A case for parallelism: reduplication-repair interaction in Maragoli

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1 Overview

I describe a reduplication-repair interaction in Maragoli (Bantu; Kenya).

The interaction between prefix reduplication and hiatus repair reflects a rule-ordering paradox.
- For one input, copying takes place before repair,
- while for another, repair takes place before copying.

Paradox is analyzable in Parallel OT (Prince & Smolensky 1993/2004), but translates into a constraint-ranking paradox in Harmonic Serialism (McCarthy 2010a, a.o).

Parallel OT succeeds because it permits direct comparison between candidates displaying opposite order of operations.

2 Empirical background

Maragoli (also referred to as Lulogooli, Luragoli, Llogoori, a.o.) is a Bantu language spoken primarily in Kenya by over 600,000 people.

Maragoli has a number of noun classes identifiable by characteristic noun-class prefixes:

(1a) ri-duːma
NCL5-corn
‘corn’

(1b) m-ťɛːɛɛ
NCL3-rice
‘rice’

The language also exhibits noun class agreement, which presents as a set of prefixes on noun modifiers:

(2a) m-ťɛːɛɛ go-ra
NCL3-rice
AGR3-this
‘this rice’

(2b) ri-duːma ri-nu
NCL7-corn
AGR7-that
‘this corn’

- Full set of noun classes and associated prefixes provided in Table A1 in the appendix.

1 I thank Bruce Hayes, Kie Zuraw, Eric Bakovic, Dustin Bowers, Robert Daland, Eleanor Glewwe, Kathryn Pruitt, Hannah Sarvasy, Brian Smith, and audiences at the UCLA Phonology Seminar and the 23rd Manchester Phonology Meeting for helpful feedback on previous incarnations of this project. I also thank Mwabeni Indire, my Maragoli consultant, for sharing his language with me.
Maragoli forbids vowel hiatus, employing a variety of repairs to avoid it, enumerated below.

**Glide formation**

(3a) \( m\text{-}f\text{e}\text{-}rɛ \quad gw\text{-}aŋге (/go\text{+}aŋге/) \)
NCL3-rice AGR3-my
‘my rice’

(3b) \( ri\text{-}du\text{m}a \quad rj\text{-}aŋге (/ri\text{+}aŋге/) \)
NCL5-corn AGR3-my
‘my corn’

• Tense vowels /i e o u/ surface as glides preceding another vowel.

**Low vowel deletion**

(4a) \( n\text{-}u\text{-}rj\text{-}e (/na\text{+}u\text{+}ri\text{+}e/) \)
REMIT-2sg-eat-FUT
‘you will eat’

(4b) \( m\text{-}u\text{v}a (/ma\text{+}u\text{v}a/) \)
NCL6-sun
‘suns’

• /a/ deletes preceding vowels.

**Front vowel deletion**

(5a) \( a\text{-}rɛ; (/a\text{+}rɛ+i/) \)
3sg-eat-PAST
‘he/she ate’

(5b) \( ko\text{-}sjɛ\text{-}z\text{-}a (/ko\text{+}sjɛ\text{+}iɛ\text{+}a/) \)
1pl-grind-CAUS-INF
‘to cause to grind’ (Leung 1991)

• /i/ deletes following front vowels.

**Velar palatalization**

(6a) \( ke\text{-}furja \quad tfj\text{-}aŋге (/ke\text{+}aŋге/) \)
NCL3-pot AGR7-my
‘my pot’

(6b) \( ko\text{-}djɛ\text{-}ɛ\text{-}n\text{-}a (/ko\text{+}djɛ\text{+}ɛn\text{+}a/) \)
1pl-NCL9-want-INF
‘to want it’ (Leung 1991)

• In underlying K{i e}V sequences, the first two segments reduce, surfacing as a palatal-glide sequence

### 2.1 Reduplicative possessives in Maragoli

This talk focuses primarily on the interaction between agreement prefix reduplication and hiatus repair observed in the human possessive paradigm.

(7) \( m\text{-}f\text{e}\text{-}rɛ \quad go\text{-}ra \)
NCL3-rice AGR3-this
‘this rice’
In the table above, the second-person and third-person singular possessives — hereafter referred to as reduplicative possessives — display prefix copying as well as hiatus repair.

What are the URs of reduplicative possessives shown above?

- The agreement prefix UR /go/- is apparent from (7).
- Copies are contiguous in the second-person singular form, and separated by an additional prefix vowel associated with the third-person singular form.
- I assume the reduplicant to be located word-initially\(^1\), and therefore posit the following URs:

<table>
<thead>
<tr>
<th>Sing.</th>
<th>1p</th>
<th>2p</th>
<th>3p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gw-aːŋɛ</td>
<td>guː-gw-ɔ</td>
<td>gw-ʔ-gw-ɛ</td>
</tr>
</tbody>
</table>
|       | AGR3-1sg.Poss | RED-AGR3-2sg.Poss | RED-3sg.Poss-AGR3-3sg.Poss | [Table 1a: Noun class 3 possessive paradigm]
| Pl.   | gw-eːtu     | gw-ɛŋju    | gw-æːvɔ              |
|       | AGR3-1pl.Poss | AGR3-2pl.Poss | AGR3-3pl.Poss        |

| Pl.   | gw-eːtu     | gw-ɛŋju    | gw-æːvɔ              |
|       | AGR3-1pl.Poss | AGR3-2pl.Poss | AGR3-3pl.Poss        |

- Height of the first vowel in the second-person possessive (/ɔ/ → [u]) is analyzed later as reduplication-specific faithfulness to the following glide.
- Reduplicants are taken to be prespecified for two morae.

Summing up, URs for reduplicative possessives are taken to be the following:

\[(8)\] Second-person singular possessives: /RED+AGR+ɔ/  
Third-person singular possessives: /RED+i+AGR+ɛ/

### 2.2 Prefix reduplication and hiatus repair in reduplicative possessives

The second-person possessives can be broken up into four categories based on reduplicant shape:
Reduplicative possessives form a closed, finite set of data. Do speakers of Maragoli have grammatical knowledge of them, or are they memorized?

I administered a nonce probe study (Berko 1958) to a native speaker to answer this question.

My consultant was provided with an illustration of a wug-shaped bird, and was given probes composed of a nonce prefix and a fixed nonce stem [taka] = ‘bird’.

First-, second-, and third-person singular possessive constructions featuring the nonce prefix were elicited, as shown below:
Nonce prefixes were modeled after agreement prefixes associated with the different copy categories in (9a-d).

- [bu]- modeled after prefixes associated with input-similar copy possessives (e.g., /go/-, [gu-gw-]),
- [u]- after prefixes associated with glided-copy possessives (e.g., /o/-, [wɔ-v-]).

My consultant largely replicated the patterns observed in the attested data.

### Table 2: nonce probe results

<table>
<thead>
<tr>
<th>Nonce word</th>
<th>1sg poss.</th>
<th>2sg poss.</th>
<th>3sg poss.</th>
</tr>
</thead>
<tbody>
<tr>
<td>bi-taka</td>
<td>bj-aŋge</td>
<td>bi-bj-ɔ</td>
<td>bi-bj-ɛ</td>
</tr>
<tr>
<td>bu-taka</td>
<td>bw-aŋge</td>
<td>bu-bw-ɔ</td>
<td>bw-i-bw-ɛ</td>
</tr>
<tr>
<td>i-taka</td>
<td>j-aŋge</td>
<td>jɔ:j-ɔ</td>
<td>jɛ:j-ɛ</td>
</tr>
<tr>
<td>u-taka</td>
<td>w-aŋge</td>
<td>wɔ-v-ɔ</td>
<td>wɛ:v-ɛ</td>
</tr>
<tr>
<td>ba-taka</td>
<td>b-aŋge</td>
<td>bɔ:b-ɔ</td>
<td>bɛ:b-ɛ</td>
</tr>
<tr>
<td>gi-taka</td>
<td>dʒi-aŋge</td>
<td>dʒi:dʒj-ɔ</td>
<td>dʒi:dʒj-ɛ</td>
</tr>
</tbody>
</table>

Copies were glided, syncopated, and palatalized in the expected contexts.

- My consultant varied with respect to the nonce prefix /gi/-, occasionally producing non-palatalized copies.

Results indicate that Maragoli speakers have grammatical knowledge of the system.

See Table A3 in the appendix for the rest of the responses to the nonce prefixes.
4 Parallel analysis: a compromise between syllable-structure preferences and base-reduplicant identity

I assume the basic premises of Prosodic Morphology (McCarthy & Prince 1986/1996).
- Underlying forms are specified with a heavy-syllable reduplicative template: \( \sigma_u \).
- The base is assumed to be everything that is not the reduplicant.

Reduplicative possessives can be accounted for by invoking base-reduplicant correspondence (IDENT-BR, MAX-BR, etc.).

(12a) Input-similar copy

m-\text{-tʃeːrɛ}  \quad gu:-gw-ɔ
\text{NCL3-rice}  \quad \text{RED-AGR3-your}
\text{‘your rice’}

\[ /\text{RED}+\text{go}+\text{ɔ}/ \rightarrow [\text{gu}:-\text{gw}-\text{ɔ}] \]

- Reduplicant is identical to the agreement prefix, except for height and length.

(12b) Glided copy

mu-s\text{-aːza}  \quad wɔ:-v-ɔ
\text{NCL1-man}  \quad \text{RED-AGR1-your}
\text{‘your man’}

\[ /\text{RED}+\text{o}+\text{ɔ}/ \rightarrow [\text{wɔ}:-\text{v}-\text{ɔ}] \]

- The glided prefix and the stem vowel are copied into the reduplicant.

How do we get both [gu:-gw-ɔ] and [wɔ:-v-ɔ]?
- The copy in these cases consists of a single syllable with a simplex onset.
- Near-perfect BR-identity in /\text{RED}+\text{o}+\text{ɔ}/ \rightarrow [\text{wɔ}:-\text{v}-\text{ɔ}]\); beats less BR-similar form *[ɔ:-v-ɔ], in which only the prefix vowel was copied.
- Less BR-similarity in /\text{RED}+\text{go}+\text{ɔ}/ \rightarrow [\text{gu}:-\text{gw}-\text{ɔ}], which beats out BR-identical *[gwɔ:-gw-ɔ], avoiding the extra complex onset.
- Ranking *COMPLEX above MAX-BR captures these facts:
Table 3: \(BR\)-identity given that syllable-structure preferences are satisfied

See (AC) in the appendix for constraint definitions.

Most of the rest of the analysis falls out from the constraints used in Table 3 above.

- \(/\text{RED}+\text{ga}+\alpha/ \rightarrow [\text{g}\alpha-\text{g}-\alpha]\) is nearly perfect, violating only \(\text{MAX}\)-\(\text{IO}\).
- \([\text{ti}-\text{tj}-\alpha]\) displays overapplication (Wilbur 1973): initial consonant surfaces as palatal, but the environment for palatalization is not met in the reduplicant.
- Overapplication is analyzed as consonant identity, driven by \(\text{IDENT}\)-\(BR\)(delayed release) (abbreviated d.r.).

Table 4: full parallel analysis of reduplicative possessives

The third-person possessives largely fall out from our analysis of second-person cases, with a few considerations still to be made.
Recall that the third-person singular bears the prefix vowel i- (2sg [gw-i:-gw-ε] versus 3sg [gw-i:-gw-ε]):

\[(13a) \text{ m-}\text{tʃɛːr} \quad \text{gw-i:-gw-ε} \quad \text{/RED+i+go+ε/} \rightarrow [\text{gw-i:-gw-ε}] \]
\[\text{NCL3-rice} \quad \text{RED-AGR3-his/her} \quad \text{‘his/her rice’} \]

- When the prefix is /go/-, prefix-vowel preservation is preferred to BR-identity.

\[(13b) \text{ mu-sə} \text{za} \quad \text{wɛ:-v-ɛ} \quad \text{/RED+i+o+ɛ/} \rightarrow [\text{wɛ:-v-ɛ}] \]
\[\text{NCL1-man} \quad \text{RED-AGR1-his/her} \quad \text{‘his/her man’} \]

- When the prefix is /o/-, BR-identity is preferred to preservation.

Suppose that prefix vowel deletion is penalized by MAX-IO([-low]), and BR-identity is regulated by MAX-BR.

The two constraints form a ranking paradox:

\[(14) \text{ MAX-IO([-low])} \gg \text{MAX-BR:} \quad [\text{gw-i:-gw-ε}] > *[\text{gwɛ:-gw-ε}] \]
\[*[\text{w-i:-v-ɛ}] > [\text{wɛ:-v-ɛ}] \]
\[\text{MAX-BR} \gg \text{MAX-IO([-low]):} \quad *[\text{gwɛ:-gw-ε}] > [\text{gw-i:-gw-ε}] \]
\[[\text{wɛ:-v-ɛ}] > *[\text{w-i:-v-ɛ}] \]

As it turns out, the base and the reduplicant are identical in all of the forms with [CV] bases, and in none of the other forms:

<table>
<thead>
<tr>
<th>Noun class agmt. prefix</th>
<th>2sg poss.</th>
<th>3sg poss.</th>
</tr>
</thead>
<tbody>
<tr>
<td>/o/-</td>
<td>wɔ:-v-ɔ</td>
<td>wɛ:-v-ɛ</td>
</tr>
<tr>
<td>/va/-</td>
<td>vɔ:-v-ɔ</td>
<td>vɛ:-v-ɛ</td>
</tr>
<tr>
<td>/ga/-</td>
<td>gɔ:-g-ɔ</td>
<td>gɛ:-g-ɛ</td>
</tr>
<tr>
<td>/e/-</td>
<td>jɔ:-j-ɔ</td>
<td>jɛ:-j-ɛ</td>
</tr>
<tr>
<td>/ka/-</td>
<td>kɔ:-k-ɔ</td>
<td>ke:-k-ɛ</td>
</tr>
<tr>
<td>/ha/-</td>
<td>hɔ:-h-ɔ</td>
<td>hɛ:-h-ɛ</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noun class agmt. prefix</th>
<th>2sg poss.</th>
<th>3sg poss.</th>
</tr>
</thead>
<tbody>
<tr>
<td>/go/-</td>
<td>gu:-gw-ɔ</td>
<td>gw-i:-gw-ɛ</td>
</tr>
<tr>
<td>/ri/-</td>
<td>ri:-rj-ɔ</td>
<td>ri:-rj-ɛ</td>
</tr>
<tr>
<td>/ke/-</td>
<td>tʃi:-tʃj-ɔ</td>
<td>tʃi:-tʃj-ɛ</td>
</tr>
<tr>
<td>/vi/-</td>
<td>vi:-vj-ɔ</td>
<td>vi:-vj-ɛ</td>
</tr>
<tr>
<td>/ro/-</td>
<td>ru:-rw-ɔ</td>
<td>rw-i:-rw-ɛ</td>
</tr>
<tr>
<td>/vo/-</td>
<td>vu:-vw-ɔ</td>
<td>vw-i:-vw-ɛ</td>
</tr>
</tbody>
</table>

Table 5: relatively strong reduplicative identity in forms with [CV] bases

Reduplicative identity stronger in cases where the surface base is CV than when it is CWV. We can posit base-specific BR-correspondence to capture the phenomenon:
(15) \( \text{MAX-B}_{\text{cvR}}: \) segments in a CV surface base must have a correspondent in the reduplicant.

Ranking \( \text{MAX-B}_{\text{cvR}} \gg \text{MAX-IO([-low])} \gg \text{MAX-BR} \) captures vowel preservation in [gw-\( \text{i}\)-gw-\( \text{e} \)] as well as strong reduplicative identity in [we:-v-\( \text{e} \)].

Size-specific correspondence is reminiscent of:
- Tagalog (Zuraw 2002): the preference for cluster simplification over BR-identity depends on reduplicant size.
- Cilungu (Bickmore 2013): perfect copying of base tones into the reduplicant seems to depend on base size.

Finally, in [gw-\( \text{i}\)-gw-\( \text{e} \)], the prefix vowel is skipped in copying.
- Nonlocal reduplication can be regulated by high-ranking MAX-BR-C\(_{\text{stem}}\) (Riggle 2004), requiring stem consonants to be copied.

5 Serial analyses: rule-ordering and constraint-ranking paradoxes

Suppose we posit a rule-based analysis (SPE; Chomsky and Halle 1968) for the forms [gu:-gw-\( \text{ɔ} \)] and [w\( \text{ɔ} \):-v-\( \text{ɔ} \)]:

(16) Copying: \( \emptyset \rightarrow \sigma_i \leftrightarrow \sigma_i \)
*Copy the first syllable in the word and place it to the left of the original.*

Glide Formation: [+high] \( \rightarrow \) [-syl] /\( \_\)V
*Render prevocalic high segments [-syl].*

In what order should the two rules apply? As the schematic derivations below illustrate, positing an analysis with extrinsically ordered rules leads to a rule-ordering paradox:

(17) UR /RED+go+\( \text{ɔ} \)/ UR /RED+go+\( \text{ɔ} \)/
Copying go:+go+\( \text{ɔ} \) Glide Formation \( \sigma_{\mu\text{u}}\)+gw+\( \text{ɔ} \)
Glide Formation go:+gw+\( \text{ɔ} \) Copying gw\( \text{ɔ} \):gw+\( \text{ɔ} \)
Assimilation gu:+gw+\( \text{ɔ} \) Assimilation — — —
SR \( \checkmark \) [gu:-gw-\( \text{ɔ} \)] SR *[gw\( \text{ɔ} \):-gw-\( \text{ɔ} \)]

Can Harmonic Serialism (Prince & Smolensky 2004, McCarthy 2010a, a.o.), a serial version of Optimality Theory, account for reduplicative possessives?
In Harmonic Serialism:
- Optimization is gradual and cyclical, allowing for GEN-EVAL cycles.
- GEN can only produce candidates differing in at most one respect from the input.
- Cycles repeat until convergence, when input and output are identical, at which point the output is taken to be the surface form.
- Single changes made to the input are called operations.

McCarthy et al. 2012 proposes a framework within HS, Serial Template Satisfaction (hereafter STS), which captures patterns of reduplication.
- Reduplicants are templates into which segmental content is copied.
- STS denies a role for BR-correspondence. Instead, HEADEDNESS (HD) (Selkirk 1995) and *COPY constraints drive and limit copying into the template.

(18) a. HD(σ): Assign a penalty for every syllable that does not contain a segment as its head.

b. *COPY: Assign a penalty for copying a nonempty string of segments.

The two constraints that drive copying and glide formation are HD(σ) and *VV. As the following tableaux reveal, they form a ranking paradox:

<table>
<thead>
<tr>
<th>Stage</th>
<th>/RED+go+ɔ/</th>
<th>HD(σ)</th>
<th>*VV</th>
<th>IDENT-IO(syll)</th>
<th>*COPY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>σₘₜ⁺go⁻</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>σₘₜ⁺gw⁻</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>→ go⁻go⁻</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>go⁻go⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>→ go⁻gw⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<tr>
<td>1</td>
<td>σₘₜ⁻go⁻</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>→ σₘₜ⁺gw⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>→ o:ɔ⁻gw⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>→ o:ɔ⁻w⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6: constraint-ranking paradox between HD(σ) and *VV

Operations driven by HD(σ) and *VV—namely, copying and glide formation—cannot be applied in a series, since both orders are required to derive the two forms.ii

- <[gu⁻gw⁻], *[gw⁻gw⁻]> and <*[o⁻v⁻], [w⁻v⁻]> are pairs of local optima that cannot all compete at once, and no under ranking can both global optima be selected.

This stands as a case of irreducible parallelism (McCarthy 2013): candidates reflecting multiple changes to the input must be compared.
5.1 Can the HS analysis be fixed?

Paradox can be dispelled if glide formation is assumed not to be an operation, but rather a *fully faithful* change to the input (McCarthy 2010b).

- Glide formation would violate no faithfulness constraints, and thus could apply freely at any stage, concurrent with any other unfaithful operation.
- But then vowels and glides must be assumed to be featurally identical, which requires that [syllabic] be abandoned along with associated constraints.
- /RED+go+/ and /RED+o+/ would undergo copying, glide formation, and syllabification, mapping to /go:-gw-\ and /wɔ:-w-\ in one fell swoop.

This option is problematic: though vowels and glides do distribute complementarily, other evidence suggests that [j] is phonemic in Maragoli.

- Compensatory lengthening apparently follows glide formation in non-final syllables (Leung 1991):
  1. (19a) nz-izuriz-a (19b) kw-i\h{i}zuriz-a (/ko+izuriz+a/)
     1sg-fill-PROG 1p-fill-PROG
     ‘I am filling’ ‘we are filling’

- Consider forms with the third-person subject agreement prefix, [a]-/\j\-, the latter allomorph of which surfaces before vowels:
  1. (20a) j-i-s\i{}ng-a (20b) j-igor-a (20c) j-a-ja:nz-a
     3sg-REFL-wash-PROG 3sg-open-PROG 3sg-HABIT-like-PROG
     ‘(s)he washes {him/her}self’ ‘(s)he is opening’ ‘(s)he likes (in general)’

- If the glide were formed from a featurally identical vowel (e.g., /i/ → [j]), then we would expect the following vowel to lengthen in turn.
- The forms above show that short vowels can follow [j], a fact that remains unexplained without phoneme /j/.

Paradox can be dispelled using weighted constraints (Serial Harmonic Grammar; Pater 2009):

- Weights are selected so that \(2w(*VV) > w(HD(\sigma)) > w(*VV)\).
- Since violating HD(\sigma) is worse than violating *VV, /RED+go+/ maps to /go:-gw-\, and eventually to /gu:-gw-\.
- As for /wɔ:-v-\, two violations of *VV is worse than one of HD(\sigma), and so the grammar selects /RED-w-\ in Stage 1 instead of the immediately copied /o-o-\, making /wɔ:-v-\ available.
- This reduces the input-contingent order of operations to a cumulative effect.
But as far as I can tell, neither freely applying glide formation nor weighted constraints can account for the paradoxical third-person possessives, reproduced below:

(21a)  /RED+i+go+ɛ/  →  [gw-ɨ:-gw-ɛ], *[gwɛ:-gw-ɛ]
(21b)  /RED+ɨ+o+ɛ/  →  [we-ɛ-v], *[w-ɨ-v-ɛ]

Recall that word-internal self-similarity is preferred in surface bases of CV-size (21b), but prefix-vowel preservation is preferred otherwise (21a).

- In the parallel analysis, this fact was explained as size-specific BR-correspondence.
- But STS frames reduplication as strict satisfaction of a reduplicant template, without recourse to correspondence.

### 6 Where has irreducible parallelism been observed?

I offer three potential cases, describing them in schematic, rule-based terms:

In Maragoli, the two operations reduplication and glide formation switch in the order of application if the output reduplicant has a suboptimal onset.

In Lithuanian:
- Adjacent obstruents typically assimilate in palatalness and voicing,
- but if the two assimilations were to produce a geminate,
- then a different sequence of changes to the UR takes place, with epenthesis applying first.
- See Albright and Flemming’s 2013 notes on Baković (2005) for a slightly different take.

In Central Veneto (Walker 2010):
- The height of a suffix vowel can spread backwards potentially over multiple vowels to the stressed vowel,
- but if the stressed vowel is lax,
- then height doesn’t spread at all — not even to posttonic vowels.

These cases share the following properties:
- A sequence $S$ of two ordered operations applies to one input,
- but a different sequence of operations $S’$ — which does not share with $S$ the same first change — applies to a second input violating the same constraints driving $S$.
- $S’$ can, in principle, consist of zero, one, or more ordered operations.

To capture this in HS, there must be a tenable set of constraints and a ranking such that:
- For the first input, application of the first operation of $S$ is optimal,
- while for the second input, application of the first operation of $S’$ is optimal.
- For instance, see Kimper (2011) for a serial analysis of Walker (2010).
If no such constraint set and ranking exists (cf. McCarthy 2010b; “no intermediate step”), then HS cannot account for the full range of data.

But Parallel OT can (at least in the above cases), since it can directly compare the outputs of $S$ and $S'$.

7 Conclusion

Maragoli displays an intricate interaction between reduplication and hiatus repair, reflecting a rule-ordering paradox.

Interaction can be accounted for in Parallel OT, but translates into a constraint-ranking paradox in HS.

- In parallel terms, BR-identity is maintained so long as higher-ranked constraints on syllable structure are satisfied.
- But in categorical HS, constraints driving copying and hiatus repair cannot be ranked with respect to each other.

Parallel OT succeeds because it permits direct comparison between candidates displaying opposite orders of operations.

8 References


Bickmore, L. 2013. Tonal copying as lapse resolution in Cilungu reduplication. Talk given at the UCLA Phonology Seminar.


McCarthy, J. J. 2013. Irreducible parallelism and desirable serialism. Talk given at the *Annual Meeting on Phonology*. 

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### 7 Appendix

<table>
<thead>
<tr>
<th>Class</th>
<th>Noun class prefix</th>
<th>Examples showing noun class prefix UR</th>
<th>Agmt. prefix</th>
<th>Examples showing agmt. prefix UR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>/mu/-</td>
<td>mu-sa:za, ‘man’</td>
<td>/o/-</td>
<td>o-ra, ‘this’</td>
</tr>
<tr>
<td>2</td>
<td>/va/-</td>
<td>va-sa:za, ‘men’</td>
<td>/va/-</td>
<td>va-ra, ‘this’</td>
</tr>
<tr>
<td>3</td>
<td>/mi/-</td>
<td>m-[tʃe:]re, ‘rice’</td>
<td>/go/-</td>
<td>go-ra, ‘this’</td>
</tr>
<tr>
<td>4</td>
<td>/mi/-</td>
<td>mi-[tʃe:]re, ‘rice’ (pl.)</td>
<td>/dʒi/-</td>
<td>dʒi-ra, ‘this’</td>
</tr>
<tr>
<td>5</td>
<td>/ɾi/-</td>
<td>ri-du:ma, ‘corn’</td>
<td>/ɾi/-</td>
<td>ri-lahe, ‘pretty’</td>
</tr>
<tr>
<td>6</td>
<td>/ma/-</td>
<td>ma-du:ma, ‘corn’ (pl.)</td>
<td>/ga/-</td>
<td>ga-ra, ‘this’</td>
</tr>
<tr>
<td>7</td>
<td>/ke/-</td>
<td>ke-sa:ra, ‘branch’</td>
<td>/ke/-</td>
<td>ke-ra, ‘this’</td>
</tr>
<tr>
<td>8</td>
<td>/ɾi/-</td>
<td>ri-sa:ra, ‘branches’</td>
<td>/ɾi/-</td>
<td>ri-ra, ‘this’</td>
</tr>
<tr>
<td>9</td>
<td>/e/-</td>
<td>e-su:ze, ‘fish’</td>
<td>/e/-</td>
<td>e-ra, ‘this’</td>
</tr>
<tr>
<td>10</td>
<td>/zi/-</td>
<td>zi-su:ze, ‘fish’ (pl.)</td>
<td>/zi/-</td>
<td>zi-ra, ‘this’</td>
</tr>
<tr>
<td>11</td>
<td>/ɾo/-</td>
<td>ro-baho, ‘wood’</td>
<td>/ɾo/-</td>
<td>ro-ra, ‘this’</td>
</tr>
<tr>
<td>12</td>
<td>/ka/-</td>
<td>ka-sa:ra, ‘twig’</td>
<td>/ka/-</td>
<td>ka-ra, ‘this’</td>
</tr>
</tbody>
</table>
Table A1: Noun classes (adopted from Leung 1991) with associated prefixes

<table>
<thead>
<tr>
<th>Noun class</th>
<th>Agmt. prefix</th>
<th>Examples showing agmt. prefix UR</th>
<th>2sg poss.</th>
<th>3sg poss.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>/o/-</td>
<td>o-ra, ‘this’</td>
<td>wo-v-o</td>
<td>we-v-e</td>
</tr>
<tr>
<td>2</td>
<td>/va/-</td>
<td>va-ra, ‘this’</td>
<td>vo-v-o</td>
<td>ve-v-e</td>
</tr>
<tr>
<td>3</td>
<td>/go/-</td>
<td>go-ra, ‘this’</td>
<td>gu-gw-o</td>
<td>gw-i-gw-e</td>
</tr>
<tr>
<td>4</td>
<td>/dʒi/-</td>
<td>dʒi-ra, ‘this’</td>
<td>dʒi-dʒi-o</td>
<td>dʒi-dʒi-e</td>
</tr>
<tr>
<td>5</td>
<td>/ri/-</td>
<td>ri-lahe, ‘pretty’</td>
<td>ri-j-j-o</td>
<td>ri-j-j-e</td>
</tr>
<tr>
<td>6</td>
<td>/ga/-</td>
<td>ga-ra, ‘this’</td>
<td>go-g-o</td>
<td>ge-g-e</td>
</tr>
<tr>
<td>7</td>
<td>/ke/-</td>
<td>ke-ra, ‘this’</td>
<td>ti-tj-j-o</td>
<td>ti-tj-j-e</td>
</tr>
<tr>
<td>8</td>
<td>/vi/-</td>
<td>vi-ra, ‘this’</td>
<td>vi-vj-o</td>
<td>vi-vj-e</td>
</tr>
<tr>
<td>9</td>
<td>/e/-</td>
<td>e-ra, ‘this’</td>
<td>j-e-j-o</td>
<td>j-e-j-e</td>
</tr>
<tr>
<td>10</td>
<td>/zi/-</td>
<td>zi-ra, ‘this’</td>
<td>zi-zj-o</td>
<td>zi-zj-e</td>
</tr>
<tr>
<td>11</td>
<td>/ro/-</td>
<td>ro-ra, ‘this’</td>
<td>ru-rw-o</td>
<td>rw-i-rw-e</td>
</tr>
<tr>
<td>12</td>
<td>/ka/-</td>
<td>ka-ra, ‘this’</td>
<td>k-e-k-o</td>
<td>ke-k-e</td>
</tr>
<tr>
<td>13</td>
<td>/to/-</td>
<td>to-ra, ‘this’</td>
<td>tw-i-tw-e</td>
<td>tw-i-tw-e</td>
</tr>
<tr>
<td>14</td>
<td>/vo/-</td>
<td>vu-ra, ‘this’</td>
<td>vu-vw-o</td>
<td>vw-i-vw-e</td>
</tr>
<tr>
<td>15</td>
<td>/ko/-</td>
<td>ko-ra, ‘this’</td>
<td>kw-i-kw-e</td>
<td>kw-i-kw-e</td>
</tr>
<tr>
<td>16</td>
<td>/ha/-</td>
<td>ha-ra, ‘this’</td>
<td>h-e-h-e</td>
<td>h-e-h-e</td>
</tr>
<tr>
<td>18</td>
<td>/mo/-</td>
<td>mo-ra, ‘this’</td>
<td>mu-mw-o</td>
<td>mw-i-mw-e</td>
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</tbody>
</table>

Table A2: full set of reduplicative possessives based on agreement prefix

<table>
<thead>
<tr>
<th>Probe noun</th>
<th>2sg poss.</th>
<th>3sg poss.</th>
<th>2sg poss.</th>
<th>3sg poss.</th>
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</thead>
<tbody>
<tr>
<td>/PREF+taka/</td>
<td>/RED+PREF+o/</td>
<td>/RED+i+PREF+i/</td>
<td>/PREF+taka/</td>
<td>/RED+PREF+o/</td>
</tr>
<tr>
<td>bi-taka</td>
<td>bi-bj-o</td>
<td>bi-bj-e</td>
<td>i-taka</td>
<td>j-e-j-o</td>
</tr>
<tr>
<td>bu-taka</td>
<td>bu-bw-o</td>
<td>bu-bw-e</td>
<td>u-taka</td>
<td>w-e-v-o</td>
</tr>
<tr>
<td>pi-taka</td>
<td>pi-pj-o</td>
<td>pi-pj-e</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pu-taka</td>
<td>pu-pw-o</td>
<td>pu-pw-e</td>
<td>ba-taka</td>
<td>bo-b-o</td>
</tr>
<tr>
<td>fi-taka</td>
<td>fi-fj-o</td>
<td>fi-fj-e</td>
<td>pa-taka</td>
<td>po-p-o</td>
</tr>
<tr>
<td>fu-taka</td>
<td>fu-fw-o</td>
<td>fu-fw-e</td>
<td>fa-taka</td>
<td>fo-f-o</td>
</tr>
<tr>
<td>di-taka</td>
<td>di-dj-o</td>
<td>di-dj-e</td>
<td>da-taka</td>
<td>do-d-o</td>
</tr>
<tr>
<td>du-taka</td>
<td>du-dw-o</td>
<td>dw-i-dw-e</td>
<td>ta-taka</td>
<td>t-e-t-o</td>
</tr>
<tr>
<td>ti-taka</td>
<td>ti-tj-o</td>
<td>ti-tj-e</td>
<td>la-taka</td>
<td>l-e-l-o</td>
</tr>
<tr>
<td>tu-taka</td>
<td>tu-tw-o</td>
<td>tw-i-tw-e</td>
<td>sa-taka</td>
<td>s-e-s-o</td>
</tr>
<tr>
<td>li-taka</td>
<td>li-lj-o</td>
<td>li-lj-e</td>
<td>za-taka</td>
<td>z-e-z-o</td>
</tr>
<tr>
<td>lu-taka</td>
<td>lu-lw-o</td>
<td>lw-i-lw-e</td>
<td></td>
<td></td>
</tr>
<tr>
<td>si-taka</td>
<td>si-sj-o</td>
<td>si-sj-e</td>
<td>gi-taka</td>
<td>dʒi-dʒj-o</td>
</tr>
<tr>
<td>su-taka</td>
<td>su-sj-o</td>
<td>su-sj-e</td>
<td></td>
<td>dʒi-dʒj-o</td>
</tr>
<tr>
<td>zu-taka</td>
<td>zu-zj-o</td>
<td>zu-zj-e</td>
<td>ki-taka</td>
<td>tʃi-tʃj-o</td>
</tr>
<tr>
<td>Ce-taka</td>
<td>Ci-Cj-o</td>
<td>Ci-Cj-e</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-taka</td>
<td>Cu-Cw-o</td>
<td>Cu-Cw-e</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table A3: nonce probe study results

(AC) a. *VV: assesses one penalty for every pair of adjacent vowels.
b. REALIZE MORPH: assesses one penalty for every input morpheme not realized in the output.

c. *COMPLEX: assesses one penalty for each complex onset.

d. MAX-BR: assesses one penalty for every base segment lacking a reduplicant correspondent.

e. *V[-l]wV[-l]: assess one penalty for every instance of [w] occurring between two non-low vowels.

g. IDENT-BR(high): assesses one penalty for each [α back] reduplicant correspondent of a [-α back] base segment.

h. IDENT-IO(syll): assesses one penalty for each [α syllabic] output correspondent of a [-α syllabic] input segment.

i. MAX-IO: assesses one penalty for every input segment lacking an output correspondent.

j. DEP-BR: assesses one penalty for every reduplicant segment lacking a base correspondent.

k. *Kj: assesses one penalty for every velar stop-[j] sequence.

l. IDENT-BR(d.r.): assesses one penalty for each [α d.r.] reduplicant correspondent of a [-α d.r.] input segment.

An infixed RED such as /AGR+RED+ɔ/ is problematic in its account of the second-person possessive [jɔ-j-ɔ] from /e/-, AGR9 (see Table 4 below), which displays interaction between reduplication and glide formation. The analyst would have to posit extensive back-copying to successfully derive the surface form (e.g., schematically /e+RED+ɔ/ → e+ɛ+ɔ → e+j+ɔ → ? [jɔ:j-ɔ]). A suffixal RED could succeed here (e.g., /e+ɔ+RED/ → j-ɔ-RED → j-ɔ-RED (via compensatory lengthening) → [j-ɔ:ju-ɔ] → [j-ɔ:jo-ɔ] (via word-final shortening)), but is incompatible with [gu-ɡw-ŋ] (shown above in Table 3), whose UR would have to be posited as /go-ɡ+RED/.

Replacing *VV with ONSET leads to the same paradox under such ranking, since the latter constraint would pathologically eliminate the intermediate form ‘go-go-ɔ’. Ranking ONSET/PWd (Flack 2009) higher than ONSET or *VV could dispel the paradox, but fails to predict the existence of vowel-initial words in the language. Moreover, medial onset formation must precede initial onset formation to derive the third-person form [wɛ-v-ɛ] from /R+i+ɑ+ɛ/‘, indicating that ONSET is ranked above ONSET/PWd.

This is somewhat of a simplification. Non-high vowels can undergo glide formation in the language, and so some outputs of glide formation reflect a change in height. As far as I can tell, these facts are unproblematic for a serial analysis: non-high glide formation can take place concurrently with copying, preceding raising to high glides.