Kosraean Monosyllabic Reduplication in Harmonic Serialism

This article presents a formal analysis of Kosraean iterative reduplication in a serial templatic approach. The analysis shows that the variable monosyllabic reduplicant starts as a syllable template, which may ultimately surface as CV, VC, or CVC, as a result from the interaction between the constraints banning sequences of identical elements, and the general phonology of the language. The implication is two-fold. First, for the (C)VC variant no heaviness condition on the reduplicant is required and the prima facie binarity effect in which codas are moraic only in reduplication but nonmoraic elsewhere, is epiphenomenal. Second, in Kosraean different stress patterns in reduplicated versus non-reduplicated forms show that footing applies after the reduplicative process. This fact suggests that the constraints favoring top-down filling of templates may outrank the constraints that favor bottom-up prosodification. If so, then there might be languages, Maori for example, in which reduplication concatenates a foot template with an unfooted stem, leading to phonological processes applying to stems at a derivational stage after the addition of affixes.

1. Introduction

This paper offers a formal analysis of iterative reduplication in Kosraean (Lee 1975, 1976), a Micronesian language spoken on the island of Kosrae, in Serial Template Satisfaction (STS, McCarthy et al. 2012), a theory of reduplication situated in Harmonic Serialism (HS, McCarthy 2000, 2010). All Kosraean data in this paper are cited from Lee's reference grammar (1975) and dictionary (1976). In Kosraean iterative reduplication, the iterative prefix appears in three different monosyllabic variants, CV, VC, and CVC, sensitive to the prosodic form of the stem:

(1) Iterative reduplication in Kosraean

fo.-foʃ	'to emit smoke'	CV
mo.-mo.ul	'not completely dead'	CV
o.n-on	'to keep singing'	VC
ip.-i.pɨs	'to roll bit by bit'	VC
tæf.-tæ.fɔŋ	'to make lots of mistakes'	CVC
fur.-fu.rok	'to turn little by little'	CVC

How STS accounts for variable monosyllabic reduplication has not been thoroughly investigated in McCarthy et al. (2012). Since STS adopts the view that reduplicative affixes are underlying templates (Marantz 1982, McCarthy and Prince 1986/1996), we must ask the following general questions for an STS analysis of the pattern above:

(2) How does STS account for Kosraean, where a single reduplicative morpheme exhibits different monosyllabic shapes (with different stems)?

(3) How is the (C)VC variant derived? Is any weight condition necessary (e.g., $\sigma_{\mu\mu}$, as in McCarthy and Prince 1986/1996, see also Marantz 1982, Thurgood 1997; or RED=$\mu\mu$, as in McCarthy and Prince 1993, see also Blevins 1996, Crowhurst 2004)? If so, what causes

such a requirement to cast inconsistent effect such that the variable reduplicative pattern emerges?

(4) What are the theoretical implications of the reduplicative pattern in Kosraean?

Regarding (2) and (3) , this paper shows that the impression that the ultimate reduplicative shape refers to the form of the stem is epiphenomenal. I propose that what is at play in the variable reduplicative pattern is the *REPEAT (Yip 1998) family, which disfavors identical sequences across the boundary between the reduplicant and the stem. Specifically, the reduplicant starts as a syllable template, which may ultimately surface as CV, VC, or CVC, as a result from the interaction between *REPEAT and the general phonology of the language. By factoring in constraints of the *REPEAT family, the STS can capture the reduplicative pattern in a consistent fashion and therefore, any heaviness requirement along with its inconsistent effect is dispensable.

The analysis in this paper also provides two-fold answers to (4). *First*, the ad hoc binarity effect in a Generalized Template Theory/BR-Correspondence analysis (Kennedy 2005), in which codas in Kosraean are moraic only in reduplication but nonmoraic elsewhere, may be dispensable. *Second*, in Kosraean different stress patterns in reduplicated versus non-reduplicated forms show that footing may apply after the reduplicative process. This fact can be captured if, contra McCarthy et al. (2012: 182, footnote 8), the constraints favoring top-down filling of templates outrank the constraints that favor bottom-up prosodification. If so, then there might be languages (e.g., Maori) in which reduplication concatenates a foot template with an unfooted stem, potentially arguing against the assumption that phonological processes apply to stems at a derivational stage prior to the addition of affixes (Wolf 2008).

The paper is organized as follows. Section 2 explains why iterative reduplication in Kosraean challenges STS. Section 3 presents an STS analysis of the reduplicative pattern. Discussion of theoretical implications of the analysis is the focus of section 4. Section 5 concludes the paper.

2 Variable Syllable Reduplication in STS

2.1 Serial Template Satisfaction

Serial Template Satisfaction (STS, McCarthy et al. 2012) is a theory of reduplication based on Harmonic Serialism (McCarthy 2000, 2010), which has been examined with respect to various phonological phenomena (McCarthy 2000, 2008a, 2008b, 2010; Wolf 2008; Elfner 2009; Pruitt 2010; Kimper 2011; inter alia). STS takes reduplicative affixes to be underlying templates (Marantz 1982), syllables(σ) or feet(FT) (McCarthy and Prince 1986/1996), below the prosodic word level.[1] Crucial in the theory is the constraint, HEADEDNESS(X), as defined below.

(5) HEADEDNESS(X) (HD(FT), HD(σ)) (Selkirk 1995)
Assign a violation mark for every constituent of type X that does not contain a constituent of type X−1 as its head.

[1] See McCarthy et al. (2012) for discussion of prosodic words as templates.

There are two operations performed by GEN that are employable to satisfy HD(X): COPY(X−1), the sole source of reduplicative identity (cf. McCarthy and Prince 1995, 1999), and INSERT(X−1). For example, given a foot template, COPY(σ) copies a string of syllables along with their content into the foot template, satisfying HD(FT) at the expense of *COPY(σ) regardless of the number of the syllables contained in the copied string. In other words, copying one syllable and copying a string of two syllables are equally unfaithful in terms of *COPY(σ):

(6) COPY(X−1): X = FT, X−1 = σ
FT-(tu.la) → (tu)-(tu.la), (tu.la)-(tu.la), *(tul)-(tu.la)

The string-copying property of COPY(X) may also violate COPY-LOCALLY(X), which accounts for the "edge-in" effect (Marantz 1982) in reduplication (cf. McCarthy and Prince 1995, 1999):

(7) COPY-LOCALLY(X) (COPY-LOC, McCarthy et al. 2012: 181)
To a candidate produced by COPY(X), assign as many violations as there are Xs intervening between the original X string and its copy.

(8) The "edge-in" effect in STS

$p_1i_2t_3b_4a_5r_6g_7u_8$	COPY-LOC(seg)
→ $p_1i_2t_3b_4a_5$-$p_1i_2t_3b_4a_5r_6g_7u_8$	
$b_4a_5r_6d_7u_8$-$p_1i_2t_3b_4a_5r_6g_7u_8$	3W($p_1i_2t_3$)

Alternatively, HD(FT) can be fulfilled by INSERT(σ), which inserts a syllable node to fill the foot template, violating HD(σ).[2]

(9) INSERT(X−1): X = FT, X−1 = σ
FT-(ta.sa) → (σ)-(ta.sa)
*HD(FT) ✓HD(FT)
*HD(σ)

In a nutshell, in STS constraint interaction between *COPY(X), HD(X), COPY-LOC(X), and other markedness constraints responsible for the general phonology of a language, determines the prosodic shape of the reduplicant, as well as when phonological processes apply (i.e., before or after applications of COPY(X)).

2.2 Iterative reduplication in Kosraean

Iterative reduplication in Kosraean has three reduplicative variants, CV, VC, and CVC, sensitive to the prosodic form of the stem:

[2] Whether INSERT(X) infringes faithfulness constraints is not crucial in STS (McCarthy et al. 2012: 180). However, if there is any faithfulness violation as such, it will go hand in hand with a HD(X) violation, but not the other way around.

(10) a. Consonant-initial bases

i. When the base is monosyllabic, the reduplicant is CV.

foʃ	'smoke'	fo.-foʃ	'to emit smoke'
kæl	'to touch'	kæ.-kæl	'to touch repeatedly'
ʃɨk	'small'	ʃɨ.-ʃɨk	'very small'

ii. The reduplicant is CV when the base is disyllabic with adjacent vowels, or a high front vowel preceding a palatal glide.

mo.ul	'alive'	mo.-mo.ul	'not completely dead'
fo.ul	'smell'	fo.-fo.ul	'to emit smell'
fi.jɔ	'to sweat'	fi.-fi.jɔ	'sweating'
fi.jɛ	'grey hair'	fi.-fi.jɛ	'to turn grey'

iii. Other disyllabic bases receive a CVC reduplicant.

tæ.fɔŋ	'to mistake'	tæf.-tæ.fɔŋ	'to make lots of mistakes'
fu.rok	'to turn'	fur.-rok	'to turn little by little'
pʌ.ʃæk	'to stop'	pʌʃ.-pʌ.ʃæk	'slopping'

b. Vowel-initial bases receive a VC reduplicant.

on	'to sing'	o.n-on	'to keep singing'
ek	'to rub	e.k-ek	'to rub repeatedly'
i.pɨs	'to roll'	ip.-i.pɨs	'to rool bit by bit'
uʃi	'to sprinkle'	uʃ.-u.ʃi	'to sprinkle off and on'

Note that in (10) monosyllabic and disyllabic stems result in different syllabification of the reduplicant: whereas the morpheme boundary in [o.n-on] is within a syllable, in [ip.-i.pɨs], the reduplicant is syllabified independently (Lee 1975: 218-219). Overall, the generalization is that the reduplicant is an open syllable only if the base (i) starts with a consonant and (ii) has no consonant-initial second syllable. Elsewhere the reduplicant is a closed syllable.

Given the reduplicative pattern, two questions arise for an STS analysis. *First*, what are the conditions held accountable for the reduplicative variants, (C)VC in particular, if the template is a syllable? *Second*, if a certain heaviness requirement (e.g., $\sigma_{\mu\mu}$ in McCarthy and Prince 1986/1996, see also Marantz 1982, Thurgood 1997; or RED=$\mu\mu$ in McCarthy and Prince 1993b, see also Blevins 1996, Crowhurst 2004) needs to be imposed on the syllable template, why does this requirement perform inconsistently such that the variable reduplicative pattern emerge? In section 3, I show that the *REPEAT (Yip 1998) family, which favors avoidance of identity across the boundary between the reduplicant and the stem, plays a crucial role in deriving the variable reduplicative pattern in STS in a consistent fashion, dispensing with any weight condition and its inconsistent effect on the syllable template.

3. An STS Analysis

3.1 The basics of Kosraean phonology

There are three notable characteristics of Kosraean phonology that are relevant to the discussion in this paper. First, vowels are never contrastive in length. In other words, vowels in Kosraean are phonologically monomoraic (Good 1989, Rehg 1993, Kennedy 2005). Second, coda consonants are nonmoraic and permitted only in derived forms (Kennedy 2005: 151-152).[3] Therefore, medial syllables in reduplicated forms and other morphologically complex forms can be closed by any single consonant of its inventory:

(11) læʃ.kæ.kɨn ‘to pour out’
æk.fo.ko ‘to make strong’
ŋal.ŋa.lis ‘RED + to bite’

This suggests that Kosraean has the constraint ranking: MAX-IO, DEP-IO, *COMPLEX » NOCODA.

(12) MAX-IO (McCarthy and Prince 1995)
Every segment of the input has a correspondent in the output.

(13) DEP-IO (McCarthy and Prince 1995)
Every segment of the output has a correspondent in the input.

(14) *COMPLEX (cf. Prince and Smolensky 1993/2004)
Syllables do not have complex margins.

(15) NOCODA (Prince and Smolensky 1993/2004)
Syllables do not have coda consonants.

(16) MAX-IO, DEP-IO, *COMPLEX » NOCODA

CV.CCV.CV	MAX-IO	DEP-IO	*COMPLEX	NOCODA
a. → CVC.CV.CV				1
b. CV.CV.CV	1W			L
c. CV.CV.CV.CV		1W		L
d. CV.CCV.CV			1W	L

Third, primary stress falls on the penultimate syllable, with secondary stress on the antepenult in trisyllabic forms (Lee 1975: 33). Since Kosraean coda consonants are nonmoraic, closed syllables do not affect stress assignment.

(17) (**æl**.ko) ‘blood vessel’
(**fo**.foʃ) ‘to emit smoke’
(**mi**$_2$)(**sɛ**$_1$.sɛ) ‘frayed’
(**mu**$_2$)(**tul**$_1$.tul) ‘to blink’

Crucially, the occurrences of secondary stress shows that PARSE(σ) outranks FT-BIN and ALIGN-R(FT, PRWD).

(18) PARSE(σ) (Prince and Smolensky 1993/2004)
Syllables are parsed by feet.

[3] However, Kennedy’s (2005) Generalized Template Theory/BR-Correspondence analysis claims that coda is moraic only in reduplicated forms, which, as I will show later, is ad hoc and may be dispensable in STS.

(19) FT-BIN (McCarthy and Prince 1986/1996)
Feet are binary under moraic or syllabic analysis.

(20) ALIGN-R(FT, PRWD) (McCarthy and Prince 1993a)
Every foot stands in final position in the prosodic word.

(21) PARSE(σ) » FT-BIN, ALIGN-R(FT, PRWD)

mi.(**sɛ**$_1$.sɛ)	PARSE(σ)	FT-BIN	ALIGN-R(FT, PRWD)
a. → (**mi**$_2$)(**sɛ**$_1$.sɛ)		1	2
b. mi.(**sɛ**$_1$.sɛ)	1W	L	L

3.2 The template as a syllable

Prior to an analysis, the size of the reduplicative template needs to be determined. Since reduplicants in Kosraean iterative reduplication are never larger than a single syllable, the null hypothesis is that the template employed in the reduplicative system is a syllable, which, I propose, may eventually surface as a CV, VC, or CVC, depending not only on the interaction within the *REPEAT (Yip 1998) family, which penalizes identical adjacent constituents, but also on the basic apparatus of STS and the constraints that do the work for the general phonology of Kosraean.

3.2.1 CVC reduplication

CVC reduplication in Kosraean, repeated below, emerges in cases in which the stem is consonant-initially disyllabic and contains no high front vowel preceding a palatal glide.

(22) CVC reduplication

tæ.fɔŋ	'to mistake'	<u>tæf</u>.-tæ.fɔŋ	'to make lots of mistakes'
fu.rok	'to turn'	<u>fur</u>.-rok	'to turn little by little'
pʌ.ʃæk	'to stop'	<u>pʌʃ</u>.-pʌ.ʃæk	'slopping'

The pattern is intriguing because the reduplicant must have a coda. What is the source of the CVC variant? How do we derive the CVC pattern in STS without unwarranted heaviness requirement on the syllable template? I propose that the CVC variant arises to avoid identical adjacent syllables (e.g., *[<u>fu</u>.-fu.rok]). This is due to *REPEAT(σ) (Yip 1998, Kennard 2004), which prohibits identical adjacent syllables.

(23) *REPEAT(σ) (Yip 1998, Kennard 2004)
Identical syllables cannot be adjacent.

If copying of CV would result in identical adjacent syllables (e.g., *[<u>tæf</u>.-tæ.fɔŋ]), *REPEAT(σ) would force the operation COPY(seg) to copy CVC instead in favor of identity avoidance (e.g., [<u>tæf</u>.-tæ.fɔŋ]).

Given the constraint *REPEAT(σ), I now turn to the derivation of the CVC pattern. In STS, the headedness requirement of a syllable template can be fulfilled either by INSERT(μ) or by COPY(μ). The analysis assumes that all segments in a syllable, including onset consonants, are immediate constituents of mora nodes (Hyman 1985; Ito 1986, 1989; and McCarthy et al. 2012).

Since coda consonants are nonmoraic in Kosraean, the headedness of the syllable template cannot be fulfilled by COPY(μ), because the copied elements in CVC reduplication are not subconstituents of the same mora node.

(24)

σ + σ σ
| | |
μ μ μ
| | |
fur **fu** **r**ok

Thus, as tableau (25) shows, I propose that the template is filled by INSERT(μ), violating HD(μ) in favor of HD(σ).

(25) 1st step of CVC reduplication: HD(σ) » HD(μ)

σ + σ σ | | μ μ | | fu rok	HD(σ)	HD(μ)
σ + σ σ | | μ μ | | fu rok	1W	L
→ σ + σ σ | | | μ μ μ | | fu rok		1

The task then amounts to explaining what forces the mora node to be realized as CVC instead of CV. This is when *REPEAT(σ) kicks in. Tableau (26) illustrates how *REPEAT(σ) comes into play at the second step of the derivation. The winning candidate [fur.-fu.rok] has two syllables violating NOCODA. In contrast, the losing form *[fu.-fu.rok] contains only one coda consonant but has adjacent identical syllables, hence the violation of *REPEAT(σ). Thus, for the winning [fur.-fu.rok] to be more harmonic, *REPEAT(σ) and HD(μ) must outrank NOCODA.

(26) 2nd step of CVC reduplication: *REPEAT(σ) » NOCODA

σ + σ σ | | | μ μ μ | | fu rok	*REPEAT(σ)	NOCODA	*COPY(seg)
σ + σ σ | | | μ μ μ | | | fu fu rok	1W	1L	1
→ σ + σ σ | | | μ μ μ | | | fur fu rok		2	1

(27) 2nd step of CVC reduplication: HD(μ) » NOCODA, *COPY(seg)

σ + σ σ | | | μ μ μ | | fu rok	HD(μ)	NOCODA	*COPY(seg)
σ + σ σ | | | μ μ μ | | fu rok	1W	1L	1
→ σ + σ σ | | | μ μ μ | | | fur fu rok		2	1

Crucially, tableau (28) shows why there is no way of non-local segment copying to meet the headedness of the mora node and satisfy both NOCODA and *REPEAT(σ). The form *[<u>ro</u>.-fu.rok] not only has no identical adjacent syllables, but also fares better than the winning [<u>fur</u>.-fu.rok] on NOCODA. Yet, the former loses to the latter because the copied segments do not constitute of a string of continuous segments of the stem. In other words, COPY-LOC(seg) dominates NOCODA.

(28) 2nd step of CVC reduplication: COPY-LOC(seg) » NOCODA

σ + σ σ | | | μ μ μ | | fu rok	COPY-LOC(seg)	NOCODA
σ + σ σ | | | μ μ μ | | | ro fu rok	2W$_{[f, u]}$	1L
→ σ + σ σ | | | μ μ μ | | | fur fu rok		2

The analysis presented so far assumes that in Kosraean the syllable template concatenates a stem that lacks foot structure.[4] Evidence for this assumption comes from the fact that footing patterns in reduplicative forms are different from those in stems, as shown by (suffixal) denotative reduplication.

(29) Denotative reduplication[5]
(**mu**.tul) → (**mu**$_2$)(**tul**$_1$-tul) ‘to blink’

Specifically, given that footing only parses “free” syllables in a *serial* fashion and bans incorporation of free syllables into previously built feet (i.e., (σ)σσσσ → *(σσ)σσσ) (Pruitt 2010)[6], in Kosraean footing should apply after reduplication. Given footing is a single step operation in the domain of feet and tone (McCarthy et al. 2012, Breteler 2018), this means that, as shown in (30), at the second step of the derivation, HD(μ), a constraint favoring top-down structure building, must outrank PARSE(σ), which favors bottom-up structure parsing.[7]

[4] This raises the general question as to whether it is possible to concatenate a template consisting solely of prosodic structure with a stem that lacks prosodic structure. For instance, is there any language that concatenates a foot template with an unfooted stem? See section 4.2 for discussion.
[5] Denotative reduplication can be accounted for by suffixing a syllable template to the stem. The fact that denotative reduplication, in contrast to iterative reduplication, consistently allows the suffixal reduplicant to be identical to the final syllable of the stem can be captured if both COPY-LOC(seg), ruling out *[mu.tul.-tu], and ONSET, penalizing *[mu.tul.-ul], dominates *REPEAT(σ).
[6] Note that GEN’s permissible bottom-up prosodic structure building does not have a necessary relationship with faithfulness constraints (Elfner 2009, Pruitt 2010, Kimper 2011).
[7] This contrasts with McCarthy et al. (2012: 182, footnote 8) according to whom the constraints favoring bottom-up parsing dominate the constraints that favor filling templates in a top-down fashion. See section 4.2 for discussion about the relationship between these two types of constraints from the perspective of stress alternations.

(30) 2nd step of CVC reduplication: HD(μ) » PARSE(σ), *COPY(seg)

σ + σ σ |	| μ μ μ | | fu rok	HD(μ)	PARSE(σ)	*COPY(seg)
σ + (σ σ) |	| μ μ μ | | fu rok	1W	1L	L
→ σ + σ σ |	| μ μ μ |	| fur fu rok		3	1

The derivation then converges after appropriate footing at subsequent steps, with [**fur**$_2$.-**fu**$_1$.rok] as the final output.

(31) 3rd step of CVC reduplication

fur.-fu.rok	PARSE(σ)	FT-BIN	ALIGN-R(FT, PRWD)
→ fur-(fu.rok)	1		
fur.-fu.rok	3W		
(fur.-fu)rok	1		1W

(32) 4th step of CVC reduplication

fur-(fu.rok)	PARSE(σ)	FT-BIN	ALIGN-R(FT, PRWD)
fur-(fu.rok)	1W	L	L
→ (fur)-(fu.rok)		1	2

3.2.2 CV reduplication

The same constraint ranking presented so far can work as well for CV reduplication with monosyllabic stems, repeated below.

(33) CV reduplication with monosyllabic stems

foʃ	'smoke'	fo.-foʃ	'to emit smoke'
kæl	'to touch'	kæ.-kæl	'to touch repeatedly'
ʃɨk	'small'	ʃɨ.-ʃɨk	'very small'

The constraint ranking predicts that, to avoid identical adjacent syllables, CV reduplicants would emerge if the first syllable of the stem is CVC. At the second step of the derivation, local copying of a CV string will lead to the least marked structure which simultaneously obeys COPY-LOC(seg), HD(μ), *REPEAT(σ), and NOCODA, at the expense of the lower ranked *COPY(seg):

(34) 2nd step of CV reduplication

a. COPY-LOC(seg), PARSE(σ) » NOCODA

σ + σ | | μ μ | foʃ	COPY-LOC(seg)	*REPEAT(σ)	NOCODA
→ σ + σ | | μ μ | | fo foʃ			1
σ + σ | | μ μ | | foʃ foʃ		1W	2W
σ + σ | | μ μ | | o foʃ	1W		1

b. HD(μ) » NOCODA, *COPY(seg)

σ + σ | | μ μ | foʃ	HD(μ)	NOCODA	*COPY(seg)
→ σ + σ | | μ μ | | fo foʃ		1	1
σ + σ | | μ μ | foʃ	1W	1	L

Footing applies at the 3rd step of the derivation, with exhaustive footing as the optimal output; and the converges at the fourth step in which further harmonic improvement is unavailable.

(35) 3rd step of CV reduplication

fo.-foʃ	PARSE(σ)	FT-BIN	ALIGN-R(FT, PRWD)
→ (fo.-foʃ)			
fo.-(foʃ)	1W	1W	
(fo)-foʃ	1W	1W	1W

A question arises as to why sequences of identical syllables in CV reduplication, as repeated below, are tolerated in cases where the stems are disyllabic and contain adjacent vowels (e.g., [mo.-mo.ul]), or a vowel preceding a palatal glide (e.g., [fi.-fi.jɔ]).

(36) CV reduplication with disyllabic stems

mo.ul	‘alive’	mo.-mo.ul	‘not completely dead’
fo.ul	‘smell’	fo.-fo.ul	‘to emit smell’
fi.jɔ	‘to sweat’	fi.-fi.jɔ	‘sweating’
fi.jɛ	‘grey hair’	fi.-fi.jɛ	‘to turn grey’

I propose this is because of PARSE(seg) and *REPEAT(F), both of which outrank *REPEAT(σ).

(37) *REPEAT(F) (Yip 1998)
Identical features cannot be adjacent.

These two constraints kick in at the second step of the derivation, forcing the reduplicant to be identical with the first syllable of the stem. Tableau (38) shows that the losing candidate *[mo.<u>-mo.ul] obeys *REPEAT(σ) and HD(μ) by copying one more segment [u] which cannot be parsed because there is only one unfilled mora node. Thus, PARSE(seg) must outrank *REPEAT(σ) for the winning candidate [mo.-mo.ul] to win over *[mo.<u>-mo.ul]. Moreover, COPY-LOC(seg) and HD(μ) must dominate *REPEAT(σ) as well to rule out the candidates either involving non-local segment copying (e.g., *[u.-mo.ul], and *[o.-mo.ul]) or containing an empty mora node.

(38) 2nd step of CV reduplication:[8] PARSE(seg), COPY-LOC(seg), HD(μ) » *REPEAT(σ)

σ + σ σ | | | μ μ μ | | mo ul	PARSE(seg)	COPY-LOC(seg)	HD(μ)	*REPEAT(σ)
σ + σ σ | | | μ μ μ | | | mo u mo ul	1W			L
→ σ + σ σ | | | μ μ μ | | | mo mo ul				1
σ + σ σ | | | μ μ μ | | | u mo ul		$2W_{[m, o]}$		L
σ + σ σ | | | μ μ μ | | | o mo ul		$1W_{[m]}$		L
σ + σ σ | | | μ μ μ | | mo ul			1W	

Likewise, tableau (39) demonstrates that the losing candidate *[fij.-fi.jɔ] obeys *REPEAT(σ) and HD(μ) at the expense of *REPEAT(F) because of two adjacent segments that are featurally identical. Thus, *REPEAT(F) must rank above *REPEAT(σ) for the winning candidate [fi.-fi.jɔ] to be more harmonic.[9]

[8] The lower ranked NOCODA is left out.

[9] Note that the sequence of [ij] is allowed in the stem, but not in the reduplicant. This can be accounted for if faithfulness constraint like IDENT-IO(F) (McCarthy and Prince 1995), DEP-IO, and MAX-IO outrank *REPEAT(F). Since reduplicants have no correspondents in the input, *REPEAT(F) will not be violated in favor of these faithfulness constraints.

(39) 2nd step of CV reduplication: PARSE(seg), COPY-LOC(seg), HD(μ) » *REPEAT(σ)

σ + σ σ | | | μ μ μ | | fi jɔ	*REPEAT(F) [- cont.] [+ palatal]	COPY-LOC(seg)	HD(μ)	*REPEAT(σ)
σ + σ σ | | | μ μ μ | | | jɔ fi jɔ		2W$_{[f, i]}$		L
→ σ + σ σ | | | μ μ μ | | | fi fi jɔ				1
σ + σ σ | | | μ μ μ | | fi jɔ			1W	L
σ + σ σ | | | μ μ μ | | | fij fi jɔ	1W$_{[i, j]}$			L

3.2.3 VC reduplication

The last challenge for the present analysis is to capture the fact that VC reduplicants appear with vowel-initial stems, as repeated below.

(40) VC reduplication with vowel-initial stems

on	'to sing'	o.n-on	'to keep singing'
ek	'to rub	e.k-ek	'to rub repeatedly'
i.pɨs	'to roll'	ip.-i.pɨs	'to roll bit by bit'
uʃi	'to sprinkle'	uʃ.-u.ʃi	'to sprinkle off and on'

Tableau (41) shows that when the stem is disyllabic, the derivation can be analyzed using the same constraint ranking. At the second step of the derivation, copying a single element [i] of the stem [i.pɨs], for example, would result in a sequence of identical syllables, *[i.-i.pɨs], violating *REPEAT(σ). Therefore, the following consonant [p] must be copied as well.

(41) 2nd step of VC reduplication: PARSE(seg), COPY-LOC(seg), HD(μ) » *REPEAT(σ)

σ + σ σ | | | μ μ μ | | ip pɨs	PARSE(seg)	COPY-LOC(seg)	HD(μ)	*REPEAT(σ)
σ + σ σ | | | μ μ μ | | | ip ɨ i pɨs	1W			
→ σ + σ σ | | | μ μ μ | | | ip i pɨs				
σ + σ σ | | | μ μ μ | | | pɨ i pɨs		$1W_{[i]}$		
σ + σ σ | | | μ μ μ | | ip pɨs			1W	
σ + σ σ | | | μ μ μ | | | i i pɨs				1W

Recall that according to Lee (1975: 218-219), VC reduplication with monosyllabic and disyllabic stems shows different processes of syllabification: the reduplicant in [ip.-i.pɨs] is syllabified independently, whereas the morpheme boundary in [o.n-on] is within a syllable. The grammatical contrast between [ip.-i.pɨs] and *[i.-i.pɨs] then shows again that *REPEAT(σ) outranks NOCODA, as already shown by CV reduplication: [fo.-foʃ] vs. *[foʃ.-foʃ]. However, as shown in (42), when the stem is monosyllabic and vowel-initial, ranking *REPEAT(σ) above NOCODA would rule out the correct output [o.n-on], which consists of identical syllables to be penalized by *REPEAT(σ). The ranking predicts that only the single vowel of the CV stem would be copied.

(42) 2nd step of VC reduplication: *REPEAT(σ) » NOCODA

σ + σ | | μ μ | on	*REPEAT(σ)	NOCODA
☹ σ + σ | | μ μ | | on on	1W	2W
☻ → σ + σ | | μ μ | | o on		1

This is, I propose, where *REPEAT(seg), another constraint of the *REPEAT family is at work.

(43) *REPEAT(seg)
Identical adjacent segments cannot be adjacent.

The actual copied segments then can be correctly calculated if *REPEAT(seg) ranks higher than *REPEAT(σ).[10]

(44) 2nd step of VC reduplication: *REPEAT(seg) » *REPEAT(σ) » NOCODA

σ + σ | | μ μ | on	*REPEAT(seg)	*REPEAT(σ)	NOCODA
→ σ + σ | | μ μ | | on on		1	2
σ + σ | | μ μ | | o on	1W	L	1L

[10] Although I have not found any instances involving CV.CV stems with identical consonants, the ranking predicts that the reduplicated form of the hypothetical stem [pu.pa] would be [pu.-pu.pa], infringing *REPEAT(σ), but not *[pup.-pu.pa], for which *REPEAT(seg) is violated.

Footing then applies at subsequent steps of the derivation, where resyllabification takes place depending on the interaction between *REPEAT(σ), ALIGN(FT, MORPH), NOCODA, and ONSET.

(45) ALIGN(FT, MORPH) (McCarthy and Prince 1993a)
Every foot boundary coincides with a morpheme edge.

(46) ONSET (Prince and Smolensky 1993/2004)
Every syllable must have an onset.

Tableau (47) compares the wining candidate [ip.-(i.pɨs)] with the losing one *[i.(p-i.pɨs)]. The form *[i.(p-i.pɨs)], though fulfilling ONSET, violates ALIGN(FT, MORPH), for having footing and resyllabification across a morpheme boundary. The winning candidate, in contrast, obeys ALIGN(FT, MORPH) but violates NOCODA and has one more violation of ONSET than the losing form. It follows that ALIGN(FT, MORPH) must outrank both ONSET and NOCODA to produce [ip.-(i.pɨs)] as the correct output. Since there is no epenthesis to satisfy ONSET presumably because DEP-IO ranks higher than ONSET, candidates involving epenthesis are left out. Further footing of the remaining syllable applies at the fourth step (i.e., [(ip.)-(i.pɨs)]), and the derivation converges subsequently at the fifth step where no more harmonic improvement is viable.

(47) 3rd step of VC reduplication: ALIGN(FT, MORPH) » ONSET, NOCODA

ip.-i.pɨs	ALIGN(FT, MORPH)	ONSET	NOCODA
→ ip.-(i.pɨs)		2	2
i.(p-i.pɨs)	1W	1L	1L

However, tableau (48) presents a different sort of situation, where ALIGN(FT, MORPH) is respected, but resyllabification for onset fulfillment across a syllable boundary will be forced in favor of *REPEAT(σ) or ONSET to avoid a sequence of identical syllables. This happens if the stem is a monosyllabic VC syllable.

(48) 3rd step of VC reduplication

on.-on	*REPEAT(σ)	NOCODA	ONSET
→ (o.n-on)		1	1
(on.-on)	1W	2W	2W

Note that as shown in (49), ALIGN(FT, MORPH) must ranks higher than *REPEAT(σ) for [(mo)-(mo.ul)] to ultimately win over *[(mo-m)(o.ul)].[11]

[11] Recall that in Kosraean the ranking PARSE(σ) » FT-BIN, ALIGN-R(FT, PRWD) in ensures that binary footing starts from the right.

(49) ALIGN(FT, MORPH) » *REPEAT(σ)

a. 3rd step of CV reduplication

mo.-mo.ul	ALIGN(FT, MORPH)	*REPEAT(σ)
→ mo.-(mo.ul)		1
mo-m(o.ul)	1W	L

b. 4th step of CV reduplication

mo.-(mo.ul)	PARSE(σ)	FT-BIN
→ (mo)-(mo.ul)		1
mo.-(mo.ul)	1W	L

The result of the footing process is not a simple story about the emergence of the unmarked prosodic structure which disfavors onsetless syllables and coda consonants (McCarthy and Prince 1994a). Such a story would favor *[(i)(p-i.pɨs)] over [(ip)-(i.pɨs)], contrary to the fact. Onsetless syllables and more coda consonants in [(ip)-(i.pɨs)] are tolerated because ALIGN(FT, MORPH) dominates ONSET and NOCODA. Likewise, that the seeming unmarked structure [(o.n-on)] is chosen over *[(on.-on)] is not due to the influence of ONSET and NOCODA, but due to *REPEAT(σ), which penalizes identical syllables in a sequence.

3.2.4 Interim summary

Iterative reduplication in Kosraean involves a syllable template filled by COPY(σ). The ultimate reduplicative shape may be CV, VC, or CVC, depending on constraint interaction. Sequences of identical syllables, segments, and features resulting from the reduplicative process will be avoided due to the *REPEAT family, unless satisfying the relevant constraints of the family would lead to violations of other higher ranked constraints. The present analysis shows that the reduplicative pattern falls under the basic mechanism of STS and the general phonology of Kosraean. Crucially, the source of the (C)VC variant is *REPEAT, which, by forcing the reduplicant to be (C)VC, prevents identical adjacent elements that would otherwise emerge. The significant point of the analysis is that the coda in the (C)VC variant is nonmoraic, according with coda consonants elsewhere in Kosraean. Therefore, any heaviness requirement and its inconsistent effect on the reduplicant or the syllable template could be abandoned. The constraint ranking for iterative reduplication in Kosraean is summarized below.

(50) Constraint ranking for Kosraean iterative reduplication[12]

HD(σ)

HD(μ) COPY-LOC(seg)/PARSE(seg)/*REPEAT(F)/*REPEAT(seg)

ALIGN(FT, MORPH)

ONSET

*REPEAT(σ)

*COPY(seg)

PARSE(σ) NOCODA

FT-BIN

ALIGN-R(FT, PRWD)

4. Theoretical Implications

4.1 The binarity effect in Generalized Template Theory/BR-Correspondence

Kennedy (2005) presents a parallel-OT analysis of the variable reduplicative pattern in Kosraean in Generalized Template Theory/BR-Correspondence (Urbanczyk 1996, 2006; Spaelti 1997; Gafos 1998; Alderete et al. 1999; McCarthy and Prince 1994b, 1999; Walker 2000, 2002; Downing 2006; among others), arguing that the reduplicative variants result from their sensitivity to the prosodic structure of the base. More specifically, a reduplicant shows "binarity effect" if and only if the stem is disyllabic (e.g., [foʃ] → [<u>fo</u>.-foʃ]; [fu.rok] → [<u>fu</u>.-fu.rok]). Apart from MAX-BR and FT-BIN, three constraints are crucial for Kennedy's analysis: ALL-σ-RIGHT, NON-FINALITY, and WEIGHT-BY-POSITION.

(51) MAX-BR (McCarthy and Prince1995)
Every segment of the base has a correspondent in the reduplicant.

(52) ALL-σ-RIGHT (ALL-σ-R, McCarthy and Prince 1993a)
Every syllable stands in final position.

(53) NON-FINALITY (NON-FIN, Prince and Smolensky 1993/2004)
Word-final syllables do not bear stress.

(54) WEIGHT-BY-POSITION (WT-BY-POS, Hayes 1989)
Every coda consonant is associated to a mora.

[12] Recall that evidence for ONSET » *REPEAT(σ) comes from (suffixal) denotative reduplication for which ONSET penalizes *[mu.tul.-<u>ul</u>] in favor of [mu.tul.-<u>tul</u>] 'to blink'.

Tableau (55) shows that in CVC reduplication, ALL-σ-R dominates MAX-BR, hence ruling out $*[(\underline{fu^{\mu}.ro^{\mu}})\text{-}(fu^{\mu}.ro^{\mu}k)]$, in which the reduplicant is disyllabic, in favor of the winning candidate $[(\underline{fu^{\mu}r^{\mu}})\text{-}(fu^{\mu}.ro^{\mu}k)]$. Meanwhile, FT-BIN eliminates $*[(\underline{fu^{\mu}})\text{-}(fu^{\mu}.ro^{\mu}k)]$ and $*[(\underline{fu^{\mu}r})\text{-}(fu^{\mu}.ro^{\mu}k)]$, both of which contain a monomoraic foot. Moreover, since NON-FIN outranks WT-BY-POS, $*[(\underline{fu^{\mu}}\text{-}\underline{fu^{\mu}})(ro^{\mu}k^{\mu})]$ loses to $[(\underline{fu^{\mu}r^{\mu}})\text{-}(fu^{\mu}.ro^{\mu}k)]$ for having a word-final stressed syllable.

(55) Generalized Template Theory/BR-Correspondence analysis

RED_{ITER} + furok	NON-FIN	ALL-σ-R	FT-BIN	WT-BY-POS	MAX-BR
$(\underline{fu^{\mu}ro^{\mu}})\text{-}(fu^{\mu}.ro^{\mu}k)$		3W		1	1L
$(\underline{fu^{\mu}})\text{-}(fu^{\mu}.ro^{\mu}k)$		2	1W	1	3W
$(\underline{fu^{\mu}r})\text{-}(fu^{\mu}.ro^{\mu}k)$		2	1W	2W	2
→ $(\underline{fu^{\mu}r^{\mu}})\text{-}(fu^{\mu}.ro^{\mu}k)$		2		1	2
$(\underline{fu^{\mu}}\text{-}fu^{\mu})(ro^{\mu}k^{\mu})$	1W	2		L	3W

The critical problem for his analysis is the "binarity effect," in which coda consonants, as in the winning candidate $[(\underline{fu^{\mu}r^{\mu}})\text{-}\ (fu^{\mu}.ro^{\mu}k)]$, are moraic only in reduplicants, in contrast to coda consonants elsewhere in the language, an assumption Kennedy must adopt for his non-templatic analysis to work. The problem arises because the specific heaviness requirement on the reduplicant, though not explicitly formulated, is implicitly imposed by WT-BY-POS. If there is no ground on which the heaviness condition on reduplicants can be stipulated, then the binarity effect may be epiphenomenal, as in the present STS analysis, which maintains that coda consonants are uniformly nonmoraic in Kosraean, regardless of the environment they appear. In this regard, a serial OT analysis is therefore more elegant than a parallel approach like Generalized Template Theory/BR-Correspondence alternative, in demonstrating that the prima facie binarity effect may be due to general prosodic conditions in the language and accordingly may not exist in the first place.

4.2 Top-down versus bottom-up operations: Foot templates with unfooted stems

Recall that Kosraean iterative reduplication involves syllable templates in concatenation with unfooted stems because HD(μ) outranks PARSE(σ). This contrasts with McCarthy et al. (2012: 182, footnote 8), who claim that in STS the constraints favoring bottom-up parsing outrank the constraints that favor top-down building of prosodic structure. Their claim is based on the traditional view that prosodification goes about in a cyclic manner (Ito 1986; Kiparsky 1979), which leads to the assumption that reduplicative templates are affixed to fully prosodified structure. However, as in the case of Kosraean, if the constraints favoring bottom-up parsing can indeed dominate the constraints that favor filling templates in a top-down fashion, then it might be possible to concatenate a foot template with stems that lack foot structure, which might be the case in Maori, another Austronesian language.

In Maori main stress falls on the leftmost mora of a word, with secondary stress placed on every other following, non-final mora. Therefore, in a trimoraic form only the first mora bears stress. However, as shown in (56), when the trimoraic form undergoes bimoraic reduplication, aside from the secondary-stressed reduplicant, the vowel of the initial, main stressed syllable is lengthened, and the third mora bears secondary stress.

(56) Maori (Meyerhoff and Reynolds 1996: 148)

(**ko**$_1$hi)ko	'interrupt'	(**koo**$_1$)(**hi**$_2$ko)-(**hi**$_2$ko)	'do irregularly'
(**po**$_1$ra)hu	'awkward'	(**poo**$_1$)(**ra**$_2$hu)-(**ra**$_2$hu)	'awkward, annoying'

Two points are worth particular attention. First, since the reduplicant is disyllabic the template should be a foot. Second, if footing only parses free syllables serially and prohibits incorporation of free syllables into previously built feet (Pruitt 2010), the different stress patterns in non-reduplicated versus reduplicated forms suggest that in Maori, like in Kosraean, footing applies after the reduplicative process. Taking these two points together, we have Maori as a language whose reduplicative process affixes a foot template with unfooted stems. If this is on the right track, then Maori stands as a case against the assumption that phonological processes apply to stems at a derivational stage prior to the addition of affixes (Wolf 2008).

5. Conclusion

This article has shown that STS, by employing *REPEAT, can tackle variable monosyllabic reduplication in Kosraean without imposing unwarranted weight requirements on the reduplicants. The present STS analysis is more elegant than a parallel Generalized Template Theory/BR-Correspondence alternative in reducing the epiphenomenal reduplicative binarity effect in Kosraean to potential prosodic conditions in the language. Furthermore, the fact that footing applies after reduplication in Kosraean suggests that in STS the constraints favoring top-down filling of templates can outrank the constraints that favor bottom-up prosodification, which is borne out by Maori, a language which affixes foot templates to unfooted stems, suggesting that the view that phonological processes applying to stems derivationally precede the addition of affixes might be too strong. The present analysis would be even stronger if Kosraean showed an avoidance of repeated constituents in other areas of the phonology too, like in the shape of stems, in allomorphy of non-reduplicative allomorphs, or in haplology (see Yip 1998 for discussion). Due to limited literature on Kosraean phonology, whether avoidance of repeated constituents is pervasive in the language awaits further investigation. This, however, would not undermine the present analysis, because the lack of evidence for identity avoidance in other phonological domains in Kosraean may be due to undominated faithfulness constraints that protect the input from any phonological alteration. Since reduplicative morphemes are phonologically zero in the input, such faithfulness constraints would not have any effect on the reduplicative morphemes. Consequently, identity avoidance would noy only show up as the emergence of the unmarked in reduplicative contexts.

References

Alderete, John, Jill Beckman, Laura Benua, Amalia Gnanadesikan, John McCarthy and Suzanne Urbanczyk. 1999. Reduplication with fixed segmentism. *Linguistic Inquiry* 30: 327–364.

Blevins, Juliette. 1996. Mokilese reduplication. *Linguistic Inquiry* 27: 523-530.

Breteler, Jereon. 2018. A foot-based typology of tonal reassociation: Perspectives from synchrony and learnability, PhD thesis, Universiteit van Amsterdam.

Crowhurst, Megan. 2004. Mora alignment. *Natural Language and Linguistic Theory* 22: 127–177.
Downing, Laura J. 2006. *Canonical Forms in Prosodic Morphology*. Oxford: Oxford University Press.
Elfner, Emily. 2009. Syllabification and stress-epenthesis interactions in Harmonic Serialism. Ms, University of Massachusetts. Amherst. Available as ROA-1047 from the Rutgers Optimality Archive.
Gafos, Diamandos. 1998. A-templatic reduplication. *Linguistic Inquiry* 29: 515–527.
Good, Elaine M. 1989. Clause-final determiners in Kusaiean. In Elaine M. Good and Weldis Welley (eds.), *Papers in Kusaiean and Ponapeic*, 127–196. Canberra: Australian National University.
Hayes, Bruce. 1989. Compensatory lengthening in moraic phonology. *Linguistic Inquiry* 20: 253–306.
Hyman, Larry. 1985. *A Theory of Phonological Weight*. Dordrecht: Foris.
Ito, Junko. 1986. Syllable theory in prosodic phonology. Doctoral dissertation, University of Massachusetts, Amherst.
———. 1989. A prosodic theory of epenthesis. *Natural Language and Linguistic Theory* 7: 217–259.
Kennard, Catherine Hicks. 2004. Copy but don't repeat: the conflict of dissimilation and reduplication in the Tawala durative. *Phonology* 21.3: 303–323.
Kennedy, Robert. 2005. The binarity effect in Kusaiean reduplication. *Phonology* 145–168.
Kimper, Wendell. A. 2011. Locality and globality in phonological variation. *Natural Language and Linguistic Theory* 29.2: 423—465.
Kiparsky, Paul. 1979. Metrical structure assignment is cyclic. *Linguistic Inquiry* 10: 421–441.
Lee, Kee-dong. 1975. *Kusaiean Reference Grammar*. Honolulu: University Press of Hawaii.
———. 1976. *Kusaiean-English dictionary*. Honolulu: University Press of Hawaii.
Marantz, Alec. 1982. Re reduplication. *Linguistic Inquiry* 13: 483–545.
McCarthy, John. 2000. Harmonic serialism and parallelism. In Masako Hirotani, Andries Coetzee, Nancy Hall, and Ji-yung Kim (eds.), *Proceedings of the North East Linguistic Society 30*: 501–524.
———. 2008a. The gradual path to cluster simplification. *Phonology* 25: 271–319.
———. 2008b. The serial interaction of stress and syncope. *Natural Language and Linguistic Theory* 26: 499—546.
———. 2010. An introduction to Harmonic Serialism. *Language and Linguistics Compass* 4(10): 1001–1018.
McCarthy, John, Wendell Kimper and Kevin Mullin. 2012. Reduplication in Harmonic Serialism. *Morphology* 22: 173–232.
McCarthy, John, Kevin Mullin and Brian Smith. 2012. Implications of Harmonic Serialism for lexical tone association, in B.Botma and R.Noske (eds.), *Phonological Explorations: Empirical, Theoretical and Diachronic Issues*, 265–297. Berlin: de Gruyter.
McCarthy, John and Alan Prince. 1986/1996. *Prosodic Morphology 1986*. New Brunswick: Rutgers University Center for Cognitive Science.
———. 1993a. Generalized alignment. *Yearbook of Morphology 1993*: 79–153.
———. 1993b. Prosodic Morphology I: Constraint Interaction and Satisfaction. Ms, University of Massachusetts and Rutgers University.
———. 1994a. The emergence of the unmarked: Optimality in prosodic morphology. In Merce

Gonzalez (ed.), *Proceedings of the North East Linguistic Society* 24, 333–379. Amherst, Mass.: GLSA Publications.
———. 1994b. Two lectures on prosodic morphology. Handouts of two lectures at OTS/HIL Workshop on Prosodic Morphology, Utrecht University. Available as ROA-59 from the Rutgers Optimality Archive.
———. 1995. Faithfulness and reduplicative identity. In J. Beckman, L. Walsh Dickey, and S. Urbanczyk (eds.), *University of Massachusetts Occasional Papers in Linguistics: Vol. 18*. *Papers in Optimality Theory*, 249–384. Amherst: GLSA Publications.
———. 1999. Faithfulness and identity in Prosodic Morphology. In Rene Kager, Harry van der Hulst and Wim Zonneveld (eds.), *The Prosody-Morphology Interface*, 218–309. Cambridge: Cambridge University Press.
Meyerhoff, Miriam and Bill Reynolds. 1996. On reduplication and its effects on the Base in Maori. In Marina Nespor and Norval Smith (eds.), *Dam Phonology: HIL Phonology Papers II*, 143–164. The Hague: Holland Academic Graphics.
Prince, Alan and Paul Smolensky. 1993/2004. Optimality Theory: Constraint interaction in Generative Grammar. Ms., Rutgers University.
Pruitt, Kathryn. 2010. Serialism and locality in constraint-based metrical parsing. *Phonology* 27.3: 481–526.
Rehg, Kenneth L. 1993. Proto-Micronesian prosody. In Jerold A. Edmondson and Kenneth J. Gregerson (eds.), *Tonality in Austronesian Languages*, 25–46. Honolulu: University of Hawaii Press.
Selkirk, Elisabeth. 1995. The prosodic structure of function words. In J. Beckman, L. Walsh Dickey, and S. Urbanczyk (eds.), *University of Massachusetts Occasional Papers in Linguistics: Vol. 18*. *Papers in Optimality Theory*, 439–470. Amherst: GLSA Publications.
Spaelti, Philip. 1997. Dimensions of variation in multi-pattern reduplication. PhD dissertation, University of California, Santa Cruz.
Thurgood, Elzbieta. 1997. Bontok reduplication and prosodic templates. *Oceanic Linguistics* 36: 135–148.
Urbanczyk, Suzanne. 1996. Patterns of reduplication in Lushootseed. PhD dissertation, University of Massachusetts, Amherst.
———. 2006. Reduplication form and the root-affix asymmetry. *Natural Language and Linguistic Theory* 24: 179–240.
Walker, Rachel. 2000. Nasal reduplication in Mbe affixation. *Phonology* 17: 65–115.
———. 2002. Yuhup prosodic morphology and a case of augmentation. *Natural Language and Linguistic Theory* 32: 551–562.
Wolf, Matthew. 2008. Optimal interleaving: Serial phonology-morphology interaction in a constraint-based model. PhD diss., University of Massachusetts, Amherst.
Yip, Moira. 1998. Identity avoidance in phonology and morphology. In Steven G. Lapointe, Diane K. Brentari and Patrick M. Farrell (eds.), *Morphology and Its Relation to Phonology and Syntax*, 216–246. Stanford: CSLI.