Plural reduplication in Tohono O'odham: An analysis in Harmonic Serialism*

Skye Anderson and Ryan Walter Smith
University of Arizona

Abstract:

This paper analyzes plural reduplication in the Uto-Aztecan language Tohono O'odham in the framework of Harmonic Serialism. Empirically, it provides a unified account of a number of seemingly distinct reduplicative patterns in the language, including C-infixation, CV-infixation, cluster simplification in the reduplicant, and double reduplication in loanwords with exceptional stress patterns. Theoretically, it employs only general, independently-motivated constraints, accounting for the variety of surface patterns observed in the data by employing a non-templatic, process-oriented view of the phonology-morphology interface in Harmonic Serialism.

Keywords: reduplication, Tohono O'odham, Harmonic Serialism, Optimality Theory

1 Introduction

In this paper we analyze plural reduplication in the Uto-Aztecan language Tohono O'odham (formerly known as Papago) using the framework of Harmonic Serialism (McCarthy 2000 *et seq.*), a serial variant of Optimality Theory (Prince and Smolensky 2004). In particular, we propose that the exponent of the plural morpheme is a basic operation of GEN, the COPY(SEGMENT) operation. Subsequent interaction of general, language-wide constraints conditions the position and amount of reduplicated material in the plural.

Empirically, this analysis provides a unified account of a number of seemingly distinct reduplicative patterns in Tohono O'odham, including forms with consonant cluster simplification in the reduplicant and double reduplication in non-initially stressed loanwords. Theoretically, it builds on previous process-oriented approaches to the phonology-morphology interface in Harmonic Serialism that allow operations of GEN to be morphological exponents (Kimper 2009; Wolf 2008). This paper also extends and improves previous Optimality-theoretic approaches to reduplication in Tohono O'odham (Fitzgerald 2002, 2012; Riggle 2006) through its greater empirical coverage and exclusive use of independently-motivated, non-reduplication-specific constraints. It also motivates a non-templatic approach to Tohono O'odham plural reduplication that has the potential to account for other reduplication patterns in which the reduplicative morpheme does not surface with a consistent prosodic shape or position.

In Section 2 we present the data, beginning with the relevant facts about Tohono O'odham stress and phonotactics. Then we present the four superficially distinct patterns of plural reduplication that we analyze in this paper. In Section 3 we provide an overview of Harmonic Serialism and argue for an analysis of the data in this framework. Finally, in Section 4 we discuss previous analyses of the same phenomenon and show how our approach incorporates their insights and achieves greater empirical coverage while obviating the need for certain theoretical innovations.

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Contact info: skanderson@email.arizona.edu, ryanwaltersmith@email.arizona.edu

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2 The data

Tohono O'odham is a Uto-Aztecan language of the Tepiman family (Bascom 1965) spoken mostly in southern Arizona and Sonora, Mexico. It exhibits several patterns of plural reduplication in which the size and position of reduplicated material varies depending on phonological, lexical and semantic factors (see amongst others Fitzgerald 1999, 2000, 2012; Hale 1965; Hill and Zepeda 1998; Riggle 2006). While a treatment of all plural reduplication patterns in the language is beyond the scope of this paper, we identify a constellation of superficially distinct patterns and show that they yield to a unified analysis given a constrained and independently motivated set of theoretical apparatus.

First we briefly outline the stress pattern and relevant phonotactic restrictions operative in Tohono O'odham in Section 2.1. In Section 2.2 we present the data[1].

2.1 Stress

Primary stress in Tohono O'odham consistently surfaces on the first syllable of every native word, as in (1) (Hale 1965).

(1)		Noun	Gloss
	a.	kóa	'forehead'
	b.	kótwa	'shoulder'
	c.	tóki̥	'cotton'
	d.	ʔókokoi	'mourning dove'
	e.	háhawaɲ	'crows'

However, Tohono O'odham preserves non-initial stress in some borrowed words, as in (2) (Hale 1965; Hill and Zepeda 1998). Note that secondary stress also surfaces on the initial syllable in these forms (Munro and Riggle 2004).

(2)		Noun	Gloss
	a.	pàɺóoma	'dove'
	b.	kàdóodi	'marble'
	c.	ʔìskóowa	'chisel'
	d.	ʔàɺivháana	'elephant'

These forms are exceptional in another way; while Tohono O'odham allows diphthongs in any position in the word, long vowels are restricted to initial syllables in native words (Fitzgerald 2012). Because VV-sequences are syllabified together as diphthongs (Fitzgerald 2012), it appears that only true long vowels of the form Vː are restricted to the first syllable. If this is correct, then the non-initial 'long vowels' in (2) are better analyzed as VV-sequences. We will adopt this analysis below.

Returning to stress, Fitzgerald (2000) observes that the language assigns stress to odd-numbered syllables counting from the left edge. The leftmost syllable bears primary stress and subsequent odd-numbered syllables receive secondary stress (with the notable exception of loanwords with

[1] All data in this paper are drawn from Fitzgerald (2012), Hill and Zepeda (1998), Riggle (2006), Munro and Riggle (2004), and Mathiot (1973).

non-initial stress like those in (2)). This pattern indicates that syllabic trochaic feet are available representational units in the phonology of Tohono O'odham (Fitzgerald 2000 *et seq*.). Moraic trochees also appear to be available to the language; while there are no words of the form CV, there are CVV and CVC words. This indicates that there is a minimal word requirement of a binary foot and that binarity can be satisfied at the mora level as well as the syllable level (Hill and Zepeda 1992).

With respect to phonotactics, Tohono O'odham prohibits laryngeal codas, as evidenced by the absence of laryngeal codas in the language (Fitzgerald 2012; Riggle 2006).

In summary, Tohono O'odham exhibits a foot-based, trochaic stress pattern in which the initial syllable always receives primary stress[2], with the exception of some loanwords which retain non-initial stress on a sequence of two identical, tautosyllabic vowels; these forms place secondary stress on the first syllable. Finally, laryngeal codas are prohibited. In the next section we introduce the patterns of plural reduplication that we will analyze in Section 3.

2.2 Plural reduplication

Consider the nouns with initial stress and simple word-initial onsets in (3). The plural forms are differentiated from the singular forms by the presence of copied material (underlined); specifically, the initial consonant of the word appears immediately to the right of the first vowel. When the initial syllable contains a tautosyllabic VV-sequence, as in (3.d,e), the reduplicated consonant surfaces between the vowels, splitting them into two syllables.

(3)

	Singular	Plural	Gloss
a.	kótwa	kóktwa	'shoulder'
b.	tóki̥	tótki̥	'cotton'
c.	síkuɹ	sískuɹ	'younger sibling'
d.	ʔóaga	ʔóʔaga	'brain, nerve'
e.	kóa	kóka	'forehead'

However, if the initial consonant of the word is laryngeal ([*h*] or [*ʔ*]), then the initial CV-sequence of the word is copied immediately to the right of the first vowel, as in (4).

(4)

	Singular	Plural	Gloss
a.	háʔa	háhaʔa	'bottle'
b.	hík	híhik	'navel'
c.	ʔókokoi	ʔóʔokokoi	'mourning dove'
d.	háwaɲ	háhawaɲ	'crow'

In words with initial stress but complex word-initial onsets, only the second consonant of the cluster appears to the right of the first vowel in the plural, as in (5).

(5)

	Singular	Plural	Gloss
a.	tɹógi	tɹóɹgi	'truck'
b.	kɹávo	kɹáɹvo	'nail'

[2] In underived words, the final syllable does not receive secondary stress; in derived words, however, final syllables may be secondarily stress (Hill and Zepeda 1992).

Finally, in words with non-initial stress, copied material surfaces after the first vowel and after the stressed vowel, as in (6), where stress is placed on the first V of the non-initial VV-sequence. In words with non-laryngeal initial consonants, the first consonant of the word appears to the right of the first vowel, as in (6.a,b). In words with an initial laryngeal consonant, the first CV-sequence of the word appears to the right of the first vowel, as in (6.c,d). There is no such asymmetry in the copied material after the stressed vowel (noted by Fitzgerald 2012); instead, a C is inserted between the stressed V and its identical, tautosyllabic counterpart in the same way that the reduplicated consonant in stress-initial words splits diphthongs, as in (3.d,e).

(6)		Singular	Plural	Gloss
	a.	pàɺóoma	pàpɺóɺoma	‘dove’
	b.	kàdóodi	kàkdódodi	‘marble’
	c.	ʔìskóowa	ʔìʔiskókowa	‘chisel’
	d.	ʔàɺivháana	ʔàʔaɺivháhana	‘elephant’

In summary, various phonological properties of the word determine the position and amount of material copied in this group of reduplicated plurals. With respect to position, copied material always surfaces after the first vowel of the stem, which typically coincides with the primary stressed vowel. If the initial and primary stressed vowels do not coincide, copied material appears immediately to the right of both. With respect to the amount of copied material, either a C- or CV-sequence may be copied after the initial vowel, where CV-copying occurs just in case the initial consonant is laryngeal. Because the stressed vowel is immediately followed by another vowel, only C-copying occurs, splitting the VV-sequence into two syllables in the same way the reduplicant can split diphthongs in initial syllables. In the next section we give a brief overview of Harmonic Serialism and argue for a unified analysis of these superficially distinct patterns of plural reduplication in Tohono O'odham.

3 Analysis

3.1 Harmonic serialism

Harmonic Serialism (HS) is a variant of Optimality Theory with serial derivations (see McCarthy 2000 *et seq.*). Similar to parallel versions of OT, GEN takes an input and produces a candidate set. However, HS restricts GEN to producing candidates that differ from the input by the application of at most one basic operation. GEN submits this finite candidate set to EVAL, which consists of a constraint hierarchy. Each basic operation of GEN has a corresponding faithfulness constraint that penalizes any candidate to which that operation has applied.

On each iteration, EVAL selects the optimal candidate in the normal way and resubmits it to GEN as an intermediate input. The derivation iterates in this manner, selecting the locally optimal candidate in each iteration, as in Figure (1). When EVAL selects its input as the locally optimal output, monotonic improvement is no longer possible and the derivation terminates, or *converges*.

What counts as a basic operation of GEN is an ongoing area of research in Harmonic Serialism. McCarthy (2008) argues that building a prosodic word entails building its head foot, since prosodic hierarchy theory requires every prosodic word to contain at least one foot. Following this precedent, we will assume that building a prosodic word and a single head foot counts as a single basic operation. Independent of the insertion of a prosodic word, Pruitt (2010) has argued that footing is strictly

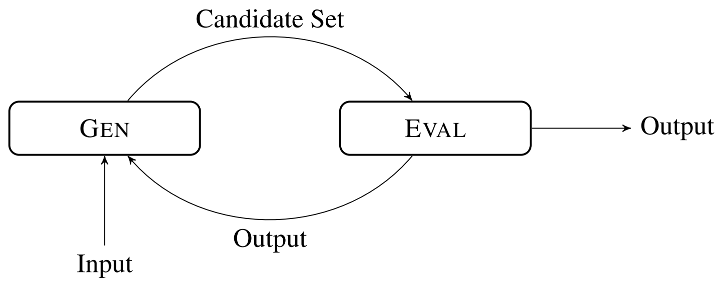

Figure 1: A Harmonic Serial Derivation

gradual, i.e. an iteration can build a single foot but may not delete or modify an existing one. This is based on the observation that an HS derivation will not select a non-optimal footing on any iteration, so modifying an existing foot should never improve harmony. While we will assume building a foot counts as a basic operation, we will note an instance in our analysis in which the modification of an existing foot can improve harmony because a morphologically-motivated process has applied and rendered a previous footing sub-optimal.

In the next section we analyze plural reduplication in words with initial stress. This will set up the analysis of reduplication in words with non-initial stress in Section 3.3.

3.2 Reduplication in words with initial stress

In this section we develop an analysis of reduplication in stress-initial words in Tohono O'odham. With respect to the position of the reduplicant, copied material always surfaces after the first vowel of the stem. There does not appear to be a phonological motivation for this position. However, it is a well-attested infixation site in the literature (Ultan 1975; Yu 2003). On this basis, we analyze the plural morpheme as an infix positioned according to a prosodic subcategorization frame defined in (7), following previous alignment-based analyses of infixation (see McCarthy and Prince 1993).

(7) ALIGN(PL,V_1,R):
Assign one violation mark if a phonological exponent of the plural morpheme is not aligned with the right edge of the first vowel of the stem.

While the position of the reduplicant is constant, its segmental form is not. There may be a consistent prosodic target (a bimoraic initial foot), but defining a fixed prosodic template is complicated by the doubly reduplicated forms in (6). Instead, we propose that the exponent of the plural morpheme is not a template but a basic operation of GEN, COPY(SEGMENT), defined in (8). This follows previous work in Harmonic Serialism proposing that operations of GEN can serve as the exponents of morphemes (Kimper 2009; Wolf 2008).

(8) COPY(SEGMENT):
An operation of GEN that creates a copy of a *string* of segments and places the copied string anywhere, incorporating it into existing prosodic structure (McCarthy et al. 2012:179).

Because the operation manipulates strings, it can copy any number of contiguous segments in one application. So GEN can apply COPY(SEGMENT) to an input /PL + *kotwa*/ 'shoulder (pl)' and produce the outputs *ko<u>k</u>twa*, *ko<u>ko</u>twa*, *ko<u>kotwa</u>twa*, *<u>kotwa</u>kotwa*, and so on.

In Harmonic Serialism, every operation of GEN has a corresponding faithfulness constraint; the relevant one here is *COPY, defined in (9).

(9) *COPY:
Assign one violation mark for every application of the COPY(SEGMENT) operation (McCarthy et al. 2012:180).

Because copying occurs in reduplicated plurals, some constraint must override *COPY. We will employ a general approach to the phonology-morphology interface that builds the pressure to express morphological contrasts phonologically into the HS derivation in the form of constraints. Specifically, we will assume that every morphosyntactic feature ϕ stands in correspondence with its phonological exponent ϕ' and that a family of MAX constraints demands that every instance of ϕ in the input must correspond to an instance of ϕ' in the output (Wolf 2008). The relevant MAX constraint is defined in (10).

(10) MAX(PL):
For every instance of the plural morpheme in the input, assign a violation mark if there is not an instance of the *exponent* of the plural morpheme in the output.

If MAX(PL) $\gg$ *COPY, copying will occur to express the plural morpheme regardless of the resulting violation of *COPY. Also, because MAX(PL) can be ordered with respect to phonological constraints, the constraint ranking will determine the order in which phonological and morphological processes are interleaved in the serial derivation. This in turn can account for the fact that plural reduplication refers to stress, as evidenced by double reduplication in words with non-initial stress. Specifically, if LX≈PR, a constraint that requires the grammar to parse morphosyntactic words into prosodic words as in (11), outranks MAX(PL), the derivation will build a prosodic word and its head foot prior to the insertion of the plural exponent[3].

(11) LX≈PR:
The left and right edges of every lexical word must coincide respectively with the left and right edges of some prosodic word (Prince and Smolensky 2004).

Finally, we will appeal to FootBinarity, defined in (12).

(12) FOOTBINARITY:
Feet must be binary at some level of analysis (Prince and Smolensky 2004).

At this point, we can derive C-copying in stress-initial words with simple onsets. First, consider the case in which the initial consonant is not laryngeal. The first iteration will build prosodic structure to satisfy the highly-ranked LX≈PR; FTBIN will favor a head foot that satisfies binarity, as in (13)[4].

[3]We denote prosodic word boundaries with | | and foot boundaries with ( ).

[4]We employ Prince (2002)'s combination format in our tableaux; violations are indicated with numerals. In rows with losing candidates, an L indicates that the constraint prefers the losing candidate over the winning candidate. A W indicates that the constraint prefers the winning candidate over the losing one.

(13) *Ranking arguments from the first iteration:* LX≈PR ≫ MAX(PL), AL(PL,V_1,R)

	/PL + kotwa/	LX≈PR	MAX(PL)	AL(PL,V_1,R)	*COPY
	PL + kotwa	1 W	1	1	
☞	PL + |(kótwa)|		1	1	
	koktwa	1 W	L	L	1 W
	kokotwa	1 W	L	L	1 W
	kokotwa	1 W	L	1	1 W

Here, the bottom three candidates exhibit an application of the COPY(SEG) operation, satisfying MAX(PL). However, none of these candidates succeed because they all violate LX≈PR, which outranks MAX(PL).

In the second iteration, shown in (14), the most harmonic candidate must satisfy the highly-ranked MAX(PL) and ALIGN(PL,V_1,R). Additionally, FTBIN will prefer a candidate in which the foot remains binary, favoring |(*kóktwa*)| over |(*kókotwa*)| because the latter contains a ternary foot.

(14) *Ranking arguments from the second iteration:* MAX(PL), AL(PL,V_1,R) ≫ *COPY

	PL + |(kótwa)|	MAX(PL)	AL(PL,V_1,R)	FTBIN	*COPY
	PL + |(kótwa)|	1 W	1 W		L
☞	|(kóktwa)|				1
	|(kokotwa)|			1 W	1

The derivation will converge on the next iteration, since the candidate |(*kóktwa*)| satisfies all of the relevant constraints and no basic operation of GEN can increase its harmony. Next consider an input in which the initial consonant is laryngeal, such as *haʔa* 'bottle'. The first iteration, shown in (15), will select a candidate in which a prosodic word and head foot have been built to satisfy LX≈PR. Just as before, the head foot will be binary to satisfy FTBIN.

(15) *Ranking arguments from the first iteration:* LX≈PR ≫ MAX(PL), AL(PL,V_1,R)

	/PL + haʔa/	LX≈PR	MAX(PL)	AL(PL,V_1,R)	FTBIN
	PL + haʔa	1 W	1	1	
☞	PL + |(háʔa)|		1	1	
	PL + |(há)ʔa|		1	1	1 W
	hahaʔa	1 W	L	L	

The current analysis predicts C-copying in the next iteration in order to preserve foot binarity instead of the observed CV-copying. However, recall that laryngeal codas are prohibited in Tohono O'odham; this motivates a constraint like *LARYNGEALCODA, defined in (16).

(16) *LARYNGEALCODA:
Laryngeal Codas are dispreferred (McCarthy 1998; Riggle 2006).

We can force CV-copying in just the right cases if *LARYNGEALCODA outranks FTBIN. Then the second iteration will select the candidate in which COPY(SEG) has copied the initial CV-sequence and placed it after the first vowel of the stem, avoiding a violation of *LARYNGEALCODA at the expense of a violation of FTBIN, as in (17).

(17) *Crucial ranking in the second iteration:* *LARCODA ≫ FTBIN

PL + |(háʔa)|	MAX(PL)	AL(PL,V_1,R)	*LARCODA	FTBIN
PL + |(háʔa)|	1 W	1 W		L
☞ |(háhaʔa)|				1
|(háhʔa)|			1 W	L

At this point the derivation could converge, since there is no harmonically improving way to repair the lingering violation of FTBIN without allowing GEN to modify existing foot structure. This situation arises because we have interleaved phonology and morphology in the derivation, allowing a morphologically-motivated process to render a previously optimal footing sub-optimal. However, if foot repair constitutes a basic operation of GEN, a third iteration will repair the violation of FTBIN. In this case, the derivation converges on the fourth iteration.

To recap, we have argued that the plural morpheme is an infix required to surface immediately to the right of the first stem vowel. The exponent of the plural is the COPY(SEGMENT) operation and we derived the preference for C-copying generally and CV-copying just in case the initial consonant is laryngeal by appealing to the ranking *LARCODA ≫ FTBIN. This accounts for plural reduplication in words with initial stress and simple onsets.

We can now extend this analysis to account for reduplication in stress-initial words with complex onsets. Recall that only the rightmost consonant of the cluster is copied in these words, resulting in *tɹóɹgi* from *tɹógi* rather than **tɹótgi* or **tɹótɹogi*. This behavior falls out naturally from another independently motivated constraint on the COPY(SEG) operation, COPYLOCALLY, defined as in (18)[5].

(18) COPYLOCALLY:
Assign a violation to every segment intervening between the original string and its copy McCarthy et al. (2012).

As before, the first iteration of the derivation will construct a prosodic word and a binary head foot, outputting |(*tɹógi*)|. Copying occurs in the second iteration, as in (19).

(19) *Ranking arguments from the second iteration:* MAX(PL), AL(PL,V_1,R) ≫ COPYLOC

PL + |(tɹógi)|	MAX(PL)	AL(PL,V_1,R)	FTBIN	COPYLOC
PL + |(tɹógi)|	1 W	1 W		L
☞ |(tɹóɹgi)|				1
|(tɹótgi)|				2
|(tɹótɹgi)|				2
|(tɹótɹogi)|			1	2

Here, the faithful candidate performs best on COPYLOCALLY, but violates the higher ranking constraint MAX(PL). Of the remaining candidates, the winning candidate, *tɹóɹgi*, performs best on COPYLOCALLY, because there is only one segment intervening between the copied string and the string from which it was copied. The derivation converges on the next iteration.

[5] Another possible analysis of these forms might appeal to restrictions on the sonority profile of syllable codas. That is, [ɹ] is copied instead of [t] because [ɹ] is more sonorous and therefore a more optimal coda. Here we pursue an analysis in terms of local copying and leave the role of sonority for future work.

To summarize, the analysis thus far accounts for reduplication in stress-initial words in Tohono O'odham. In the next section, we extend the analysis to account for double reduplication in words with non-initial stress.

3.3 Reduplication in words with non-initial stress

As established in Section 2.2, words with non-initial stress exhibit reduplication in two places: after the first vowel of the word, and after the primary stressed vowel, indicating that the domain of plural reduplication is both the first and the primary stressed vowel. In order to capture this generalization, we posit an additional subcategorization frame, defined in (20).

(20) ALIGN(PL,V́,R):
Assign one violation mark if a phonological exponent of the plural morpheme is not aligned with the right edge of the primary stressed vowel.

Stress initial words conflate the influence of AL(PL,V́,R) and AL(PL,V_1,R), since the stressed vowel coincides with the first vowel. However, in words with non-initial stress, copying must occur in two locations to satisfy both subcategorization frames and the derivation cannot converge until both positional requirements are met. For space reasons, we will combine the two alignment constraints under the umbrella constraint ALIGN(PL); the violation marks assigned by ALIGN(PL) equal the sum of the violation marks accrued by the two component constraints. This does not constitute a theoretical claim but merely a notational abbreviation.

Consider the derivation of *pàpɭóɭoma* 'doves', which we assume contains a lexically-specified stressed foot. The high-ranked LX≈PR again enforces the building of a prosodic word in the first iteration, despite the fact that it creates violations of EXHAUSTIVITY(WORD), a constraint that penalizes syllables that are direct dependents of the prosodic word (Itô and Mester 1992).

(21) *Ranking argument from the first iteration:* LX≈PR ≫ EX(WD), MAX(PL), ALIGN(PL)

/PL + pa(ɭóo)ma/	LX≈PR	EX(WD)	MAX(PL)	ALIGN(PL)
PL + pa(ɭóo)ma	1 W	L	1	2
☞ PL + |pa(ɭóo)ma|		2	1	2
pap(ɭóo)ma	1 W	L	L	1 L
pa(ɭóɭo)ma	1 W	L	L	1 L

In the second iteration, the high-ranked EX(WD) favors a candidate in which one of the peripheral syllables is footed. All else being equal, the constraint ALL-FOOT-LEFT, defined in (22), will favor creating a foot at the left edge, modelling the fact that the initial syllables of the data in (6) bear secondary stress but the final syllables do not.

(22) ALL-FOOT-LEFT:
For each foot in a word, assign one violation mark for every syllable separating it from the left edge of the word.

(23) *Ranking arguments from the second iteration:* EX(WD) ≫ MAX(PL), ALIGN(PL), FTBIN

PL + |pa(ɹóo)ma|	ALL-FT-L	EX(WD)	MAX(PL)	ALIGN(PL)	FTBIN
PL + |pa(ɹóo)ma|	1	2 W	1	2	L
☞ PL + |(pà)(ɹóo)ma|	1	1	1	2	1
PL + |pa(ɹóo)(mà)|	2 W	1	1	2	1
|pap(ɹóo)ma|	1	2 W	L	1 L	L
|pa(ɹóɹo)ma|	1	2 W	L	1 L	L

The third iteration will select a candidate in which COPY(SEG) has applied and FTBIN will favor a binary foot at either the mora- or syllable-level. Currently, however, there is no constraint that favors C-copying over CV-copying, demonstrated in (24).

(24) *Third iteration produces a tie*

PL + |(pà)(ɹóo)ma|	MAX(PL)	ALIGN(PL)	FTBIN
PL + |(pà)(ɹóo)ma|	1 W	2 W	1 W
☞ |(pàp)(ɹóo)ma|		1	
☞ ! |(pàpa)(ɹóo)ma|		1	
|(pà)(ɹóɹo)ma|		1	1 W

To select only the correct form |(pàp)(lóo)ma|, we need to invoke a constraint that breaks this tie. The strong tendency for primary stress to surface at the left edge in Tohono O'odham (a tendency that is categorical with the exception of loanwords that we have analyzed as having an underlyingly stressed foot) motivates the constraint in (25) (McCarthy and Prince 1993; Pater 2000).

(25) ALIGN-HEAD-LEFT (Align (PrWd-L, Head(PrWd)-L):
Align the left edge of the Prosodic Word with the left edge of the head of the Prosodic Word.

This constraint assigns one violation for every syllable intervening between the left edge of the head foot of the prosodic word and the left edge of the prosodic word. This correctly selects the winner:

(26) *Third iteration with* ALIGN-HEAD

PL + |(pà)(ɹóo)ma|	MAX(PL)	ALIGN(PL)	FTBIN	ALIGN-HEAD
PL + |(pà)(ɹóo)ma|	1 W	2 W	1 W	1
☞ |(pàp)(ɹóo)ma|		1		1
|(pàpa)(ɹóo)ma|		1		2 W
|(pà)(ɹóɹo)ma|		1	1 W	1

Also, recall that we modelled the alternation between C- and CV-copying in stress-initial words with the ranking *LARCODA ≫ FTBIN. By ranking ALIGN-HEAD below *LARCODA as well, CV-copying will occur here just in case the initial consonant of the word is laryngeal. For example, the third iteration of the derivation of *ʔiʔiskókowa* 'chisels' will select |*(ʔìʔi)(skóo)wa*| rather than *|*(ʔìʔ)(skóo)wa*|.

A fourth iteration will satisfy the remaining violation of ALIGN(PL,V́,R) by copying the onset of the primary stressed syllable and placing it immediately to the right of the stressed vowel. This splits the identical, tautosyllabic VV-sequence into two syllables, as in (27).

(27) *Ranking argument from the fourth iteration*: ALIGN(PL) ≫ *COPY

	|(pàp̲)(ɹóo)ma|	ALIGN(PL)	*COPY
	|(pàp̲)(ɹóo)ma|	1 W	L
☞	|(pàp̲)(ɹóɹ̲o)ma|		1
	|(pàp̲)(ɹóoɹ̲)ma|	1 W	1 L

In sum, we have accounted for double reduplication by positing an additional positional constraint on the plural morpheme and anlyzing the stressed 'long' vowels in loanwords with non-initial stress as tautosyllabic VV-sequences that behave in the same way as diphthongs. This analysis demonstrates that single and double reduplication represent a coherent process of non-templatic infixation in Tohono O'odham. In the next section, we situate our analysis with respect to previous treatments of O'odham plural reduplication and conclude.

4 Previous analyses and conclusion

Previous work has analyzed Tohono O'odham plural reduplication as the prefixation of a CV-template accompanied by syncope in the base unless that would result in an ill-formed coda (Fitzgerald 2000; Hale 1965; Hill and Zepeda 1992). On this analysis, the reduplicant is more faithful to the input than the base is, motivating the Full Model of reduplication with Input-Reduplicant (IR) faithfulness and a distinction between Input-Output and Input-Base faithfulness in Correspondence Theory (McCarthy and Prince 1999). However, Riggle (2006) notes that the prefixing account is unable to explain cluster simplification in reduplication of words with complex onsets (e.g. *tɹóɹgi* 'trucks'). Riggle (2006) proposes an infixation analysis in which an ANCHOR constraint forces a templatic C-infix to surface after the first vowel. The template can be expanded to a CV to avoid phonotactically illicit codas. Cluster simplification emerges by ranking *COMPLEXONSET below MAX-IO but above MAX-BR. Since syncope is no longer necessary to account for the lack of a vowel in the base, the infixation analysis eliminates the need for IR faithfulness.

Fitzgerald (2012) replies to Riggle, citing forms with non-initial stress that exhibit double reduplication (e.g. *pàpɹóɹoma* 'doves') and noting that they appear to exhibit mandatory CV-copying after the stressed vowel despite the lack of phonotactic motivation, an objection based on the assumption that the long vowel of forms like *paɹóoma* are underlyingly short. Fitzgerald argues that these facts are inconsistent with an infixation analysis and instead support the CV-prefix + syncope account of Tohono O'odham plural reduplication.

Here we have argued for an infixation analysis somewhat similar to Riggle's analysis, but it differs both in terms of empirical scope and theoretical approach. Empirically, it accounts for four superficially distinct reduplicative patterns in the language: C-copying after the first vowel of most words, CV-copying after the first vowel of words with word-initial laryngeal onsets, apparentl cluster simplification in the reduplicant in words with initial consonant clusters, and double reduplication in words with non-initial stress. Theoretically, we argue that the plural exponent is not a template but rather the COPY(SEGMENT) operation, which positions copied material according to two prosodic subcategorization frames. The preference for C-copying over CV-copying falls out from constraints on prosodic structure. Forms with 'cluster simplification' in the reduplicant fall out from constraints on the COPY(SEGMENT) operation (the COPYLOCALLY constraint in particular). Finally, we incorporated the supposedly problematic doubly reduplicated forms, showing that the apparent asymmetry between the size of the reduplicants after the first and stressed vowels emerges as an epiphenomenon of the representation of non-initial 'long vowels' in the language. Thus, the doubly reduplicated forms actually support an infixation analysis of Tohono O'odham plural reduplication.

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