Iterativity in phonology

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Iterativity workshop
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Goals

1. The origins of iterativity in generative phonology
2. Theories of iterativity and their predictions
3. The connection between iterativity and:
   - Opacity
   - Locality
   - Cyclicity
   - Optionality
4. Open questions

Question: How does a rule apply when its structural description is met more than once (in the input or in the course of the derivation)?

Two possible answers:

1. **Iteratively**: the rule applies repeatedly to one target at a time
2. **Non-iteratively**: the rule applies simultaneously to all targets

The answer matters when multiple applications of the rule can interact.

A rule that creates additional inputs to itself

Rule: a → b / _ b
Input: /aab/

Iterative application:

Input	/aab/
a → b / _ b	a**b**b
a → b / _ b	**b**bb
Output	[bbb]

Result: **self-feeding**

Non-iterative application:

Input	/a**a**b/
a → b / _ b	a**b**b
Output	[abb]

Result: **self-counterfeeding**

Self-feeding and self-counterfeeding: examples

Vowel harmony in two different dialects of Crimean Tatar (McCollum and Kavitskaya 2018):

$V \rightarrow$ [+round] / [+round] C_0 _

Southern dialect

Iterative application:

Input	/tuz-lɯɣ-ɯ/
VH	tuz-l**u**ɣ-ɯ
VH	tuz-luɣ-**u**
Output	[tuz-luɣ-u]

Result: **self-feeding**

Central dialect

Non-iterative application:

Input	/tuz-l**ɯ**ɣ-ɯ/
VH	tuz-l**u**ɣ-ɯ
Output	[tuz-luɣ-ɯ]

Result: **self-counterfeeding**

A rule that destroys potential inputs to itself

Rule: a → b / a _ a
Input: /aaaa/

Non-iterative application:

Input	/a**aa**a/
a → b / a _ a	a**bb**a
Output	[abba]

Result: **self-counterbleeding**

Iterative Left-to-Right:

Input	/aaaa/
a → b / a _ a	a**b**aa
a → b / a _ a	-
Output	[abaa]

Result: **self-bleeding**

Iterative Right-to-Left:

Input	/aaaa/
a → b / a _ a	aa**b**a
a → b / a _ a	-
Output	[aaba]

Result: **self-bleeding**

Self-counterbleeding: example

Consonant gradation in Finnish (Anderson 1974, Kiparsky 2003):
Rule (simplified): TT → T / _ VCC

Input: /rokko-tta-tta-tte/
Output: [roko-ta-ta-tte]

Result: **self-counterbleeding**

Non-iterative application:

Input	/ro**kk**o-**tt**a-**tt**a-tte/
CG	roko-ta-ta-tte
Output	[roko-ta-ta-tte]

Iterative Left-to-Right:

Input	/rokko-tta-tta-tte/
CG	roko-tta-tta-tte
CG	roko-ta-tta-tte
CG	roko-ta-ta-tte
Output	[roko-ta-ta-tte]

Self-bleeding: example

Optional schwa deletion in French (Dell 1980):
Rule (simplified): ə → ∅ / V#C _ (optional)

Input: /ãvi#də#tə#batʁ/ (Riggle and Wilson 2005)
Outputs (3):

- ãvi#də#tə#batʁ
- ãvi#d∅#tə#batʁ
- ãvi#də#t∅#batʁ
- Not: *ãvi#d∅#t∅#batʁ

Iterative Left-to-Right:

Input	/ãvi#də#tə#batʁ/
Deletion	ãvi#d∅#tə#batʁ
Deletion	-
Output	[ãvi#d#tə#batʁ]

Iterativity and types of opacity

	Non-iterative	**Iterative**
Creates additional inputs	Self-counterfeeding	Self-feeding Self-counterfeeding
Destroys potential inputs	Self-counterbleeding	Self-bleeding Self-counterbleeding

Sound Pattern of English (Chomsky and Halle 1968)

Non-iterative application:

> *To apply a rule, the entire string is first scanned for segments that satisfy the environmental constraints of the rule. After all such segments have been identified in the string,* ***the changes required by the rule are applied simultaneously****.*
>
> *page 344, (39)*

Predictions:

- No self-feeding
- No self-bleeding

Unbounded harmony is a non-local rule with the Star Operator:

$$V \rightarrow [+round] \ / \ [+round]C_0(\textbf{[-round]}\textbf{C}_0)^* \_\_$$

Anderson (1974): arguments for iterativity

Argument for **self-bleeding**: French schwa deletion
(Five more cases of self-bleeding in Howard 1972)

Locality argument for **self-feeding**:

- Universal: a phonological process applies across arbitrarily long sequences only if it has the effect of creating new environments for its own application
  - Attested: /aaaai/ → [iiiii]
  - Unattested: /aaaai/ → [ooooi] (while /aaaao/ → [aaaao])
- The Star Operator can generate patterns that violate this universal:
  - $a \rightarrow i \ / \ \_ \ (C_0 a)^* C_0 i$
  - $a \rightarrow o \ / \ \_ \ (C_0 a)^* C_0 i$
- Iterativity and no Star Operator give the correct result:
  - $a \rightarrow i \ / \ \_ \ C_0 i$ (iterative): /aaaai/ → [iiiii] (unbounded spreading)
  - $a \rightarrow o \ / \ \_ \ C_0 i$ (iterative): /aaaai/ → [aaaoi] (one application)

Johnson (1972): all rules are iterative

- All rules are iterative
- Reported non-iterative rules are iterative in some direction
- Example: Crimean Tatar (V → [+round] / [+round] C_0 _)

Southern dialect

Left-to-Right application:

Input	/tuz-lɯɣ-ɯ/
VH	tuz-l**u**ɣ-ɯ
VH	tuz-luɣ-**u**
Output	[tuz-luɣ-u]

Central dialect

Right-to-Left application:

Input	/tuz-lɯɣ-ɯ/
VH	tuz-l**u**ɣ-ɯ
Output	[tuz-luɣ-ɯ]

- Patterns generated by crucially simultaneous rules do not exist

Input	/a**aa**a/
a → b / a _ a	abba
Output	[a**bb**a]

Osborn (1966): Warao labial voicing

Optional context-free labial voicing in Warao:

p → b (optional)

If it applies, then **all** /p/'s in the word become [b]

Input: /paro-parera/
Outputs (2):

- paroparera
- **b**aro**b**arera
- Not: *paro**b**arera, ***b**aroparera

(However, evidence limited to a 1-2 words.)

Late rule-based phonology

Parametrized rules:

- Iterativity: [±iterative]
- Directionality: Left-to-Right or Right-to-Left
- Optionality: [±optional]

Examples of theories with parameters:

- Archangeli and Pulleyblank (1994)
- Nevins (2010)

Optimality Theory

- **Opacity**: Output optimization leads to a transparency default (self-feeding, self-bleeding) but some opaque non-iterativity can be generated.
- **Locality**: Potential to generate non-local dependencies.

Debates about the existence of non-local dependencies and non-iterativity.

Non-local dependencies: Sour Grapes

Hypothetical non-local dependency (McCarthy 2011):

- Rightward nasal harmony: /mawa/ → [mãw̃ã]

	/mawa/	AGREE[N]	IDENT[N]
a.	mawa	*!	
b.	mãwa	*!	*
c. ☞	mãw̃ã		***

- Liquids are never nasal: high-ranking *r̃.
- /r/ prevents harmony altogether: /mawara/ → [mawara]

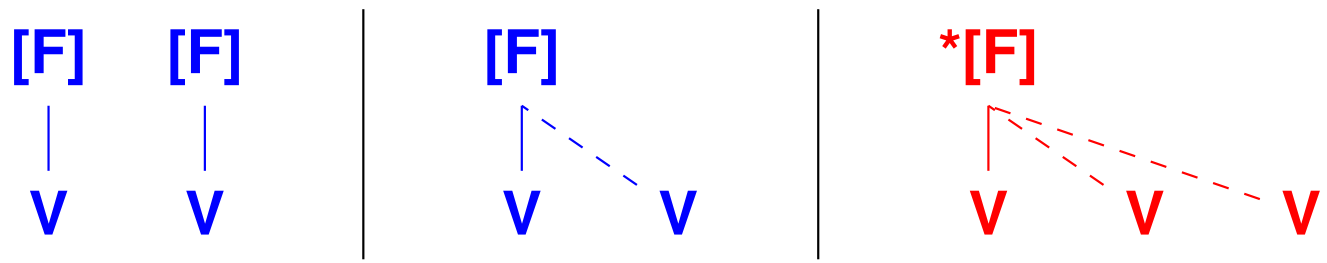
	/mawara/	*r̃	AGREE[N]	IDENT[N]
a. ☞	mawara		*	
b.	mãwara		*	*!
c.	mãw̃ãr̃ã	*!		*****

Active debate: do such non-local dependencies exist?

- Yes: Walker (2010, 2014), Stanton (2018), McCollum and Essegbey (2018)
- No: Wilson (2006), Kimper (2011), Dresher and Nevins (2017)

Representational account of assimilatory self-counterfeeding

- OT does not have a general theory of counterfeeding (McCarthy 2007), but some cases of self-counterfeeding can be generated
- Autosegmental representations encode the application of a process on the surface and de-opacify self-counterfeeding



- Logic of the analysis:

$$*\text{NON-ADJACENT-SHARE}[\text{F}] \gg \text{SHARE}[\text{F}]$$

Representational account of assimilatory self-counterfeeding

Self-counterfeeding in Central Crimean Tatar
(McCollum and Kavitskaya 2018)

- ∀-HARMONY-R([RD]$_{\sigma_1}$,V): assign a violation to every vowel to the right of a [+rd] vowel in the initial syllable σ_1 that is not associated with [rd].
- ADJACENCY[RD]: given a string Y, consisting of $V_1 \ldots V_N$, assign a violation to every autosegmental linkage of [rd] between non-adjacent vowels, V_y and V_{y+2}.

	/tuz-lɯɣ-ɯ/	ADJACENCY[RD]	∀-HARMONY-R	ID[RD]
a.	tuz-lɯɣ-ɯ		*!	
b. ☞	tuz-luɣ-ɯ			*!
c.	tuz-luɣ-u	*!		**

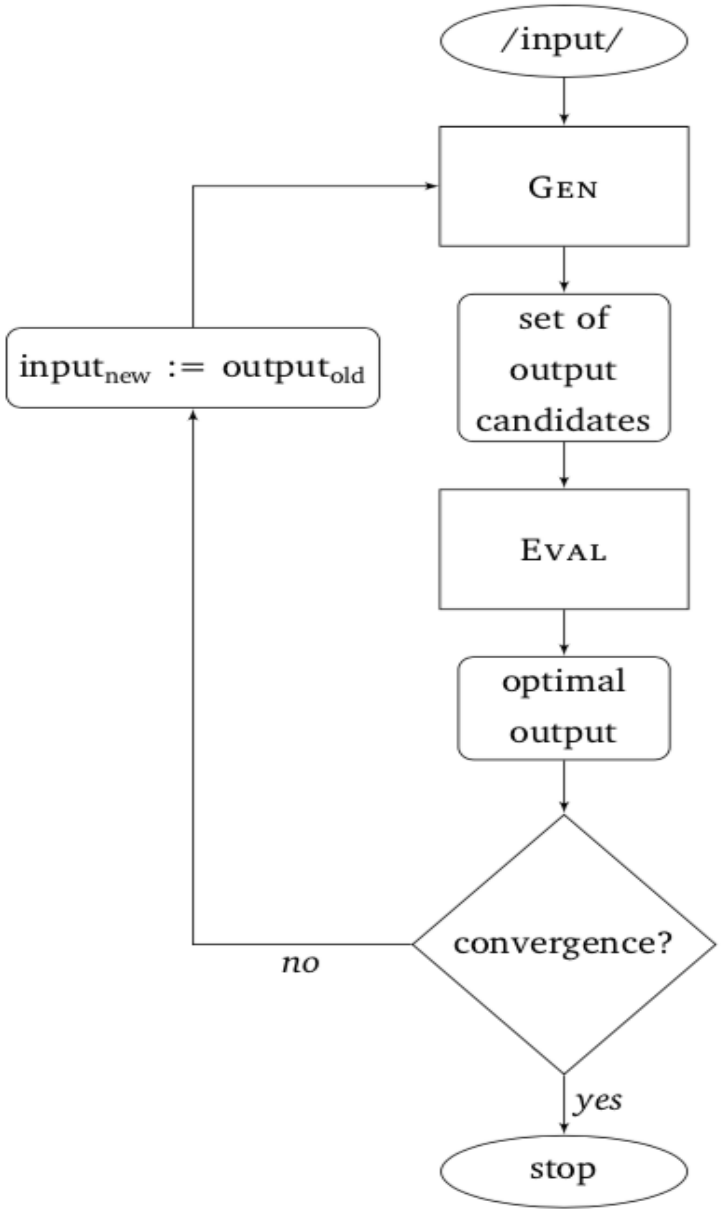
Optimality Theory: more open questions

1. Does **non-assimilatory self-counterfeeding** exist?
   - Note: many apparent cases of self-counterfeeding can be re-analyzed using processes that don't create additional inputs to themselves (Kaplan 2008).

2. **Self-counterbleeding**.

3. Does **global (non-iterative) optionality** exist?
   - Vaux (2008): OT is unable to generate local optionality (as in French).
   - Riggle and Wilson (2005): An extended version of OT can generate local optionality (as in French) but not global optionality (as in Warao labial voicing).

Harmonic Serialism



Iterative Harmony in HS (McCarthy 2011)

	/(m)aw/	SHARE[N]	IDENT[N]
a.	(m)aw	**!	
b. ☞	(mã)w	*	*

⇓

	/(mã)w/	SHARE[N]	IDENT[N]
a.	(mã)w	*!	
b. ☞	(mãw̃)		*

⇓

	/(mãw̃)/	SHARE[N]	IDENT[N]
a. ☞	(mãw̃)		

⇓

Convergence

Blocking sour grapes by SHARE

AGREE[N]: Adjacent segments should agree on the feature [±nasal]

	/mawara /	*r̃	AGREE[N]	IDENT[N]
a. ☞	mawara		*	
b.	mãw̃ãra		*	*!**
c.	mãw̃ãr̃ã	*!		*****

SHARE[N]: Adjacent segments should share a [+nasal] feature

	/mawara/	*r̃	SHARE[N]	IDENT[N]
a.	(m)awara		***!*	
b. ☞	(mãw̃ã)ra		**	***
c.	(mãw̃ãr̃ã)	*!		*****

HS Prevents pathological repairs for SHARE

Trigger Nasalization: ba ⇒ mã

Parallel OT: ba → mã

	/ba/	SHARE[N]	IDENT[N]
a.	ba	*!*	
b. ☞	(mã)		**

Harmonic Serialism: ba → ma → mã

	/ba/	SHARE[N]	IDENT[N]
a. ☞	ba	**	
b.	(m)a	**	*!*

⇒ Convergence

(intermediate step is not optimizing)

Local optionality in HS (Kimper 2011)

Unranked constraints can be reranked at each iteration:

/ətə/	MAX	*ə
☞ ətə		**
tə	*!	*

⇒ Convergence

/ətə/	*ə	MAX
ətə	**!	
☞ tə	*	*

⇒

/tə/	MAX	*ə
☞ tə		*
t	*!	

⇒ Convergence

/ətə/	*ə	MAX
ətə	**!	
☞ tə	*	*

⇒

/tə/	*ə	MAX
tə	*!	
☞ t		*

⇒

/t/	MAX	*ə
☞ t		
Ø	*!	

⇒ Convergence

(presupposes unranked markedness and faithfulness Constraint)

Global optionality in HS (Kimper 2011)

(Two Unranked Markedness Constraints)

/pp/	*VO	*p
☞ pp		*
bp	*!	*

⇒ Convergence

/pp/	*p	*VO
pp	**!	
☞ bp	*	*

⇒

/bp/	*p	*VO
bp	*!	*
☞ bb		**

⇒

/bb/	*p	*VO
bp	*!	*
☞ bb		**

⇒ Convergence

/pp/	*p	*VO
pp	**!	
☞ bp	*	*

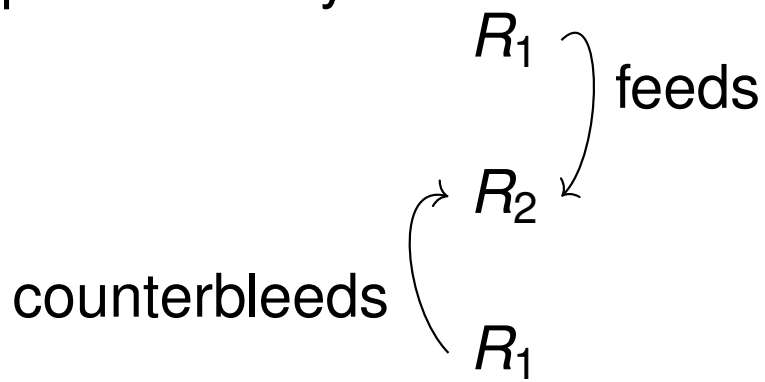
⇒

/bp/	*VO	*p
bp	*!	*
☞ pp		**

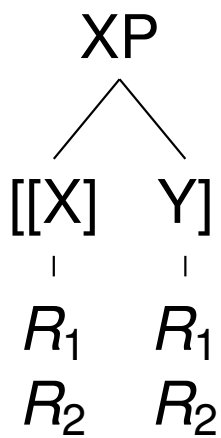
⇒ ↻

Cyclicity

- So far: multiple applications of a rule interact with each other
- **Rule sandwiching**. Multiple applications of a rule interact with another rule paradoxically:



- SPE: ordered rules apply cyclically from the innermost to outermost syntactic constituent. Every rule applies multiple times, once per cycle.



Rule sandwiching in Huave (Noyer 2013)

Two rules (simplified):

- Stress a final (C)VC syllable
- Lowering: é → a

Mappings:

- /tet'/ → [t'át']
- /teim/ → [t'e.ím]
- /te^{m}b-an/ → **[t'a^{m}bán]**

Cycle I	/t'e^{m}b/
Stress	t'é^{m}b
Lowering	t'á^{m}b
Cycle II	/t'á^{m}b-an/
Stress	t'a^{m}bán
Lowering	-
	[t'a^{m}bán]

Cyclicity and iterativity

Many apparent cases of iterativity can be reduced to multiple application that results from cyclicity (cf. Baković 2000).

Example: Finnish consonant gradation, one application per morpheme

Iterative Left-to-Right:

Input	/rokko-tta-tta-tte/
CG	ro**k**o-tta-tta-tte
CG	roko-**t**a-tta-tte
CG	roko-ta-**t**a-tte
Output	[roko-ta-ta-tte]

Non-iterative cyclic application:

Input	/[[[rokko-tta]-tta]-tte]/
CG	ro**k**o-tta
CG	roko-**t**a-tta
CG	roko-ta-**t**a-tte
Output	[roko-ta-ta-tte]

Open question: how does cyclicity change the empirical picture of iterativity?

Summary of some open questions

1. Do non-local dependencies like Sour Grapes exist?
2. Does non-assimilatory self-counterfeeding exist?
3. Does global optionality exist?
4. If so, can it be reduced to an interaction between markedness constraints (like Warao)?
5. How does cyclicity change the empirical picture of iterativity?

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