ ℕμ ℕ ℕℕ ℕμ e.(CVCV)(CVCCVV)(CV)		*!				**	*	*	**

St.Lawrence Is: FBs^{max}/FBℕ^{min}/FBμ^{min} ? Recμ/Recℕ ? **Parses** ? FBℕ^{max}/FBs^{min}/FBμ^{max}

Candidates	s^{max}	$ℕ^{min}$	$μ^{min}$	Rec ℕ	Rec μ	Parse s	$ℕ^{max}$	s^{min}	$μ^{max}$
ℕ ℕμ ℕ ℕℕ ℕ a.(CVCV)CVC(CVV)CV					*	**!		*	*
☞ ℕ ℕμ ℕ ℕℕ ℕ b.(CVCV)(CVCCVV)CV					*	*	*		**
ℕ ℕμ ℕμ ℕℕ ℕ c.(CVCV)(CVC)(CVV)CV		*!			**	*		**	*
ℕ ℕμ ℕμ ℕℕ ℕμ d.(CVCV)(CVC)(CVV)(CV)		*!*			***			***	*
ℕ ℕμ ℕ ℕℕ ℕμ e.(CVCV)(CVCCVV)(CV)		*!			**		*	*	**

The point of this narrow comparison is that the deconstruction of FootBinarity into its component prosodic levels combined with the min/max distinctions allows us to capture the variation among the dialects while using the exact same set of constraints. The canonical iamb pattern of St.Lawrence Island Yupik does not necessarily require the deconstruction of FootBinarity. The constraint ranking given groups FBsmax, FBℕmin and FBμmin together at the top of the hierarchy. This grouping contains the maximum expansion of the canonical iamb template (bisyllabic) as well as the standard minimality restriction to two moras. However the other dialects, which do not form tri-nuclear feet, absolutely require the deconstruction of FtBin within the non-derivational framework of OT.

6.0 Conclusion

In (46) I have listed all of the constraints discussed in the preceding sections. They are listed in the appropriate domination relationships, unranked constraints are listed in vertical columns. In (45) have listed the constraints that were placed in the construct GEN', which dominate the constraints in (46). The '(I)' designates constraints which are surface true - i.e. inviolable due to their high-ranking position, or non-interaction with dominating constraints.

(45) GEN': Prosodic Integrity(I), Align-L-Root-L-σ(I) ? Onset ? Complex

(46) Align-L-Root-L-Foot(I)
Recover-Distinctive-Feature[18]
*Trimoraic-σ(I)
Align-R-Foot-R-μ(I)
Align-R-Head-R-Foot(I)
FtBinℕ^{max}(I)
FtBinσ^{max}(I)
FtBinμ^{min}(I)
PeakProm(I)
Parse-Segment ? *e-Ft' ? Parseℕ(I) ? *Link-C-Nuc ? Recμ ? LinkVℕ ?
Recℕ(I)
Parseμ InitStress
FtBinμ^{max}
*Emptyμ

NoCoda ? Parse-σ-to-Ft ? Align-L-Ft-L-PrWd ? ParsePath
FtBinℕ^{min}
FtBinσ^{min}
*Align-R-PrWd-R-V

The OT framework aims at stating a grammar in terms of competing output constraints and eschews derivational rule ordering. This account of Koniag/Yupik is a successful OT account as it captures the placement of feet and their surface weight instantiations without recourse to level or rule orderings. This account crucially relies on a deconstructed FootBinarity constraint (i.e. FtBin undergoes fission into a family of constraints), which evaluate Binarity at the component prosodic levels of the foot (σ,ℕ,μ) and distinguishes between violations in excess of two and those which are less than two. A deconstructed FootBinarity constraint (boradly ranked as in (48)) is needed to capture the range of possible and impossible feet in Yupik (47).

(47) * { (σσσ),(ℕℕℕ) } ✔ { (μμμ),(σσ),(ℕℕ),(μμ),(σ),(ℕ) } * { (μ) }

(48) FtBinσ^{max}, FtBinℕ^{max}, FtBinμ^{min} ? FtBinσ^{min}, FtBinℕ^{min}, FtBinμ^{max}

---

[18] Captures the non-insertion of segments other than schwa (treated as the default vowel).

For Koniag it is necessary to distinguish trinuclear feet from mononuclear feet such that trinuclear feet never surface while mononuclear ones do in the case of the initial closed syllable. In CAY it is necessary to expand the contexts in which mononuclear feet arise, while still disallowing the formation of trinuclear feet. In OT terms this means that minimality violations at the nuclear level are tolerated in certain circumstances while maximality violations are not tolerated in any context.

The other crucial factor for the OT account is the nuclear/non-nuclear distinction of (Shaw 1992). This provides a structural distinction between surface and underlying sequences of short and long vowels. Together with FtBin$\mathbb{N}^{max}$ this allows us to block the formation of bisyllabic feet consisting of underlying short-long vowels (trinuclear), while allowing the bisyllabic feet to contain a short-long vowel sequence that is binuclear and trimoraic. Without such a distinction an OT account would have to rely on level distinctions or allow FtBin to be sensitive to input/output distinctions. The nuclear/non-nuclear distinction also required for the fine-grain prominence distinctions necessary for capturing the differential behavior of bisyllabic and mononuclear feet (i.e. vowel lengthening vs. C-gemination).

A final advantage of the OT account is that the behavior of the initial closed syllable can be integrated with the behavior of other closed syllables. The initial closed is special as a result of the Initial Stress constraint, which overrides the usual patterning of closed syllables as light (monomoraic) in non-head position and bimoraic in head position. This is a significant advance, since the behavior is motivated by the presence of a well-attested constraint in other languages and suppports the strong claims of Prince & Smolensky (1993) regarding the presence of all constraints within each grammar - here we have a grammar for what is superficially an activist iambic language that employs a mechanism/constraint typically associated with trochaic systems. The OT account presented here supports the view that there is no fundamental iambic/trochaic split in metrical systems and it also supports the view that constraints/conditions on metrical heads and constituency are stated independently in the grammar.

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