Morphologically Motivated Prosodic and Metrical Structures
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# Morphologically Motivated Prosodic and Metrical Structures*

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## 0. Introduction

In Nuu-chah-nulth some suffixes trigger alternation in stem vowels in length. There are three kinds of vowel alternation: vowel lengthening, vowel shortening and vowel alternation occurring with reduplication. In this paper, I provide a unified system to a superficially complex array of these apparently separate processes under Optimality Theory (McCarthy & Prince 1993, Prince & Smolensky 1993).[1]

## 1. Vowel lengthening

Some suffixes trigger lengthening of a stem-initial vowel. There are two patterns in this process: i) with some suffixes, if the second syllable of the stem is long, then it is shortened, and ii) with some other suffixes, only the first syllable of the stem is affected. In both cases, the second syllable does not have to be part of a root morpheme. In the case that the triggering suffix itself occupies the second syllable, the vowel of the suffix is not affected. (1) summarises the observation.

(1) Patterns of Nuu-chah-nulth vowel lengthening

| Type | Triggering suffixes | Root/stem | |
|---|---|---|---|
| | | 1st syllable | 2nd syllable |
| Type I | -(q)iiɬ, -ḥwaaɬ, -ʔiƛ, -, -ʔinḥi -p̓a(a), -p̓ičḥ | Lengthened | Shortened |
| Type II | -iʔaḵuuḥ, -awiɬ, -panač, | Lengthened | No change |

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[1] Nuu-chah-nulth, along with Ditidaht and Makah, constitutes the Southern Wakashan branch of the Wakashan language family. It is spoken along the west coast of Vancouver Island in B.C., Canada. The data in this paper are from Ahousaht, one of the 12 dialects.

Consider the following examples. *-(q)iiɬ* 'to make' is a Type I case. The first syllable of the stem is lengthened, while as seen in (2b), if the second syllable is underlyingly long, it is shortened on the surface.

(2) -(q)iiɬ 'to make'[2]

| | | |
|---|---|---|
| a. č̓/a/pac-iiɬ | → | č̓[aa]paciiɬ |
| canoe-to make | | 'making a canoe' |
| b. s/a/pn/ii/-qiiɬ | → | s[aa]pn[i]qiiɬ |
| bread-to make' | | 'making bread' |

(3) is one of type II cases. The first syllable of the stem is lengthened; the second syllable, as seen in (3b), is not affected unlike type I.

(3) -panaj 'moving around'

| | | |
|---|---|---|
| a. ʔ/a/ya-panač | → | ʔ[aa]yapanač |
| many-moving around | | 'Many people moving around' |
| b. n/a/qč/uu/-panač | → | n[aa]qč[uu]panač |
| drunk-moving around | | '(s.o.) moving around drunk (from place to place)' |

## 2. Vowel shortening

Some suffixes cause the syllable(s) of a root or stem to shorten, which is the opposite of the lengthening process shown above.[3]

| | | |
|---|---|---|
| (4) a. t/uu/ḥukʷ-(q)aq-mit-siš | → | t[u]ḥukʷaqitsiš |
| scared-very-PAST-1sg/IND | | 'I was very scared.' |
| b. c̓/ii/q/aa/-qaq | → | c̓[i]q[a]qaqʔiš naʔaat |
| a spiritual song-very | | 'S/he is singing a spiritual song very loudly. |

## 3. Vowel alternation with reduplication

Some suffixes trigger reduplication and sometimes the stem vowels are modified. There are 9 patterns in Nuu-chah-nulth reduplication in terms of the forms of both the reduplicant and the base. I provide 4 patterns in (5), which exhibit vowel alternation in the base (see Kim *in prep.* for the full discussion).

[2] The suffix initial /q/ disappears on the surface, when it follows a consonant-final stem.

[3] Abbreviations used in this paper are: DUR=durative, IND=indicative, INT=interrogative NEG=negative, RED=reduplicant, sg=singular, pl=plural.

(5) Patterns of Nuu-chah-nulth reduplication

| TYPE | Vowel length in | | RED-BASE |
|---|---|---|---|
| | Reduplicant | Base | |
| Class IV | Long | Affected; lengthened, if underlyingly short | CVV(C)-CVV(C) |
| Class V | Short | Affected; shortened, if underlyingly long | CV-CV(C) |
| Class VI | Long | Affected; shortened, if underlyingly long | CVV-CV(C) |
| Class VII | Short | Affected; lengthened, if underlyingly short | CV(C)-CVV(C) |

### 3.1. Class IV: Red=σμμ; Base=$_1$σμμ

The reduplicant vowel is always long, and the base (or the first syllable of the base, if it consists of more than one syllable) is also long. If the vowel of the base is short, then it is lengthened as shown in (6).

(6) a. ẇaaẇaasaqaʔiš
**RED**-ẇasaq-(y)a-ʔiš
RED-to cough-continuously-3sg/IND
'She is continuously coughing.'

b. cuuccuucaʔiš
**RED**-cuc-(y)a-ʔiš
RED-to scratch-continuously-3sg/IND
'S/he is continuously scratching.'

### 3.2. Class V: Red=σμ; Base=$_1$σμ

The reduplicant has a short vowel and (the first syllable of) the base is also short. If the vowel of the base is long, then it is shortened as shown in (7).

(7) a. ʔuʔusumḵukʔiš
**RED**-ʔusum-ḵuk$^w$-ʔiš
RED-to need/want-to resemble-3sg/IND
'S/he appears to need (s.t.)'

b. ƛ̓iƛ̓ix$^w$aḵuk
**RED**-ƛ̓iix$^w$-(a)a-ḵuk$^w$
RED-to smile/laugh-DUR-to resemble
'Smirk'

### 3.3. Class VI: Red=σμμ; Base=$_1$σμ

The reduplicant is always long, but (the first syllable of) the base is short. If

the vowel of the base is long, then it is shortened as shown in (8).

(8) a. wiiwikitʔyak
**RED**-wik-itʔyak
RED-NEG-afraid/fear
'Not afraid of anything'

b. siisicitʔyaksiš
**RED**-siic-itʔyak-siš
RED-maggot-afraid/fear
'I am afraid of maggots.'

### 3.4. Class VII: Red=σμ; Base=$_1$σμμ

The process is exactly opposite to Class VI reduplication: the reduplicant is always short, but if (the first syllable of) the base is underlyingly short, then it is lengthened as shown in (9).

(9) a. ʔuʔuušsapiʔiš
**RED**-ʔuuš-sapi-ʔiš
RED-some-to depend on-3sg/IND
'S/he is depending on someone.'

b. ʔaʔaaqisapiḥsuu waaɬak mituuni
**RED**-ʔaqi-sapi-ḥsuu waɬ-ak mituuni
RED-what-to depend-2pl/INT to go-DUR Victoria
'What are you depending on to go to Victoria?'

## 4. Analysis

We have seen so far that vowel alternation in Nuu-chah-nulth exhibits complex properties both phonologically and morphologically. I summarise the questions these data raise as follows:

1. How do we treat the different patterns of vowel alternations?
2. How do we treat the modification of base forms in terms of vowel length?
3. Is there any way of dealing with these processes under a unified system?
4. How do we integrate morphological aspects of the processes with phonology?

In the following sections, I will discuss these problems.

### 4.1. Metrical requirements

Modification of root/stem vowel length is due to metrical conditions specified for each vowel lengthening, shortening, and reduplication-triggering suffix. Adapting Pulleyblank *to appear,* I propose that metrical requirements are defined as templates as seen in (10) (cf. Crowhurst 1991, Hayes 1994).[4]

[4] See Kim (in prep.) for detailed discussion for Nuu-chah-nulth foot structure.

(10) I. Trochaic foot

a. FootForm$_{I}$: two light syllables $(\sigma \ \sigma)_{\varphi}$

b. FootForm$_{II}$: two moras $(\sigma)_{\varphi}$

c. FootForm$_{III}$: two syllables with one heavy $(\sigma \ \sigma)_{\varphi}$

d. FootForm$_{IV}$: two heavy syllables $(\sigma \ \sigma)_{\varphi}$

II. Iambic foot

e. FootForm$_{V}$: two syllables with first light: $(\sigma \ \sigma)_{\varphi}$

f. F(oot)F(orm)$_{VI}$: two moras: $(\sigma)_{\varphi}$

g. FootForm$_{VII}$: two syllables with first light; second heavy: $(\sigma \ \sigma)_{\varphi}$

Each template is specified for specific suffixes and their surface effects are realized by the following constraints, (11), and their language-specific ranking, (12).

(11) Constraints:

a. FootForm$_{\delta}$: A foot must obey the prosodic requirement specified on suffixes, if any. ($\delta$ indicates morphological domains: each class of suffixes.)

b. MAX$_{\mu}$: Moras in the input must have a correspondent in the output.

c. DEP$_{\mu}$: Moras in the output must have a correspondent in the input.

(12) Ranking:

FootForm$_{\delta}$ >> MAX$_{\mu}$, DEP$_{\mu}$

The implication of the ranking is that observing the metrical requirements is more crucial than maintaining the quantity of the input vowel.

The effect of the ranking is illustrated by the tableaux below. The first case is vowel lengthening. (13) is an example of Type I lengthening, where a triggering suffix is specified for FootForm III: the first syllable of the foot is long and the second is short.

(13) Type I: $\text{FootForm}_{\text{III}}$: $(\sigma \quad \sigma)_{\varphi}$

μ μ μ

(14) is the relevant example and (15) is its tableau.

(14) s/a/pn/ii/-qiiɬ ➔ s[aa]pn[i]qiiɬ
bread-to make 'making bread'

(15) Tableau for (14)

| sapnii-qiiɬ(FFIII) | $\text{FootForm}_{\text{III}}$ | MAXIOμ | DEPIOμ |
|---|---|---|---|
| ☞ a. $(\text{saapni})_{\varphi}$qiiɬ | | * | * |
| b. $(\text{sapnii})_{\varphi}$qiiɬ | *! | | |
| c. $(\text{sapni})_{\varphi}$qiiɬ | *! | * | |

(16) is a case of Type II lengthening, where the fist syllable of the stem is long, but the second is not affected.

(16) Type II: $\text{FootForm}_{\text{II}}$: $(\sigma)\varphi$

μ μ

(17) n/a/qj/uu/-panaj ➔ n[aa]qj[uu]panaj
drunk-moving around '(s.o.) moving around drunk '

(18) Tableau for (17)

| naqčuu-panač (FFII) | $\text{FootForm}_{\text{II}}$ | MAXIOμ | DEPIOμ |
|---|---|---|---|
| ☞ a. $(\text{naaq})_{\varphi}$čuupanač | | * | |
| b. $(\text{naaqčuu})_{\varphi}$panač | *! | * | |
| c. $(\text{naqču})_{\varphi}$panač | *! | | |
| d. $(\text{naqčuu})_{\varphi}$panač | *! | | |

(19) is a case of vowel shortening, where the first two syllables of the stem are shortened. (20) and (21) are the relevant example and tableau, respectively.

(19) $\text{FootForm}_I$: $(\sigma \ \sigma)_\varphi$
$\mu \ \mu$

(20) t/uu/ḥuk$^w$-(q)aq-mit-siš → t[u]ḥuk$^w$aqitsiš
scared-very-PAST-1sg/IND 'I was very scared.'

(21) Tableau for (20)

| tuuḥuk$^w$-aq(FFI) | $\text{FootForm}_I$ | MAXIOμ | DEPIOμ |
|---|---|---|---|
| ☞ a. (tuḥu)$_\varphi$k$^w$aq | | * | |
| b. (tuuḥu)$_\varphi$k$^w$aq | *! | * | |
| c. (tuuḥuu)$_\varphi$k$^w$aq | *! | | * |
| d. (tuḥuu)$_\varphi$k$^w$aq | *! | * | * |

## 4.2. Prosodic characterization of reduplicants

In the same spirit, each reduplication-triggering suffix is not only specified for a metrical requirement on the foot structure, but also manifests a prosodic requirement σ as a cooccurring prefix, adapting Marantz 1982, McCarthy & Prince 1986, Downing 2000, 2001, Pulleyblank *to appear,* and following Kim *to appear*. For example, a suffix of class IV, *-ya*, could be represented in the lexicon as follows.

(22) σ…ya

## 4.3. Indexation of faithfulness constraints

Adopting Itô & Mester (1999), I propose that phonological as well as morphological domain-specified faithfulness constraints are closely related to the modification of the base forms of some classes. That is, the following faithfulness constraints are domain-specified both phonologically and morphologically.

(23) Input-Output faithfulness: δ=phonological or morphological
a. $\text{MAXIO}_\delta$: Every segment of the input in the domain of δ has a correspondent in the output.

b. $\text{DEPIO}_\delta$: Every element in the output in the domain of δ has a correspondent in the input.

Segments are never deleted or inserted, so MAXIO/DEPIO(seg) are undominated. However, length alternation is suffix-dependant, leading to the following ranking:

(24) a. Classes IV & VII: FootForm >> $\text{DEPIO}(\mu)_{\text{IV,VII}}$
b. Classes V & VI: FootForm >> $\text{MAXIO}(\mu)_{\text{V,VI}}$

We need FaithBR constraints to obtain the effect of the Base-Reduplicant identity.

(25) Base-Reduplicant Faithfulness: δ=all classes (McCarthy & Prince 1994, 1995)
a. $\text{MAXBR}_{\delta}$: Every element of the base in the domain δ of has a correspondent in the reduplicant.
b. $\text{DEPBR}_{\delta}$: Every element of the reduplicant in the domain of δ has a correspondent in the base.

The coda of the base is copied depending on the triggering suffixes and the following markedness constraint plays a crucial role in determining the form of the reduplicant.

(26) Markedness
NOCODA: Syllables may not have codas.

(27) is the portion of the Nuu-chah-nulth grammar relevant for the particular processes under discussion:

(27) MAX/DEPIO(SEG), **$\text{MAX/DEPIO}(\mu)_{\text{I-III}}$ $\text{MAXIO}(\mu)_{\text{IV,VII}}$, $\text{DEPIO}(\mu)_{\text{V-VI}}$**
⇩
**$\text{FootForm}_{\delta}$**
⇩
**$\text{MAXIO}(\mu)_{\text{V,VI}}$, $\text{DEPIO}(\mu)_{\text{IV,VII}}$**
⇩
$\text{MAX/DEPBR}_{\text{[I-1,IV, VII-1]}}$
⇩
NOCODA
⇩
$\text{MAX/DEPBR}_{\text{[I-2,II,III,V, VII, VII-2]}}$

The implication of the ranking is illustrated in tableaux as follows, with the relevant examples.

(28) Class IV suffixes- $\text{FootForm}_{\text{IV}}$: $(\sigma \quad \sigma)_{\varphi}$
$\mu \ \mu \ \mu \ \mu$

(29) cuuccuucaʔiš
**RED**-cuc-(y)a-ʔiš
RED-to scratch-continuously-3sg/IND
'S/he is continuously scratching.'

(30) Tableau for (29)

| /Rσ-cuc-(y)a(FFIV)/ | **MAXIO IV** | **Foot Form$_{IV}$** | **DEPIOμ IV** | MAXBR IV | DEPBR IV | NO CODA |
|---|---|---|---|---|---|---|
| ☞a. {σ[cuuc]cuu}$_{φ}$ca | | | * | | | * |
| b. {σ[cuc]cuu}$_{φ}$ca | | *! | * | *(μ) | | * |
| c. {σ[cuc]cu}$_{φ}$ca | | *! | | | | * |
| d. {σ[cuuc]cu}$_{φ}$ca | | *! | | | *(μ) | * |
| e. {σ[cuu]cuu}$_{φ}$ca | | | * | *!(seg) | | |
| f. {σ[cuu]cuu}$_{φ}$ya | *!(seg) | | * | | | |

With FootForm$_{IV}$ outranking DEPIOμ, the base vowel is lengthened on the surface (and the reduplicant has a long vowel).

(31) Class V suffixes-FFI: (σ σ)$_{φ}$
| |
μ μ

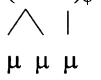
(32) ƛ̓iƛ̓ixʷak̓uk
**RED**-ƛ̓iixʷ-(a)a-k̓uk
RED-to smile/laugh-DUR-to resemble
'Smirk'

(33) Tableau

| /Rσ-ƛ̓iixʷ... k̓uk(FFI) | **MAXIO [Seg.]$_{V}$** | **Foot Form I** | **MAXIO μ$_{V}$** | NO CODA | MAXBR V | DEPBR V |
|---|---|---|---|---|---|---|
| ☞ a.{σ[ƛ̓i]ƛ̓i}$_{φ}$xʷa | | | * | | *(seg) | |
| b. {σ[ƛ̓ii]ƛ̓ii}$_{φ}$xʷa | | *! | | | *(seg) | |
| c. {σ[ƛ̓i]ƛ̓ii}$_{φ}$xʷa | | *! | | | *(seg) *(μ) | |
| d.{σ[ƛ̓ixʷ]ƛ̓i}$_{φ}$xʷa | | | * | *! | | |
| e. {σ[ƛ̓i]ƛ̓i}$_{φ}$a | *! | | * | | | |
| f. {σ[ƛ̓ii]ƛ̓i}$_{φ}$xʷa | | *! | * | | *(seg) | *(μ) |

With $\text{FootForm}_{\text{I}}$ outranking MAXIOμ, the base vowel is shortened on the surface (and the reduplicant has a short vowel).

(34) Class VI suffixes-FFIII: (σ σ)$_{\varphi}$



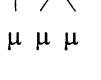
(35) siisicitʸaksiš
RED-siic-itʸak-siš
RED-maggot-afraid/fear
'I am afraid of maggots.'

(36) Tableau for (35)

| /Rσ-siic-itʸak(FFIII) | **MAXIO [Seg.]$_{\text{VI}}$** | **Foot Form III** | **MAXIO $\mu_{\text{VI}}$** | NO CODA | MAXBR VI | DEPBR VI |
|---|---|---|---|---|---|---|
| ☞a. {σ[sii]si}$_{\varphi}$ci | | | * | | *(seg) | *(μ) |
| b. {σ[sii]sii}$_{\varphi}$ci | | *! | | | * | |
| c. {σ[si]si}$_{\varphi}$ci | | *! | * | | * | |
| d.{σ[siic]sii}$_{\varphi}$ci | | *! | | * | | |
| e. {σ[sii]si}$_{\varphi}$ci | *! | | * | | | *(μ) |
| f. {σ[sii]sii}$_{\varphi}$ci | *! | * | | | | |
| g. {σ[si]sii}$_{\varphi}$ci | | *! | | | *(seg) *(μ) | |
| h{σ[siic]si}$_{\varphi}$ci | | | * | *! | | *(μ) |

With $\text{FootForm}_{\text{III}}$ outranking MAXIOμ, the base vowel is shortened on the surface (and the reduplicant has a long vowel).

(37) Class VII suffixes-FFVII: (σ σ)φ



(38) ḫicḫiicn̓uk
**RED-**ḫic-n̓uk
RED-feces-on the hand
'Feces on the hand'

(39) Tableau for (38)

| /σ-ḥic-ʔnuk(FFVII) | MAXIO VII | Foot Form VII | DEPIO $\mu_{VII}$ | MAXBR VII | DEPBR VII | NO CODA |
|---|---|---|---|---|---|---|
| ☞ a. {σ[ḥic]ḥiic}$_{\varphi}$ | | | * | *(μ) | | ** |
| b. {σ[ḥii]ḥiic}$_{\varphi}$ | | *! | * | *(seg) | | * |
| c. {σ[ḥi]ḥic}$_{\varphi}$ | | *! | | *(seg) | | * |
| d. {σ[ḥic]ḥic}$_{\varphi}$ | | *! | | | | ** |
| e. {σ[ḥii]ḥi}$_{\varphi}$ | *!(seg) | * | | | *(μ) | |
| f. {σ[ḥii]ḥii}$_{\varphi}$ | *!(seg) | * | * | | | |
| g. {σ[ḥi]ḥiic}$_{\varphi}$ | | | * | *(seg)<br>*!(μ) | | * |
| h. {σ[ḥii]ḥic}$_{\varphi}$ | | *! | | *(seg) | *(μ) | * |

With FootForm$_{VII}$ outranking DEPIOμ, the base vowel is lengthened on the surface (and the reduplicant has a short vowel).

## 5. Conclusion

Nuu-chah-nulth prosodic and metrical structures are morphologically determined. Vowel alternations motivated by vowel lengthening, shortening, and reduplication-triggering suffixes are due to metrical requirements specified for the suffixes. Moreover, multiple patterns of reduplication and modification of the base forms are due to such metrical requirements. Nuu-chah-nulth reduplication results from prosodic requirements specified for suffixes. In addition, Nuu-chah-nulth vowel alternations provide a case where faithfulness constraints can be both phonologically and morphologically domain-specified. This study provides a unified approach to a superficially complex array of apparently separate processes.

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