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ORIGINAL PAPER

Infixing reduplication in Pima and its theoretical consequences

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Abstract Pima (Uto-Aztecan, central Arizona) pluralizes nouns via partial reduplication. The amount of material copied varies between a single C (*mavit / ma-m-vit* ‘lion(s)’) and CV (*hodai / ho-ho-dai* ‘rock(s)’). The former is preferred unless copying a single C would give rise to an illicit coda or cluster, in which case CV is copied. In contrast to previous analyses of similar patterns in Tohono O’odham and Lushootseed, I analyze the reduplicant as an infix rather than a prefix. The infixation of the reduplicant can be generated via constraints requiring the first vowel of the stem to correspond to the first vowel of the word. Furthermore, the preference for copying the initial consonant of the word can be generated by extending positional faithfulness to the base-reduplicant relationship. I argue that the infixation analysis is superior on two grounds. First, it reduces the C vs. CV variation to an instance of reduplicant size conditioned by phonotactics. Second, unlike the prefixation analyses, which must introduce a new notion of faithfulness to allow syncope in the base just in the context of reduplication (e.g. “existential faithfulness” (Struijke 2000a)), the infixation analysis uses only independently necessary constraints of Correspondence Theory.

Keywords Reduplication · Uto-Aztecan · Correspondence Theory · Generalized Template Theory

1 Introduction

Pima reduplication offers an interesting analytic puzzle, the solution of which bears on a number of important issues in the theory of reduplication. In this paper I will present

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the Pima data, provide an analysis within the framework of Optimality Theory (OT; Prince & Smolensky, 1993), and address the theoretical implications of this analysis. I will argue that a particular set of reduplicative patterns that some previous scholars have analyzed as prefixing reduplication plus syncope in the base can be analyzed simply as infixing reduplication. Moreover, I will show that these two analyses have very different theoretical ramifications. At stake here are the flexibility with which a grammar is allowed to pick out which segments get copied in reduplication and the nature of the distinction between the base and the reduplicant.

1.1 Overview

Reduplication in Pima copies the left edge of the stem and is used to mark plural forms of nouns, adjectives, adverbs, verbs and even some determiners. Pima reduplication is particularly interesting because the amount of material duplicated in the pluralized forms varies between a single consonant and the initial CV sequence. I will refer to these two patterns of reduplication as C-Copying and CV-Copying respectively.[1]

(1) C-Copying: má.vit̪ 'lion' mám.vit̪ 'lions'
(2) CV-Copying: hó.d̪ai 'rock' hó.ho.d̪ai 'rocks'

I use the term 'copying' here simply to reference the appearance of material twice in reduplicated forms and not to indicate an assumption about which part of the surface form is the reduplicant. Variation between these two patterns of reduplication is conditioned by a handful of phonotactic restrictions, most of which show their effects only in the context of reduplication. These will be discussed in Sect. 2.

Fitzgerald (1999a, 2000) and Struijke (2000b) discuss similar patterns of reduplication in Tohono O'odham (TO) and Lushootseed, respectively. In their analyses the C-copying pattern arises from the prefixation of a CV reduplicant accompanied by a process of syncope in the base that is specially licensed in the context of reduplication. In this work I will argue that this pattern should instead be seen as a case of reduplicative infixation. In (3) I sketch these two analytical possibilities. Throughout this work reduplicants are underlined and in boldface.

(3) Reduplicative prefixing + syncope in the base:
mavit̪$_{sg.}$ →**ma**mvit̪$_{pl}$.

Reduplicative infixation:
mavit̪$_{sg}$. →ma**m**vit̪$_{pl}$.

The two analyses in (3) entail significantly different assumptions about the nature of the distinction between the base and the reduplicant. Specifically, pursuit of the prefixation+syncope analysis requires that Correspondence Theory (CT; McCarthy & Prince, 1995) be augmented with a new dimension of faithfulness so that the deletion

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[1] Distributives are also marked with reduplication. For nouns this indicates that there are multiple kinds of the noun. Plural and distributive reduplication show a similar dichotomy with respect to how much material is copied. For reasons of space, I won't discuss the distributive here.

	gloss	sg.	pl.	dist.
C-Copying:	cake	t͡ʃɨ.mait̪	t͡ʃ ɨt͡ʃ.mait̪	t͡ʃɨ.ʔ ɨ t͡ʃ.mait̪
CV-Copying:	drum	t̪ám.boɹ	t̪á.tam.boɹ	t̪á.ʔa.tam.boɹ

of material in the base is licensed just in case a faithful copy of that material has been preserved in the reduplicant. Struijke (2000a) dubs this new correspondence relation 'existential faithfulness.' The infixation analysis, on the other hand, does not require existential faithfulness but does require a theory of infixation that allows a copy of the initial consonant to be infixed after the first vowel of the stem.

I will show in Sect. 3 that the addition of existential faithfulness to Correspondence Theory allows the generation of a strict superset of the languages that can be generated under the original formulation of CT. The relevant questions are then, whether patterns like those observed in Pima reduplication truly require that the theory be extended in this way and whether or not the consequences of this extension of CT are desirable. I will argue that the answer to both of these questions is negative. In Sect. 2, I show that an analysis of Pima reduplication as an infixation process can readily account for the C-Copying pattern without revising CT. In Sect. 3, I show that modifying Correspondence Theory to include existential faithfulness is problematic in that it predicts odd and unattested reduplicative patterns.

1.2 Background on Pima; data sources, phonemes, and stress

Pima is a Uto-Aztecan language spoken on the Gila River Reservation and the Salt River Reservation in central Arizona. The data presented here comes from the generous assistance of my Pima consultant Mr. Virgil Lewis in field work that I carried out from Fall 2000 to Winter 2002. Much guidance in collecting this data was taken from the Tohono O'odham/Pima-English dictionary by Saxton, Saxton, and Enos (1983).[2] Pima and Tohono O'odham are highly similar in their inventories, phonotactic restrictions, and patterns of reduplication, though there are a few differences that will be discussed in this work. The phonemic inventory of Pima is given in (4).

(4)

Inventory:[3]	Bilabial	Labio-dental	Dental	Alveolar	Palato-alveolar	Palatal	Velar	Glottal
Plosive	p b		t̪ d̪	d			k g	ʔ
Nasal	m			n		ɲ		
Lat. Flap				ɺ				
Fricative		v		s	ʃ			h
Approx.						j	w	
Affricates				t͡ʃ d͡ʒ				

	Front	Central	Back
High	i	ɨ	u
Mid			o
Low		a	

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[2] Tohono O'odham (also known as Papago) and Pima are closely related and mutually intelligible, but in many cases they diverge in their lexicons and in the specifics of certain phonological processes. Previous work on Pima and TO includes Hale (1959, 1965), Hale and Selkirk (1987), Hill and Zepeda (1992, 1998, 1999), Saxton (1963), Zepeda (1984, 1987, 1988), and the extensive work on Tohono O'odham of Fitzgerald (1994, 1996, 1997a, b, c, 1998, 1999a, b, 2000, 2001a, b, c, d, 2002a, b, c, 2003a, b).

[3] A couple of notes are in order here. The high front vowel has many allophones. It surfaces as [i] *kw**i*** 'tree', [ɪ]*ʃaːlɪv* 'pants', [e] *t͡ʃ**e**ɲ* 'mouth' and [ɛ] *dɛtaʃ* 'today' its variation conditioned by the preceding consonant; for more on this see Lyon (2001). [ʃ] sometimes sounds like the retroflex fricative [ʂ]; for more on this see Avelino and Kim (2003). Finally, what I transcribe as [ɨ] sounds a bit further back, but not quite like [ɯ]; for more on this see Jackson (2003).

Stress in Pima is extremely regular, almost always consisting of a single primary stress on the stem-initial syllable. However, in compounds and a few exceptional words of (usually) Spanish origin, primary stress occurs on a medial syllable and the initial syllable gets secondary stress (e.g. *bàʔitk-kámpaɲ* 'uvula [lit. throat-bell]', *mà.ɹó.ma* 'acrobat (Sp)' cf. Munro and Riggle (2004)). Fitzgerald (1996, 1997a, b, c, 1999b, 2002a, b, c) has worked extensively on secondary stress in Tohono O'odham, noting that in TO reduplication can alter the occurrence of secondary stress. For example, in TO, monomorphemic trisyllabic forms like *mú.si.go* 'musician (Sp)' do not show secondary stress while polymorphemic forms like *mú**m**.si.gò* 'musicians (Sp)' do. I have been unable to discern any difference in the final vowels of pairs like these in Pima and conclude that (outside of compounds and lexically accented loans) secondary stress is either extremely subtle or nonexistent in Pima. In this work, the issue of whether Pima has regular secondary stress will be set aside because, if any regular secondary stress is present, it does not condition C vs. CV-copying in reduplication. Stress will only be marked in the forms cited here if it deviates from the regular pattern of a single stem-initial primary stress.

2 Conditioning the size of the reduplicant

In this section I will present a set of phonotactic restrictions that condition the variation between C-Copying and CV-copying reduplication. I will argue that the C-Copying pattern (e.g. *mavit* → *ma**m**vit*) is the default mode of reduplication in Pima and that the CV-Copying pattern (e.g. *hohodai* → *ho**ho**dai*) should be seen as a deviation from the C-Copying pattern that is tolerated in order to avoid the creation of phonotactically illicit codas. Finally, I will show that this state of affairs can be readily modeled as variation in the size of an infixed reduplicant.

A small set of relatively common phonotactic restrictions condition variation between C- and CV-Copying. Many of these restrictions are 'emergent' in the sense of McCarthy and Prince (1995) in that they are not generally active in Pima but rather show their effects only in the context of reduplication. This represents a fairly typical instance of the well-known tendency for unmarked structures to surface in reduplication (McCarthy & Prince, 1986; Shaw, 1987; Steriade, 1988, others). McCarthy and Prince (1995) dub this phenomenon 'The Emergence of the Unmarked' (TETU) and show how it can be generated under Correspondence Theory.

The phonotactic restrictions that emerge in Pima reduplication are (i) a dispreference for laryngeal codas, (ii) a dispreference for palatal-nasal codas, (iii) a sonority restriction on coda clusters, and (iv) a dispreference for complex onsets.

Consider in (5) cases in which the phonotactic restrictions are not at stake. These forms show that whenever the stem-initial consonant can serve as a coda without violating any of the phonotactic restrictions, it does so, and C-Copying is observed.

(5)

gloss	**sg.**	**pl.**	**unattested: CV-Copying**
'scorpion'	nak.ʃɨɹ	nank.ʃɨɹ	*na.nak.ʃɨɹ
'quail'	ka.kai.t͡ʃu	kak.kai.t͡ʃu	*ka.ka.kai.t͡ʃu
'cardinal'	si.puk	sis.puk	*si.si.puk
'earlobe'	nak	nank	*na.nak
'lion'	ma.vit̪	mam.vit̪	*ma.ma.vit̪

‘moon’	ma.ʃad	mam.ʃad	*ma.ma.ʃad
‘packrat’	ko.son	kok.son	*ko.ko.son
‘cake’	t͡ʃɨ.mait̪	t͡ʃɨt͡ʃ.mait̪	*t͡ʃɨ.t͡ʃɨ.mait̪
‘cocoon’	kos.vuɹ	koks.vuɹ	*ko.kos.vuɹ
‘lower skull’	kuʃ.va	kukʃ.va	*ku.kuʃ.va
‘rust’	vɨ.gio.mi	vɨp.gio.mi	*vɨ.pɨ.gio.mi
‘barrel’	va.ɹin	vap.ɹin	*va.pa.ɹin

Note that the hypothetical reduplicative forms marked as unattested in (5) actually show less-marked syllable structure than the attested forms in that they have fewer codas and coda clusters. This suggests that C-Copying is the ‘default’ reduplicative pattern that is used when its results won’t violate the phonotactic restrictions. Fricatives ‘s’ and ‘ʃ’ behave exceptionally, as shown in *koks.vuɹ* ‘cocoons’ and *kukʃ.va* ‘lower skulls’, suggesting either that they are extra-syllabic or that they are exceptions to the generalizations about clusters.[4]

Laryngeal codas are not generally allowed in Pima. If the initial consonant of the stem is laryngeal, then CV-Copying ensures that both copies of the laryngeal surface as onsets.[5]

(6)

gloss	**sg.**	**pl.**	**unattested: C-Copying**
‘rock’	ho.d̪ai	ho.ho.d̪ai	*hoh.d̪ai
‘lima bean’	ha.voɹ	ha.ha.voɹ	*hah.voɹ
‘blacksmith’	hi.ɹo	hi.hi.ɹo	*hih.ɹo
‘dress’	ʔi.put̪	ʔi.ʔi.put̪	*ʔiʔ.put̪
‘circle’	ʔo.ɹas	ʔo.ʔo.ɹas	*ʔoʔ.ɹas
‘wart’	ʔu.pu.ɹik	ʔu.ʔu.pu.ɹik	*ʔuʔ.pu.ɹik

Palatal nasal codas are not created by reduplication. Whenever stems begin with a palatal nasal, the initial CV sequence is copied so that both copies of the palatal nasal surface as onsets.

(7)

gloss	**sg.**	**pl.**	**unattested: C-Copying**
‘liver’	ɲu.matʃ	ɲu.ɲu.matʃ	*ɲuɲ.matʃ
‘night hawk’	ɲɨ.pod	ɲɨ.ɲɨ.pod	*ɲɨɲ.pod
‘disaster’	ɲɨ.d͡ʒig	ɲɨ.ɲɨ.d͡ʒig	*ɲɨɲ.d͡ʒig
‘legendary snake’	ɲɨ.big	ɲɨ.ɲɨ.big	*ɲɨɲ.big

The restriction responsible for this pattern is not a ban on palatal nasal codas, as palatal nasals do occur in codas outside of reduplication (e.g. *totoɲ* ‘ant’, *huːɲkus*‘cornstalk’).

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[4] The v→p mutation in the last two forms is totally productive in Pima reduplication occurring even in relatively recent borrowings like *vaɹin* from Spanish *baril*. In other Uto-Aztecan languages like Southeastern Tepehuan this mutation is more extreme, affecting every intervocalic [v] in the stem in reduplicated forms (Willet, 1982; Kager, 1997). In Pima, only the stem-initial [v] becomes [p] and it does so regardless of whether or not it is intervocalic.

[5] Initial glottal stops are allowed to geminate with the onset of the second syllable (e.g. *ʔaʔag*$_{\text{sg.}}$ → *ʔaʔʔag*$_{\text{pl.}}$ ‘horns’).

Palatal nasals are also disallowed before non-high vowels, but this restriction isn't relevant for the current analysis.

Sonority reversals and plateaus in coda clusters are not generally created in reduplication. Whenever copying the lone initial consonant would create a cluster of constant or rising sonority, the initial consonant-vowel sequence is copied. This is illustrated in (8).

(8)

gloss	**sg.**	**pl.**	**unattested: C-Copying**
‘dog’	gogs	go.gogs	*goggs
‘cape’	mon.d͡ʒuɹ	mo.mon. d͡ʒuɹ	*momn.d͡ʒuɹ, *mom.nd͡ʒuɹ
‘joint’	namks	na.namks	*nanmks, *nan.mks
‘horse collar’	biʃp	bi.biʃp	*bibʃp
‘mountain lion’	gɨv.ho	gɨ.gɨv.ho	*gɨgv.ho, *gɨg.vho
‘lizard’	vat͡ʃ.ɹo	va.pat͡ʃ.ɹo	*vapt͡ʃ.ɹo, *vap.t͡ʃɹo
‘candle’	kan.d͡ʒɨɹ	ka.kan.d͡ʒɨɹ	*kakn.d͡ʒɨɹ, *kak.nd͡ʒɨɹ
‘lentil’	ɹan.d͡ʒɨ.ki	ɹa.ɹan.d͡ʒɨ.ki	*ɹaɹn.d͡ʒɨ.ki, *ɹaɹ.nd͡ʒɨ.ki

Coda clusters with sonority plateaus are allowed outside the locus of reduplication (e.g. *totpk* ‘purr’) but they are not generally created by reduplication. Note, however, that there are a few exceptions to this generalization, involving sequences of obstruents that occasionally surface as coda clusters in reduplication (e.g. *tok.dot*$_{\text{sg.}}$ → *totk.dot*$_{\text{pl.}}$ ‘spider’). Also, the cluster [ɹn] is never created in reduplication even though it declines in sonority (e.g. *ɹan.d͡ʒ ɨ.ki* $_{\text{sg.}}$→***ɹaɹn.d͡ɨʒ .ki*$_{\text{pl.}}$). These facts, together with the exceptional behavior of [ʃ] and [s], show that the conditions that govern coda clusters are complicated. For the purposes of the current analysis I will use the slightly oversimplified generalization that coda clusters in Pima must show sufficient decline in sonority to be licit.[6] While this topic is worth more research, the simple sonority generalization will suffice for the current analysis. Note that the restriction here is not a ban on triconsonantal sequences; such clusters are created when the sonority restrictions can be respected, for example: *nak.ʃ ɨ.ɹ*$_{\text{sg.}}$ → *nank.ʃ ɨ.ɹ*$_{\text{pl.}}$ ‘scorpion’.

Though onset clusters are rare in Pima, a few words do have them (e.g. *spuɹvam* ‘alfalfa, *ʔo.vis.pɹa* ‘bishop’, and *tɹogi* ‘truck’). When a word that begins with a cluster is pluralized, both the C-Copying and CV-Copying patterns can occur, with one interesting twist. It is always the second member of the cluster that is copied in reduplication, not the initial consonant. Modulo this factor we see the regular phonotactic conditioning of the variation between C-Copying and CV-Copying. The forms in (9) provide an especially appealing case for the infixation analysis.

(9)

	gloss	**sg.**	**C-Copying**	**CV-Copying**
a.	‘truck’	t̪ɹo.gi	t̪ɹoɹ.gi	*t̪ɹo.ɹo.gi $^{-unattested}$
	‘nail’	kɹa.vo	kɹaɹ.vo	*kɹa.ɹa.vo $^{-unattested}$
	gloss	**sg.**	**C-Copying**	**CV-Copying**
b.	‘tramp’	t̪ɹam.ba	*t̪ɹaɹm.ba $^{-unattested}$	t̪ɹa.ɹam.ba
	‘an iron’	pɹan.dʒa.kud	*pɹaɹn.dʒa.kud $^{-unattested}$	pɹa.ɹan.dʒa.kud

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[6] For more on sonority restrictions on coda clusters see Clements (1990) and Baertsch (2002), among others.

In (a) only the rightmost consonant of the initial cluster is copied (the C-Copying pattern) and in (b) the rightmost consonant of the cluster and the following vowel are copied so as to avoid the creation of an illicit coda cluster (the CV-Copying pattern). The fact that the entire onset is not copied shows that Pima reduplication avoids the creation of complex onsets.

The data in (9) might suggest an analysis whereby an empty C was infixed after the first stem vowel and then had its content filled in by spreading (or surface correspondence à la Rose and Walker (2004)). Though such an analysis would offer a neat account of the locality of the copying, it would require that the CV-Copying cases come about from V epenthesis. This would be messy because the clusters to be 'repaired' by epenthesis are generally licit in Pima and thus the epenthesis would have to be specially licensed in the context of pluralization. It seems more straightforward to explain the emergent phonotactics that condition CV-Copying as an instance of TETU rather than as epenthesis that's specially licensed by pluralization.

To summarize the generalizations made up to this point, C-Copying is preferred unless copying the initial consonant alone would create a coda or coda cluster that violates one of the phonotactic restrictions, in which case the initial CV sequence is copied.

Interestingly, when forms with diphthongal nuclei in the initial syllable are considered, these preferences seem to be reversed. That is, when the initial syllable contains a diphthong, the initial CV sequence is copied even though there are several ways that the initial consonant alone could be copied without violating the phonotactic restrictions discussed so far. The reduplication of words with diphthongs in the stem-initial syllable is illustrated in (10).

(10)

gloss	**sg.**	**pl.**	**unattested:** $\mathbf{C_1V_1.C_1V_2}$…	$\mathbf{(C_1V_1V_2C_1….)}$
'firefly'	t̪ai.vig	t̪a.t̪ai.vig	*t̪a.t̪i.vig	(*t̪ait̪.vig)
'party'	piast̪	pi.piast̪	*pi.past̪	(*piapst)
'firecracker'	kui.t̪as	ku.kui.t̪as	*ku.ki.t̪as	(*kuik.t̪as)
'burn'	mɨi	mɨmɨi	*mɨ.mi	(*mɨim)
'pet'	ʃoi.ga	ʃo.ʃoi.ga	*ʃo.ʃi.ga	(*ʃoiʃ.ga)
'thorn'	hoi.pat̪	ho.hoi.pat̪	*ho.hi.pat̪	(*hoih.pat̪)
'worker'	pion	pi.pion	*pi.pon	(*piopn)
'soul'	doa.kag	do.doa.kag	*do.da.kag	(*doad.kag)
'twin'	kua.di	ku.kua.di	*ku.ka.di	(*kuak.di)
'cry, wail'	ʃoak	ʃo.ʃoak	*ʃo.ʃak	(*ʃoaʃk)
'iron'	vai.nom	va.pai.nom	*va.pi.nom	(*vaip.nom)
'trench'	vai.ka	va.pai.ka	*va.pi.ka	(*vaip.ka)

In (10) I give unattested plurals where diphthongs are split between two syllables, e.g. **t̪a.t̪i.vig*, and where copies of the initial C flank the diphthong, e.g. **t̪ait̪.vig* (recall that CVVC syllables are allowed, e.g. *piast̪* 'party'). The fact that neither alternative surfaces indicates that the CV-Copying pattern is preferred when the initial syllable of the stem contains a diphthong.[7]

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[7] Pima doesn't allow onsetless syllables but, if the forms in (10) were analyzed as beginning [CV.V, then they would simply constitute more CV-initial forms. Pima and Tohono O'odham differ in how they treat forms containing initial diphthongs. Fitzgerald (2000) reports that, in TO, diphthongs in

The patterns described thus far present an apparent contradiction in that words with complex nuclei in the initial syllable and words with simple nuclei in the initial syllable seem to require opposing assumptions about which pattern of reduplication is the ‘default’ in Pima.

To simplify the initial analysis, the unattested plurals in parentheses in (10) will be set aside for the moment. Focusing on the unattested plurals that begin $\mathbf{C}_1\mathbf{V}_1.\mathbf{C}_1\mathbf{V}_2\ldots$, the apparent contradiction can be resolved by appeal to the following pair of facts. When the initial syllable has a simplex nucleus, copying the initial CV sequence will increase the number of syllables in the word, but copying C alone will not. This is illustrated in (11).

(11) C-Copying: *ma.vit̪*$_{\text{sg.}}$ → *mam.vit̪*$_{\text{pl}}$ -plural form has two syllables
CV-Copying: *ma.vit̪*$_{\text{sg.}}$ → **ma.ma.vit̪*$_{\text{pl}}$ -plural form has three syllables

On the other hand, when the initial syllable contains a diphthongal nucleus, either pattern of reduplication will yield output forms with the same number of syllables. For example:

(12) C-Copying: *t̪ai.vig*$_{\text{sg.}}$ → **t̪a.t̪i.vig*$_{\text{pl.}}$ -plural form has three syllables
CV-Copying: *t̪ai.vig*$_{\text{sg.}}$ → *t̪a.t̪ai.vig*$_{\text{pl}}$ -plural form has three syllables[8]

These observations suggest the following characterization of Pima reduplication: The reduplicant copies as much of the base as possible while respecting the emergent phonotactic restrictions and avoiding an increase in the number of syllables in the word if at all possible. This generalization also suggests an explanation of why Pima reduplication is only partial, never copying more than a single syllable.

The hypothetical plural forms with the $\mathbf{C}_1\mathbf{V}_1\mathbf{V}_2\mathbf{C}_1$.... reduplicative pattern (e.g. **t̪ait̪.vig*$_{\text{pl.}}$), can be ruled out with a requirement that the infixed reduplicant occur as close as possible to the left edge of the word.[9] This aspect of reduplicant placement will be analyzed in Sect. 2.2.

Having laid out the basic patterns of Pima reduplication, I will devote the remainder of Sect. 2 to an Optimality Theoretic analysis of these patterns. There are three basic issues to be resolved in the analysis of any system of reduplication: the amount of material that the reduplicant copies (size), the placement of the reduplicant (location), and the selection of which base material is copied (content). Each of these issues will be treated in turn in the next three sections.

2.1 Deriving the size of the reduplicant: why C-Copying is preferred

Various strategies have been proposed in Optimality Theory for deriving reduplicant size. One strategy is the direct imposition of prosodic templates on reduplicants using constraints that require the reduplicant to be coextensive with particular prosodic constituents such as a syllable or a foot (see McCarthy & Prince, 1993, 1996; Prince &

Footnote 7 continued
which one vowel is round and the first vowel higher than the second are split in reduplication. For example *doa.kag*$_{\text{sg.}}$ → *do.da.kag*$_{\text{pl.}}$‘soul(s)’, which is not attested in Pima, is a valid plural derivation in Tohono O’odham.

[8] The failure of plural forms like *t̪a.t̪ai.vig*$_{\text{pl}}$ and *t̪ait̪.vig*$_{\text{pl}}$ will be ruled out below.

[9] Assuming here that the reduplicant is ‘closer’ to the edge when separated from it only by a light open syllable.

Smolensky, 1993, *et seq.*). However, McCarthy and Prince (1994a, b, 1995), Urbanczyk (1995, 1996a), Spaelti (1997), Gafos (1998a, b), and others have argued that reduplicative templates are undesirable for several reasons. McCarthy and Prince (1995) claim that templatic constraints make problematic typological predictions. They discuss a hypothetical case pointed out by René Kager and Philip Hamilton whereby templatic constraints interact with B/R-Faithfulness so as to yield bizarre and improbable reduplicative patterns. This issue will be raised again in section 3 with respect to the prefixation analysis of Pima reduplication.

As an alternative to templates, McCarthy and Prince (1994b, 1995), Urbanczyk (1995, 1996a, 1998), Gafos (1998a), Alderete et al. (1999) and others have proposed that template-like effects in reduplication should be derived from general properties of morphology, phonology and their interface. This program is referred to as Generalized Template Theory (GTT). In the current analysis I'll follow this strategy by minimizing the reduplicant with a markedness constraint in the Emergence of the Unmarked ranking. The constraints used here are just the members of the MAX family of constraints in Correspondence Theory listed in (13).

(13)a. INPUT/BASE-MAX: (**I/B-MAX**)
Every segment in the input must have a correspondent in the base.

b. BASE/REDUPLICANT-MAX: (**B/R-MAX**)
Every segment in the base must have a correspondent in the reduplicant.

Minimization of the reduplicant will occur whenever a markedness constraint that prefers output forms with fewer syllables, a *Size Restrictor* (SR), is ranked between I/B-MAX and B/R-MAX. As long as the SR is ranked below I/B-MAX but above B/R-MAX the base will be unaffected but the reduplicant will be minimized at the expense of matching the size of the base. Thus the unmarked value, in this case having fewer syllables, is said to 'emerge' in the context of reduplication. This scheme for minimizing reduplicant size is represented in (14).

(14) Reduplicant size restriction as the Emergence of the Unmarked
INPUT/BASE-MAX ≫ *Size Restrictor* ≫ BASE/REDUPLICANT-MAX

There are several ways that a preference for the C-Copying pattern in Pima reduplication could be generated. The mechanism that prefers C-Copying is basically analytically independent of the status of the reduplicant as an infix or a prefix save for the following fact. In the infixation analysis the C-Copy preferring constraints will minimize the size of the reduplicant in the TETU ranking in (14), but in the prefixation analysis the C-Copy preferring constraints will demand the deletion of base material in the context of reduplication.

Fitzgerald's (1997a) analysis of Tohono O'odham utilizes a constraint demanding that stressed syllables be heavy to motivate syncope in the base in order to close the initial syllable (which is always stressed in Pima and TO)—this analysis will be discussed in more detail in Sect. 3. Struijke (2000a, b) analyzes a Pima-like pattern of reduplication in Lushootseed in which the vowel in the second syllable of reduplicated forms varies between reduction and deletion using a constraint *UNSTRESSED CORNERV to cause syncope in the base in the context of reduplication. Either of these approaches could be extended to the prefixing analysis of Pima reduplication by asserting that the size restricting constraints were applied to the reduplicant rather than the base.

Another way to select minimal reduplicants, and thus prefer C-Copy, is a general strategy that Gouskova (2003a, b, c) has called ‘Economy’ in which all structure is penalized. This can be done indirectly with constraints like ALL-σ-LEFT, which penalize every non-initial syllable (Mester & Padgett, 1994; Spaelti, 1997), or more directly with a constraint like *STRUCTURE-σ that penalizes every syllable (Zoll, 1993, 1994). This strategy has been used to generate Pima-like reduplicative patterns in Klamath (Cole, 1997), the Salish languages Bella Coola (Raimy & Idsardi, 1997) and Halq’eméylem (Urbanczyk, 1998), and many others.

As yet another alternative, Gouskova (2003a, b, 2004), while arguing against the general strategy of economy, suggests that Output–Output constraints (Benua, 1997; Burzio, 1994; Kenstowicz, 1996) such as DEP-SYLLABLE-OO should be used to require singular and plural forms to have the same number of syllables.

There are many more strategies that could be used in the analysis of the size restriction on Pima reduplicants, some of which will be discussed in Sect. 3. For the time being I will adopt the straightforward penalization of structure offered by economy with the constraint in (15).

(15) *STRUCTURE-σ: (***Struc-**σ)
Assigns one violation per syllable in the output. (Zoll, 1993, 1994)

This is a complex issue, and the final determination of what size-restricting strategies fit best in the theory of reduplication is important. Nonetheless, provided that constraints on reduplicant size are used in the TETU ranking, any of the size restricting schemes outlined thus far could be plugged into the analysis given.

There are two main reasons to prefer analyses that use only basic markedness constraints in TETU rankings as size restrictors. First, markedness constraints are formally simpler than either alignment constraints or Output–Output faithfulness constraints (see Eisner (1997) on the former and Potts and Pullum (2002) on the latter), and though alignment and OO-Faith have come under fire as unnecessary complications of OT, markedness constraints are clearly needed. Second, markedness constraints in TETU rankings do not give rise to the same sorts of anomalous predictions as templatic constraints. In Sect. 3 I will discuss the problems with templates and show how the same sort of anomalous predictions also arise under more exotic size-restricting schemes based on constraints like INTEGRITY and CONTIGUITY or on existential faithfulness.

Placing *STRUC-σ in a TETU ranking, above B/R-MAX but below I/B-MAX, will leave unreduplicated forms and bases intact, but will ensure that reduplication increases the syllable count of the word only minimally or not at all. To prevent size restrictors like *STRUC-σ from selecting candidates that don’t reduplicate anything at all some analysts have used a REALIZE MORPHEME constraint to demand that each morpheme have an observable output exponent (see Gafos, 1998a; Kurisu, 2001; Rose, 1997; Samek-Lodovici, 1993; Walker, 1998). In Sect. 2.3, the REALIZE MORPHEME constraint will be shown to be unnecessary in the analysis of Pima because the constraints that require a copy of stem-initial consonant in the reduplicant outrank *STRUC-σ and thereby block the possibility of an empty reduplicant.

The simplest cases are those in which the size restrictor can reduce the reduplicant to a single consonant unfettered by the phonotactic restrictions. This is illustrated in (16). Candidate (a), with a reduplicant consisting of a lone consonant, yields a surface form with fewer syllables than (b)–(e) which copy more of the base. Candidate (f)has even fewer syllables, but is suboptimal because material from the base has been deleted in violation of I/B-Max.

(16)

RED+nak 'earlobes'	I/B-Max	*Struc-σ	B/R-Max
a. ☞na**n**k		*	ak
b. nak		*	nak!
c. na.**na**k		**!	k
d. **na**.nak		**!	k
e. nak.**nak**		**!	
f. **nak**.nak		**!	
g. ∅	*!		

The factors which give rise to reduplicants larger than a single consonant are a variety of fairly ordinary markedness constraints. Two of these constraints are presented in (17) and (18):

(17) *Complex Onset: (***Cplx Ons**)
Complex onsets are dispreferred. (Prince and Smolensky, 1993)

(18) *Laryngeal Coda: (***Lar]**$_\sigma$)
Laryngeal codas are dispreferred. – cf. McCarthy (1998), which uses [*ʔ]$_\sigma$ for Arabic

*Cplx Ons and *lar]$_\sigma$ must be placed in the TETU ranking, below I/B-Faithfulness but above B/R and I/R-Faithfulness, in order to restrict the shape of reduplicants but leave unreduplicated forms and bases unaffected. Crucially, these constraints must also dominate *Struc-σ in order to select CV-Copying over the syllable-minimizing C-Copying pattern. This is illustrated in (19).

(19)

Phonotactics >> **Size Restrictor**

RED + hod̪ai 'rocks'	*lar]$_\sigma$	*Cplx Ons	*Struc-σ
a. ho**h**.d̪ai	*!		**
b. ho.**h**d̪ai		*!	**
c. ☞ho.**ho**.d̪ai			***

In (19) candidates (a) and (b) are less marked than (c) with respect to *Struc-σ but are ruled out because they violate *Cplx Ons and *lar]$_\sigma$, respectively. This scenario is a reversal of typical TETU effects in that the emergent phonotactics dominate the emergent size restrictor and thus make the reduplicant larger rather than smaller.[10]

Complex onsets are tolerated outside of reduplication, as evidenced by forms like *tlampa* 'tramp', and forms with the stative prefix '*s*-' such as *sgigivkim* 'tremulous'. To allow such forms to surface, *Cplx Ons must be dominated by Input/Base-Faithfulness constraints.

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[10] Kager (1996) describes a similar pattern in Guugu Yimidhirr where larger spans of material are copied just in case the base-reduplicant syllable contact rises in sonority. In (19) and throughout this section I ignore candidates that fail to copy the stem-initial C. These candidates will be dealt with in Sect. 2.3 once the constraints on reduplicant content have been introduced.

(20)

t̪ɹampa 'tramp'	I/B-Max	*Cplx Ons
a. ☞ t̪ɹampa		*
b. t̪ampa	*!	

When forms with initial clusters are reduplicated, it is the second consonant of the cluster that is copied. Modulo this point both C-Copying and CV-Copying patterns occur. For example, *t.ɹo.gi* 'truck' pluralizes as *t.ɹoɹ.gi* 'trucks' (C-Copying), while *t.ɹam.pa* 'tramp' pluralizes as *t.ɹa. ɹ**a**m.pa* 'tramps' (CV-Copying). These forms will be more fully analyzed in Sects. 2.2 and 2.4 once the constraints are introduced that condition the location and content of the reduplicant. The immediately relevant fact is that even when an extra syllable is added by reduplication, the onset cluster is not copied (e.g.**t.ɹa.***t*ɹa*m.pa* 'tramps'). This is expected, because, as shown in (21), if *Cplx Ons dominates *Struc-σ it must, by transitive domination, also outrank B/R-Max.

(21)

red + t̪ɹampa 'tramps'	*Cplx Ons	*Struc-σ	B/R-Max
a. ☞ t̪ɹa.**ɹa**m.pa	*	***	t mpa
b. t̪ɹa.**tɹa**m.pa	**!	***	mpa

Another factor that conditions the size of the reduplicant is the dispreference for coda clusters of level or rising sonority. To capture this effect, the following constraint can be used.

(22) Sonority Sequencing Principle: (SSP)[11]
Sonority must decline towards the syllable margin; plateaus and reversals aren't allowed.

If SSP is ranked above *Struc-σ, then the grammar will select CV-Copying over C-Copying when necessary to avoid a marked coda sequence. This is illustrated in (23).

(23)

red+ kan.dʒɨɹ 'candles'	*Cplx Ons	SSP	*Struc-σ
a. ☞ ka.**ka**n.dʒɨɹ			***
b. ka**k**n.dʒɨɹ		*!	**
c. ka**k**.ndʒɨɹ	*!	*	**

I use SSP here as a cover term for the set of sonority restrictions on Pima codas. In general this restriction blocks sonority reversals and sonority plateaus, but recall that [s] and [ʃ] may follow any consonant and [ɹm] is not acceptable as a coda cluster.[12] Like the ban on complex onsets, the SSP must be ranked below I/B-Faithfulness because coda clusters of non-falling sonority are licit outside of reduplication, as in *t̪ot̪pk* 'purr'.

Reduplication in Pima never creates palatal nasal codas. Ranking a ban on palatal nasal codas above *Struc-σ correctly predicts that CV-Copying will occur whenever the stem begins with a palatal nasal because copying the initial ɲ alone would create a dispreferred coda.

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[11] I'm assuming that a Minimal Distance Principle (Clements, 1990; Selkirk, 1984) conditions what constitutes a sufficient decline in sonority. See also Jesperson's (1904) discussion of this issue.

[12] Candidates that obey the SSP by infixing the reduplicant deeper into the word (e.g. *kan**k**.dʒɨɹ*) will be ruled out by a left alignment constraint on the reduplicant in Sect. 2.2.

(24) ***ɲ]$_{\sigma}$**: palatal nasal codas are dispreferred.

(25)

RED+ɲumat͡ʃ 'livers'	*ɲ]$_{\sigma}$	*Struc-σ
a. ☞ ɲu.**ɲu**.mat͡ʃ		***
b. ɲu**ɲ**.mat͡ʃ	*!	**

Like the SSP and the ban on complex onsets, *ɲ]$_{\sigma}$ must be ranked below Input/Base-Faithfulness because *ɲ* codas do occur outside of the context of reduplication, as in *huːɲkus* 'cornstalk'.

Turning to the cases of C-Copying, in (26) it is clear that when no phonotactic constraints are at stake *Struc-*σ* violations can be minimized by copying just the stem-initial consonant.

(26)

RED+nakʃɨɹ 'scorpions'	*Cplx	*Lar]$_{\sigma}$	SSP	*Struc-σ	B/R-Max
a. na.**na**k.ʃɨɹ				***!	kʃɨɹ
b. ☞ na**n**k.ʃɨɹ				**	akʃɨɹ

There is one more circumstance that can condition of the size of the reduplicant. Because *Struc-*σ* penalizes material one syllable at a time, when the phonotactics force the addition of a syllable in reduplication, B/R-Max should prefer candidates that copy enough material to fill out the largest syllable possible. And yet, this does not occur: *hi.ɹo* 'blacksmith' reduplicates as *hi.**hi**.ɹo* not **hi.**hiɹ**.ɹo*, despite the fact that intervocalic geminates are allowed in Pima. This can be attributed to the familiar action of the general constraint against codas illustrated in (28).

(27) **NoCoda**: Syllables may not have codas. (Prince & Smolensky, 1993)

(28)

RED+hiɹo 'blacksmiths'	*Struc-σ	NoCoda	B/R-Max
a. ☞ hi.**hi**.ɹo	***		ɹo
b. hi.**hiɹ**.ɹo	***	*!	o

*Struc-*σ* and NoCoda conflict in cases of C-Copying where reduplication creates codas. For codas to be permitted in such cases *Struc-*σ* must dominate NoCoda. This is shown in (29).

(29)

RED+mavit̪ 'lions'	I/B-Max	*Struc-σ	NoCoda	B/R-Max
a. ☞ ma**m**.vit̪		**	**	avit
b. ma.**ma**.vit̪		***!	*	vit
c. ma.**ma**.vit̪	*!	***		vi

Lastly, the pluralization of forms with diphthongs in the stem-initial syllable needs to be considered. In these forms, the reduplicant always occurs immediately after the first of the two vowels (e.g. *pion*$_{\text{sg}}$ → *pi.**pion***$_{\text{pl}}$). The constraints responsible for determining the placement of the reduplicant will be discussed shortly, but for now this will be taken as a given, so as to focus only on the issue of reduplicant size.

Inserting the reduplicant immediately after the first vowel of the stem, so that it ‘splits’ the diphthong, will result in an increase in the syllable count regardless of whether the infixed reduplicant is a single C or a CV sequence. If an increase in the number of syllables is inevitable, then, because NoCoda is inapplicable, B/R-Max is free to express the preference for copying the relatively-larger CV sequence. Provided that B/R-Max also dominates any general constraint against diphthongs, the initial CV will be copied and infixed to split the diphthong in the first syllable, thereby becoming the initial CV of the second syllable. This is illustrated in (30).

(30)

RED+kuadi ‘twins’	*Struc-σ	B/R-Max	*Diphthong
a. ☞ku.**ku**a.di	***	adi	*
b. ku.**k**a.di	***	uadi!	

The account of the behavior of diphthongs needs one further bit of explanation. Candidates like *kua**k**.di* or *kua.**kua**.di*, which place a copy of the initial C or CVV sequence *after* the diphthong, get fewer violations of *Struc-σ or B/R-Max respectively and thus seem to harmonically bound the attested form. This is illustrated in (31).

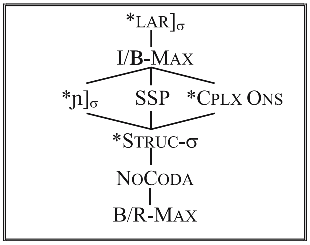
(31)

RED + kuadi ‘twin’	*Struc-σ	B/R-Max
a. ku.**ku**a.di$^{\textit{-attested form}}$	***!	adi
b. 💣kua**k**.di	**	uadi
c. kua.**kua**.di	***	di

The failure of candidates like *kua**k**.di* and *kua.**kua**.di* can be attributed to an independent aspect of the grammar, namely to the principles that determine where the reduplicant is placed. In Sect. 2.2 I will present a ranking of constraints under which the reduplicant is forced to split diphthongs that occur in the first syllable. Given that the split diphthong will inevitability increase the number of syllables in the pluralized form, the reduplicant is free to respect B/R-Max by copying the larger CV substring of the base without creating any additional *Struc-σ violations.

In summary, the conditioning of the size of the reduplicant in Pima can be explained as the interaction of the size restrictor *Struc-σ with phonotactic constraints: *Cplx Ons, SSP, *lar]$_\sigma$, *ɲ]$_\sigma$, and NoCoda. By ranking the size restrictor and many of the phonotactics in the Emergence of the Unmarked ranking, below I/B-Max but above B/R-Max, it is guaranteed that the restrictions they impose will affect only the reduplicant and never the base or underived forms. The rankings that have been justified thus far are diagrammed in (32).

(32)



2.2 Analysis of the location of the reduplicant

Many languages have affixes which vary in their location, sometimes occurring at the edge of the word and sometimes inside it. McCarthy and Prince's (1993) analysis of Tagalog *-um-* affixation illustrates how this can be accounted for in OT by ranking a constraint expressing a phonotactic restriction above the constraint demanding left alignment of the affix.

(33)

gloss	**affixed form**	**explanation**[13]
'teach'	**u.m**a.ral	- left alignment adds no ONSET violations for V initial words
'write'	s**u.m**u.lat	-***um**.su.lat has good alignment but violates NOCODA or ONSET

Other languages have affixes which consistently surface as infixes. For instance, the reductive affix in Maŋarayi always surfaces word-internally: *ɟalwaji*→ *ɟ**alw**al-waji* '(very) muddy' (Merlan, 1982). This pattern has been analyzed with a range of assumptions about which substring of the output is the reduplicant and with a range of mechanisms designed to derive the placement and size of the reduplicant (cf. Merlan, 1982; Davis, 1988; McCarthy & Prince, 1986, 1993, 1995; Kurisu & Sanders, 1999). In this work I will follow Kurisu and Sanders' (1999) proposal that anchoring constraints on material at stem edges should be used to derive infixation.

Pima reduplicative infixation presents a relatively uncommon pattern of infixation in which the reduplicant is obliged to surface immediately after the first vowel of the stem. In a typological survey of infixation patterns, Yu (2003) identifies seven 'pivots' at edges and prominent positions to which infixes are always adjacent. Among the pivots described by Yu (2003) are both the initial vowel and the stressed vowel. Either or both of these prominent positions might drive infix placement in Pima, but for the sake of this analysis I will assume here that the reduplicant is obliged to occur after the first vowel.[14] To generate this pattern of infixation I'll use an anchoring constraint (McCarthy & Prince, 1995) that requires the first vowel of the stem to coincide with the first vowel of the word. This constraint is given in (34).

(34) ANCHOR-V_1: (**ANCHOR-V_1**)
The first vowel of the stem must coincide with the first vowel of the word.

Though this is a bit of a departure from typical anchoring constraints which require the coincidence of constituent edges, it represents a straightforward expression of Beckman's (1998) insight that salient positions should be specially indexed in faithfulness

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[13] The data here is from Schachter and Otanes (1972). Some researchers have claimed that this case isn't so straight-forward and that vowel-initial forms in Tagalog actually begin with (possibly epenthetic) glottal stops. For this and for additional complications having to do with complex onsets see Zuraw (2003), Orgun and Sprouse (1999), and Halle (2001).

[14] But see Munro and Riggle (2004) for discussion of loans with lexically marked stress that can show reduplication at both the vowel bearing main stress and the stem-initial vowel e.g. *ʔò.vís.p.ɹa* .→ *ʔò.ʔ**o**.ví.**pi**s.p.ɹa* 'bishop'. Munro and Riggle analyze these forms as pseudo-compounds because their prosodic structure (medial primarily stress) is licit only in compounds in the native vocabulary. Under such an analysis the second reduplicant occurs after the first vowel of the second 'word' in the pseudo-compound. Alternatively, in an analysis without pseudo-compounds the stressed vowel could be the pivot after which the medial reduplicant occurs.

relations. Anchor-V$_1$ demands that the first vowel of the stem (a highly salient piece of the stem) coincide with the first vowel of the word (a highly salient position).[15] To place the reduplicant immediately after the anchored vowel, the alignment constraint presented in (35) can be used.

(35) Align-L-Red$_{\text{Wd}}$: (**Red-L**)
The left edge of the reduplicant must occur as close as possible to the left edge of the word.
-*evaluated gradiently*: one violation per segment between red and the edge of the word

Though Yu (2003) does not use Anchor-V$_1$, he points out that some mechanism with this effect is clearly motivated cross-linguistically. Yu cites fixed-segment infixes that occur immediately after the stem-initial vowel in several languages, including Alabama's mediopassive illustrated in (36) with data from Martin and Munro (1996, 2005).

(36)

takco	'rope' (v.)	ta**li**kco	'be roped'
hocca	'shoot'	ho**li**cca	'be shot'
oːti	'make a fire'	oː**l**ti	'kindling'

Characterizing the anchoring constraint as anchoring of the stem-initial vowel rather than the initial consonant is necessary to explain why forms with initial consonant clusters show both C-Copying and CV-Copying. If the anchoring targeted the stem-initial consonant, then only CV-Copying would occur in forms with initial CC clusters. This is so because a copy of the second C of the onset and the vowel could be infixed after the initial consonant of the stem, as illustrated by candidate b in (37), and thereby achieve better leftward alignment while still respecting the anchoring of the initial C. Using Anchor-V$_1$, on the other hand, will allow both C-Copying and CV-Copying to occur in forms with initial clusters. This is illustrated in (37).

(37)

red + t̪ɹogi 'trucks'	Anchor-C$_1$	Anchor-V$_1$	Red-L
a. ☞ t̪ɹo**ɹ**.gi	✓		***
b. t̪**ɹo**.ɹo.gi	✓	*!	*

Anchoring of the initial vowel is also respected in reduplication of forms with the stative prefix (e.g. *s-t͡ʃuk*$_{\text{sg.}}$ →*s-t͡ʃu**t**͡ʃk*$_{\text{pl.}}$ 'black'). Initial vowel anchoring explains why satisfaction of Red-L does not lead to infixation of a -VC- reduplicant immediately after the initial consonant of the stem (as happens in Maŋarayi). This is illustrated in (38).

(38)

red + mavit̪ 'lions'	Anchor-V$_1$	Red-L
a. ☞ ma**m**.vit̪		**
b. m**a.v**a.vit̪	*!	*

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[15] Crowhurst's (2004) mora alignment approach using the constraint Leftmost-Root-μ, which demands that the leftmost root mora align with the leftmost mora of the prosodic word, could work here as well.

With this apparatus in place, it is possible to explain why the infixed reduplicant always splits diphthongs in the stem-initial syllable even though this move incurs an extra *Struc-σ violation. If Red-L dominates *Struc-σ, then reduplication can't produce a form with fewer syllables, such as *kua**k**di* in the tableau below, at the expense of embedding the infix deeper into the word. This is illustrated in (39).

(39)

	RED + kuadi 'twins'	Anchor-V_1	*Cplx Ons	Red-L	*Struc-σ	B/R-Max
a.	☞ ku.**ku**a.di			**	***	adi
b.	ku.**k**a.di			**	***	uadi!
c.	kua**k**.di			***!	**	uadi
d.	kua.**kua**.di			***!	***	di
e.	**k**kua.di		*!		**	uadi
f.	**ku**.kua.di	*!			***	adi
g.	**ku**.ka.di	*!			***	adi
h.	**kua**k.di	*!			**	di

The assumption that something like Anchor-V_1 rules out the prefixing candidate (f), which is homophonous with the winning candidate (a), is necessary to rule out candidates like (h) which fare best with respect to every other constraint in (39). Note also that candidates like (h) can't be ruled out by phonotactic constraints like *Diphthong because such constraints would select candidates like (b) or (g) where diphthongs are 'repaired' in reduplication. Nor can (h) be ruled out with a constraint against diphthongs in closed syllables (*VVC]$_\sigma$) because forms like *ʃoak* 'wail' reduplicate as *ʃoʃoak* 'wails', and if *VVC]$_\sigma$ were to dominate Red-L then *ʃoak* would reduplicate as *ʃoʃak* to 'repair' the violation of *VVC]$_\sigma$.[16]

The ranking Anchor-V_1 ≫ Red-L ≫ *Struc-σ also explains why only CV-Copying is observed in forms with diphthongal nuclei in the initial syllable. Because diphthongs have two vowels, an infix can occur immediately after the first V, and still satisfy Anchor-V_1. Once the diphthong is split, B/R-Max is free to demand copying of the relatively larger CV sequence without incurring extra *Struc-σ violations. With the analysis of the location and the size of the reduplicant in place, the final component needed to complete the account of Pima reduplication is an analysis of the content of the reduplicant.

2.3 Selecting reduplicant content by positional B/R-faithfulness

When a reduplicative CV affix occurs as an infix, it could conceivably copy the material that precedes or the material that follows it. Thus far, no constraints have been given that would express a preference for the pluralization of *ʔu.pu.ɺik*$_{\text{sg.}}$ 'wart' as *ʔu.ʔ**u**.pu.ɺik*$_{\text{pl.}}$ over alternative candidates like *ʔu.**pu**.pu.ɺik*$_{\text{pl.}}$ (*u**la**lampoy* in Timugon Murut (Prentice, 1971)).

The content of reduplicative prefixes is usually determined by constraints that require the reduplicant to copy the following string of segments—those that have

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[16] It is worth noting that, with the possible exceptions of *kukadi* and *kkukadi*, the reduplicative patterns generated by reranking these constraints seem fairly standard. A *kukadi*-like pattern has been observed in Pima's sister language Tohono O'odham by Fitzgerald (1997a *et seq.*) and, though its position as the initial cluster is a bit odd, the [*kk*] sequence of *kkukadi* is reminiscent of other patterns of 'bare-consonant reduplication' (see Sloan (1988) and much discussion of these types of patterns in Hendricks (1999a, b)).

been designated the 'base.' By extension, infixed reduplicants that occur at the beginning of the word are usually treated like prefixes in that they are expected to copy the material that immediately follows the infix. In Pima, however, though the reduplicant is infixed at the beginning of the word, it nonetheless copies the material that immediately precedes it. Thus, in order to pursue the infixation analysis of Pima reduplication, it will be necessary to reexamine some of the standard assumptions about how the content of the reduplicant is selected and exactly what constitutes the 'base.'

Marantz (1982) made the generalization that the copying observed in reduplication tends to exhibit "edge-in association"; that is, the material that gets copied in the reduplicant tends to start at the edge to which the affix is attached and proceed into the word.

(40) **bad**.ba.du.pi – *edge-in association*

Though Marantz described edge-in association as a tendency, some subsequent researchers have, tacitly or explicitly, treated edge-in association as an inviolate principle that is used to select the 'base' in reduplication (e.g. McCarthy & Prince, 1996, p. 74; Kager, 1999, p. 202, Nelson, 2003).

In Correspondence Theory, B/R-Max constraints demand that reduplicants copy material from the substring of the output that has been designated the base. The assumption that edge-in association is an inviolate principle leads Kager (1999, p. 202) to define bases as "the output string of segments to which the reduplicant is attached, more specifically: for reduplicative *prefixes,* it is the *following* string of segments; for reduplicative *suffixes* the *preceding* string of segments."

The main problem with the hypothesis of universally inviolate edge-in association is the existence of languages in which the reduplicant does not appear adjacent to the material that it copies. Cases of nonlocal reduplication are discussed in Riggle (2004). The most striking of these is presented in (41) with data from reduplication in Creek from Martin and Mauldin (2000).

(41)

gloss	**singular**	**plural**
'sweet'	cámp-iː	cam**ca**p-íː
'crooked'	fayátk-iː	fayat**fa**k-íː
'soft'	lowáck-iː	lowác**lo**.k-iː

McCarthy and Prince (1996), Nelson (2003), and others have argued that apparent cases of nonlocal reduplication can be analyzed as local reduplication that has been rendered non-local by independent phonological processes. For instance, this sort of 'opaque' locality could be present in absolutive reduplication in Chukchee like *nute* → *nute**nut*** 'land' (Bogoras, 1969, p. 689) if local reduplication is followed by final vowel deletion. This strategy will not, however, explain away nonlocal reduplication in Creek because, other than the general phenomenon of reduplicant minimization, there aren't independent phonological processes that explain the nonlocality.

To preserve edge-in association as an inviolable principle, one might suppose that locality was always respected at an abstract level in a full-copy + deletion model à la Steriade (1988). At this level of abstraction, however, it's not clear what substantive predictions an edge-in law would make and even less clear how it would apply in a non-procedural model like OT. It seems easier to simply abandon the premise that some independent and invariable mechanism picks out bases and instead allow constraint interaction to determine which material gets copied in reduplication. To allow this we can generalize the notion of the base as in (42).

(42) The base generalized
The entire word to which the reduplicant is affixed is the base.[17]

This definition of basehood represents a departure from a theory in which the analytical work is done in two stages, first by picking out a substring of the word and designating it as the base, and then, second, by using B/R-Anchoring constraints to force copying from one edge of that string. With the definition in (42), the material that the reduplicant is obliged to copy can be determined solely by the action of the B/R-Max family of constraints. This follows Nelson's (1998, 2000) idea that reduplication that targets stressed syllables should be captured via a B/R-Max constraint demanding that the stressed rhyme be preserved in the reduplicant. Subsuming both base selection and reduplicative anchoring constraints under B/R-Faith is especially appealing given that B/R-Faith is already independently needed in the analysis of reduplication.

As an added benefit, this proposal offers an explanation of why reduplicants tend to copy salient elements like edges, stressed syllables, and stems. Given Beckman's (1998) insight that salient positions are often subject to the most stringent faithfulness constraints, the tendency to copy such material follows readily as the expression of positional faithfulness in the domain of Base/Reduplicant-Correspondence. The positional B/R-Max constraint for Pima is given in (43).

(43) B/R-Max-initial-syllable-onset: (**B/R-Mx-O$_1$**)
The onset of the initial syllable of the stem must have a correspondent in the reduplicant.
For complex onsets one violation is incurred per onset segment without a correspondent.

B/R-Mx-O$_1$ must dominate *Struc-σ to avoid selecting candidates where the reduplicant copies segments from positions deeper in the stem to avoid phonotactically illicit codas. This dominance relationship also explains why *Struc-σ can't select forms that fail to reduplicate anything at all and why a Realize-Morpheme constraint isn't needed here. This is illustrated in (44).

(44)

	RED + hod̪ai 'rocks'	B/R-Mx-O$_1$	Red-L	*Struc-σ
a.	ho.**ho**.d̪ai		ho	***
b.	ho**d̪**.d̪ai	*!	ho	**
c.	h**o.d̪**o.d̪ai	*!	h	**
d.	ho.d̪ai	*!		**

---

[17] This includes the stem and any other morphemes or epenthetic segments in the word—any segment that is not part of the reduplicative affix itself. Alternatively, the base might be defined as any material in correspondence with the morphological constituent to which the reduplicant is attached. The definition in (42) straightforwardly accounts for why epenthetic segments and material from nearby morphemes can be copied in reduplication.

If *COMPLEX ONSET dominates B/R-MX-O$_1$ then CC onsets will never get copied in reduplicants. The fact that it is the second consonant of the complex onset that is copied in the reduplicant, and not the first, can be attributed to a restriction that no material intervene between the reduplicative infix and the segments it copies. This restriction can be expressed with the constraint LOCALITY if it is formulated as in (45).

(45) LOCALITY: (**LOC**)—Steriade (1988, 1995), Nelson (2002, 2003), Riggle (2004), i.a. One violation is assessed for each segment ***s*** that intervenes between two segments that are in B/R-correspondence relation $\mathcal{R}$ unless ***s*** is in correspondence with some ***s***′ via $\mathcal{R}$.

(46)

RED + t̪ɺogi 'trucks'	*CPLX ONS	B/R-MX-O$_1$	*STRUC-σ	LOCALITY
a. ☞ t̪ɺo**ɺ**.gi	*	*	**	*
b. t̪ɺo**t**.gi	*	*	**	**!
c. t̪ɺo.**ɺo**.gi	*	*	***!	
d. t̪ɺo**g**.gi	*	**!	**	
e. t̪ɺo.**t̪ɺo**.gi	**!		***	

The cases of CV-Copying in forms with initial clusters then follow naturally from the action of the phonotactic constraints that dominate *STRUC-σ. This is illustrated in (47).

(47)

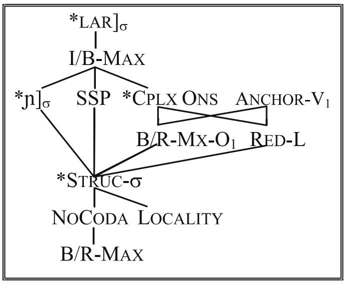
RED+t̪ɺampa	ANCHOR-V$_1$	SSP	*CPLX-ONS	B/R-MX-O$_1$	RED-L	*STRUC-σ	LOC
a. ☞ t̪ɺa.**ɺa**m.pa			*	*	***	***	
b. t̪ɺa.**ta**m.pa			*	*	***	***	*!
c. t̪ɺa.**t̪ɺa**m.pa			**!		***	***	
d. t̪ɺa**ɺ**m.pa		*!	*	*	***	**	*
e. t̪**ɺa**.ɺam.pa	*!		*	*	*	***	

In the view of reduplication advocated here, the general tendency for edge-in association will be expressed whenever B/R-MAX and reduplicative alignment constraints target the same edge or, in cases of conflict, whenever LOCALITY dominates the conflicting constraints.

Bringing together the analyses of the size, placement, and content of the reduplicant, it is now possible to review the complete account of Pima reduplication. First, whenever it is possible to minimize the number of *STRUC-σ violations by infixing a copy of a single onset consonant as the coda of the first syllable without violating any phonotactic restrictions, C-Copying is observed. Second, the additional *STRUC-σ violation that results from CV-Copying is tolerated whenever copying a lone consonant would give rise to a phonotactically illicit sequence. Third and finally, when the stem-initial nucleus is a diphthong, ANCHOR-V$_1$ and RED-L force the reduplicant to split the diphthong. In such cases, an increase in the number of syllables is unavoidable, so B/R-MAX prefers copying of the entire initial CV sequence.

Combining all of the ranking arguments given for the constraints that derive the size, the location, and the content of the reduplicant into one master ranking diagram gives us the picture of the grammar in (48).

(48)



In this section, I have shown that plural reduplication in Pima can be readily analyzed as an instance of reduplicative infixation. The pattern of infixation arises directly from the ranking of anchoring and alignment constraints that are independently motivated in the analysis of other languages. This analysis has the advantage that it captures variation between C-Copying and CV-Copying as an instance of TETU and does so without adding new dimensions to CT.

In this analysis I adopt a general definition of the base that allows positional B/R-FAITH constraints to determine reduplicant content. This move obviates any external mechanism that delineates the base and allows reduplicant content to be derived solely from constraint ranking.

3 Conundrum revisited: the prefixation+syncope analysis

In this section I will present and argue against the prefixation+syncope analysis of Pima reduplication. When seen as reduplicative prefixation, the CV-Copying cases are straightforward.

(49) Prefixation of a CV reduplicant:
hod̪ai → **ho**hod̪ai

The cases of C-Copying will require more explanation. Because Pima neither syncopates vowels nor simplifies clusters outside of reduplication, the prefixation analysis will require some mechanism that specially licenses these moves in the context of reduplication.

(50) Prefixation of a CV reduplicant + syncope (and C deletion) in the base:
a. mavit̪ → **ma**-mavit̪ → **ma**mvit̪ - *syncope deletes* /a/*from the base*
b. t̪ɹogi → t̪ɹ**o**-t̪ogi → t̪ɹ**o**ɹgi - *both* /o/*and* /t/*are deleted from the base*

In order to allow reduplication to license syncope in forms with structure parallel to that of *ma**m**vit* in Tohono O’odham and Lushootseed respectively, Fitzgerald (1998, 1999a) and Struijke (2000a) have proposed modifications to McCarthy and Prince’s (1995) original formulation of Correspondence Theory that add new dimensions of correspondence which keep track of whether or not each input segment (and feature) has some correspondent somewhere in the output.[18] Struijke calls this new type of correspondence ‘existential’ faithfulness.

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[18] Other proposals that incorporate a modification of Correspondence Theory with something like ∃-FAITH are made in Spaelti (1997), Struijke (1997), Raimy and Idsardi (1997) and Yip (2001), among others.

(51) Existential Faithfulness (**∃-Faith**)
Each input segment must have all of its specifications preserved in some correspondent (or correspondents) somewhere in the output form.

Existential faithfulness constraints are unlike standard CT constraints in that they are able to be satisfied in two different ways. Like the original constraints of CT, they are satisfied if an input segment has a faithful correspondent in the base. But unlike other faithfulness constraints, existential constraints are also satisfied if an input segment has a faithful correspondent in the reduplicant. A highly ranked existential version of Max-Vowel will allow deletion of a vowel in the base, provided that a faithful correspondent of that vowel is preserved in the reduplicant. Before getting into the details of Struijke and Fitzgerald's existential faithfulness models, the full model of Correspondence Theory (McCarthy & Prince, 1995) should be briefly reviewed. There are three dimensions of faithfulness in this model; these are given in (52).

(52)a. Input/Base-Correspondence: **(I/B-Faith)**
Segments in the input must have correspondents in the base and vice versa.
b. Input/Reduplicant-Correspondence: **(I/R-Faith)**
Segments in the input must have correspondents in the reduplicant and vice versa.
c. Base/Reduplicant-Correspondence: **(B/R-Faith)**
Segments in the base must have correspondents in the reduplicant and vice versa.

Struijke (2000a) replaces I/R-Faith with ∃-Faith but Fitzgerald (1999a) leaves I/R-Faith intact and adds ∃-Faith to the full model.[19] Struijke also replaces I/B-Faith with Root-Faith. In the cases considered here Root-Faith acts just like I/B-Faith, so I/B-Faith will be used when working through the models below. Both Struijke and Fitzgerald leave B/R-Faith intact.

As in McCarthy and Prince's (1995) model, standard Emergence of the Unmarked (TETU) effects in reduplicants can be generated if a markedness constraint is ranked above B/R-Faith but below I/B-Faith (or Root-Faith). What ∃-Faith brings is the possibility of a new type of TETU effect which can occur in *either* the base *or* the reduplicant. This can arise if a markedness constraint is ranked below ∃-Faith but above both I/B-Faith and B/R-Faith. Because 'classic' TETU effects are restricted to reduplicants but the new TETU effects arising from ∃-Faith are not, I will refer to the former as unilateral-TETU and the latter as bilateral-TETU. The rankings under which these types of TETU occur are schematized in (53).

(53) Bilateral- and Unilateral-TETU Schematized

$$\exists{-}\text{Faith} \gg \underset{\substack{\uparrow\\ \text{bilateral-TETU}}}{\textit{Constraint-X}} \gg \text{I/B-Faith} \gg \underset{\substack{\uparrow\\ \text{unilateral-TETU}}}{\textit{Constraint-Y}} \gg \text{B/R-Faith}$$

In (53), constraints *X* and *Y* don't affect unreduplicated forms because each segment has only one chance to surface faithfully. In reduplicated forms, since some segments have correspondents in both the base and reduplicant, *Constraint-X* can reduce the markedness in one or the other of the correspondents without violating ∃-Faith while *Constraint-Y* will only affect the reduplicant.

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[19] Fitzgerald refers to her addition as I/O-Faith. I will use ∃-Faith as a cover term to refer to both proposals here.

The analyses made possible by existential faithfulness are intuitively appealing. It seems reasonable that grammars might respond to the surface redundancy created in reduplication by reducing the markedness of a redundant element. But giving grammars this power by means of existential faithfulness gives rise to anomalous and undesirable typological predictions. In Sect. 3.1 I will review the base-truncation problems that arise with templates. In Sects. 3.2 and Sect. 3.3 I will show how the use of INTEGRITY and CONTIGUITY as size restrictors on reduplicants can give rise to the same sort of base-truncation as templates. I will also show that INTEGRITY and CONTIGUITY can give rise to another problematic typological prediction in which most of the underlying material surfaces in the reduplicant rather than in the base. Finally, in Sect. 3.4 I will show how these same problematic candidates arise as a prediction of the basic mechanisms of existential faithfulness.

3.1 The trouble with templates

In Fitzgerald's (1998, 1999a) analysis of Tohono O'odham, C-Copying is analyzed as an instance of syncope in the base that is motivated by the Stress-to-Weight principle given in (54) and licensed by an existential faithfulness constraint with the effect of (55).

(54) STRESS TO WEIGHT PRINCIPLE: (**SWP**)[20]
Stressed syllables must be heavy.

(55) ∃−**MAX-V**
Each underlying vowel must have a correspondent somewhere in the output.

If ∃-MAX-V dominates SWP, unreduplicated forms won't syncopate to close initial light syllables but reduplicated forms will. Because this is a possible analysis of Pima, I use Pima data in (56).

(56)

ʔupuɹik ‘algae’$_{sg.}$	∃-MAX-V	SWP	I/B-MAX-V
a. ☞ʔú.pu.ɹik		*	
b. ʔúp.ɹik	u!		u

RED+mavit ‘lions’	∃-MAX-V	SWP	I/B-MAX-V
a. ☞**má**m.vit			a
b. **má**.ma.vit		*!	

To keep the reduplicant from closing initial syllables by copying more of the base and thereby better satisfying B/R-MAX while avoiding an I/B-MAX violation, a templatic constraint is used.

(57) RED$_{CV}$: The reduplicant is a CV (light) syllable. (Fitzgerald, 1999a)

(58)

RED+mavit̪ ‘lions’	RED$_{CV}$	I/B-MAX-V	B/R-MAX
a. ☞**ma**m.vit̪		a	vit
b. **mav**.ma.vit̪	*!		it

---

[20] Prince (1990) discusses the SwP while arguing for its converse the Weight-to-Stress principle, which demands that heavy syllables be stressed. Also, see Hayes (1995) on the interaction of weight and stress.

Templatic constraints aren't necessarily required in order to analyze Pima reduplication as a prefixation process. But, in order to specially license deletion in the base in the context of reduplication, something like ∃-Faith is necessary. I'll now review the problematic typological predictions that are said to arise from templatic constraints, and in the remainder of the paper I'll show how these same problems come up in a variety of schemes for restricting the size of the reduplicant and finally that they also arise from the basic mechanisms of existential faithfulness.

Prince (1996) dubbed cases in which templatic constraints and B/R-Faith conspire to truncate bases as the Kager-Hamilton Conundrum (KHC). This can happen whenever B/R-Max and a templatic constraint both dominate I/B-Max, in which case vacuous satisfaction of B/R-Max allows the template to back-copy its restriction onto the base and force truncation.

(59)

RED + $\sigma_1\ \sigma_2\ \sigma_3$	RED=σ	B/R-Max	I/B-Max	I/R-Max
a. $\underline{\boldsymbol{\sigma_1}}\ \sigma_1\ \sigma_2\ \sigma_3$		*!*		**
b. ☠ $\underline{\boldsymbol{\sigma_1}}\ \sigma_1$			**	**
c. $\underline{\boldsymbol{\sigma_1\ \sigma_2}}\ \sigma_1\ \sigma_2$	*!		*	*
d. $\underline{\boldsymbol{\sigma_1\ \sigma_2\ \sigma_3}}\ \sigma_1\ \sigma_2\ \sigma_3$	*!*			

The triumph of (b) in (59) illustrates how the existence of templatic constraints makes the weird typological prediction that there should be languages where unreduplicated words can be of any length but where reduplicated forms are truncated to a pair of identical syllables.

McCarthy and Prince (1995) take this as evidence that the concept of reduplicative templates is flawed and that reduplicative templates *per se* do not exist.[21] Rather, they assert that any template-like effects observed in reduplication should be derived from general properties of morphology and phonology and their interface. This is one of the prime motivations for the introduction of Generalized Template Theory.

Downing (2000) has claimed that concern over the KHC is misguided, citing data from Hausa that appears to show base truncation in reduplication. Downing illustrates her point with the forms in (60) from Abraham (1962) and Newman (1989).

(60)

isolation form		*reduplicated*	
cakwale	'to be slushy'	cakwal=cakwal	'slushy'
buntsura	'joggling'	buntsur=buntsur	'joggling'
dabule	'trampled'	dabul=dabul	'trampled'
facaka	'squandering'	faca=faca	'squandering'
cukunkune	'to become tangled'	cukun=cukun	'state of confusion'

Though the pairs in (60) do seem to show a KHC-like pattern, it turns out that they aren't related to one another in a derivational fashion. The forms on the right are ideophones while the forms on the left are their 'cognate' verbs and adjectives. Newman (2000, p. 255) notes that "some ideophones can be morphologically identified with extant non-ideophonic words (mostly verbs) even though they cannot be related by any regular derivational process." Distinguishing features of Hausa ideophones

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[21] The possibility that the problematic back-copying of the reduplicant size restriction onto the base could be blocked by an *a priori* ranking of I/B-Faith ≫ B/R-Faith is untenable because there are attested cases where changes to the reduplicant are back-copied onto the base that require the opposite ranking (McCarthy & Prince, 1995).

include the lack of final vowels and sometimes full reduplication. The form *cakwal* is an independently occurring ideophone, as is *cakwal-cakwal* (Abraham 1962, p. 131), but neither is productively derived from *cakwale*. Crucially, the absence of final vowels is a property of ideophones in general and not a property of reduplicated ideophones. Hausa authorities Russell Schuh (p.c.) and Paul Newman (p.c.) both agree that there are no reduplicative patterns in Hausa involving partial reduplication accompanied by the deletion of material that is not reduplicated.[22]

Somewhat surprisingly, KHC-like base truncation and another similarly odd pattern can arise in strategies for restricting the size of reduplicants that use mechanisms which seem, at first blush, to be very different from templates. This will be illustrated in the next three sections.

3.2 The trouble with Integrity

Spaelti (1997) notes that if the constraint Integrity is ranked above B/R-Faithfulness, the reduplicant will be minimized in order to reduce the number of segments in the output that share a common input correspondent. McCarthy and Prince (1995) define Integrity as in (1) below:

(61) Integrity (**Integ**)
No element of S_1 has multiple correspondents in S_2.
For $x \in S_1$ and $w, z \in S_2$, if $x \mathcal{R} w$ and $x \mathcal{R} z$, then $w = z$.

Spaelti (1997) points out that if $\mathbf{S}_2$ refers to the entire output string then Integrity is violated whenever a segment has correspondents in both the base and the reduplicant. Under this view, which Struijke (2000a) expands on greatly, reduplication is an instance of wholesale segmental fission. Thus, if Integrity is highly ranked then each output segment will surface in either the base or the reduplicant but not both. This tug-of-war between the base and reduplicant can lead to truncation whenever Integrity dominates B/R-Max. A hypothetical case is given in (62).

(62)

	red + badupi	Integ	B/R-Max	I/B-Max	B/R-Dep	I/R-Max
a.	badu**badupi**	ba! du		pi	pi	
b.	badupi**pi**	pi	b! adu			badu
c.	badu**du**	du	b! a	pi		bapi
d.	☠ ba**ba**	ba		dupi		dupi (!)
e.	☠ ba**badupi**	ba		dupi	dupi (!)	

The selection of (d) or (e) will fall to the relative ranking of B/R-Dep and I/R-Max. Candidate (d) illustrates another instance of KHC-like truncation but candidate (e) represents a new type of problem in which the bulk of the underlying material surfaces in the reduplicant rather than the base. I call this phenomenon red-Shift since it results in the majority of the input material being ‘shifted’ into the reduplicant.[23]

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[22] Newman (p.c.) explains further that *cukunkunee* is a ‘frozen’ reduplicated pluractional verb from the stem **cukune* which has the related ideophone *cukun-chukun*, and that if *facakaa* and *faca-faca* are related, their relationship is totally idiosyncratic and doesn’t tell us anything about active processes of Hausa morphology.

[23] The constraints used in (62) are from the full model of Correspondence Theory. Fitzgerald keeps all of these but Struijke supplants I/R-Max with ∃-Faith. With this latter move, candidate (d) is no longer predicted but candidate (e) will still be a possible winner (i.e. candidate (e) wins if ∃-Max is ranked at the top, I/B-Max is replaced with ∃-Max-Root, and I/R-Max is omitted). I will return to this prediction in Sect. 3.5, where I discuss ∃-Faith in more detail.

In and of itself the RED-Shift candidate might not seem totally outrageous. Indeed, the surface form of (e) in (62) looks like reduplicative prefixation. Such a candidate might seem like an odd, yet harmless, alternative assumption about which portion of the output is the reduplicant and which portion of the output is the base. But problems immediately arise when one considers how unilateral-TETU would be expressed under the RED-Shift ranking.

Imagine a hypothetical language with the following combination of properties: (i) word-initial stress, (ii) a reduplicative prefix, and (iii) a TETU effect whereby all unstressed vowels reduce to schwa in the reduplicant. In this hypothetical language, a RED-Shift ranking will predict that all unstressed vowels in a word will be reduced to schwa just in case the word is reduplicated but otherwise no vowel reduction will occur. The way this effect comes about is illustrated in the tableau in (63).

(63)

		RED-Shift					vowel reduction		
	RED + badupi	INTEG	B/R-MAX	I/B-MAX	I/R-MAX	B/R-DEP	I/B-IDENT	*UNSTRESSED MARGIN-V	B/R-IDENT
a.	bádu**badupi**	bad! u		pi		pi		****	
b.	bádupi**pi**	pi	b! adu		badu			***	
c.	bádu**du**	du	b! a	pi	ba pi			**	
d.	bá**ba**	ba		dupi	d! upi			*	
e.	bá**badupi**	ba		dupi		dupi		*! **	
f.	☠ bá**bədəpə**	ba		dupi		dəpə			*

It might seem that existential faithfulness could come to the rescue at this point since the problematic predictions involve forms in which specifications in the input are totally lost in the output. But this is not the case. Existential faithfulness will only prevent the loss of features and segments when the relevant ∃ -FAITH constraints are dominant in the grammar. Because ∃-FAITH constraints must be freely rankable with respect to the vowel reduction constraints in (63) to allow vowel reduction to occur cross-linguistically, the prediction of languages like the hypothetical one in (63) cannot be avoided by the introduction of existential faithfulness.

The constraint INTEGRITY was originally conceived to penalize segmental fission. The problematic predictions discussed here arise only when it is extended to reduplication. These predictions can be eliminated if INTEGRITY is redefined so that it penalizes segmental fission but doesn't penalize the multiple correspondence that arises through reduplication. This can done by modifying the constraint so that it penalizes multiple correspondence except in cases where the correspondents belong to different morphemes. A new version of INTEGRITY is given in (64).

(64) INTEGRITY *-redefined*
Correspondents of the same underlying element must belong to different morphemes.
For $x \in S_1$ and $w, z \in S_2$, if $x\mathcal{R}w$ and $x\mathcal{R}z$, then $w = z$ or $w \in \boldsymbol{m}_1, z \in \boldsymbol{m}_2$ and $\boldsymbol{m}_1 \neq \boldsymbol{m}_2$.

This redefined version of INTEGRITY won't give rise to languages with the KHC or RED-Shift. On the other hand, because the constraint no longer treats reduplication as a case of fission to be penalized, it will no longer be able to act as a size restricting constraint in reduplication.[24]

3.3 The trouble with Contiguity and the Compression model

Any ranking scheme for minimizing the size of the reduplicant that uses constraints that aren't *a priori* ranked below base faithfulness can generate KHC and RED-Shift patterns. Another example of such a system comes in the Compression model proposed by Hendricks (1998, 1999a, b, 2001) and pursued by Crowhurst (2004). Hendricks proposes to restrict the size of reduplicants through the competition of alignment constraints like the one in (65).

(65) ALIGN-RED-L$_{\text{PRWD}}$ (**RED-L**)
The left edge of the reduplicant must be aligned to the left edge of the prosodic word.

Hendricks calls this the Compression model because it will minimize the size of the reduplicant by squeezing it between the edge of the stem and the edge of the word. When Red-L dominates Stem-L, the reduplicant will be a prefix. If Stem-L in turn dominates B/R-Max, the reduplicant will be compressed so that the stem will occur as close as possible to the left edge of the word.

(66)

RED + badupi	Red-L	Stem-L	B/R-Max
a. ☞ **ba**badupi		**	dupi
b. **badu**badupi		***!*	pi
c. badupi**pi**	*!*****		badu

In order for the reduplicant to be minimized rather than interrupted by the stem, the constraint Output Contiguity must also dominate B/R-Max. Following McCarthy and Prince's (1995) definition, we can define Output Contiguity as in (67).

(67) Output-Contiguity: (**O-Contig**)
The output exponent of a morpheme must be a contiguous string.

Ranking O-Contig above B/R-Max will ensure that the reduplicant is minimized, while the converse ranking will simply yield a reduplicant that is a circumfix (candidate b in (68)).

(68)

RED + badupi	Stem-L	O-Contig	B/R-Max
a. ☞ **ba**badupi	**		dupi
b. **ba**badupi**dupi**	**	*!	
c. **badu**badupi	***!*		pi

But, because there is no *a priori* ranking among alignment, contiguity and B/R-Max, this model predicts languages in which the vacuous satisfaction of B/R-Max leads to truncation.

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[24] Keer (1999) has argued that because Integrity can distinguish geminates that arise from pairs of input segments and those that arise through fission from one another, its existence in CON erroneously predicts that these types of geminates may behave differently. The redefined version of integrity in (64) does not change this state of affairs.

(69)

	RED + badupi	RED-L	STEM-L	O-CONTIG	B/R-MAX	I/B-MAX
a.	☠ **ba**ba		**			dupi
b.	**ba**badupi		**		d!upi	
c.	**ba**badupi**dupi**		**	*!		

Because the reduplicant must occur at the left edge of the word (the effect of RED-L), and it may not be interrupted (the effect of O-CONTIG), and the stem must occur as far left as possible (the effect of STEM-L), the reduplicant will be a single-syllable prefix. Unfortunately, at this point the stem will be truncated to a single syllable (candidate a) in order to vacuously satisfy B/R-MAX.

This problem is not restricted to reduplicative infixation. Whenever O-CONTIG dominates I/B-MAX, truncation can occur. Consider, in (70), a hypothetical fixed-segment infix *-ke-*.

(70)

	ke + badupi	STEM-L	*ke*-LEFT	O-CONTIG	MAX
a.	*ke*-badupi	ke!			
b.	badupi-*ke*		bad!upi		
c.	ba-*ke*-dupi		ba	*!	
d.	☠ ba-*ke*		ba		dupi

If the infix in (70) were reduplicative, the action of O-CONTIG could select a RED-Shift candidate in much the same fashion that the original version of INTEGRITY did in Sect. 3.3.

Consider in (71) a hypothetical language that shows how truncation and the RED-Shift can arise in the COMPRESSION model. Imagine a language that has (i) initial stress, (ii) a left aligned reduplicative prefix, and (iii) the markedness constraint *UNSTRESSED-VOWEL ranked in the unilateral-TETU ranking. In this hypothetical language rampant syncope occurs throughout the word in the context of reduplication but nowhere else.

(71)

	RED + badupi	STEM-LEFT	RED-LEFT	O-CNTG	I/B-MAX	*UNSTRESSED VOWEL	I/R-MAX	B/R-MAX	B/R-DEP
a.	**bá**.ba.du.pi	b!a				***	dupi	dupi	
b.	bá.du.pi.**ba**		bad! upi			***	dupi	dupi	
c.	bá.**ba.du**.du.pi		ba	*!		*****	pi	pi	
d.	bá.**ba.du.pi**		ba		dupi	**!*			dupi
e.	bá.**ba.du**		ba		dupi	**!	pi		du
f.	bá.**ba**		ba		dupi	*	du!pi		
g.	☠ bá**b.dup**		ba		dupi	*	ai	a	dup

With this ranking *UNSTRESSED-VOWEL should show normal unilateral-TETU effects. But, since the bulk of the output is in the reduplicant rather than in the base, syncope occurs throughout the word. Thus, while candidate (d) simply shows the RED-Shift, candidate (g) shows the RED-Shift with concomitant syncope in the reduplicant. Because the effect of compression—requiring the reduplicant to be coextensive with a single syllable—is just like a template, it is no surprise that KHC-like truncation in candidate (f) can be generated by inverting I/R-MAX and B/R-MAX.

The source of the problem here is the constraint O-CONTIG. In any instance of infixation, O-CONTIG prefers truncated candidates over those that are interrupted.

This problem can be remedied with a strategy similar to that used for Integrity. If Contiguity is redefined so as to operate only morpheme internally, then epenthesis and deletion will still be penalized but the problematic predictions pertaining to infixation will be eliminated.

(72) **Contiguity** *-redefined*
If x and $y \in \boldsymbol{m}_1$ are adjacent in S_1 and have correspondents x' and y' respectively in S_2 then any element z occurring between x' and y' in S_2 must belong to $\boldsymbol{m}_2$, $\boldsymbol{m}_1 \neq \boldsymbol{m}_2$

This redefined version of Contiguity will not be violated in cases of infixation. Thus, though the competition of alignment constraints will still be able to generate infixation, it will no longer lead to the KHC or the RED-Shift. This is illustrated in (73).

(73)

RED + badupi	Red-L	Stem-L	Contig	B/R-Max	I/B-Max
a. ☞ **ba**badupi**dupi**		**			
b. **badu**badupi		***!*		pi	
c. badupi**ba**	*!*****			dupi	
d. **ba**ba		**			d! upi

If Contiguity is not violated when the reduplicative affix interrupts the base, then, rather than being compressed (truncated), affixes that are in competition for alignment at the same edge will simply interrupt each other. This eliminates the KHC and RED-Shift predictions but, because Compression crucially relies on the truncative action of Contiguity, this move also eliminates the Compression model as a viable method for minimizing reduplicants.

Crowhurst (2004) notes that the Compression model predicts KHC-like base truncation effects but cites Downing's (2000) discussion of Hausa as reason not to be concerned about this prediction. As shown in Sect. 3.1, however, the Hausa facts do not support the idea that the KHC is a non-problem. Regardless of the status of the KHC as a truly undesirable prediction, the RED-Shift predictions that arise from the Compression model are so odd that they cannot be dismissed.

3.4 The trouble with existential faithfulness

Even if templates are eliminated, and size restrictors are limited to general prosodic and phonotactic constraints, the addition of existential faithfulness to the theory can bring about just the sort of tug-of-war between the base and reduplicant that causes the RED-Shift.

Whenever a size restrictor occurs in a bilateral-TETU ranking, below ∃-Max but above I/B-Max, it will ensure that input material surfaces either in the base or in the reduplicant but not in both. Consider, for instance, a hypothetical language that allows only CV syllables where ∃-Max is ranked above Root-Max which is in turn ranked above B/R-Max and B/R-Dep. Under this ranking the reduplicant will be minimized. This is illustrated in (74).

(74)

RED + badupi	∃-Max	*Struc-σ	Root-Max	B/R-Max	B/R-Dep
a. ☞ **ba**badupi		****		dupi	
b. **ba**ba	*!***	**	dupi		
c. **badupi**dupi		*****!	ba		ba
d. **badupi**pi		****	b!adu		badu

However, if the ranking of Root-Max and B/R-Max is inverted then the red-Shift will occur.

(75)

red + badupi	∃-Max	*Struc-σ	B/R-Max	Root-Max	B/R-Dep
a. **<u>ba</u>**badupi		****	d!upi		
b. 💣 **<u>badupi</u>**pi		****		badu	badu

In (75), ∃-Max and *Struc-σ are optimally satisfied when underlying material surfaces in either the reduplicant or the base but not in both. This is the same scenario as the one discussed in Sect. 3.1 regarding the original definition of Integrity. The difference here is that, though the red-Shift arises in the same way, I/R-Faith is no longer crucially involved.

One possible response to this problem would be to assert that the malady lies not in the existential faithfulness constraints themselves but rather in the unrestricted ranking of B/R-Max with respect to Root-Max. But Struijke (2000a, p. 54) notes that the ranking B/R-Faith $\gg$ Root-Faith, which has been shown above to cause the red-Shift, is needed in grammars that contain existential faithfulness to generate cases where changes to the reduplicant are reflected back onto the base (see McCarthy and Prince's (1995) discussion of Wilbur (1973) for such cases).

These problems with bilateral-TETU offer yet another illustration of how deviation from the unilateral-TETU rankings of the original formulation of Correspondence Theory leads to predictions in which constraints intended to affect the reduplicant can run amok and deform the base. These predictions can be avoided if we stick with McCarthy and Prince's original (1995) formulation of Correspondence Theory, which does not allow bilateral-TETU.

It is not the case that it is impossible to analyze Pima or Tohono O'odham plural formation as instances of reduplicative prefixation using existential faithfulness. Indeed, the constraints and ranking given in (74) correctly generates Pima-like minimization of the reduplicant. Nonetheless, the infixation analysis of Pima reduplication does not require that existential faithfulness be added to Correspondence Theory. Given that the augmentation of CT with existential faithfulness yields a less restrictive theory that predicts a superset of the languages predicted in the original model, and given that some of the newly predicted languages show anomalous patterns like the red-Shift, the original model of CT, and thus the infixation analysis, is preferable. It is not unimaginable that a language could be found that evidenced reduplication with bilateral-TETU thereby necessitating that Correspondence Theory be augmented existential faithfulness, but Pima, Tohono O'odham, and Lushootseed are not such languages.

4 Conclusions

The goals of this paper have been twofold. First, I have endeavored to provide an account of pluralization in Pima that illustrates how several emergent phonotactic restrictions condition the variation between the C-Copying and CV-Copying patterns of reduplication. Second, I have examined the ramifications of different assumptions about the relative designation of the base and the reduplicant and the typological implications of several mechanisms for restricting the size of the reduplicant.

Analyzing Pima reduplication as a process of infixation allows an account of the variation between C-Copying and CV-Copying patterns as the result of a conflict between a size restrictor (*Struc-σ) and several phonotactic restrictions (SSP, NoCoda, *ɲ]$_\sigma$, and *Lar]$_\sigma$). The fact that the size restrictor and the phonotactic constraints don't affect the base or unreduplicated forms is explained via the unilateral-TETU ranking offered by McCarthy and Prince's original formulation of Correspondence Theory. Of central importance is the fact that an infixation analysis is capable of generating the C-Copying vs. CV-Copying dichotomy using only fairly common markedness constraints and without using templatic constraints or existential faithfulness.

The generalization of the KHC and red-Shift problems to a range of analyses in which the size of the reduplicant is conditioned by means other than unilateral-TETU provides further support for the thesis of Generalized Template Theory. These cases support the GTT hypothesis by showing that the anomalous typological predictions associated with templatic constraints are not actually a problem with templates *per se*, but rather a problem for any size restricting strategy that uses mechanisms other than basic markedness constraints in TETU rankings.

Despite the intuitive appeal of existential faithfulness and the fact that it permits a wider range of analyses, including the ability to generate syncope in bases, I suggest that the existential faithfulness analysis of Pima reduplication, and existential faithfulness in general, should be rejected for two reasons. First, Correspondence Theory with ∃-Faith predicts a strict superset of the languages predicted without ∃-Faith, and, without definitive evidence that this extension is necessary, the more restrictive theory should be retained. Second, and more importantly, one of the new patterns predicted under this extension of Correspondence Theory, the red-Shift, is truly odd, thus another reason to prefer the original formulation of CT without existential faithfulness.

In order to pursue the infixing analysis of Pima reduplication, I have extended the Stem-Anchoring strategy of Kurisu and Sanders (1999) with the constraint Anchor-V_1, which I argue constitutes a natural extension of Beckman's (1998) insight that salient elements may be subject to special faithfulness constraints. In this case, Anchor-V_1 demands the coincidence of highly salient material from the stem with a highly salient position in the surface form.

In this analysis I have also proposed a generalized theory of the base in which reduplicant content is selected by positionally indexed members of the B/R-Max family of constraints rather than from the action of some independent principle of base selection. This represents yet another extension of the insight of Beckman's positional faithfulness, in this case into the realm of Base/ Reduplicant Faithfulness. This innovation decouples reduplicant placement and content with the pleasing consequence of allowing reduplicant content to be selected solely by the interaction of rankable constraints in standard Optimality Theoretic fashion.

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