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Reduplication in Rotuman:

A curious case of emergent unmarkedness*

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Abstract. This article gives a comprehensive analysis of reduplication in Rotuman (Oceanic). The main reduplication shape is a heavy syllable prefix (e.g., CVC-, CVV-), which we document with a list of 847 reduplicated words and native speaker elicitation. We argue that the heavy syllable shape is predicted in large part by the phonology of the incomplete phase, a system-wide generalization also requiring heavy syllables. The apparent markedness of the reduplicant thus follows from the phonology of phase and other independently motivated constraints for anti-gemination, under-application, and prosodic faithfulness effects.

Keywords: reduplication, minimal word, generalized templates, Rotuman, Austronesian

1. Introduction

The idea that the form of reduplicated words is shaped by ambient phonology has been a powerful one. Capturing insights from prior research (McCarthy & Prince 1986; Shaw 1987; Steriade 1988), the paradigm of generalized templates argues that shape facts can be directly predicted by allowing non-reduplication constraints to apply to reduplicated words (McCarthy & Prince 1994; McCarthy & Prince 1995). In McCarthy and Prince's analysis of Diyari reduplication, for example, tried-and-true prosodic constraints like FOOTBINARITY play a direct role in shaping the reduplicant as a minimal word. By avoiding language particular stipulation of shape facts, generalized templates has inspired new and original research on reduplication systems and typology (Alderete et al. 1999; Gafos 1998a; Gafos 1998b; Hendricks 1999; Kennedy 2003;

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Lin this volume; Nelson 2003; Spaelti 1999; Urbanczyk 1996; Urbanczyk 2006).

Despite this progress, however, subsequent research has clarified a set of problems with generalized templates. Analyses within generalized templates typically emphasize the role of markedness constraints in the treatment of shape, whence the term ‘the emergence of the unmarked’ in reduplication (McCarthy & Prince 1994). However, reduplicants also sometimes contain marked structure (Takeda 1998). While some of these cases can be subsumed within the general ranking schema for under-application (Alderete et al. 1999), other examples do not seem compatible with such an analysis. For example, Blevins (2005) argues that CVC reduplication in Hoava (Oceanic) is problematic for generalized templates because there does not seem to be a constraint with cross-linguistic support that can motivate the existence of marked closed syllables. Recent research has amassed a number of problems that seems to show that a theory of reduplication requires more than base-reduplicant correspondence and independently motivated well-formedness constraints (Downing 2005; Downing 2006; Gouskova 2007; Inkelas 2008; Inkelas & Zoll 2005; Pulleyblank 2009; Yu 2007).

We acknowledge that both sides of this debate have uncovered important theoretical insights and empirical problems, but believe that a solid understanding of the shape facts must be rooted in detailed investigations of particular languages. We investigate reduplication in Rotuman with this in mind. Reduplication in Rotuman is interesting because it appears at first blush to be problematic for the same reasons as Hoava. As shown below, the copied part is a heavy syllable, with marked closed syllables, diphthongs, and long vowels. However, a deeper understanding of Rotuman phonology reveals that the marked structure in the reduplicant is related to the phonological structures emerging from the phonology of phase, an independent phonological system native to Rotuman. Phase alternation in Rotuman is a language-wide pattern of allomorphy in which content morphemes appear in two forms: the incomplete phase form in PrWd-final contexts, and the complete phase form elsewhere. Incomplete phase forms, as shown below, always end in a heavy syllable, so any analysis of Rotuman phonology will have to account for this fact. Because of the morpho-phonology of reduplication, the reduplicant is PrWd-final, thus in incomplete phase. It seems clear, therefore, that if an analysis exists that accounts for the marked syllable structures in the incomplete phase, it will likely extend naturally to the same phenomenon in reduplication.

(1) Heavy syllable reduplication in Rotuman

Complete, Incomplete	Reduplication
fɑnɑ, fɑn 'to shoot'	fɑn-fɑnɑ 'to shoot repeatedly'
mɑtɑ, mɑt 'wet'	mɑt-mɑtɑ 'wet in patches'
mofɑ, moɑf 'rubbish, refuse'	moɑf-mofɑ 'littered with rubbish'
tɑːtuː, tɑːtuː 'to bang, thud'	tɑː-tɑːtuː 'to bang, thud'
ɑoŋɑ, ɑoɑŋ 'cloud'	ɑo-ɑoŋɑ 'cloudy'

We argue that such an analysis exists in McCarthy (2000) and extend this analysis to the domain of reduplication. In particular, we show how the analysis of the incomplete phase applies to reduplication, and also how mismatches between reduplication and non-reduplicant incomplete phase forms can be brought under grammatical control. We begin with an introduction to the phonology of Rotuman (section 2) and a description of reduplication (section 3). Then we sketch McCarthy's (2000) analysis of the incomplete phase (section 4) and show how it extends naturally to the core shape facts (section 5.1) and its apparent exceptions (section 5.2).

2. Background

Rotuman is an Oceanic language in the Malayo-Polynesian subgroup of the Austronesian language family. It is spoken by approximately 2,500 people on the island of Rotuma in the South Pacific Ocean and by an additional 5,000 Rotumans on the Fijian Islands and diasporas overseas (Schmidt 2002). While Rotuman is classified as a language isolate within Central Oceanic (Lynch et al. 2002; Schmidt 2002), its next closest linguistic relative is Western Fijian and there are many lexical borrowings from the Polynesian languages, Tongan and Samoan (Churchward 1940; Schmidt 2002; Schmidt 2003).

The consonant phonemes of Rotuman are /p t k ʔ f v s h tʃ m n ŋ r l/. For pronunciation details of consonants see Churchward (1940: 64).[1] Rotuman has five primary vowel phonemes /i ɛ ɑ o u/ that relate straightforwardly to Proto-Oceanic (Lynch et al. 2002). Fourteen surface vowels can be derived from these primary vowels though regular phonological and morpho-phonemic processes. Thus, five additional vowels /e æ ɑ̩ ɔ o̩/ are conditioned variants of these phonemes resulting from regular fronting and raising rules, and the remaining four /a œ ø y/ appear only in the morpho-phonological environment of the incomplete phase (Blenkiron 2013; Blevins 1994; Churchward 1940). Details of the phonology of phase alternations are outlined in section 4. The five primary vowels contrast for length, but long vowels are predictable from word size requirements (Blevins 1994), so are not assumed to be phonemic (cf., Churchward 1940). Finally, the labiovelar glide /w/ and palatal glide /j/ are predicable allophones of /u/ and /i/, either as off-glides in diphthongs or as 'on-glides' of /u o/ and /i e/, respectively, in metathesized forms (Schmidt 2002: 815, Churchward 1940: 64).

In general, Rotuman syllables are open: (C)V(V), and onsets are optional. Closed syllables, however, are observed in loanwords, e.g., *tʃɛs.lɛ* 'chisel', and are required in some word-final contexts in the incomplete phase. Thus, closed syllables like C V_1V_2C, as in *sɛ.sɛav* (incomplete) 'mistaken', cf. *sɛ.sɛ.va* (complete), are a frequent occurrence morpheme-finally as the result of special morpho-phonemic requirements. The status of diphthongs is somewhat unclear, though Schmidt (2002: 817) lists a number of rising diphthongs that appear to occur word-finally in the complete phase.

Stress falls on the syllable containing the penultimate mora in Rotuman (Blevins 1994; Churchward 1940; Schmidt 2002; Schmidt 2003). In the complete phase, stress can either be in a final long vowel, as in *su.ká: 'sugar'* (which Blevins (1994) argues to be compensatory lengthening of a final lexical stress) or on the penult if the final syllable is light. Words in incomplete phase retain the stress from complete phase, as in *fóra ~ fóar* 'to tell', *hanísi ~ hanís* 'to feel pity', *lɛlɛ́.i ~ lɛlɛ́i* 'good', but they can be

[1] All sounds are transcribed in the IPA; see Blenkiron (2013) for correspondences between orthography and phonetic symbols.

affected by a following adjacent stressed syllable, e.g., *lɛ́lɛi páu* 'very good'. Following standard analysis of this pattern in Austronesian languages (see e.g., Hayes 1995), Blevins (1994) and McCarthy (2000) analyse this pattern as a right-to-left moraic trochee.

3. The facts of reduplication

This section describes the principal reduplication patterns we analyze below, but see Blenkiron (2013) for a more comprehensive account. The data presented here was assembled using both corpus study and traditional fieldwork. 847 reduplicated forms from 794 different root words (some roots have two reduplicated forms) were extracted from the Rotuman dictionary (Churchward 1940) and used as our principal dataset. In addition to this corpus, a native speaker of Rotuman was consulted to verify word meanings, general prosodic information, and correct pronunciation for certain words and phrases. Our larger objective was to collect a large sample of reduplicated words, the largest to date, in order to avoid spurious generalization. All our data is available from the second author's webpage.

The most common type of reduplication (roughly 91% of our corpus) involves prefixing a heavy syllable that consists of segmental content copied from the left edge of the base. Blevins (1994) calls this 'foot-based reduplication' to capture the fact that this heavy syllable satisfies a bimoraic foot requirement in Rotuman, which she demonstrates is also a minimal word. The minimal word analysis is discussed in more detail in section 5 where we develop the minimal word structure as a by-product of the analysis of the incomplete phase.

The data below illustrate all the different reduplicant shapes in heavy syllable reduplication. The frequency of each shape is indicated (out of a total 847 reduplicated forms) in parentheses after each reduplicant shape. Because the reduplicants are morphemes in the incomplete phase, they form closed syllables when the initial sequence is CVCV (2) and open when the base starts with (C)VV (3). This is consistent with the phonology of phase alternations outlined in section 4. These examples show that all of the possible instantiations of a heavy syllable are in fact attested. The reduplicant may have an onset or not, but it must contain sufficient material to support two moras, and no more. Like the phonology of phase discussed below, we assume that all coda consonants dominate a mora, and the CVVC and VVC heavy syllables contain light monomoraic diphthongs.

(2) Reduplicants with closed syllables:

a. CVC (509)	fɑn-fɑnɑ	‘to shoot repeatedly’
	mɑʔ-mɑʔɔnu	‘muddy’
b. CVVC (64)	fuɛʔ-fuɛʔi	‘to take hold of loosely’
	miol-milo	‘peaked head-dress with feathers’
c. VC (43)	ɑl-ɑlɑ	‘mortal, mortality’
	ok-oko	‘bewildered, confused, perplexed’
d. VVC (4)	uɑs-usɑ	‘to be wet, rainy’
	uɑt-uɑtɑ	‘to retch’

(3) Reduplicants with open syllables:

a. CVV (101)	sui-sui	‘covered with spikes’
	ruɛ-ruɛ	‘to move to and fro’
b. CV: (31)	ko:-ko:	‘having thorns, prickly’
	tɑ:-tɑ:tu:	‘to bang, thud’
c. VV (10)	oi-oi	‘to vex, annoy’
	ɑo-ɑoŋɑ	‘cloudy’
d. V: (5)	o:-o:	‘to make a rumbling noise’
	u:-u:	‘to shelter from the wind (also fig.)’

Partial CV reduplication, which involves prefixing a copy of the initial CV portion of the base (4c), is infrequent and constitutes less than 10% of our corpus. Together with their idiosyncratic meanings, this fact supports the contention that they are lexicalized and are often listed as wholes in the lexicon (see Blenkiron 2013 for a comprehensive account). However, there are a few interesting facts to note before we move on. First, stems that exhibit partial CV reduplication also tend to have heavy syllable reduplication, but with slightly different meanings (Churchward 1940, Blevins 1994), as shown in (4). Second, words with partial CV reduplication can be reduplicated again, resulting in double reduplication (4d).

(4)	a.	sɑpo – 'to take hold of'	
	b.	sɑp-sɑpo – repetitive of *sapo*	(heavy syllable redup.)
	c.	sɑ-sɑpo – 'to hold'	(partial.)
	d.	sɑ-sɑ-sɑpo – continuative of *sasapo*	(double redup.)

Of the 80 forms with CV reduplication, half of them are clear cases of partial CV reduplication. The remaining 40 cases have a specific structure that led Churchward (1940: 103) to treat them as full CVC reduplication plus deletion. The cases in question contain identical C_1 and C_2 in the base, so heavy syllable reduplication would result in a sequence of identical consonants at the reduplicant-base boundary, e.g., *koko* 'foolish' → *ko-koko *kok-koko*. Rather than retaining the marked C_i-C_i sequence, the heavy syllable reduplication system deletes the coda consonant.

(5) CV reduplicants with C_iVC_iX bases

fu-fufu 'to light, kindle'
hɑ-hɑhɑu 'to interlace/weave'
rɑ-rɑrɑ 'to fumigate, to toast'

Two facts in our corpus suggest that Churchward's original intuition is correct. First, none of these ambiguous CV forms have a related heavy syllable reduplicated form, which, as we have seen, is unlike partial CV reduplication. Second, while many stems with partial CV reduplication have double CV-CV-X reduplication (4d), there are no ambiguous CV forms with double reduplication, e.g., **ko-ko-koko*. Any analysis of heavy syllable reduplication will therefore have to account for the fact that CVC reduplication is blocked when the first two base consonants are identical.

4. The phonology of phase alternations

We assume that the heavy syllable reduplicant is a minimal word. Studies of minimal word phonology have shown how minimal words may be subject to some of the same phonotactic or prosodic requirements of full prosodic words. This is the case in Rotuman, and we use phase alternations as a means to illustrate this. When we understand the structure of PrWds in general, we can understand more fully the parallels between incomplete phase forms and reduplication.

Phase is a morphological phenomenon unique to Rotuman whereby content morphemes take two different forms, a complete phase form thought to be the underlying representation of the morpheme, and an incomplete phase form derived from the complete phase form. The conditions that determine whether morphemes are in complete or incomplete phase are rather complex, but contemporary accounts have identified morphological, syntactic, semantic, and phonological factors. Phase alternations are in essence a lexicon-wide pattern of allomorphy where morphemes in particular environments surface without special phonology in the complete phase form, and in a complementary set of environments they appear in the incomplete phase form that is the result of special phonology. The incomplete phase is formed by a set of phonological alternations (explained below) altering the final V(C)V of the morpheme so that it appears in a heavy syllable. The examples below illustrate some of the morpho-syntactic contexts for complete and incomplete phase forms (the latter are underlined).

(6) Illustration of phase alternations

a. Suffixed word: <u>fɑr</u>-ʔɔki ‘to make request for’; fɑrɑ ‘to request’ + ʔɔki (relational suffix), cf. hoʔɑ-me ‘to take (directional)’

b. Syntactic phrase: <u>siɑv</u> ririʔi ‘the little fans’; sivɑ ‘fans’, ririʔi ‘little (pl)’

c. Prefixed word: <u>fɑk</u>-muri ‘to go/be last’; fɑkɑ- (derivational prefix, N→V) + muri ‘end, rear’

d. Compound: <u>fɑn</u> tɔnu ‘syringe’; fɑnɑ ‘gun’ + tɔnu ‘water’

e. Reduplicated word: <u>tɑl</u>-tɑlu ‘rocky’; tɑlu ‘stone, rock’

The traditional account of phase alternation given in Churchward (1940) is that morphemes that are final in a word and a syntactic phrase, and that mark certain semantic categories, are in complete phase, and incomplete phase forms appear elsewhere. A recent account given in Hale & Kissock (1998), however, investigates Churchward’s original observations, and arrives at an entirely phonological generalization. While not perfect, the generalization is that morphemes are in complete phase when they precede monosyllabic suffixes, and incomplete phase elsewhere, i.e., when preceding disyllabic suffixes or when preceding no suffixes at all. McCarthy (2000) proposes that this distinction, based on related observations in Yidiny, Diyari, and Fijian, is a matter of whether the final VCV in a morpheme is final in the prosodic word. PrWd-final VCV sequences feel the effects of the following constraint.

(7) ALIGN-HEAD-σ

The main-stressed syllable is final in every PrWd.

In particular, McCarthy captures Hale & Kissocks' generalization by assuming footable suffixes form their own PrWd, but unfootable monosyllabic suffixes are appended to the PrWd of the base stem. In this analysis, the difference between incomplete and complete phase is that the monosyllabic appendage creates a buffer between the final foot and the right edge of the PrWd (8b), making it impossible to satisfy ALIGN-HEAD-σ. When phrase-final or before a disyllabic suffix, however, feet are PrWd-final (8a), and so ALIGN-HEAD-σ comes into effect to ensure the main stressed syllable is PrWd final.

(8) Phonological basis for phase distinction

a. Incomplete phase (via deletion)
___ + disyllabic or no suffix
ala 'to die' + *-tia* 'completive'

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PrWd    PrWd
 |        |
 Ft       Ft
(ˈɑl)   (ˈtiɑ)
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b. Complete phase
___ + monosyllabic suffix
hoʔa 'to take' + *-mɛ* 'directional'

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    PrWd
   /    \
  Ft     \
(ˈhoʔɑ)  mɛ
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Concretely, this follows from ALIGN-HEAD-σ dominating MAX_{IO} and two standard prosodic well-formedness constraints, as shown below. Incomplete phase forms do not have the canonical (ˈCVCV) trochee found in complete phase forms because the stressed syllable is not final, as required by ALIGN-HEAD-σ (9b). Likewise, FOOTBINARITY and FOOTFORMTROCHEE ensure that alternative strategies like unary feet (9c) or foot form flipping (9d) are not used to push the stressed syllable to the right edge. The winner is the form that creates a heavy syllable by deleting the final vowel (9a).

(9) Rightward alignment of stressed syllable

/sapo/	ALN-HD-σ	FTBIN	FTFORMTROCH	MAX_{IO}
☞ a. {(sɑ́p)}				*
b. {(sɑ́po)}	*!			
c. {sɑ(pó)}		*!		
d. {(sɑpó)}			*!	

McCarthy's (2000) analysis also accounts for the five ways in which heavy syllables are created in the incomplete phase. Since these are important to the analysis of reduplication, we summarize briefly the facts and McCarthy's analysis. The conditioning factors for these alternations have many layers, but are all phonological in nature (Biggs 1965; Blenkiron 2013; Churchward 1940; McCarthy 2000; Schmidt 2002). The first distinction relevant to the alternations is morpheme final syllable structure. For morphemes that end in a VV sequence, if the two vowels are identical, i.e., VV is a long vowel, then no change takes place because the final syllable is already heavy (10b.ii). If they are non-identical, then the VV sequence forms a heavy diphthong, which is assumed to be a heavy syllable (10b.i). For morphemes ending in a CV syllable, sonority and front/back distinctions come into play. When the penultimate vowel in the complete phase is greater in sonority than the final vowel, where sonority is inversely correlated with vowel height, the final vowel is lost and the onset becomes a coda (10a.i). If, however, V_1CV_2 rises in sonority, then the final CV metathesizes to produce a CV_1V_2C heavy syllable (10a.ii). The final process in (10a.iii) is responsible for producing the non-basic vowels [a œ ø y]: when V_1CV_2 is back-to-front and falls in sonority, a front counterpart of the back vowel forms a $CV_{12}C$ syllable, where V_{12} is a coalesced vowel containing the roundness of V_2.

(10) Heavy syllable formation in incomplete phase

__#	Comp. ~ Inc.	Process	Conditioning factor
a. V_1CV_2	i. tɑlu ~ tɑl	Deletion	$V_1 \geq_{son} V_2$
	ii. tokɑ ~ toɑk	Metathesis	$V_1 <_{son} V_2$
	iii. futi ~ fyt	'Umlaut'	V_1[+bk]V_2[-bk]; $V_1 \geq_{son} V_2$
b. VV	i. tʃɑo ~ tʃɑ͡o	Diphthongization	Non-identical VV
	ii. rii ~ rii	No change	Long vowel

While it is straightforward how CVV syllables satisfy ALIGN-HEAD-σ, this is not the case with CVCV final morphemes. How does the analysis predict deletion, metathesis, or umlaut in the three environments laid out above? In McCarthy's analysis, these are predicted by the ranking below in (11), which incorporates two faithfulness constraints, LINEARITY and UNIFORMITY, as well as the markedness constraint, LIGHTDIPHTHONG. The latter is active in CVVC syllables (where again the VV is a single mora) and requires light diphthongs to have rising sonority. The three ways of forming closed heavy syllables from section 3 are all three ways of satisfying ALIGN-HEAD-σ, but they are sensitive to the structure of the VCV# sequence. Metathesis is in a sense the default option, when the VCV# sequence results in a rising sonority VVC# (11i). When this is not possible, deletion occurs (11ii). However, when the VCV# is back-to-front, a MAX violation can be avoided via coalescence of the round feature of V_1 and the other features of V_2, (11iii).

There are some empirical problems with the analysis of phase based on the syllable count generalization. Hale & Kissock (1998: 120) list eleven suffixes that trigger the complete phase in a stem, the majority of which are monosyllabic (e.g., *-me* 'hither', *-a* 'completive', *-a* 'transitive'), however two of them, the definitive plural and locative suffixes, involve zero morphology. Hale & Kissock argue that these suffixes are in fact monosyllabic null moras that pattern with the overt suffixes, e.g., /vɑkɑ + μ/ → *vaka* 'the canoes (complete phase)', which accounts for the occasional complete phase forms occurring phrase- and word-finally. As the focus of this study is on reduplicant shape and its relation to the larger grammar, we do not include phase triggering suffixes in the tableaux below. Bases of reduplication can be either in complete or incomplete phase, but we select certain contexts to illustrate the relationship between the base and reduplicant.

(11) Phonological processes producing incomplete phase heavy syllables

Input	Outputs	ALN-HD-σ	LTDIPH	MAX	LIN	UNIF
i. /purɛ/	☞ a. {(puɛr)}				*	
	b. {(pur)}			*!		
	c. {(purɛ)}	*!				
ii. /rɑko/	a. {(rɑok)}		*!		*	
	☞b. {(rɑk)}			*		
	c. {(rɑko)}	*!				
	d. {(rok)}			*	*!	
iii. /mu_1ri_2/	☞ a. {($my_{12}r$)}				*	*
	b. {(muir)}		*!			
	c. {(muri)}	*!				
	d. {(mur)}			*!		

5. Reduplicant as minimal word

5.1 Core analysis

Our approach to Rotuman builds on the analysis of Diyari reduplication in McCarthy and Prince (1994), sketched in (12). The reduplicant is assumed to be a separate prosodic word (shown with {}-bracketing), because it receives an independent stress and obeys the phonotactics of prosodic words in Diyari. As an independent PrWd, the reduplicant must therefore contain at least one foot to satisfy strict succession of prosodic categories. Because faithfulness properties of reduplicants are distinct from those of the base, reduplicants can be shaped by markedness constraints when they are ranked above base-reduplicant faithfulness. Thus, FOOTBINARITY rules out PrWds with subminimal feet (12e) and ALLFEETLEFT rules out more than one foot, because multiple feet cause non-final feet to be mis-aligned in a PrWd (12c).

PARSESYLLABLE rules out three syllable reduplicants since the third syllable cannot be parsed into a binary foot (12d). Thus, these standard constraints on prosodic constituency apply directly to the PrWd dominating the reduplicant to explain shape facts.

(12) MinWd reduplication, /t^{j}ilparku$_{RED}$/ → t^{j}ilpa-t^{j}ilparku 'bird species'

Input: t^{j}ilparku$_{RED}$	*C}$_{PrWd}$	FTBIN	PARSESYL	ALLFTLT	MAX$_{BR}$	BR-INTEG
a. ☞ {(t^{j}ilpa)}-{(t^{j}ilpar) ku}			*		***	
b. {(t^{j}ilpar)}-{(t^{j}ilpar) ku}	*!		*		**	
c. {(t^{j}ilpar)((kuku)}-{(t^{j}ilpar) ku}			*	*!		**
d. {(t^{j}ilpar) ku}-{(t^{j}ilpar) ku}			**!			
e. {(t^{j}i)}-{(t^{j}ilpar) ku}		*!	*		*****	

Additional support for reduplicants being independent prosodic words in Diyari is that they obey prosodic word phonotactics. All PrWds are vowel final in Diyari, and reduplicants drop coda consonants in the second syllable to satisfy this requirement (12a), cf. (12b). Thus, the logic supporting {*reduplicant*}$_{PrWd}$ is rich and internally consistent. The same logic can be applied to Rotuman. If we assume that foot-sized reduplicants are separate prosodic words, then shape characteristics and special phonology can be explained as constraints on prosodic words. Thus, just as Diyari drops coda consonants PrWd-finally because of special PrWd requirements, Rotuman has a host of segmental alternations, including deletion, that satisfy the constraint that PrWds end in heavy syllables, ALIGN-HEAD-σ.

The minimal word analysis of Rotuman reduplication is illustrated below for two characteristic cases, metathesis and deletion. The same constraints that are top-ranked in the incomplete phase system are likewise top-ranked here, weeding out candidates that are subminimal (13i-ii.d), fail to satisfy ALIGN-HEAD-σ (13i-ii.c), or that satisfy ALIGN-HEAD-σ with foot-flipping (13i-ii.e). The only difference between these cases is that one case can satisfy ALIGN-HEAD-σ by forming a light diphthong with metathesis (13ii), and the other cannot (13i), just like the analysis of the incomplete phase in non-reduplicated words.

(13) Heavy syllable reduplicant as an effect of phase

Input	Outputs	FtBin	FtForm	AlnHd-σ	LighDiph	Max$_{BR}$	Lin$_{BR}$
i. /RED + tɑlu/	☞ a. {(tɑl)}-{(tɑlu)}			*		*	
	b. {(tɑul)}-{(tɑlu)}			*	*!		*
	c. {(tɑ́lu)}-{(tɑlu)}			**!			
	d. {(tɑ)}-{(tɑlu)}	*!		*		**	
	e. {(tɑlú)}-{(tɑlu)}		*!	*		**	
ii. /RED + purɛ/	☞ a. {(puɛr)}-{(purɛ)}			*			*
	b. {(pur)}-{(purɛ)}			*		*!	
	c. {(púrɛ)}-{(purɛ)}			**!			
	d. {(pu)}-{(purɛ)}	*!		*		**	
	e. {(purɛ)}-{(purɛ)}		*!	*		**	

It is an important fact of the heavy syllable reduplication system that front-to-back VCV# sequences do not get umlauted: *tus-tusi* 'spotted' and not **tys-tusi* from *tusi* (*tys*) 'dot'. This is not like canonical phase phonology and its analysis and theoretical consequences are discussed in detail in section 5.2.2.

The analysis so far accounts for reduplication with disyllabic bases, which are by far the most common. It can be straightforwardly extended to reduplication with trisyllabic bases, with some additional independently motivated constraints. With trisyllabic bases, it is clear that reduplication copies specifically from the first two syllables, so left-anchoring is at work. Following standard protocol, ANCHORLEFT(RED, BASE) >> ANCHORRIGHT(RED, BASE) ensures copying from the beginning of the stem. The same rankings from above work in essentially the same way, but an additional prosodic well-formedness constraint, PARSESYLLABLE, is needed to prevent copying of more than the initial CVC (14c).

(14) Heavy syllable reduplication with trisyllabic bases

Input: RED+sakoto	FtBin	ParseSyll	AlignHd-σ	LightDiph	Max_{BR}	Lin_{BR}
☞a. {(sɑk)}-{sɑ(koto)}		*	*		***	
b. {(sɑok)}-{sɑ(koto)}		*	*	*!	**	*
c. {sɑ(kot)}-{sɑ(koto)}		**!	*		*	
d. {(sɑko)}-{sɑ(koto)}		*	**!			
e. {(sɑ)}-{sɑ(koto)}	*!	*	*		*	

One other difference with non-reduplicative incomplete phase revealed here is that there is always a match of the head syllable in complete and incomplete phase, e.g., $\textit{rák}_{\text{Incomp}}$ ~ $\textit{ráko}_{\text{Comp}}$. This is not the case in base-reduplicant faithfulness, so McCarthy's HEADMATCH, applied to base-reduplicative correspondence, must be bottom-ranked (see Blenkiron 2013 for full ranking details).

To summarize the core analysis thus far, the reduplicant is in a PrWd independent of the PrWd of the base. As a separate PrWd it must at least be a foot, so all reduplicants are at least bimoraic. But because it is PrWd-final, it is in incomplete phase. Consistent with incomplete phase phonology, the final V(C)V sequence must form a heavy syllable. The creation of this heavy syllable also follows the main pattern of incomplete phase heavy syllables: metathesis when rising light diphthongs can be formed from VCV# (15b), deletion when it cannot (15a), and recruitment of heavy diphthongs and long vowels from final VV# sequences (15c-d).

(15) Attested reduplicant shapes

a. CVC	Deletion	/RED + tɑlu/ → {(tɑl)}-{(tɑlu)}
b. CVVC	Metathesis	/RED + purɛ/ → {(puɛr)}-{(purɛ)}
c. CVV	Diphthongization	/RED + sui/ → {(sui)}-{(sui)}
d. CV:	No change	/RED + ko:/ → {(ko:)}-{(ko:)}

The larger theoretical point is, contrary to first impressions, the heavy syllable shape of reduplicants can be analyzed with independently motivated constraints. All of the usual suspects employed in minimal word phonology, FOOTBINARITY, ALIGNFOOTRIGHT/LEFT, PARSESYLLABLE, and FOOTFORM, are at work here. Furthermore, ALIGN-HEAD-σ, the real force behind the final heavy syllable target, is also independently motivated by the phonology of incomplete phase. It is true that ALIGN-HEAD-σ does not yet enjoy wide cross-linguistic support (though see the parallels McCarthy (2000) makes with Oceanic and Australian languages), but its language internal support is very strong. It unifies the analysis of the conditioning environment for incomplete phase phonology with that of the actual phonological processes that produce final heavy syllables.

However, before we can say this analysis is complete, we must reckon with some apparent exceptions.

5.2 Apparent problems with minimal word analysis

5.2.1 Antigemination effects: NoGem

Our analysis so far predicts that reduplicants, because they are dominated by a minimal word, will be bimoraic. As mentioned in section 3, there is a systematic gap in the heavy syllable reduplication system. These are stems with the form C_iVC_iV, such as *koko,* which surface with CV reduplicants, *ko-koko*, rather than with predicted bimoraic reduplicants, **kok-koko*. Note that these patterns are uncharacteristic of partial reduplication because they lack related heavy syllable and double reduplication patterns.

(16) lolo, n. 'grease, lard'; lo-lolo *lol-lolo adj./vi 'oily, greasy'
koko, adj. 'foolish'; ko-koko *kok-koko adj. pl. 'foolish'
nono , v. 'to grasp' ; no-nono *non-nono v. 'to grasp repeatedly'

Given richness of the base (McCarthy & Prince 1995; Prince & Smolensky 1993/2004), a complete analysis of reduplication must account for this systematic gap in words with two identical root consonants rather than impose an arbitrary restriction on the input. The analysis offered here does this by ranking anti-gemination constraints, shown to be active in other languages, with those already established in Rotuman morpho-phonology.

McCarthy (1986) first used the term anti-gemination to describe instances where syncope fails to apply between consonants to avoid adjacent identical consonants, a geminate in some analyses. Urbanczyk (1999) uses anti-gemination to describe a phenomenon in Lushootseed (Salish) that is nearly identical to Rotuman. In Lushootseed, CVC reduplication marks a distributive meaning. However, if the first and second consonant of the stem are identical, the reduplicant is always CV, *c'i - c'ic'al-b* 'sprouted wings', rather than **c'ic' - c'ic'al-b.* Lushootseed allows a few geminate consonants, requiring Urbanczyk's analysis to use two separate antigemination constraints. Rotuman, on the other hand, prohibits geminates of any type and thus it is more economical to use a single anti-gemination constraint. Bakovic (2005), building on work by Rose (2000), proposes the markedness constraint NOGEM to account for all possible representations of geminates.

(17) NOGEM
Adjacent completely identical consonants – geminates, in any representation – are prohibited.

NOGEM blocks the realization of a heavy syllable reduplicant by preventing a consonant from copying into the second mora in a bimoraic foot. However, there are other possible ways of satisfying the desired foot shape. In her argument for the minimal word in Rotuman, Blevins (1994) proposes that all mono-syllabic lexical words are augmented to satisfy a bimoraic minimal size requirement, e.g., /ri/ → ri: 'house'. Since this strategy is not available in reduplication, the faithfulness constraint, DEP-μ-BR, is required.

(18) DEP-μ_{BR}: moras in the reduplicant have base correspondents.

The roles of these constraints in the analysis are shown in (19). DEP-μ-BR must dominate FOOTBINARITY, because it is better to have a subminimal foot (19a) than lengthen the reduplicant vowel (19c). Likewise, NOGEM dominates FOOTBINARITY, preventing geminates (19b) from surfacing.

(19) Anti-gemination effects on reduplicant as minimal word

Input: RED + *fufi*	NOGEM	DEP-μ_{BR}	FOOTBIN	MAX$_{BR}$
☞a. {(fu)}-{(fufi)}			*	**
b. {(fuf)}-{(fufi)}	*!			*
c. {(fu:)}-{(fufi)}		*!		

Thus, this lapse in the minimal word requirement, while initially troubling, can be straightforwardly accounted for by incorporating NOGEM into our larger analysis.

5.2.2 Blocking of umlaut: under-application

Our analysis in its current form predicts that the ways of achieving final heavy syllables in the incomplete phase should be the same for reduplicated and non-reduplicated words. Both types of incomplete phase forms are PrWd-final, so they should have the same pattern. The data in (20) illustrate that the reduplicant for a disyllabic stem is the same as that stem in its incomplete phase, with one exception. In words ending in VCV where the two vowels are back-to-front, the reduplicant does not have the umlauted vowel characteristic of the incomplete phase in non-reduplicated contexts, i.e., it has *mos* (deletion), not **mœs* (umlaut), as expected. However, when the entire reduplicated form is in its incomplete phase (fourth column), both reduplicant and stem vowels are umlauted. This gap in umlauting is specific to reduplicants with complete phase stems, since umlauted vowels appear in initial stems of compounds: *mœsteŋi* 'nod with drowsiness' from *mose* (*mœs*) 'sleep' + *teŋi* 'to nod'.

(20)

	Non-reduplicated words		Reduplicated words	
	complete	incomplete	complete	incomplete
	ri:	ri:	ri:-ri:	ri:-ri:
	ru.ɛ	ruɛ	ruɛ-ruɛ	ruɛ-ruɛ
	purɛ	puɛr	puɛr-purɛ	puɛr-puɛr
	sɑpo	sɑp	sɑp-sɑpo	sɑp-sɑp
	mosɛ	mœs	mos-mosɛ	mœs-mœs

Our ranking as it stands does not account for this gap in umlaut, as illustrated by the tableau in (21) where the first mapping is a reduplicated word in its complete phase and the second input is a reduplicated word in its incomplete phase. The constraint ranking LIGHTDIPH, MAX_{IO} >>MAX_{BR}>>LIN_{BR} that was established in section 4 for deletion and metathesis, captures the facts in reduplicated words in the incomplete phase (21ii), but incorrectly predicts that a candidate with a base in complete phase will have umlauting, rather than the attested form with deletion (21i).

(21) Problem: predicted umlaut

Input	Output	LIGHTDIPH	MAX_{IO}	MAX_{BR}	LIN_{BR}
i. RED + mosɛ + σ	a. {(mos)}-{(mosɛ) σ }			*	
	💣 b. {(mœs)}-{(mosɛ) σ }				*
ii. RED + mosɛ	a. {(mos)}-{(mos)}		*!		
	☞ b. {(mœs)}-{(mœs)}				
	c. {(mos)}-{(mœs)}			*!	*
	d. {(mœs)}-{(mos)}		*!		*

A solution lies with the fact that reduplicants differ from other non-reduplicated forms in being governed by BR-faithfulness. The parallels we look for are well-established in reduplication studies under the rubric of under-application (McCarthy & Prince 1995; Wilbur 1973). Languages as diverse as Akan, Chumash, and Dakota exhibit reduplication patterns in which an otherwise regular process in the language fails to apply in reduplicated words. These cases are accounted for by assuming that there are a set of faithfulness constraints defined on a base-reduplicant correspondence relation, and such constraints block the regular process. Recent theoretical work on reduplication has challenged the existence of such constraints (Inkelas & Zoll 2005), but this case clearly seems to require them.

McCarthy's (2000) analysis of umlauting phase alternation is an effect of the ranking: MAX$_{IO}$ >> UNIFORMITY$_{IO}$, LINEARITY$_{IO}$. Coalescence does not violate the faithfulness constraint MAX since every input segment has a correspondent in the output. However, coalescence does violate LINEARITY since vowels can only coalesce once they are adjacent after undergoing metathesis. Coalescence also violates UNIFORMITY, which prohibits two or more segments from sharing a correspondent. Crucially, coalescence is only possible in Rotuman when VCV# combinations fall in sonority and have a back-to-front vowel sequence. As shown in section 4, the single resulting vowel is identical to the penultimate vowel in height and roundedness, but has the frontness of the final vowel. McCarthy does not elaborate on the specific identity constraints interacting to preserve the appropriate vowel features, but an obvious choice is IDENT[BACK].

Because umlauted vowels appear in the incomplete phase of non-reduplicated forms, IDENT[BACK]$_{IO}$, must be ranked below all other constraints in the analysis of these forms. However, the lack of umlaut in reduplicated forms can be predicted by ranking IDENT[BACK]$_{BR}$ above MAX$_{BR}$ and LINEARITY/UNIFORMITY$_{BR}$. The first mapping in (22i) shows the crucial ranking of IDENT[BACK]$_{BR}$ >> MAX$_{BR}$: it prefers deletion (22i.a) over umlaut (22i.b). But when the base vowel has been umlauted separately, this ranking allows the front rounded vowel to be transferred to the reduplicant (22ii).

(22) Under-application of umlaut in reduplication

Input	Output	MAX$_{IO}$	IDENT$_{BR}$[BK]	MAX$_{BR}$	LIN$_{IO}$/ UNIF$_{IO}$
i. RED + mosɛ + σ	☞a. {(mos)}-{(mosɛ) σ}			*	
	b. {(mœs)}-{(mosɛ) σ}		*!		
ii. RED + mosɛ	a. {(mos)}-{(mos)}	*!			
	☞b. {(mœs)}-{(mœs)}				*
	c. {(mos)}-{(mœs)}		*!	*	*
	d. {(mœs)}-{(mos)}	*!	*		

Again, what appears to be a problem for a minimal word analysis of reduplication is simply a case of under-application, a logical possibility given the free ranking of BR-identity constraints.

5.2.3 Size effects: prosodic faithfulness

A final problem concerns a size effect in certain trisyllabic stems. The incomplete phase phonology in VCVs with rising sonority is metathesis, e.g., *puɛr-pu.rɛ*. This is the default in disyllabic forms, which far outnumber mono- and trisyllabic stems. When we examine trisyllabic stems, however, instead of the expected metathesis, we find deletion of V_2.

(23) Metathesis and deletion in uCɛ→ uɛC

	Stem		Reduplicated Stem	
	complete	incomplete	complete	incomplete
a)	purɛ	puɛr	puɛr-purɛ	puɛr-puɛr
b)	furɛʔi	furɛʔ	fur-furɛʔi (*fuɛr-furɛʔi)	fur-furɛʔ

To put these exceptions in perspective, from the stem list, only six of the 98 trisyllabic words and none of the seven 4+ syllable words had the environment for metathesis (see Blenkiron 2013 for details). While small in number, all six trisyllabic reduplicated stems where we currently predict metathesis, in fact exhibit deletion, a discovery due to Blenkiron (2013).

There is no general word length restriction on metathesis, since it appears base finally in reduplicated trisyllabic words: *man-manɛʔa* → *man-manɛaʔ* ‘to play’ and *sɔk-sɔkiro* → *sɔk-sɔkior* ‘to examine or scrutinize closely’. Similarly, in compounds, when the first stem in the compound ends in a sequence of vowels that rise in sonority, it will metathesize to form its incomplete phase: *fiʔa* + *rɛrɛ* → *fiaʔ-rɛrɛ* ‘to squat’. Thus, this blocking of metathesis is restricted to reduplicants with trisyllabic bases.

The salient difference between the metathesis environment in reduplicated words, on the one hand, and non-reduplicated words, on the other, is whether or not the target syllable is stressed. In the case of disyllabic stems, the segments undergoing metathesis are members of an unstressed syllable (e.g., *rɛ* in *púrɛ*). However, in stems larger than two syllables, the segments that would participate in metathesis are in a stressed syllable: *fu.rɛ́.ʔi*. Cross-linguistically, stressed syllables tend to resist phonological processes and have larger structural inventories (Alderete 1995; Beckman 1999). Indeed, as mentioned in section 4, McCarthy’s (2000) analysis employs such a positional privilege in the retention of stressed syllables in metathesis: the constraint HEADMATCH ensures that the head syllable of the complete phase matches that of the incomplete phase, i.e. *ráko* → *rák* **rók*. While the corresponding HEADMATCH constraint in BR-correspondence must be low-ranked, another option here, because of the different orientation of copying, is to privilege the linear order of the segments of the stressed syllable. Thus, we propose the positional faithfulness constraint below for the observed size effect.

(24) LINEARITYHEAD$_{BR}$

No segment reversal within the head syllable in reduplicant-base correspondence.

With LINEARITYHEAD$_{BR}$ ranked above MAX$_{BR}$, the winner is the word with deletion of the stressed vowel in trisyllabic stems, {(fur)}-{fu.(rɛ.ʔi)}. LINEARHEAD$_{BR}$ is satisfied vacuously here, because LINEARITY constraints are only enforced if the two elements to be linearized are retained in the output (McCarthy & Prince 1995). This option avoids both switching the linear order of the segments of the stressed syllable *{(fuɛr)}-{fu.(ˈrɛ.ʔi)} and retaining the stressed syllable by copying an unfooted initial syllable *{fu.(rɛʔ)}-{fu.(rɛ.ʔi)}. This last potential problem for the generalized templates approach can thus be solved by appealing to positional faithfulness, an idea that has both language internal and cross-linguistic support.

6. Conclusion

One of the main goals of this paper is to offer an analysis of heavy syllable reduplication within the generalized templates paradigm. In particular, our goal was to implement an analysis in which the reduplicant is a minimal word. The assumed minimal word status of the reduplicant was then the basis of the explanation for the heavy syllable shape. The reduplicant must be at least a foot, because every prosodic word in Rotuman is at least a foot. But prosodic words must end in stressed syllables because of ALIGN-HEAD-σ. Since Rotuman, like many related Oceanic languages, has trochaic feet, this means the reduplicant must end in a heavy syllable; to do otherwise would produce a subminimal foot. In this way, the curious pattern of heavy syllable reduplication is due to a combination of language particular and language external forces.

The exceptions to the normal phase phonology also have independent support. The systematic avoidance of CVC- reduplicants with C_iVC_iX bases stems from a general constraint banning geminates, NOGEM. The blocking of umlaut in reduplication is treated as a standard type of under-application. Finally, the blocking of metathesis in reduplicants of trisyllabic bases is accounted for with the positional faithfulness constraint, $\text{LINEARITYHEAD}_{BR}$, which effectively blocks metathesis of the segments of the stressed syllable. These problems initially raised doubt about the viability of an analysis making use of general phonological constraints. However, the success of all of these constraints supports the generalized templates approach.

The main goal of this article is to document the facts of reduplication in Rotuman and analyze it against the backdrop of more general patterns of Rotuman phonology. As a result, we have not seriously considered alternatives to the generalized template analysis. However, the under-application of umlauting is a theoretically interesting pattern that appears to distinguish the present account from an alternative approach to this type of reduplication given in Inkelas & Zoll (2005). Because of its size and compounding nature, reduplication in Rotuman is classified as 'morphological doubling' in this theory. Morphological doubling is a morphologically-motivated copying of morpho-semantic features in prosodically large units. An important theoretical position taken in this theory is that morphological doubling involves morpho-semantic identity relations, and therefore does not require BR-faithfulness constraints of the type in common use in correspondence-based reduplication studies (McCarthy & Prince 1993; McCarthy & Prince 1995; Spaelti 1999; Urbanczyk 1996). Morphological doubling, therefore, does not have a ready mechanism for over- or under-application in morphological doubling, which is clearly attested in Rotuman. Future research will have to carefully assess the viability of the morphological doubling approach here, including recognition of the many opacity effects it can account for. However, under-application in Rotuman reduplication appears to be problematic to the contention that morphological reduplication lacks BR-faithfulness.

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