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A Minimalist Approach to Reduplication in Optimality Theory

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1. Minimalist Ideals in Phonology

In this paper we will develop a minimalist (Chomsky 1995) approach to reduplication in Optimality Theory (OT, Prince and Smolensky 1993, McCarthy and Prince 1995, etc.). This will entail following the principles of Full Interpretation (1) and Bare Output Conditions (2) as they pertain to phonology.

(1) **Full Interpretation (FI)**

"... there can be no superfluous symbols in representations ..."

"The principle of FI is assumed as a matter of course in phonology; if a symbol in a representation has no sensorimotor interpretations, the representation does not qualify as a PF representation." (Chomsky 1995:27).

(2) **Bare Output Conditions**

"Another source of possible specificity of language lies in conditions imposed 'from the outside' at the interface, what we may call *bare output conditions*."

"... the information provided by L (language) has to be accommodated to the human sensory and motor apparatus" (Chomsky 1995:221).

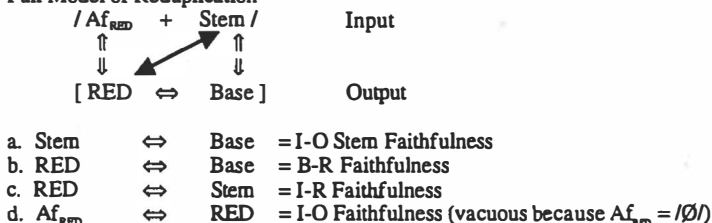
The principles of Full Interpretation and Bare Output Conditions mandate only the use of strictly phonological information within the phonology. Therefore, the interface between phonology and other modules, such as the morpho-syntax, should convert all relevant information into phonological information for the phonology to deal with. For example, the syntactic phrase marker is systematically not accessible from within the phonology. In general, phonological calculations should ideally involve only purely **phonological** units, and Correspondence functions should be in terms of **phonological** units and their affiliations. In other words, **phonological** categories are necessary for phonology, so they should also be sufficient, rather than allowing systematic access within the phonology to component-external information, such as morphological or syntactic affiliations.

2. The Basic and Full Models of Reduplication

McCarthy and Prince 1995 give a detailed model for reduplication within OT. Many of the aspects of reduplication can be handled with their "basic" model, but occasionally languages have reduplicated material that is more faithful to the underlying representation than the non-reduplicated material in the Base is. In this paper will

examine data from Bella Coola that exhibits this property. In order to account for such cases, McCarthy and Prince extend the "basic" model by the introduction of a direct calculation of the Input-Reduplicant faithfulness, as illustrated in (3):

(3) Full Model of Reduplication



The Full model expresses four kinds of faithfulness. Two kinds of faithfulness are expected regardless of reduplication — the Input-Output faithfulness for the two morphemes involved (3a) and (3d). As McCarthy and Prince argue, viewing the reduplicative affix as zero morphologically allows it to behave in a chameleon-like fashion. There are two types of Faithfulness specific to reduplication: Base-Red faithfulness (3b) and faithfulness between the input for the Base and the reduplicant output, (3c), which McCarthy and Prince term I-R Faithfulness. Thus, the full model of reduplication introduces two new kinds of reduplication-specific faithfulness constraints. One of these, I-R Faithfulness, evaluates the faithfulness between the input of one morpheme and the output of a different morpheme. The other, B-R Faithfulness requires identification of quasi-morphological structures in the output — the Base and Red strings. We will argue that a simpler model can be constructed; one which does not add new arbitrary constituency such as Base and Red, and which does not need to stipulate I-R Faithfulness. We will do this by analyzing reduplication as a case where an input segment has multiple output correspondents.

3. Reduplication in Bella Coola

Bella Coola (Newman 1971, Nater 1984, 1990, Bagemihl 1991) is remarkable not only for its long strings of consonants but also for its wide and lexically unpredictable range of reduplication patterns. Bella Coola uses reduplication in constructing diminutive nouns, continuative verb forms, and in derivational processes. In Bagemihl's (1991) analysis there are two lexically-specified reduplication templates (σ_{μ} and $\sigma_{\mu\mu}$) that interact with lexically controlled auxiliary rules such as Syncope and Initial Consonant Deletion (ICD) to produce the observed surface forms. In the example in (4) Bagemihl's model first copies the material from the first foot of base, associates to the template and then syncopeates a vowel in the stem.



The form in (4) illustrates a case where the reduplicant is more faithful to the input of the Base than the Base itself is. In (4) the input for the Base is /kap'ay/, and the initial vowel is retained in the reduplicant but dropped from the Base. Without I-R Faithfulness, McCarthy and Prince's "basic" model would have no way of ensuring that the vowel in the reduplicant is the same vowel, /a/, as in the input of the Base. Of course this problem does not arise in Bagemihl's derivational account, where the vowel is copied prior to syncope.

Interestingly, though the other auxiliary processes (changes in length or [cont]) are attested in unreduplicated forms, syncope and initial consonant deletion are found only in reduplicated forms. One of the goals of our analysis is to explain this limitation of deletion to reduplication contexts.

Our approach to reduplication accounts for the semi-unpredictable nature of reduplication in Bella Coola by lexically reordering certain constraints. (This aspect of the grammar is lexically controlled by the stem or the stem-affix combination.) Thus, different words (and therefore different reduplicative forms) can have a different ordering of constraints. Our approach allows a minimal and simple reordering of constraints to account for the different patterns. This approach to the typology of reduplication patterns in Bella Coola is in essence the same as Bagemihl's — each stem (or word) can control a small number of options in the grammar. This allows for the explanation of a small amount of variation within the lexicon while still capturing the overall regularities in the language.

The reduplication patterns in Bagemihl's analysis are shown in (5). The V- and VC- patterns are accomplished by the initial consonant deletion process mentioned above. For clarity, we will refer to the patterns by their CV shapes (CV-, V-, CVC-, VC-).

- (5) Bella Coola reduplication patterns (Bagemihl 1991:598)
- | | | | | |
|---------------------------------|--------------|-------------------|---|----------------------------|
| σ_{μ}
(CV-) | Plain | a. qayt | ⇒ | qaqayti |
| | | 'hat' | | 'toadstool dim.' |
| | With syncope | b. kap'ay | ⇒ | kakp'ayi |
| | | 'humpback salmon' | | 'humpback salmon dim.' |
| σ_{μ} +ICD
(V-) | Plain | c. t'ixʔala | ⇒ | ?it'ixʔala |
| | | 'robin' | | 'robin dim.' |
| | With syncope | d. k'inax | ⇒ | ?ik'naax |
| | | 'crab' | | 'crab dim.' |
| $\sigma_{\mu\mu}$
(CVC-) | Plain | e. yaʔk | ⇒ | yaʔyaʔk- |
| | | 'do too much' | | 'do too much continuative' |
| | With syncope | f. silin | ⇒ | silslin |
| | | 'kidney' | | 'kidney dim.' |
| $\sigma_{\mu\mu}$ +ICD
(VC-) | Plain | g. c'usm | ⇒ | ?usc'usmi |
| | | 'evening' | | 'evening dim.' |
| | With syncope | h. ?isut | ⇒ | ?issut |
| | | 'paddle' | | 'paddle a long way' |
- (No unambiguous examples, only ?V-)

Forms such as (5h) are analytically ambiguous. They can be analyzed either as examples of medial gemination, or of a very minimal reduplication. The analysis that we develop in this paper will force the conclusion that these forms are really cases of gemination. We will return to this point below.

Notice that stem-initial V- reduplication (5c,d) is accompanied by a prothetic initial glottal stop. Bagemihl inserts these stops with a phonological rule. We will ignore these glottal stops in the account below, that is, we will not treat them phonologically. We believe that these glottal stops are a late phonetic detail of Bella Coola pronunciation, and do not reflect an active **phonological** process, such as epenthesis to meet Onset. In fact, Bella Coola seems to allow hiatus in such words as [mʔa] 'man' so Onset is apparently not particularly high-ranked. Therefore, we will suppress the prothetic glottal stop in the subsequent examples.

Another remarkable aspect of Bella Coola reduplication is that initial strings of obstruents are ignored for the purposes of reduplication, for example [q̥psta] 'taste' ⇒ [q̥psta-] 'taste iterative' (Bagemihl 1991:609). We agree with Bagemihl that this is the result of non-exhaustive phonological syllabification in Bella Coola. The minimal syllable in Bella Coola is [R] where R is any sonorant, and the maximal syllable is [CRVC]. For this paper we will assume the correct syllabifications, forgoing the formalization of the syllable canon into a set of appropriately ranked constraints.

Cases of reduplication with syncope require I-R Faithfulness in the Full Model because the input vowel of the stem is not preserved in the output for the Base, and therefore cannot be a result of Base-RED Faithfulness. Three examples are shown in (6).

(6) I-R Faithfulness in the Full Model

INPUT: a.[DIM [ka'pay_{STEM}]] b.[DIM [silin_{STEM}]] c.[DIM [k'inax_{STEM}]]
 OUTPUT: [ka_{RED}] [k'pay_{BASE}] [sil_{RED}] [sli_n_{BASE}] [i_{RED}] [k'naax_{BASE}]

In all of the forms in (6), the Base in the output is degenerate because it violates I-O Faithfulness to the Stem, having lost the first vowel of the stem. B-R Faithfulness is also violated because the correspondence between RED and Base is also disrupted by the deleted vowel. I-R Faithfulness must be introduced to allow RED to correspond with the Stem in the input (and thus copy the vowel in question for these examples) while still allowing B-R Faithfulness violations. That is I-R Faithfulness is invoked in cases where RED is more faithful to the Input than the Base is. Such cases were incorrectly ruled out in principle in the Basic model.

4. Problems with the Full Model

4.1. The Principle of Full Interpretation

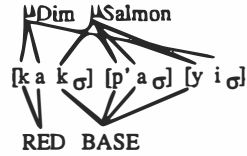
Consistency of Exponence, (7), violates the Principle of Full Interpretation because morphological affiliations are directly visible in the phonological output, see (8) below.

- (7) "Consistency of Exponence means that the phonological specifications of a morpheme (segments, moras, or whatever) cannot be affected by Gen. In particular, epenthetic segments posited by Gen will have no morphological affiliation, even if they are bounded by morphemes or wholly contained within a morpheme. Similarly, underparsing will not change the make up of a morpheme, though it will surely change how that morpheme is realized phonetically. Thus, any given morpheme's phonological exponents must be identical in underlying and surface form, unless the morpheme has no phonological specifications at all (as is the case with the reduplicative affix Red, ...)" (McCarthy and Prince 1993:20-21)

4.2 Economy of Representation

RED is an additional formal output structure beyond whatever morpho-syntactic features license reduplication such as Diminutive or Continuative. A theory without Red would thus be preferable according to any idea of economy.

- (8) Output Relations in McCarthy and Prince (1995)
 INPUT: [DIM [kap'ay]] ⇒ OUTPUT:



Notice that the Base is also not definable in terms of a coherent prosodic category, such as Foot.

Additional problems come about when dealing with initial obstruent sequences. The Base and RED portions must cross over in those cases, as shown in (9).

- (9) tqnk- 'be under' ⇒ (q n σ) [q n σ]k- 'underwear' (Newman 1971:38)
-

Therefore the Red and Base "constituents" do not behave as do other known constituent structures, violating principles of coherence. Rather, they provide a means for further encoding relations between the input and the output, as is normally handled by correspondence relations.

4.3 I-R Faithfulness

I-R Faithfulness (and all the other B-R Faithfulness constraints) add another dimension of Correspondence Constraints that is only used for reduplication. Once again, a theory that operates without these additional devices will be preferable due to economy conditions.

The most important aspect (and the most serious shortcoming) of I-R Faithfulness is that it evaluates faithfulness by comparing the input of one morpheme against the output of a different morpheme. This constitutes a serious weakening of the idea of faithfulness as the preservation of characteristics in a phonological calculation. We strongly believe that cross-morpheme evaluation of faithfulness should be ruled out in principle, and therefore I-R Faithfulness cannot be the right explanation for the interaction between reduplication and syncope as is observed in Bella Coola.

5. Minimalist Reduplication

Our proposal is that reduplication is segmental fission, as illustrated in (10b). That is, in reduplication one input segment corresponds to multiple output segments. By allowing correspondence to be a one-to-many relation under certain circumstances, we can directly express cases of segmental fusion as well.

- (10) Segmental Fusion and Fission
- a. Fusion: Sanskrit (Gonda 1966:11)
-
- b. Fission: Bella Coola
-
- I-O Correspondence
- O-O Correspondence

We can then define, as in (11), a pure output notion of segmental correspondence which we will call O-O Correspondence. This is to be distinguished with notions of Output-Output correspondence which compare different output forms in a paradigm, as advocated by Benua 1995. The definition in (11) identifies pairs of segments in the output which are the fissioned correspondents for a single input segment.

- (11) **O-O Correspondence**
 \forall distinct $x, y \in O$ and $a \in I$, if $\text{Corr.}(x, a)$ and $\text{Corr.}(y, a)$ then $\text{OCorr.}(x, y)$
 where 'Corr.' is the I-O Correspondence Function.

Thus, O-O Correspondence is a derived notion. A syntactic analog is c-command, which is defined in terms of dominance. This means that the lines in our diagrams linking output correspondents are illustrative only, and do not represent information which is directly manipulated by Gen. Rather, Gen establishes the general I-O correspondence function Corr, and the output correspondence function OCorr is totally defined by Corr.

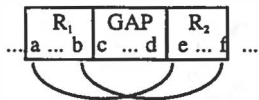
Since our analysis makes significant use of the idea of phonological precedence, we will notate precedence explicitly:

- (12) $x \wedge y = x$ immediately precedes y

In keeping with the minimalist program, immediate precedence is the mathematically minimal encoding of order and locality (that is, it is the most efficient encoding).

We will also define other significant portions of the output as in (13).

- (13) R_1 is the segmental region containing the precedent multiple correspondents
 R_2 is the segmental region containing the non-precedent multiple correspondents
 Gap is the segmental region between the end of R_1 and the beginning of R_2



So, for example, in (10b) R_1 is the first [tux], and the Gap is empty. Obviously R_1 and R_2 share many of the properties of RED and Base in McCarthy and Prince's Full Model. However, rather than being randomly generated, R_1 , R_2 and Gap follow definitionally from the correspondence function Corr. Therefore, the only random generation by Gen is random fissioning of individual segments, no output structures specific to reduplication are generated. This is clearly a more minimal theory than the Full Model, requiring only that segments be allowed to have multiple correspondents.

A fundamental constraint producing pressure for segmental fission is Non-Homophony, stated in (14).

- (14) **Non-Homophony**
 Morphological Level X X+Y
 Output [A] [B]
 * [A] = [B] (A must be distinct from B)

Non-Homophony requires that morphologically related but distinct forms must be phonologically distinct. This is obviously a constraint that interfaces morphology and phonology, rather than being a part of the purely phonological calculation. As such, it

cannot be minimal in Chomsky's (1995) sense, because being an interface condition, it must mediate representations on both sides of the interface. Note that the Non-Homophony constraint has a very specific definition of homophony. Homophony for the present purposes is calculated only for those items that are in a morphological subset relationship, such as DEER and DEER+PLURAL. Other types of homophony that do not satisfy this requirement will not violate this constraint, such as English 'bear' and 'bare'.

Non-Homophony will force violations of lower ranked constraints that will result in the fission of segments that is our theory of reduplication. High-ranking I-O constraints, such as Max (Max Segment), Dep (Dep Segment) and Max[^] (Max Immediate Precedence) force segmental fission. Since each of the fissioned segments do have input correspondents, they do not violate Dep. An example tableau is shown in (15). In (15) "D" refers to the derivational morpheme that contributes to the meaning 'trout'.

(15)	tup 'spotted' ⇒ tutup 'trout' (Nater 1984:110)				
	/D+tup/	Non-H	Max	Dep	Max [^]
a.	tutup				
b.	tup	*!			
c.	tu		*!		*
d.	tupi			*!	
e.	put				*!*

The Tableau in (15) shows that segmental fission is the optimal way to respond to this ranking of constraints. Other responses (deletion, metathesis, or epenthesis) result in either violations of these constraints or of other Correspondence constraints. Max[^] counts instances where an immediate precedence pair is lost in the output. For example in (15c) [tu] fails to have the a [u[^]p] structure corresponding to the input /u[^]p/. Clearly, every segment lost will entail at least one Max[^] violation. But scrambling the input, as in (15e), also results in Max[^] violations.

However, we have not yet shown how [tu] is the optimal pattern.

5.1. CV- Reduplication

CV- reduplication is the basic pattern of reduplication. The other patterns of reduplication will be shown to deviate from the CV- reduplication by simple rerankings of certain constraints.

CV- reduplication results from minimizing the Gap and minimizing the amount reduplicated. There are various ways to minimize the amount reduplicated, we will choose *OCorr, (16), which minimizes the number of segments that stand in output correspondence to each other.

$$(16) \quad *OCorr \quad \forall x, y \in O, \text{ not } OCorr(x, y)$$

To get the fact that reduplication is prefixing in Bella Coola, we will align R₁ with the left edge of the word, (17).

$$(17) \quad \text{Align-R}_1 \quad \text{Align}(R_1, L, \text{PrWd}, L)$$

This partial grammar generates the correct form for 'trout', as shown in (18). In (18) we employ the Obligatory Contour Principle (OCP) to prevent false-geminates in the output. In the case of reduplication this would produce adjacent output correspondents. False geminates never appear in Bella Coola, hence this use of the OCP is never violated. To simplify the presentation we will suppress the OCP constraint in the following tableaux.

(18) tup 'spotted' ⇒ tutup 'trout' (Nater 1984:110)

	/D+tup/	Dep	IOCP	*Gap	*OCorr	Align-R ₁
☞	a. tutup				**	
	b. ttup		*!		*	
	c. utup			*!	*	
	d. ttup	*!		*	*	
	e. tuup		*!		*	*
	f. tupup				**	*!
	g. tupu			*!	*	*
	h. tup _t			*!*	*	
	i. ptup			*!*	*	
	j. putup			*!	**	

In order to handle stems which have initial obstruent sequences, we notice that the elements of R₁ are always parsed into syllables, following Bagemihl's observations. In Bagemihl's analysis reduplication copied the segmental material of a foot, and feet were constructed on top of syllables. Therefore, an element had to be syllabified in order to be copied in reduplication. Since we are not constructing such derivations we must capture this fact with an output constraint, and minimizing Parse Segment (Parse) violations does the appropriate work, as shown in (19).

(19) tqnk- 'be under' ⇒ tqnqnk- 'underwear' (Newman 1971:38)

	/D+tqnk/	*Gap	*OCorr	Parse	Align-R ₁
☞	a. t[qn σ][qnk σ]		**		*
	b. tqt[qnk σ]		**		*!*

A particularly interesting aspect of Bella Coola reduplication is that CRVX words are reduplicated as CRCRVX in CV- reduplication. This minimizes the amount reduplicated while still obeying the syllable constraints of Bella Coola. What is interesting is that the vowel head of the Base syllable is not copied in the reduplication. Put another way, the resonant R does not fill the same syllabic function in the Base as it does in the copy. Interestingly, CV- reduplication involving [CRVX] syllables is calculated correctly within the present model without further modification of the constraints or their rankings. A tableau for such a word is shown in (20).

(20) skma 'moose' ⇒ skmkmay 'moose dim.' (Newman 1971:37)

	/DIM+skma/	*Gap	*OCorr	Parse	Align-R ₁
☞	a. skmkmay		**		*
	b. skskmay		**		*!*
	c. smkmay	*!			*
	d. skmamay		**		*
	e. skmakmay		***!		*

5.2. V- Reduplication

In order to correctly generate forms with V- reduplication we must rerank some of the constraints. We can get V- reduplication by minimizing the amount reduplicated. This can be done by promoting *OCorr above *Gap, as shown in (21).

(21) t'ixłala 'robin' ⇒ ?it'ixłala 'robin dim.' (Nater 1984:109)

	/DIM+t'ixłala/	*OCorr	*Gap	Parse
☞	a. t'ixłat'ixłala		*!*	
	b. t'it'ixłala		*!	
☞	c. it'ixłala		*	

As mentioned above, we assume that the prothetic initial glottal stop is a phonetic detail of Bella Coola pronunciation, and is introduced in the phonetic implementation component, and therefore is not a visible part of the phonology. It would also be possible to treat this problem by breaking Dep Segment into various component constraints, but we will not pursue that option in this paper.

This ranking also correctly generates V- reduplication for stems beginning with a sequence of obstruents, as illustrated in (22).

(22)	ɬkʷɬx-	'become old'	⇒	ɬkʷɬx-	'become old cont.'	(Newman 1971:36)
	/CONT+ɬkʷɬx-/			*OCorr		*Gap
				*		*
	a. ɬkʷɬx-			**!		*
	b. ɬkʷɬkʷɬx-					*

Since V- reduplication is generated by ranking *OCorr >> *Gap, it will only have effects in words with multiple correspondents, that is, only in reduplicated forms. This correctly restricts the 'initial consonant deletion' effect to reduplicated forms. This is a significant improvement over Bagemihl's account, which must stipulate the fact that his rule of Initial Consonant Deletion is restricted to apply only to reduplicated forms.

5.3. CVC- Reduplication

To achieve CVC- reduplication, we must again perturb the CV- grammar slightly. Specifically, we must require that R₁ be Aligned with a bimoraic syllable, that is we require the Generalized Alignment constraint Align(R₁, R, σ_{μμ}, R). An example of a form with CVC- reduplication is shown in (23).

(23)	yaɬk	'do too much'	⇒	yaɬyaɬk	'do too much cont.'	(Newman 1971:35)
	/CONT+yaɬk/			Align(R ₁ , σ _{μμ})		*Gap
						*OCorr
	a. yaɬyaɬk			*!		***
	b. yayaɬk					**
	c. ayaɬk					*
	d. aɬyaɬk					**

As was pointed out above, the syllabic function of elements is not necessarily preserved in reduplication. The grammar for CVC- reduplication correctly predicts that the consonant closing the syllable for R₁ can have a correspondent that is an onset, for example [milixʷ] 'bear berry' ⇒ [milmilixʷ] 'bear berry plant' (Nater 1984:108). Such forms were somewhat problematic for Bagemihl as the copying mechanism has to copy more than one syllable of material, even though the reduplication templates were never larger than a syllable. To do this, Bagemihl copied the segmental material of an entire foot and then associated the material to the template, discarding the excess segments. In the present analysis there is no need to define a reduplication foot, as Bagemihl does. Instead, general constraints on R₁ and output correspondence give the correct result.

When there is too little material to achieve CVC- reduplication normally, some reordering of the elements in R₁ is apparently possible, as shown by the example in (24)

(24)	xli	'penis'	⇒	xilxli	'dim.'	(Newman 1971:36)
	/DIM+xli/			IOCP		Align(R ₁ , σ _{μμ})
	a. xilxli					
	b. xlxli			*!		**
	c. lixxli					***

Such forms have previously been handled by prespecification of the reduplicant's [i]. In the present analysis this can be construed as "metathesis" in the reduplicant. This is an

unexpected but useful effect in this case.

5.4. VC- Reduplication

As expected, VC- reduplication is generated by reranking *OCorr >> *Gap in the CVC- grammar, giving the overall ranking $\text{Align}(R_1, \sigma_{\mu\mu}) \gg *Gap \gg *OCorr$. An example tableau is shown in (25).

(25) c'usm 'evening' \Rightarrow ?usc'usmi 'evening dim.' (Bagemihl 1991:598)

/DIM+c'usm/	Align($R_1, \sigma_{\mu\mu}$)	*OCorr	*Gap
a. usc'usmi		**	**
b. uc'usmi	*!	*	*
c. c'usc'usmi		***!	

5.5. Summary of Basic Reduplication Patterns

At this point we summarize the basic reduplication patterns in Bella Coola in (26). The reduplication patterns are generated by changing the relative rankings of *Gap, *OCorr and $\text{Align}(R_1, \sigma_{\mu\mu})$.

(26) Rankings for Basic Reduplication Patterns

CV-:	*Gap >> *OCorr >> $\text{Align}(R_1, \sigma_{\mu\mu})$
V-:	*OCorr >> *Gap >> $\text{Align}(R_1, \sigma_{\mu\mu})$
CVC-:	$\text{Align}(R_1, \sigma_{\mu\mu}) \gg *Gap \gg *OCorr$
VC-:	$\text{Align}(R_1, \sigma_{\mu\mu}) \gg *OCorr \gg *Gap$

5.5. Reduplication with 'Syncope'

We will now turn to the reduplication patterns that involve divergence between the Base and the reduplicant — the 'syncoated' forms. In the present analysis, syncope is the result of minimizing the number of syllables in the output through * σ and Parse. (One could also count syllable alignments with the Prosodic Word, but this approach is complicated in Bella Coola by the non-exhaustive syllabification.) Syncoated forms are generated by minimizing the number of syllables while still ensuring that every input segment has at least one output correspondent. Because of segmental fission, there is in effect a 'spare copy' of the first stem vowel, allowing this vowel to delete. Therefore 'syncope' is correctly restricted to reduplicated forms. In contrast, Bagemihl had to stipulate this relationship between reduplication and vowel deletion. Vowel deletion necessarily results in loss of at least one precedence relationship, so * σ must be ranked above Max^\wedge to generate the correct forms. In (27) we compare a syncoated CV- reduplication with a normal CV- reduplication.

(27) i. 'Syncoated' CV-
kap'ay 'humpback salmon' \Rightarrow kək'ayi 'dim.' (Newman 1971:35)

/DIM+kap'ay+i/	Parse	* σ	Max^\wedge	*Gap	*OCorr
a. kək'ayi		***	*	*	*
b. kakap'ayi		****!			**
c. kap'kayi		***	*	**!	*
d. kap'kap'ayi		****!			***
e. akp'ayi		***	**!		
f. kap'kp'ayi	*!	***			**

ii. 'Normal' CV-

qayt 'hat' ⇒ qaqaqt-i 'toadstool dim.' (Newman 1971:38)

	/DIM+qayt+i/	Max^	*Gap	*OCorr	Parse	*σ
a.	qaqaqt			**		***
b.	qayqayti			***!		***
c.	qaqyti	!*	*	*	*	**
d.	qayqyti		*!*	*	*	**

Due to the syllabification of words in Bella Coola, the examples in (27ii c-d) would have to vocalize /y/ to /i/, we ignore this detail here in order to facilitate comparison of the candidates. Notice that the syncopating grammar differs from the normal CV- grammar in reranking the constraint set {Max >> *Gap >> *OCorr} over the constraint set {Parse, *σ}. Thus, the reranking is not as radical as it may first appear.

Since CVC- reduplication without syncope was obtained by a high-ranking Align constraint, one might expect to get the syncopated CVC- cases through the same method. However, the winning candidate for CV- reduplication with syncope, (27ia), already satisfies Align(R₁, R, σ_{μμ}, R). Therefore raising the ranking of Align(R₁, R, σ_{μμ}, R) will not have the desired effect in all cases. Rather, syncopated CVC- results from enforcing *σ but relaxing the enforcement of Parse. In other words, the constraint set {Max >> *Gap >> *OCorr} splits the constraint set {Parse, *σ} as shown in (28).

(28) 'Syncopated' CVC-
q^wtu^t 'cradle basket' ⇒ q^wtu^tti 'dim.' (Nater 1984:108)

	/q ^w tu ^t /	*σ	Max^	*Gap	*OCorr	Parse
a.	q ^w tu ^t ti	**		*	**	**
b.	q ^w tu ^t t ⁱ	***!			***	
c.	q ^w tu ^t ti	**	*!	*	*	*
d.	q ^w tu ^t i	**	*!*			
e.	q ^w tu ^t ti	**	*!*	*	*	**
f.	q ^w tu ^t ti	**		*	**	***!

Thus, it is interesting that CVC- with syncope can be generated without the imposition of the 'shape' constraint, Align(R₁, σ_{μμ}). In fact, though ranking Align(R₁, σ_{μμ}) highly does not have any adverse consequences, it also does not pick (28a) over (28b).

Another interesting consequence is that (28e), which would be an unambiguous case of VC- reduplication with syncope is uniformly worse than (28d) in terms of the constraints in our analysis. This implies that without adding new constraints, it is impossible to generate forms with VC- reduplication and syncope. As mentioned above, unambiguous cases of this kind of reduplication do not appear to exist. This means that forms such as (2h) must be analyzed as true gemination rather than reduplication.

As discussed by Bagemihl, the net result of V- reduplication and 'syncope' is to metathesize the vowel with the preceding consonant, as in (29a). Interestingly, this minimizes *Gap and *OCorr completely, for in this case there are no multiple correspondents at all. Thus, to get this pattern to be optimal, we must rerank Max^ below *Gap, as shown in (29).

(29) 'Syncopated' V-
k'inax 'crab' ⇒ ?ik'naax 'crab dim.' (Newman 1971:37)

	/DIM+k'inax/	*σ	*OCorr	*Gap	Max^
a.	ik'naax	**			**
b.	k'ik'naax	**	*!	*	*

Thus, all of the reduplication patterns can be generated from minimal perturbations of the core ranking which generates CV- reduplication.

6. Conclusions and Further Issues

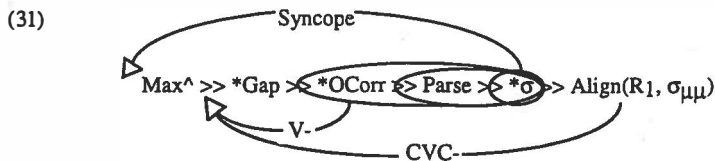
The theory of reduplication that we have developed in this paper introduces the utility of one powerful new idea—correspondence is not always one-to-one. This extension to correspondence theory directly yields the derived notion of output correspondents. Constraints on output correspondence and constraints mandating the preservation of contiguity relations, such as Max^\wedge , yield the various types of reduplication observed in Bella Coola, including the syncopated cases which had motivated I-R Faithfulness in the Full Model of McCarthy and Prince 1995. The account here is minimalist in meeting the Full Interpretation condition and in minimizing the use of constraints not defined on the phonetic output (that is, it maximizes the use of Bare Output Conditions).

The canonical ordering of the constraints of interest to yield CV- reduplication is shown in (30).

(30) $\text{Max}^\wedge \gg * \text{Gap} \gg * \text{OCorr} \gg \text{Parse} \gg * \sigma \gg \text{Align}(\text{R}_1, \sigma_{\mu\mu})$

By permuting the order of the constraints we can generate the various patterns of reduplication in Bella Coola. Thus, it is possible to provide specifications of the order of these constraints and thereby lexically control Bella Coola reduplication. The marking is usually found on stems. There are a handful of stems with different patterns in different derivational contexts. For such cases it will be necessary to store the constraint ranking on the composite form, and thus at least this aspect of the composite form must be memorized. This is a familiar situation from compounds, which can have special semantics which are not wholly predictable from the individual pieces of the compound, for example the English compound "hot dog". Special phonological characteristics in compounds can also be observed in many languages, such as the choice of linking elements *-i-*, *-o-* or *-Ø-* in English "meter" compounds, "altimeter", "thermometer", and "voltmeter". Similar limited choice is observed in the accentuation of Japanese compounds.

The deviations from the canonical order amount to simple permutations from the canonical order. For example, CVC- reduplication promotes $\text{Align}(\text{R}_1, \sigma_{\mu\mu})$ over $* \text{Gap}$, while V- reduplication promotes $* \text{OCorr}$ over $* \text{Gap}$. Syncopated forms involve promoting $* \sigma$ or Parse and $* \sigma$ over Max^\wedge . We diagram the canonical ranking and the reranking permutations in (31).



The present analysis is a significant empirical improvement over Bagemihl's analysis in one important area. The present analysis does not need to stipulate that initial consonant deletion and syncope are restricted to reduplicated forms. The restriction of initial consonant deletion to reduplicated forms falls out from the minimization of multiple correspondents. Since this has no effect in forms without multiple correspondents, it will have no effect in non-reduplicated forms. The restriction of syncope to reduplicated forms

falls out from the interaction of the minimization of the length of the form in terms of syllable with the preservation of the existence of output correspondents for every input segment. Because reduplication produces multiple output correspondents, one of the output correspondents can be sacrificed to achieve a smaller overall length. This is a significant improvement over Bagemihl's analysis, which had to stipulate the restriction of his auxiliary rules of Syncope and Initial Consonant Deletion to reduplicated forms.

This theory also does not suffer from the unwanted Emergence of the Unmarked effect notice by Paul Stemberger on the Optimality Theory Email List. Stemberger pointed out that a high-ranking NoCoda should be able to strip out all codas even in total reduplication cases, hypothetical CVCCVC reduplicating as CVCV-CVCCVC. Because of the high-ranking constraints on contiguity (Max[^]) this is not possible in the present model. Instead, the contiguity constraint Max[^] predict that coda-loss in reduplication should be restricted to the last element of the output correspondence region, that is to the reduplication juncture. Thus, we predict for this case that only loss of the final coda is possible: CVCCVC reduplicating as CVCCV-CVCCVC.

We have not addressed the issue of shape constraints in reduplication beyond the cases observed in Bella Coola (V, CV, CVC). Further shape constraints can obviously be developed using the multiple correspondence regions R₁ and R₂; we leave such developments for further research.

Likewise, we have not addressed total reduplication cases in the present model, as Bella Coola does not exhibit total reduplication. One obvious method would be to maximize the number of output correspondents. However, since this would yield a simple diametric opposition with *OCorr, this is not a good choice. Diametrically opposing constraints cannot be very well understood in terms of their intended effects on the output. Further, there seems to be no particular advantage to maximizing output correspondence. It would thus be preferable instead to find a different constraint which would motivate violations of *OCorr. One likely possibility is to force output correspondents to fulfil the same prosodic function. If carried to the Prosodic Word level, this should result in reduplicative compounds. There are obviously many technical details to be examined in such an account, as with shape constraints we leave the fleshing out of these ideas to future research.

References

- Bagemihl, Bruce. 1991. Syllable Structure in Bella Coola. *Linguistic Inquiry* 22:589-646.
- Benua, Laura. 1995. Identity Effects in Morphological Truncation. In Jill Beckman, Laura Walsh Dickey and Suzanne Urbanczyk (editors) *Papers in Optimality Theory*. University of Massachusetts Occasional Papers in Linguistics 18, 77-136. Amherst MA: GLSA University of Massachusetts.
- Chomsky, Noam. 1995. *The Minimalist Program*. Cambridge MA: MIT Press.
- Gonda, Jan. 1966. *A Concise Elementary Grammar of the Sanskrit Language*. Tuscaloosa: University of Alabama Press.
- Nater, Henry. 1984. *The Bella Coola Language*. Canadian Ethnology Service Paper 92. Ottawa: Museum of Man.
- Nater, Henry. 1990. *A Concise Nuxalk-English Dictionary*. Canadian Ethnology Service Paper 115. Ottawa: Museum of Civilization.
- Newman, Stanley. 1971. Bella Coola Reduplication. *International Journal of American Linguistics*. 37:34-38.
- McCarthy, John and Alan Prince. 1993. Prosodic Morphology I: Constraint Interaction and Satisfaction. Ms. University of Massachusetts and Rutgers University.

- McCarthy, John and Alan Prince. 1995. Faithfulness and Reduplicative Identity. In Jill Beckman, Laura Walsh Dickey and Suzanne Urbanczyk (editors) *Papers in Optimality Theory*. University of Massachusetts Occasional Papers in Linguistics 18, 249-384. Amherst MA: GLSA University of Massachusetts.
- Prince, Alan and Paul Smolensky. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. ms. Rutgers University and University of Colorado at Boulder.

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