Lookahead effects in the reduplication-phonology interaction*

Wei Wei & Rachel Walker

University of Southern California

1. Introduction

In reduplication, *lookahead effects* refer to phenomena where the amount of material copied depends on a subsequent phonological change. Parallel and serial versions of Optimality Theory make different predictions about the possibility of lookahead effects, emerging from their different versions of GEN. In Base-Reduplicant Correspondence Theory (McCarthy & Prince 1995), implemented in the classic parallel version of Optimality Theory (henceforth P-OT; Prince & Smolensky 1993/2004), the candidate-generating function GEN can simultaneously apply multiple changes to the input (e.g. deletion, insertion, assimilation, etc.). In this framework, the underlying representation is thus directly mapped to surface candidates, which are assessed by a constraint hierarchy. The P-OT version of GEN is distinct from that of Harmonic Serialism (McCarthy 2000, 2002, 2008), a derivational version of OT with evaluation of intermediate levels of structure. In Harmonic Serialism, GEN is restricted to making no more than one change in each derivational step, a property known as *gradualness*. McCarthy, Kimper, and Mullin (2012) (henceforth MKM) proposed a theory of reduplication within Harmonic Serialism, Serial Template Satisfaction (STS). P-OT predicts lookahead effects, because it includes output candidates with multiple, simultaneous changes. In contrast, STS predicts that lookahead effects are not possible, because at the step where reduplication takes place, information about the possibility of alteration at any following step is not available.

This paper argues that two types of reduplication in Mbe instantiate patterns involving a lookahead effect. For both cases, we argue that the surface variation in reduplicant shape warrants derivational lookahead, which can be accounted for by P-OT without difficulty. However, since lookahead is impossible in STS, an analysis in this framework has to seek help from either different underlying representations or constraints with stipulative interpretations. Specifically, we consider an analysis in STS with an

* We would like to thank audiences at NELS 48 and the PhonLunch group at USC for valuable feedback.

amendment to the template shape. While this alternative is capable of deriving the pattern in question in a Copy + Deletion path, it gives rise to inconsistent interpretation of two constraints that regulate the size of the reduplicative affix. Moreover, in addition to exhibiting a plausible lookahead effect, the surface shape of the diminutive reduplication in Mbe alternates between a homorganic nasal in the coda and null realization. This poses a challenge for the STS approach, in which satisfaction of the reduplicative template appears to be a prerequisite.

The paper is organized as follows. Section 2 briefly reviews the mechanism of STS and a hypothetical lookahead effect. In Section 3, we show that the formation of imperative verbs and diminutive nouns in Mbe instantiates this very effect. This reduplicative pattern is straightforwardly captured in P-OT but problematic for STS. In section 4, we consider two alternatives within STS and discuss potential problems. Section 5 concludes and discusses implications.

2. Lookahead effects in STS

The STS framework has three primary components. First, in STS, reduplicative affixes are represented as templates in the form of specified empty prosodic constituents (e.g. syllable, foot, or prosod), rather than an unspecified RED morpheme, as in P-OT. Second, the empty template is populated through one of two operations applied in GEN: (i) Insert(X), which inserts an empty prosodic constituent of type X and integrates it into the template, and (ii) Copy(X), which copies a continuous string of constituents of type X with their contents and places them within the template. Third, in addition to the general well-formedness constraints on syllable or foot structure, such as ONSET and FOOT-BINARITY (FT-BIN) (Prince & Smolensky 1993/2004), a family of constraints, HEADEDNESS(X) (HD(X) for short), applies to a prosodic category X and requires X to have a head of type X-1. Because Insert(X) inserts an empty prosodic constituent X, this operation incurs a violation of HD(X). The alternative template-filling operation, Copy(X), is penalized by a constraint, *COPY(X). The ranking of constraints from the HD(X) and *COPY(X) families determines whether Insert(X) or Copy(X) is applied first to satisfy the template. Consequently, the surface shape of the reduplicant is determined collectively by the shape of the underlying prosodic template of the reduplicative affix and the constraint ranking.

In MKM, reduplication patterns in the Austronesian languages, Manam and Balangao, demonstrate the two primary ways to satisfy a foot (*ft*) template. Manam takes a derivational path of syllable copy. Manam has a bimoraic *ft* template suffixed to the prosodified stem, as in *salaga-<u>laga</u>* 'long (sg)' (Lichtenberk 1983; reduplicative affix underlined), shown in tableau (1). *COPY(σ) is dominated and is thus applied to satisfy requirements such as foot binarity and headedness. The ranking triggers the copy of a continuous string of two syllables into the foot template (1a). A single violation of *COPY(σ) is incurred for any copied string of contiguous syllables. (1b) is the faithful output and violates both FT-BIN and HD(ft). Applying the operation Insert(σ) yields candidate (1c), which provides the foot template with a head but does not satisfy foot binarity, and it further violates the headedness requirement of the syllable by inserting an empty σ node.

(1) *Syllable copying in Manam (adapted from MKM: 183)*
Step 1 of *sa.la.ga-<u>la.ga</u>*

ft + ft △ σ σ σ sa.la.ga	FT-BIN	HD(ft)	HD(σ)	*COPY(σ)
a. → ft + ft △ △ σ σ σ σ σ sa.la.ga la.ga				1
b. ft + ft △ σ σ σ sa.la.ga	1W	1W		L
c. ft + ft △ | σ σ σ σ sa.la.ga	1W		1W	L

In Balangao, the prefixal reduplicative affix is also a *ft* template, but the reduplicant is not always the full first two syllables in the stem: reduplication omits copying a coda consonant in the second syllable, as in *ma-<u>tay.na</u>-tay.nan* 'repeatedly be left behind' (Shetler 1976). Copy(σ), which copies entire syllables including the coda, cannot generate this surface shape. Instead, Insert(σ) operates first to build the prosodic structure of the *ft* template, and then a continuous string of segments is copied, terminating before the coda of the second syllable. As shown in tableau (2) (focusing on the reduplicative portion), *COPY(σ) is top-ranked and blocks syllable copying. This rules out candidate (2c). Applying Insert(σ) provides the foot template with a syllable head in (2a), which is favored over the faithful candidate in (2b). A syllable-level version of FT-BIN is assumed in the analysis of Balangao in MKM, requiring that feet contain two syllables.

(2) *Syllable insertion in Balangao (adapted from MKM: 184-186)*
Step 1 of *ma-<u>tay.na</u>-tay.nan*

ft + ft △ σ σ tay.nan	*COPY(σ)	HD(ft)	FT-BIN(σ)	HD(σ)	*COPY(seg)
a. → ft + ft | △ σ σ σ tay.nan			1	1	
b. ft + ft △ σ σ tay.nan		1W	1	L	
c. ft + ft △ △ σ σ σ σ tay.nan tay.nan	1W		L	L	

In step 2, syllable copying continues to be blocked, and the template is further populated by inserting another syllable node. In step 3, segment copying applies to fill in the empty syllables in the template, satisfying HD(σ). The operation Copy(seg) copies a continuous string of segments of any amount from the stem. To select *tay.na-tay.nan* over *tay.nan-tay.nan,* The analysis calls on NOCODA, ranked below HD(σ). Meanwhile, *ta.na-tay.nan* is not a possible candidate in step 3 because *ta.na* is not a continuous string of segments in the stem.

In STS, the two operations that realize the empty prosodic templates that represent reduplicative affixes are thus independent operations applied in GEN, along with operations that insert, delete, spread, or change phonological elements. Because of Harmonic Serialism's built-in property of gradualness, each step of the derivation can apply only one operation. Therefore, STS does not predict lookahead effects**,** where the amount of material copied depends on its possible subsequent phonological manipulation.

A hypothetical pattern is discussed in MKM to illustrate a lookahead effect. Suppose that a language allows a coda only if it is a nasal that is homorganic with a following onset, as enforced by CODA-COND. Suppose further that this language exhibits a reduplicative pattern where the reduplicant takes the form CVC when a nasal can be copied into the coda and place-assimilated (3a), and otherwise it takes the form CV (3b).

(3) *Assimilation-dependent copying (MKM: 213)*
a. pa.na pam-pa.na
b. pa.ta pa-pa.ta

As shown in MKM, this hypothetical case is predicted to be possible by P-OT. Assuming a syllable-sized maximum for reduplication, ranking CODA-COND and MAX-BR over IDENT-BR(Place) drives copy and place assimilation of a post-vocalic nasal, as in (4ia).[2] Ranking CODA-COND over MAX-BR blocks copy of an oral consonant into the reduplicant coda, in (4iia).

(4) *Assimilation-dependent copying in P-OT (adapted from MKM: 213)*

		CODA-COND	MAX-BR	IDENT-BR(Place)
i. /RED-pana/	→ a. pam-pa.na		1	1
	b. pa-pa.na		2W	L
	c. pan-pa.na	1W	1L	L
ii. /RED-pata/	→ a. pa-pa.ta		2	
	b. pat-pa.ta	1W	1L	

However, the pattern in (3) presents a derivational paradox for STS: the nasal cannot be copied unless it is assimilated, but it cannot assimilate until it has been copied; copying and assimilation cannot apply in the same step. We illustrate the mechanics of this paradox in section 3.3. The discussion in MKM makes note that the existence of lookahead effects such as this would present a serious challenge to STS theory.

[2] We assume familiarity with correspondence constraints in the Base-Reduplicant Correspondence framework. For details, we refer readers to McCarthy & Prince (1995).

3. Mbe reduplicative affixation

Mbe (Benue-Congo, Nigeria) presents a reduplication pattern in which a nasal in the stem triggers a reduplicated coda nasal with place features that are homorganic with the following onset. This pattern is found in both imperative verb reduplication and diminutive noun reduplication in Mbe, despite their differences in reduplicant size.[3] In substance, this pattern closely resembles the lookahead nasal assimilation described in the previous section. The data and description are drawn from Bamgboṣe (1966, 1967a, b, c, 1971) and our account is informed by the analysis of Walker (2000).

3.1 Data

Verbs in Mbe are categorized into two classes, Class 1 and Class 2, and the imperative affixation has two formations: either reduplicated or simple (non-reduplicated). For Class 2 singular verbs, the imperative reduplication forms a prefix with the shape of either an open syllable or a CVN syllable, depending on the segmental content of the stem. When the stem contains only oral consonant(s), the reduplicant shape is CV, without copying the post-vocalic consonant into the coda (5a-f). However, the presence of a post-vocalic nasal in the stem triggers the occurrence of a nasal coda in the reduplicant that is homorganic to the following onset (5g-l).

(5) *Class 2: reduplicative imperative singular*

a.	rû	rû-rû	'pull'	g.	tâŋ	tə̂n-tâŋ	'teach'
b.	fûel	fû-fûel	'blow'	h.	gbé.nò	gbə̂ŋm-gbé.nò	'collide'
c.	jú.bò	jû-jú.bò	'go out'	i.	pûɔ.nì	pûm-pûɔ.nì	'mix'
d.	ʃîa.rì	ʃî-ʃîa.rì	'scatter'	j.	dzûɔŋ	dzûn-dzûɔŋ	'be higher'
e.	só.rò	sə̂-só.rò	'descend'	k.	jíɔ.nî	jîɲ-jîɔ.nì	'forget'
f.	tá.rò	tə̂-tá.rò	'throw'	l.	lúo.nî	lûn-lûo.nì	'repair'

Class 2 imperative singular reduplication is accompanied by two vocalic simplifications. When the stem vowel is high, the vowel in the reduplicant is identical (5a-d), but when the stem vowel is non-high, the vowel in the reduplicant is [ə] (5e-h). When the stem contains a diphthong, only the first vowel is copied (5b, d, i-l).

Diminutive affixation in Mbe shares the common property with Class 2 imperative reduplication that the copied material in coda is always a place-assimilated nasal. A nasal in the stem triggers the occurrence of a nasal coda following a separate Class 4 singular nominal prefix [kɛ-], and the place features of the nasal are homorganic with the following onset (6a). Vowel harmony produces a [ka-] variant of the Class 4 prefix before syllables that contain [a]. In stems that contain only oral content, the prefix does not display a coda nasal (6b).

(6) *Diminutive singular*

a. kàm-bàm 'little bag' b. kɛ̌-ʧî 'little head'

[3] Inchoative verbs in Mbe show a similar pattern to diminutives with a reduplicative coda nasal exponing the inchoative morpheme (Walker 2000).

kɛ̀m-mù	'little story'	kɛ̆-bɛ̂l	'little breast'
kàŋ-faŋ	'little path'	kɛ̆-lîe	'little food'
kɛ̆n-tɛ́m	'little heart'	kɛ̀-kpíʧù	'little crocodile'
kɛ́ŋ-kùɔm	'little snake skin'	kà-bàrò	'little liver'

Plural diminutives are formed with the same pattern but with the Class 4 plural nominal prefix [ke-]:

(7) *Diminutive plural*

a.	kĕn-tɛ́m	'little axes'	b.	kĕ-bél	'little wives'
	kĕn-rén	'little fruits'		kĕ-fúɔrɔ	'little brains'

Different from the imperative reduplicative prefix, where the assimilated coda nasal occurs as part of a string of copied segments, the place-assimilated nasal in diminutive nominals does not occur alongside other copied material. However, the condition that triggers the presence of a homorganic nasal is the same: the stem must contain a nasal. Following Walker's (2000) analysis, we take the homorganic nasal as the only segmental material belonging to the diminutive morpheme and analyze it as a reduplicated segment. When the stem contains no nasal segment, the diminutive morpheme fails to be realized.

3.2 P-OT analysis of Mbe

The assimilation-dependent nasal copy in Mbe plausibly exemplifies a lookahead effect, which is predicted to be impossible by STS. Similar to the hypothetical case introduced in section 2, Mbe has strict constraints on coda consonants. With the exception of root-final position, oral codas are prohibited in Mbe and nasal codas are place-assimilated with a following consonant. We assume that CODA-COND proscribes consonants that do not share their place features with a following onset (Itô 1989). We attribute the prohibition on oral coda consonants to a cover constraint that we label $*C_{oral}]_\sigma$.[4] Following this set of assumptions about the relevant constraints, $*C_{oral}]_\sigma$ would also be high-ranked in the hypothetical case, because for the reduplicated form of (3b) [pa.ta], the reduplicative form [<u>pap</u>-pa.ta] is supposed to be unattested.

The Mbe pattern is straightforwardly captured in P-OT, as demonstrated in Walker (2000). Focusing on the lookahead effect, the P-OT analysis in (4) for the hypothetical case obtains the Mbe data. Tableau (8) illustrates the evaluation for an input without a nasal consonant. CODA-COND rules out copy of post-vocalic /r/ (8b), resulting in a CV reduplicant, which incurs two violations of MAX-BR (8a). Following Walker, we assume that [ə] is a reduced copy of the vowel in the base, rather than inserted.

(8) *[tə̂-tárò] 'throw-IMP.SG'*

RED + tárò	CODA-COND	MAX-BR	IDENT-BR(PLACE)
→ a. <u>tə̂</u>-tá.rò		2	
b. <u>tə̂r</u>-tá.rò	1W	1L	

[4] See Padgett (1995) for a proposal on specifics of this manner-based restriction.

Tableau (9) shows the evaluation for a stem that contains a post-vocalic nasal. Because MAX-BR dominates IDENT-BR(Place), the nasal is copied at the expense of violating place identity, and the reduplicant surfaces with a CVC shape. The fell-swoop change (copy and place assimilation) in the winner (9a) is critical for the copied nasal to escape a violation of CODA-COND, which would otherwise block nasal copy (9c).

(9) *[pûm-pûɔnì] 'mix-IMP.SG'*

RED + pûɔnì	CODA-COND	MAX-BR	IDENT-BR(PLACE)
→ a. <u>pûm</u>-pûɔ.nì		2	1
b. <u>pû</u>-pûɔ.nì		3W	L
c. <u>pûn</u>-pûɔ.nì	1W	2	L

The nasal copy in diminutive reduplication can be captured with the same ranking as in (9). The size of the reduplicant can be attributed to a common size-restrictor that limits the number of syllables in the output. The constraint, *STRUC-σ (Zoll 1996), imposes a size restriction by favoring outputs with fewer syllables. Positioned in the TETU ranking schema in (10), a size minimization effect emerges only in the reduplicant. Walker assumes differently ranked morpheme realization constraints for the imperative and diminutive affixes, with a null realization prevented for the Class 2 imperative singular.

(10) MAX-IO >> *STRUC-σ >> MAX-BR.

Similarly, the two vocalic changes in the reduplicant—diphthong reduction and mapping of non-high vowels to [ə]—are also attributed by Walker to TETU rankings. The ranking in (11a), with the markedness constraint NODIPH penalizing diphthongs (Rosenthall 1997), gives rise to the avoidance of diphthongs in the reduplicative prefix. The ranking in (11b) obtains the non-high vowel reduction. The constraint *NONHIFULLV disfavors non-high peripheral vowels, while IDENT[color] requires faithful mapping of vowel color features ([back] and [round]).

(11) *Diphthong avoidance in the reduplicative affix*
a. MAX-IO >> NODIPH >> MAX-BR[5]

Non-high peripheral vowel avoidance in the reduplicative affix
b. IDENT-IO[color] >> *NONHIFULLV >> IDENT-BR[color].

The P-OT analysis also captures the commonality across different affixations in Mbe. What differs between the imperative and diminutive affixations is the ranking of their respective REALIZE-MORPHEME constraints, and also the occurrence of the diminutive reduplicant after a segmental CV class prefix, which provides an existing syllable frame into which the nasal can be copied.

[5] MAX-BR dominates a BASECONTIGUITY constraint to drive copy of the non-contiguous nasal in the case of diphthong reduction (Walker 2000).

3.3 STS analysis of Mbe

STS theory faces difficulty capturing the nasal copy in Mbe. Because the surface shape of the reduplicative prefix is either CV or CVC, it is reasonable to assume a σ template for the reduplicative affix. When there is no nasal in the stem, the output is derived in two steps. The first step copies segments from the stem to satisfy undominated HD(σ), as in (12a). Candidate (12b) copies the onset of the second syllable in the stem, which fatally violates CODA-COND. Recall that copy of a contiguous string of any length incurs a single violation of *COPY, as seen for (12a) and (12b). Candidate (12c) makes no change, and thus obeys *COPY(seg) but violates the higher-ranked HD(σ).

(12) *Step 1 of [jû-jú.bò]*

σ + σ σ jú.bò	HD(σ)	CODA-COND	*COPY(seg)
→ a. σ + σ σ jû jú.bò			1
b. σ + σ σ jûb jú.bò		1W	1
c. σ+ σ σ jú.bò	1W		L

With the ranking of HD(σ) >> *COPY(seg), however, the STS grammar would generate the wrong output for a stem containing a nasal. Consider the stem [gbé.nò] 'collide'. In the first step, illustrated in (13), segment copying provides the empty syllable template with a head, satisfying Hd(σ). Copying the nasal in (13a) fatally violates CODA-COND. Note that a candidate [gbéŋm-gbé.nò], which simultaneously copies the nasal and changes its place to obey CODA-COND, is not available in STS. This is because gradualness prevents copy of the stem nasal /n/ and change of its features in a single derivational step. Thus, (13b) [gbé-gbé.nò] will be the most harmonic intermediate output in step 1, with vowel reduction occurring at the next step.

(13) *Step 1 of [gbə̂ŋm-gbé.nò]*

σ + σ σ gbé.nò	HD(σ)	CODA-COND	*COPY(seg)
a. σ + σ σ gbén gbé.nò		1W	1
☹ b. σ + σ σ gbé gbé.nò			1
c. σ + σ σ gbé.nò	1W		L

In the constraint ranking in (13), the copy operation is triggered by HD(σ), requiring the syllable template to be headed. This constraint is not in conflict with CODA-COND because HD(σ) can be satisfied by copying a CV segment string, without a coda that potentially infringes upon CODA-COND. Since there is no pressure for a faithful or maximal mapping between the base and the reduplicant (given that BR-correspondence does not exist in STS), the CV shaped reduplicant would always be more harmonious than a CVC one, all else being equal. In order to ensure that the nasal segment is copied in the step where Copy(X) applies, there must be some requirement from the template itself or a high-ranked well-formedness constraint that can only be satisfied by copying the nasal or the segment string that contains the nasal. We consider an alternative of this kind in the following section.

Turning to the diminutive reduplication pattern, it presents a challenge to an STS analysis on both assumptions concerning the serial derivation and the reduplicative template. Derivationally, the nasal copying faces the same lookahead effect as witnessed in the imperative reduplication. Furthermore, because the copy of the diminutive prefix is either a nasal or not realized, the reduplicant does not seem to fit into either a *ft* or a σ template. We may speculate that a mora template would be suitable for the diminutive prefix and use HD(μ) as the constraint that triggers the consonant copying. However, a similar derivational paradox arises: to satisfy the template, HD(μ) needs to dominate both CODA-COND and $*C_{oral}]_{\sigma}$, so that a consonant can be copied into the coda position to satisfy the headedness requirement. Under this ranking, we expect an oral consonant to be copied in the first step.[6] In step 2, to satisfy the lower-ranked CODA-COND and$*C_{oral}]_{\sigma}$, the copied oral consonant would have to be deleted (violating MAX-IO), while the copied nasal consonant undergoes place assimilation (violating IDENT(Place)). However, deletion of the oral consonant would leave the μ node empty, violating the higher-ranked HD(μ), and would thus not show harmonic improvement.

In addition to this derivational paradox, the nasal copy in the diminutive affixation introduces complications to the templatic approach. A basic premise of STS is that the reduplicative affix starts out as a certain prosodic constituent whose content needs to be filled in over the course of a derivation. However, as the diminutive morpheme is not realized when there is no nasal to be copied in the stem, the empirical generalization challenges the basic premise of template satisfaction (i.e., realization).

To summarize, the Mbe reduplicative affixation in imperative and diminutive forms shows the hallmarks of a lookahead effect. Assuming a syllable template for the imperative reduplication cannot obtain the surface variation in reduplicant shape. For the diminutive affix, assuming a mora template, problems arise involving derivational lookahead or template satisfaction.

4. Alternative accounts in STS

We consider two alternative analyses of the Mbe imperative reduplication within STS. The first treats the surface shape variation as allomorphs. MKM offers a reanalysis of reduplication in Southern Paiute (Uto-Aztecan). In MKM, it is argued that these differences in reduplicant shape are not conditioned by a coda restriction (CODA-COND). Instead, Southern Paiute has two distinct reduplicative affix allomorphs: a σ template for CV reduplication and a *ft* template for CVC reduplication. The key argument for this proposal is that the choice between the CV and the CVC shape is unpredictable and thus lexically idiosyncratic. However, the lexical specificity of the reduplication pattern is not

[6] STS requires the Copy(X) operation to produce a candidate with the copied material X adjacent to the original X string. This requirement is enforced by the constraint COPY-LOCALLY(X) (MKM: 181). In the case like [kĕn̠-tɛ́m], the copied nasal is non-adjacent to the original segment in the stem. Thus, COPY-LOCALLY(X) must be violated in this case.

attested in Mbe imperative reduplication. In Mbe, it is fully predictable whether a given verb root will reduplicate as CV or CVC. Therefore, the surface shape variation is phonologically predictable and conditioned by CODA-COND; it cannot be taken on a par with the allomorphy in Southern Paiute.

In the second alternative, we consider a uniform *ft* template for the imperative affix. The challenge in the Mbe data is the disyllabic verbs in which the target nasal is in the onset of the second syllable, as in forms like (5h-i), repeated in (14).

(14) a. gbé.nò <u>gbə̂ŋm</u>-gbé.nò 'collide'
b. pûɔ.nì <u>pûm</u>-pûɔ.nì 'mix'

In order for the nasal to be copied, the second syllable must be copied in the first step. We note first that an alternative where the template is specified to be a heavy syllable is problematic, because evidence signals that both syllables with diphthongs as well as closed syllables are heavy in Mbe.[7] Under a heavy syllable template, we expect copy of the first syllable with a diphthong in (14b) and not the following nasal.

We illustrate the derivation with a *ft* template for (14b). We assume *COPY(σ) is dominated and adopt the Copy(σ) operation to populate the template. Similar to the analysis of Balangao in MKM, it will be necessary to employ a version of FT-BIN that enforces bisyllabicity. A traditional version of FT-BIN, where binarity may be satisfied at the syllabic or moraic level (McCarthy & Prince 1986/1996, Prince & Smolensky 1993/2004), would fail to trigger copying of the second stem syllable, because copying a heavy first syllable into the *ft* template would obey FT-BIN on the moraic level. Step 1 in (15) generates a full copy of the stem.

(15) *Step 1 of [<u>pûm</u>-pûɔ.nì]*

ft + ft △ σ σ pûɔ.nì	FT-BIN(σ)	*COPY(σ)
a. → ft + ft △ △ σ σ σ σ pûɔ.nì pûɔ.nì		1
b. ft + ft | △ σ σ σ pûɔ pûɔ.nì	1W	1
c. ft + ft △ σ σ pûɔ.nì	1W	L

After the string of syllables with the nasal is copied, (15a) becomes the input in step 2. The second vowel in the diphthong and the vowel in the second syllable must be

[7] According to Bamgboṣe (1967a: 176, footnote 6), in Mbe imperative I plural verbs, the tone on the first syllable is rising or high with free variation. When it is high, an initial open syllable with a monophthong is lengthened: [táːlì] 'touch', but a diphthong does not show any lengthening [líali] 'eat', nor does a closed syllable [tábli] 'follow'.

deleted. We assume that the diphthong reduction takes place in step 2 in (16), triggered by NODIPH, as introduced earlier. To restrict diphthongs to roots only, we rank a root-specific version of MAX-IO over general MAX-IO (Urbanczyk 2006).

(16) *Step 2: diphthong reduction*
Crucial ranking: $\text{MAX-IO}_{\text{root}}$ >> NODIPH >> MAX-IO

```
Input:                        Output:
    ft  +  ft                     ft  +  ft
    △      △          →           △      △
   σ σ    σ σ                    σ σ    σ σ
 pûɔ.nì  pûɔ.nì                pû.nì  pûɔ.nì
```

After diphthong reduction, the vowel [i] in the second syllable of the reduplicative prefix needs to be deleted. This operation could be triggered by a generalized templatic constraint, AFFIX≤σ, defined in (17) (McCarthy & Prince 1994b).[8]

(17) AFFIX≤σ: Assign a violation mark to any affix whose phonological exponent is larger than a syllable.

To reduce the prefix size from two syllables to one, a syllable nucleus must be deleted. We assume that concomitant (re)syllabification within this derivational step is consistent with gradualness, because it is not a distinctive operation (McCarthy 2008). Deleting the first prefix vowel in [<u>pû.nì</u>-pûɔ.nì] would lead to a syllable with a complex onset, which is not observed in Mbe (Bamgboṣe 1967c). Deleting the second prefix vowel, as in [<u>pûn</u>-pûɔ.nì], is preferred, because the nasal would be resyllabified as the coda of the first syllable. Since [<u>pûn</u>-pûɔ.nì] violates CODA-COND and MAX, and it leaves a headless syllable node (violating HD(σ)), AFFIX≤σ must dominate these constraints.

The question now is whether the prosodic structure shown for the output in (18) satisfies AFFIX≤σ. The output has two syllable nodes, but only one has realization at the segmental level. Therefore, in order to have the output satisfy AFFIX≤σ, the constraint must be assessed on the basis of segmental material and affiliated prosodic structure but ignore prosodic constituents without segmental realization.

(18) *Step 3: affix size reduction*
Crucial ranking: AFFIX≤σ >> HD(σ), CODA-COND, MAX

```
Input:                        Output:
    ft  +  ft                     ft  +  ft
    △      △          →           △      △
   σ σ    σ σ                    σ σ    σ σ
 pû.nì  pûɔ.nì                  pûn    pûɔ.nì
```

AFFIX≤σ must be dominated at step 1. Specifically, AFFIX≤σ must be ranked below FT-BIN(σ); otherwise copying of two syllables would not transpire at the first derivational

[8] An alternative would be to rank an atemplatic constraint that assigns a violation to each syllable, such as *STRUC-σ or ALL-σ-R (Spaelti 1997), between MAX_{root} and MAX. However, this option would not alter the implications we discuss for STS theory.

step. Yet this leads to a potential ranking paradox. If constraints involving prosodic constituency are evaluated on the basis of categories with realization at the segmental level, then it is expected that FT-BIN(σ) will be violated by the output in (18). However, since FT-BIN(σ) must dominate AFFIX≤σ to drive copy of two syllables, then FT-BIN(σ) is expected to block derivation of the structure in (18).

To make the Copy + Deletion account succeed, we could suppose that FT-BIN(σ) is instead evaluated on the basis of prosodic structure without reference to its segmental realization. However, a principled basis for this interpretation eludes us. Employing this second interpretation of FT-BIN(σ), the workings of the constraint ranking are shown in tableau (19). Non-crucial constraints from the previous step are omitted here to save space. HD(σ) is ranked below AFFIX≤σ because the selected output has a headless syllable, driven by the affixal size-restrictor. The prefix in (19b) meets the size requirements but violates the top-ranked *COMPLEXONSET. The faithful candidate, (19c), fatally violates the affixal size restriction. Candidate (19d) satisfies AFFIX≤σ by deleting a syllable node together with its segment content (incurring what we interpret to be a single violation of MAX, for deletion of the syllable), but it violates FT-BIN(σ).

(19) *Step 3 of [pûm-pûɔ.nì]*

ft + ft △ △ σ σ σ σ pû.nì pûɔ.nì	*COMPLEX ONSET	FT-BIN(σ)	AFFIX≤σ	HD(σ)	CODA-COND	MAX
a. → ft + ft △ △ σ σ σ σ pûn pûɔ.nì				1	1	1
b. ft + ft △ △ σ σ σ σ pnì pûɔ.nì	1W			1	L	1
c. ft + ft △ △ σ σ σ σ pû.nì pûɔ.nì			1W	L	L	L
d. ft + ft │ △ σ σ σ pû pûɔ.nì		1W		L	L	1

Finally, in step 4, CODA-COND triggers place assimilation, and [pûm-pûɔ.nì] is selected as the output. To recapitulate, assuming a *ft* template, STS can derive the Mbe imperative reduplication pattern as a seeming but not genuine lookahead effect, via the Copy + Deletion path. To fulfill foot bisyllabicity, two syllables in the stem are copied; then post-copying deletion reduces the segmental size of the reduplicant to CV/CVC. The key constraint that drives the two-syllable size of copy is FT-BIN(σ) and the size-restricting constraint that triggers deletion of the second nucleus is AFFIX≤σ. To make the alternative approach work, however, these two size-related constraints must be assessed in essentially opposite ways, with FT-BIN(σ) inspecting only the prosodic structure without reference to its segmental realization, while AFFIX≤σ is obeyed on the basis of segments and their affiliated prosodic structure.

5. Conclusion

In this paper, we have argued for a lookahead effect in Mbe imperative and diminutive affixations. This type of pattern is predicted to be impossible under STS. Although the surface realizations of the reduplicants are different, both the imperative and the diminutive reduplicative affixations show a lookahead effect conditioned by CODA-COND: a consonant is copied into the coda position of the prefix only when it is a nasal that undergoes place-assimilation with the following onset. The restriction on the coda consonants leads to the surface shape alternation of reduplicative prefixes: CV/CVC for the imperative prefix and C/Ø for the diminutive prefix.

The STS theory faces a derivational paradox originating from the built-in pressure of gradualness, as the copy operation and place-assimilation cannot apply in the same step. We have considered a Copy + Deletion alternative. Although this approach could derive the desired outputs, this treatment seems to be stipulative: it seems inconsistent to us to interpret the prefix's *ft* template as at once satisfying foot bisyllabicity and also AFFIX≤σ. By contrast, the BR correspondence theory of P-OT predicts the possibility of lookahead effects. The lookahead effect in Mbe is captured by the parallel evaluation of BR-correspondence and phonotactic constraints. Furthermore, the surface variation and the non-realization of the reduplicative affix pose difficulties for the satisfaction of a fixed reduplicative template throughout the derivation, but the variation can be analyzed as an emergent characteristic in Mbe morphophonology under P-OT.

Another lookahead effect in reduplication is discussed by Adler & Zymet (2016). In Maragoli, the copy operation looks ahead to the result of hiatus repair (i.e. whether an onsetless syllable or complex onset is created in the reduplicants). It has also been pointed out in Zukoff (2017) that STS does not actually restrict medial-coda skipping as claimed. These two points are among the main arguments for STS against P-OT. With these purported advantages of STS in question, it is not clear how strong the residual evidence is for a gradual approach to reduplication, even in some revised form.

References

Adler, Jeff & Jesse Zymet (2016). Irreducible parallelism in process interactions. Talk given at *NELS 47*.

Bamgboṣe, Ayọ.1966. Nominal classes in Mbe. *Afrika und Übersee* 49: 32–53.

Bamgboṣe, Ayọ. 1967a. Verbal classes in Mbe. *Afrika und Übersee* 50: 173–193.

Bamgboṣe, Ayọ. 1967b. Tense /aspect forms in Mbe. *Research notes* 1: 12–20. Department of Linguistics and Nigerian Languages, University of Ibadan.

Bamgboṣe, Ayọ. 1967c. Notes on the phonology of Mbe. *Journal of West African Languages* 4: 5-11.

Bamgboṣe, Ayọ. 1971. Nasal harmony in Mbe. *Annales de l'Université d'Abidjan 1971*, Série H, Fascicule hors série. Vol. 1: 101–107.

Itô, Junko. 1989. A prosodic theory of epenthesis. *Natural Language & Linguistic Theory* 7: 217–259.

Lichtenberk, Frantisek. 1983. *A grammar of Manam*. Honolulu: University of Hawaii Press.

McCarthy, John J. 2000. Harmonic serialism and parallelism. In *Proceedings of the North East Linguistics Society 30,* ed. by M. Hirotani, 401-524. Amherst, Mass.: GLSA.

McCarthy, John J. 2002. Research surveys in linguistics: A thematic guide to Optimality Theory. Cambridge: Cambridge University Press.

McCarthy, John J. 2008. The serial interaction of stress and syncope. *Natural Language and Linguistic Theory* 26, 499–546.

McCarthy, John J. & Alan Prince. 1986/1996. *Prosodic morphology 1986*. New Brunswick: Rutgers University Center for Cognitive Science.

McCarthy, John J. & Alan Prince. 1994a. The emergence of the unmarked: Optimality in prosodic morphology. *NELS* 24, 333–379.

McCarthy, John J. & Alan Prince. 1994b. Two lectures on prosodic morphology (Utrecht, 1994). University of Massachusetts, Amherst and Rutgers University.

McCarthy, John J. & Alan Prince. 1995. Faithfulness and reduplicative identity. In *University of Massachusetts Occasional Papers in Linguistics* 18, ed. by J. Beckman, L. Walsh Dickey, & S. Urbanczyk, 249-384. Amherst: GLSA Publications.

McCarthy, John J., Wendell Kimper & Kevin Mullin. 2012. Reduplication in Harmonic Serialism. *Morphology* 22: 173-232.

Padgett, Jaye. 1995. Partial class behavior and nasal place assimilation. In K. Suzuki and D. Elzinga (eds.), *Proceedings of the 5th Arizona Phonology Conference*, 145–183.

Prince, Alan & Paul Smolensky.1993/2004. *Optimality Theory: constraint interaction in generative grammar*. Malden: Blackwell.

Rosenthall, Sam. 1997. The distribution of prevocalic vowels. *Natural Language and Linguistic Theory* 15: 139–180.

Sapir, Edward. 1930. Southern Paiute, a Shoshonean language. *Proceedings of the American Academy of Arts and Sciences*. Vol. 65. No. 1. American Academy of Arts & Sciences.

Shetler, Joanne. 1976. *Language data: Asian-Pacific series: Vol. 9. Notes on Balangao grammar*. Huntington Beach: Summer Institute of Linguistics.

Spaelti, Philip.1997. *Dimensions of variation in multi-pattern reduplication*. Doctoral dissertation, University of California, Santa Cruz.

Urbanczyk, Suzanne. 2006. Reduplicative 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.

Zoll, Cheryl. 1996. *Parsing below the segment in a constraint based framework*. Doctoral dissertation, University of California, Berkeley.

Zukoff, Sam. 2017. Actually, Serial Template Satisfaction does predict medial coda skipping in reduplication. AMP Proceedings.

Wei Wei, Rachel Walker
wei490@usc.edu, rwalker@usc.edu