A typology of OCP-resolutions across morphological domains: An argument for Harmonic Layer Theory

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Main Claim

- Harmonic Layer Theory where phonological elements can get incrementally stronger/weaker at every optimization cycle predicts different at morphosyntactic layers behaviour from **a single phonological grammar**
- In contrast to multi-grammar alternatives, the theory is **restricted by monotonicity** and excludes unattested XYX patterns.
- Lexical exceptions fall out from the same general mechanism (=activity differences) than layer asymmetries

Harmonic Layer Theory and Shona

Data: Different morphosyntactic domains in Shona

Shona

- Zezuru dialect, spoken in Zimbabwe
  (Atlantic-Congo –> East Bantu –> Southern Bantu)
- sources for data and generalizations: Myers (1997) and Myers (1986)
- TBU's = syllables
- high-toned (=V́) or low-toned (=V)
- L-tones are taken to be (underlyingly) absent/inserted later

Relevant processes in Shona: OCP contexts

(1) Context 1: A singly-linked first H

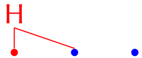
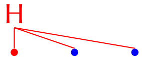
H H	OCP$_{\text{TBU}}$	MaxH	‖Unif‖
a. H H –	-1		
b. H Del		-1	
c. H Fus			-1

(2) Context 2: A multiply-linked first H

H H	OCP$_{\text{TBU}}$	MaxH	‖Unif‖
a. H H Ret			

Relevant processes in Shona: Spreading contexts

(3) Spreading: Long or short

	Spec	‖*LongH$_3$‖	‖*LongH‖
a. 	-2		
b.  H1S	-1		-1
c.  H2S		-1	-1

Different morpho-syntactic domains=different phonologies

(4) Structure of the Shona verb

Word			
[Macrostem]	**[Macrostem]**		
Clitics (copula, Assoc., remaining inflection)	prefixes– (object, some subject, some Tns)	root	–suffixes
ku	mú̱-	té̱ng	-és-ér-a
INF	OBJ	buy	CAUS-applied-FV

(5) Different behaviour at different layers: Overview

	OCP context	H-spread
1 (Macro)Stem	Ret > Fus	H2S
2 Word	Ret > Del	H1S
3 Phrase	Ret > –	H1S

Examples: Spreading asymmetries

(underlying H-tones are notated with v̲, surface H-tones with v́)

(6)

a. H2S at 1, triggered by Obj

[tí̲-táríse]

1PL/SUBJ-look-FV

'we would look' (M7:870)

b. H1S at 2; triggered by copula

[í̲]-[sádza]

COP-porridge

'(it) is porridge' (M7:860)

c. H2S at 1 + H1S at 3

[ku]-[té̲ng-és-á] [sádza]

INF-buy-CAUS-FV porridge

'to sell porridge' (M7:862)

d. H1S at 2 blocked by OCP

[í̲]-[badzá̲]

COP-hoe

'(it) is a hoe' (M7:860)

OCP asymmetries

(7)

a. Fus at 1 between Obj+root

[ku]-[mú-téng-és-ér-a]

INF-OBJ-buy-CAUS-applied-FV

'to sell him/her' (M7:869)

b. Del at 2

[í]-[banga]

COP-knife

'(it) is a knife' (M7:856)

OCP asymmetries

(8)

Ret at 2, fed by Fus at 1

[á-cha]-[téng-á]

3SG-FUT=buy-FV

's/he will buy' (M7:864)

(9)

H H a cha	H teng a	underlying representations
Fus H a cha	H2S H teng a	1 Two macrostems
Ret H H a cha teng a		2 One Word

OCP asymmetries

(10)

a. Del at 2, fed by Fus at 1

[há]-[ti-teng-es-e]

HORT-1PL/SUBJ-buy-CAUS-FV

'let us sell' (M7:870)

b. – if Ret impossible at 3

[badzá] [gúrú]

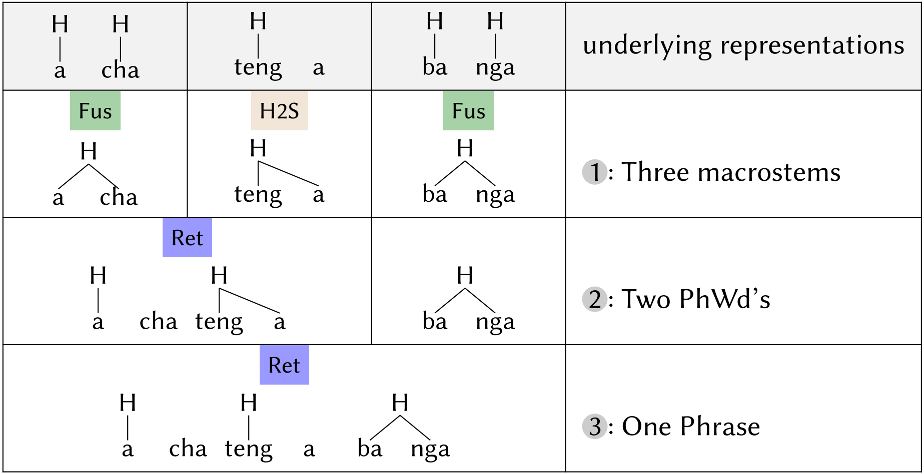
hoe big

'big hoe' (M7:874, FN.21)

(11)

H [ha]	H H [ti teng es e]	underlying representations
H [ha]	Fus + H2S H [ti teng es e]	1 Two macrostems
Del H [ha] [ti teng es e]		2 One word

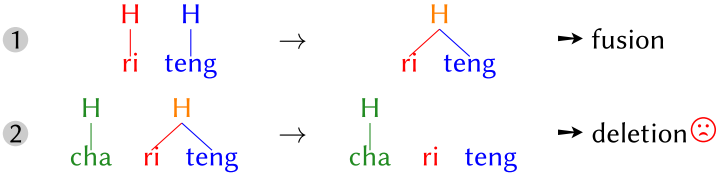
A sample derivation



An exception: Object /rí̲-/

(12) [ku]-[**rí̲**-té̲ng-és-á]
INF-OBJ/5-buy-CAUS-FV
'to sell it' (Myers, 1986, 197)

(13) Our expectation



(14) [ndi-chá̲]-[**ri**-té̲ng-á]
1SG-FUT-OBJ-buy-FV
'I will buy it' (Myers, 1986, 211)

- /rí̲/ surfaces with its H in 1 (with or without a following H)
- but it exceptionally is the only undergoer of H-deletion at 2

➙ /rí̲-/ fails to undergo fusion at 1

Shona: Empirical summary

(15)

	OCP context				H-spread	
1 (Macro)Stem	Ret	>	Fus	*	H2S	*exceptional non-undergoer /rí/
2 Word	Ret	>	Del		H1S	
3 Phrase	Ret	>	–		H1S	

HLT: The assumptions

Harmonic Layer Theory: Defining assumptions

1. a **single constraint ranking** for a grammar
2. cyclic evaluation at **three layers** (=stem, word, phrase)
3. phonological elements can have **gradient activity** that results in gradient constraint violations
4. activity can predictably **decay** at every optimization

Background: Gradient Symbolic Representations (=GSR)

- all linguistic symbols have **activity** that can **gradiently** differ (Smolensky and Goldrick, 2016; Rosen, 2016, 2019*a*,*b*; Zimmermann, 2018*a*, 2019; Kushnir, 2019, e.g.)
- different activities result in **gradient constraint violations** of both faithfulness and markedness constraints (Zimmermann, 2021, to appear; Faust and Smolensky, 2017; Jang, 2019; Walker, 2019)
- grammatical computation modeled inside **Harmonic Grammar** where constraints are weighted (Legendre et al., 1990; Potts et al., 2010)

cite something

GSR and constraint violations

- gradient constraints are **violated/satisfied relative to the activity** of the relevant elements

(16) a. $\textsc{Max}_H$: Assign -x violation for every H_x in the input without an output correspondent.

b. $\textsc{Max}_L$: Assign -x violation for every L_x in the input without an output correspondent.

c. *H: Assign -x violation for every H_x.

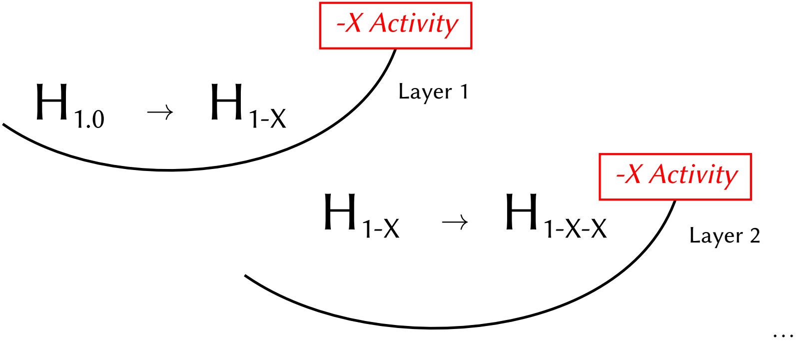
d. *L: Assign -x violation for every L_x.

(17) Gradient activity=gradient constraint violations

$H_1\ L_{0.8}$	$\textsc{Max}_H$ 20	$\textsc{Max}_L$ 20	*H 10	*L 10	
☞ a. $H_1\ L_{0.8}$			-1.0	-0.8	-18
b. $L_{0.8}$	-1.0			-0.8	-28
c. H_1		-0.8	-1.0		-26

HLT: Predictable loss of activity at every layer

- constraint interaction can ensure that all instances of a certain element (e.g. H) **loose a fixed amount of activity** at every optimization cycle



Harmonic Layer Theory: Assumptions open to debate

1. **constraint cloning**: Every faithfulness and markedness constraint exists in a gradient and ‖categorical version‖

   (18) a. MAX$_H$: Assign -x violation for every H_x in the input without an output correspondent.

   b. ‖MAX$_H$‖: Assign -1 violation for every H in the input without an output correspondent.

   c. *H: Assign -x violation for every H_x.

   d. ‖*H‖: Assign -1 violation for every H.

2. **Egalitarian** optimization: Every morpheme is optimized at every layer

3. the default underlying activity (assumed by the learner) is 1

4. activity can only decay across layers

A HLT account of Shona

HLT account of Shona

1. tones get weaker at each layer
2. gradient markedness:
   - spreading becomes a worse repair the weaker the tone becomes
   - the OCP problem gets less severe the weaker the tone
3. gradient faithfulness:
   - deletion as a repair gets cheaper the weaker the tone
4. lexical activity differences: object /rí̱/ is weak and hence doesn't demand an OCP-repair

Activity loss at every optimization: Logic

- constraint interaction ensures that all **H's decay** by 0.2 at every layer

(19) Predictable decay by 0.2

	INPUT	OUTPUT
1	H_1	$H_{0.8}$
2	$H_{0.8}$	$H_{0.6}$
3	$H_{0.6}$	$H_{0.4}$

(20) a. *H: Assign -x violation for every TBU associated to H_x.

b. IDACT: Assign -x violation for every input tone H_a corresponding to output tone H_b where a-b=x and x is > 0.

c. $\text{IDACT}_{\leq 0.2}$: Assign -x violation for every input tone H_a corresponding to output tone H_b where a-b=x and x is > 0.2.

Activity loss at every optimization: Tableaux

1

	$H_{1.0}$	IDACT$_{\leq 0.2}$ w=∞	MAX$_H$ w=20	*H w=10	IDACT w=1	$\mathcal{H}$
	a. $H_{1.0}$			-1.0		-10.0
	b. Ø		-1.0			-20.0
	c. $H_{0.5}$	-0.5		-0.5	-0.5	∞
☞	d. $H_{0.8}$			-0.8	-0.2	-8.2

2

	$H_{0.8}$	IDACT$_{\leq 0.2}$ w=∞	MAX$_H$ w=16	*H w=15	IDACT w=1	$\mathcal{H}$
	a. $H_{0.8}$			-0.8		-8.0
☞	b. $H_{0.6}$			-0.6	-0.2	-6.2

3

	$H_{0.6}$	IDACT$_{\leq 0.2}$ w=∞	MAX$_H$ w=16	*H w=15	IDACT w=1	$\mathcal{H}$
	a. $H_{0.6}$			-0.6		-6.0
☞	b. $H_{0.4}$			-0.4	-0.2	-4.2

Different behaviour for spreading: In a nutshell

- spreading applies to provide otherwise toneless TBU's with a tone
- but this strategy gets less helpful, the weaker the tone is

(21) a. SPEC
Assign -(1-x) violation for every TBU associated with tone T_x (and no tone=T_0).

b. ||*LONGH||
Assign -1 violation for every tone that is associated to more than one TBU.

c. ||*LONGH$_3$||
Assign -1 violation for every tone that is associated to more than two TBU's.

Tableaux: H2S at 1 but H1S at 2

1 H_1		SPEC 8	$\|$*LONGH$_3\|$ 6	$\|$*LONGH$\|$ 0	$\mathcal{H}$
a. $H_{0.8}$	–	-2.2			-17.6
b. $H_{0.8}$	H1S	-1.4		-1.0	-11.2
☞ c. $H_{0.8}$	H2S	-0.6	-1.0	-1.0	-10.8

2 $H_{0.8}$		SPEC 8	$\|$*LONGH$_3\|$ 6	$\|$*LONGH$\|$ 0	$\mathcal{H}$
a. $H_{0.6}$	–	-2.4			-19.2
☞ b. $H_{0.6}$	H1S	-1.8		-1.0	-14.4
c. $H_{0.6}$	H2S	-1.2	-1.0	-1.0	-15.6

Spreading asymmetry: The weighting arguments

(22)

1	H2S	0.8xSpec	>	$\|$*LongH$_3$$|$
2	H1S	$\|$*LongH$_3$$|$	>	0.6xSpec
3	H1S	$\|$*LongH$_3$$|$	>	0.4xSpec

Different behaviour for OCP problems: In a nutshell

(23) Different behaviour at different layers: Overview

	OCP avoided by:	H-spread
1 (Macro)Stem	Ret > Fus	H2S
2 Word	Ret > Del	H1S
3 Phrase	Ret > –	H1S

- fusion is the default repair but:
  - the weaker the H, the cheaper deletion
  - the weaker the H, the easier it is to tolerate the OCP
- (additional constraint ||DEL2!|| favours deletion of second over deletion of first H)

(24)

a. OCP$_\bullet$: Assign -x violation for every H_x followed by another H if both are associated with adjacent TBU's.

b. MAX$_H$: Assign -x violation for every H_x in the input without an output correspondent.

c. ||UNIF||: Assign -1 violation for every pair of input tones corresponding to the same output tone.

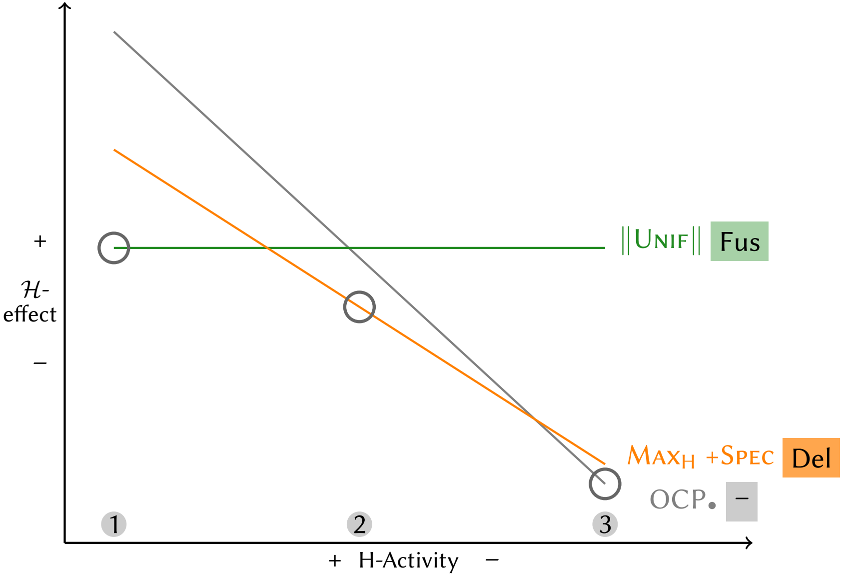
Three layers and the OCP

1	$H_{1.0}$ $H_{1.0}$		OCP• 27	MAX$_H$ 20	‖UNIF‖ 17	*H 10	SPEC 8	$\mathcal{H}$
a.	$H_{0.8}$ $H_{0.8}$	–	-0.8			-1.6	-0.4	-40.8
b.	$H_{0.8}$	Del		-1.0		-0.8	-1.2	-37.6
☞ c.	–$H_{0.8}$–	Fus			-1.0	-1.6	-0.4	-36.2

2	$H_{0.8}$ $H_{0.8}$		OCP• 27	MAX$_H$ 20	‖UNIF‖ 17	*H 10	SPEC 8	$\mathcal{H}$
a.	$H_{0.6}$ $H_{0.6}$	–	-0.6			-1.2	-0.8	-34.6
☞ b.	$H_{0.6}$	Del		-0.8		-0.6	-1.4	-33.2
c.	–$H_{0.6}$–	Fus			-1.0	-1.2	-0.8	-35.4

3	$H_{0.6}$ $H_{0.6}$		OCP• 27	MAX$_H$ 20	‖UNIF‖ 17	*H 10	SPEC 8	$\mathcal{H}$
☞ a.	$H_{0.4}$ $H_{0.4}$	–	-0.4			-0.8	-1.2	-28.4
b.	$H_{0.4}$	Del		-0.6		-0.4	-1.6	-28.8
c.	–$H_{0.4}$–	Fus			-1.0	-0.8	-1.2	-34.6

Shona: HLT thresholds, OCP contexts



Multiply linked H1: Retraction is always cheaper (MStem)

(25) $\|$MAX$_{|}\|$: Assign -1 violation for every input association between elements A and B that is not realized in the output.

1 H_1 H_1	OCP• 27	MAX$_H$ 20	$\|$UNIF$\|$ 17	$\|$MAX$_{\|}\|$ 1	$\mathcal{H}$
a. $H_{0.8}$ $H_{0.8}$ –	-0.8				-21.6
b. $H_{0.8}$ Fus			-1.0		-17
c. $H_{0.8}$ Del		-1.0		-1.0	-21
☞ d. $H_{0.8}$ $H_{0.8}$ Ret				-1	-1

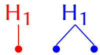
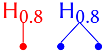
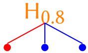
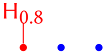
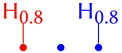
Multiply linked H1: Retraction is always cheaper (Phrase)

3	$H_{0.6}$ $H_{0.6}$	OCP• 27	MAX$_H$ 20	‖UNIF‖ 17	‖MAX$_{\mid}$‖ 1	$\mathcal{H}$
a.	$H_{0.4}$ $H_{0.4}$ –	-0.4				-10.8
b.	$H_{0.4}$ Fus			-1.0		-17
c.	$H_{0.4}$ Del		-0.6		-1.0	-13
☞ d.	$H_{0.4}$ $H_{0.4}$ Ret				-1	-1

Multiply linked H2: Retraction always impossible

(26) $\|\textsc{Max}_{\#|}\|$: Assign -1 violation for every input association between elements A and B that is not realized in the output if there is no other input association of A to X and X precedes B.

1

	$\|\textsc{Max}_{\#\|}\|$ ∞	OCP• 27	$\textsc{Max}_{H}$ 20	$\|\textsc{Unif}\|$ 17	$\|\textsc{Max}_{\|}\|$ 1	$\mathcal{H}$
a.  –		-0.8				-21.6
☞ b.  Fus				-1.0		-17
c.  Del			-1.0		-1.0	-21
d.  Ret	-1				-1	$-\infty$

Lexical exception: No trigger

- object prefix /rí̠/ contains a weakly active $H_{0.6}$ in its underlying representation
  ➙ not strong enough to trigger an OCP repair at 1

1 No fusion triggered by /rí̠/

$H_{0.6}$ $H_{1.0}$		OCP• 27	MAX$_H$ 20	‖UNIF‖ 17	*H 10	SPEC 8	$\mathcal{H}$
☞ a. $H_{0.4}$ $H_{0.8}$	–	-0.4			-1.2	-0.8	-29.2
b. $H_{0.8}$	Del		-1.0		-0.8	-1.2	-37.6
c. –$H_{0.6}$–	Fus			-1.0	-1.2	-0.8	-35.4

Lexical exception: But a regular undergoer

② Deletion predicted for /rí/

$H_{0.8}$ $H_{0.4}$ $H_{0.8}$			OCP• 27	MAX$_H$ 20	‖UNIF‖ 17	*H 10	SPEC 8	$\mathcal{H}$
a.	$H_{0.6}$ $H_{0.2}$ $H_{0.6}$	–	-0.8			-1.4	-1.6	-48.4
☞ b.	$H_{0.6}$ • $H_{0.6}$	Del		-0.4		-1.2	-1.8	-34.4
c.	$H_{0.6}$ $H_{0.2}$ •	Del	-0.6	-0.2		-0.8	-2.2	-45.8
d.	–$H_{0.7}$–	Fus			-2.0	-2.1	-0.9	-62.2

Shona and HLT: Summary

- **consistent decay** of activity across layers predicts different behaviours from a **single grammar**
  - two different spreading domains
  - three different OCP responses
- a **lexical exception** cross-cuts this pattern: predicted from a different underlying activity

HLT and typology of OCP repairs

More HLT accounts of OCP asymmetries

OCP resolutions and OT

H H	OCP_H	$\text{OCP}_\bullet$	Max_H	DepL	‖Unif‖	*!H	Spec
a. H H –	-1	-1					
b. H Del			-1				-1
c. H Fus					-1		
d. H L H DS		-1		-1		-1	
e. H L OW			-1		-1		

Kishambaa: OCP repairs (Odden, 1982)

(27) Two optimal strategies

Input	Optimal at 1 Fus	Optimal at 2 & 3 DS
H H	H	H L H
	–H–	H (L) H

HLT account in a nutshell: Gradual weakening by 0.2

- for a strong H, the downstep repair is blocked since the *!H violations are quite severe
- for weaker H's, the *!H violations are tolerated and L-insertion is a cheaper repair than fusion

Kishambaa: HLT tableaux

1

$H_{1.0}$ $H_{1.0}$			OCP$_H$ 14	*!H 10	‖UNIF‖ 8	‖DEP$_L$‖ 1	$\mathcal{H}$
	a. $H_{0.8}$ $H_{0.8}$	–	-0.8				-11.2
	b. $H_{0.8}$ (L_1) $H_{0.8}$	DS		-0.8		-1.0	-9.8
☞	c. –$H_{0.8}$–	Fus			-1.0		-8

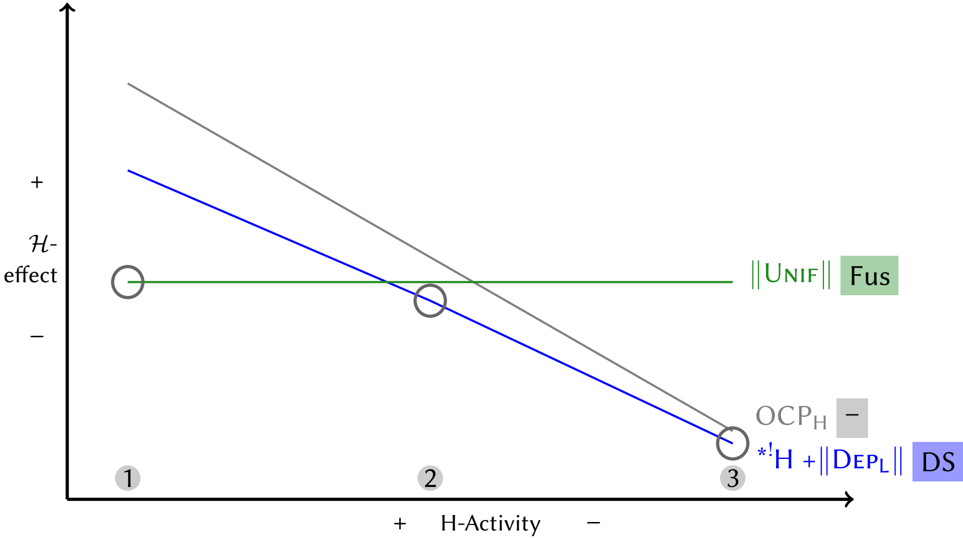
2

$H_{0.8}$ $H_{0.8}$			OCP$_H$ 14	*!H 10	‖UNIF‖ 8	‖DEP$_L$‖ 1	$\mathcal{H}$
	a. $H_{0.6}$ $H_{0.6}$	–	-0.6				-8.4
☞	b. $H_{0.6}$ (L_1) $H_{0.6}$	DS		-0.6		-1.0	-7.7
	c. –$H_{0.6}$–	Fus			-1.0		-8

3

$H_{0.6}$ $H_{0.6}$			OCP$_H$ 14	*!H 10	‖UNIF‖ 8	‖DEP$_L$‖ 0	$\mathcal{H}$
	a. $H_{0.4}$ $H_{0.4}$	–	-0.4				-5.6
☞	b. $H_{0.4}$ (L_1) $H_{0.4}$	DS		-0.4		-1.0	-5.4
	c. –$H_{0.4}$–	Fus			-1.0		-8

Kishambaa: HLT thresholds



Dagaare: OCP repairs (Anttila and Bodomo, 2022)

(28) Three optimal strategies

Input	Optimal at 1 OW	Optimal at 2 DS	Optimal at 3 –
H H	H L	H L H	H H
	H L	H (L) H	H H

HLT account in a nutshell: Gradual weakening by 0.2

- OCP_H only resolved by OW (=strongest H)
- weaker tones only avoid a violation of (29-b) via DS
- the weakest tones don't need to resolve any of the OCP violations

(29) a. OCP_H: Assign -x violation for every H_x followed by another H.
b. $OCP_\bullet$: Assign -x violation for every H_x associated to a TBU that is adjacent to a TBU also associated to a H.

Dagaare: HLT tableaux

1

$H_{1.0}$ $H_{1.0}$		OCP_H 9	OCP• 9	$\|\text{MAX}_H\|$ 6	$\|\text{DEP}_L\|$ 5	$\mathcal{H}$
a. $H_{0.8}$ $H_{0.8}$	–	-0.8	-0.8			-14.4
b. $H_{0.8}$ (L_1) $H_{0.8}$	DS		-0.8		-1.0	-12.2
☞ c. $H_{0.8}$ L_1 ($H_{0.8}$)	OW			-1.0	-1.0	-11

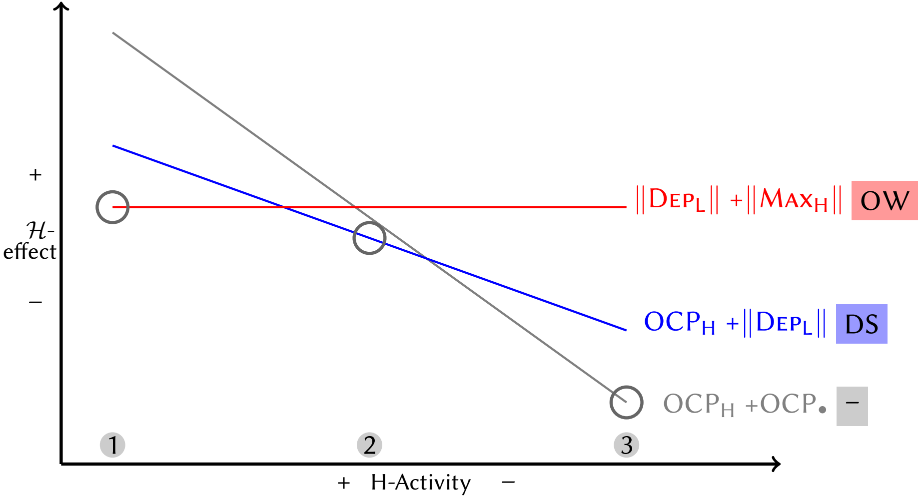
2

$H_{0.8}$ $H_{0.8}$		OCP_H 10	OCP• 9	$\|\text{MAX}_H\|$ 2	$\|\text{DEP}_L\|$ 1	$\mathcal{H}$
a. $H_{0.6}$ $H_{0.6}$	–	-0.6	-0.6			-10.8
☞ b. $H_{0.6}$ (L_1) $H_{0.6}$	DS		-0.6		-1.0	-10.4
c. $H_{0.6}$ L_1 ($H_{0.6}$)	OW			-1.0	-1.0	-11

3

$H_{0.6}$ $H_{0.6}$		OCP_H 10	OCP• 9	$\|\text{MAX}_H\|$ 2	$\|\text{DEP}_L\|$ 1	$\mathcal{H}$
☞ a. $H_{0.4}$ $H_{0.4}$	–	-0.4	-0.4			-7.2
b. $H_{0.4}$ (L_1) $H_{0.4}$	DS		-0.4		-1.0	-8.6
c. $H_{0.4}$ L_1 ($H_{0.4}$)	OW			-1.0	-1.0	-11

Dagaare: HLT thresholds



Bari: OCP repairs (Yokwe, 1986)

(30) Two optimal strategies

Input	Optimal at 1 –	Optimal at 2 & 3 OW
H H	H H	H L
	H H	H L

HLT account in a nutshell: Gradual weakening by 0.2

- $\text{M}\textsc{ax}_{\text{H}}$ is gradient but the relevant ‖OCP•‖ is categorical and has a lower weight
  ➙ Only weakened tones can be deleted to avoid an ‖OCP•‖ violation

Bari: HLT tableaux

1

$H_{1.0}$ $H_{1.0}$		‖UNIF‖ 11	‖OCP•‖ 10	MAX$_H$ 10	‖DEP$_L$‖ 1	$\mathcal{H}$
☞ a. $H_{0.8}$ $H_{0.8}$	–		-1.0			-10
b. –$H_{0.8}$–	Fus	-1.0				-11
c. $H_{0.8}$ L_1	OW			-1.0	-1.0	-11

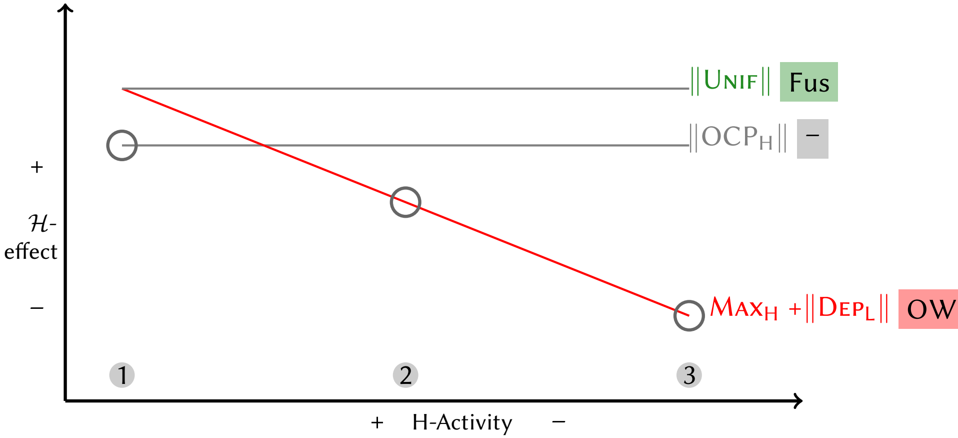
2

$H_{0.8}$ $H_{0.8}$		‖UNIF‖ 11	‖OCP•‖ 10	MAX$_H$ 10	‖DEP$_L$‖ 1	$\mathcal{H}$
a. $H_{0.6}$ $H_{0.6}$	–		-1.0			-10
b. –$H_{0.6}$–	Fus	-1.0				-11
☞ c. $H_{0.6}$ L_1	OW			-0.8	-1.0	-9

3

$H_{0.6}$ $H_{0.6}$		‖UNIF‖ 11	‖OCP•‖ 10	MAX$_H$ 10	‖DEP$_L$‖ 1	$\mathcal{H}$
a. $H_{0.4}$ $H_{0.4}$	–		-1.0			-10
b. –$H_{0.4}$–	Fus	-1.0				-11
☞ c. $H_{0.4}$ L_1	OW			-0.6	-1.0	-7

Bari: HLT thresholds



Tswana: HLT thresholds (Zerbian and Kügler, 2023)

(31) Two optimal strategies

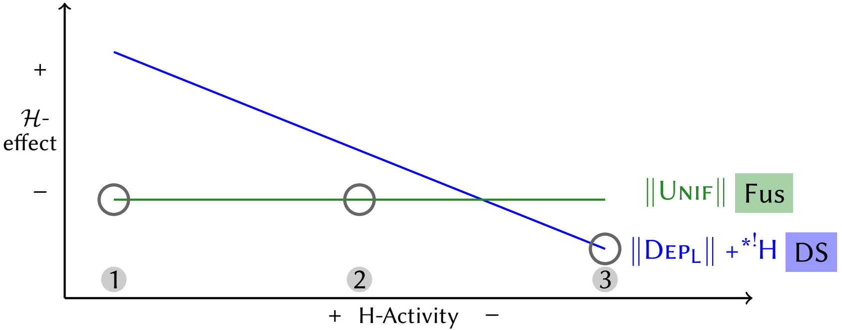
Input	1 + 2 Fus	3 DS
H H	H	H L H

(32) Crucial weights

a. *!H = 10

b. ‖UNIF‖ = 9

c. ‖DEP_L‖ = 2



Tiriki: HLT thresholds (Paster and Kim, 2011)

(33) Two optimal strategies

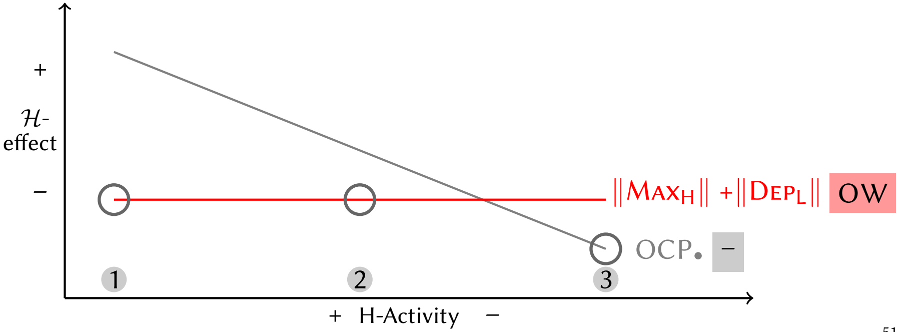
Input	1 + 2 OW	3 –
H H	H L	H H

(34) Crucial weights

a. OCP• = 10

b. $\|$Max$_H\|$ = 4

c. $\|$Dep$_L\|$ = 3



OCP resolutions across layers: Summary of patterns

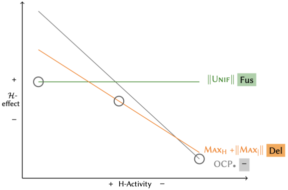
(35)

	Moro (Kordofanian; Sudan)	Shona (East Bantu->Southern Bantu; Mozambique)	Chitonga (East Bantu -> Botatwa; Zambia)	Tiriki (East Bantu->Northeast Savanna Bantu; Kenya)	Dagaare (Gur->Central Gur; Ghana)	Kishambaa (East Bantu->Northeast Savanna Bantu; Tanzania)	Tswana (East Bantu->Southern Bantu; Botswana)	Bari (Nilotic->Eatern Nilotic; South Sudan)
1	Del	Fus	Fus	OW	OW	Fus	Fus	–
2	–	Del	Del	OW	DS	DS	Fus	OW
3	–	–	–	–	DS	DS	DS	OW

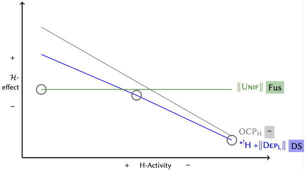
Patterns excluded by HLT

Thresholds in HLT

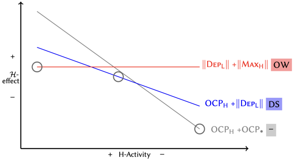
Shona: HLT thresholds



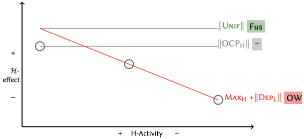
Kishambaa: HLT thresholds



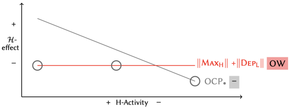
Dagaare: HLT thresholds



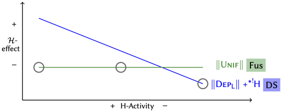
Bari: HLT thresholds



Tiriki: HLT thresholds



Tswana: HLT thresholds



The $\mathcal{H}$-effects of constraints can cross

- if one is categorical and the other gradient
- if two gradient constraints differ in their weighting (='steepness' of their $\mathcal{H}$-effect)

HLT is restricted by monotonicity

Representations become monotonically weaker
+ single constant grammar
= monotonicity of phonological behaviour

(36) Monotonicity of thresholds for phonological behavior in HLT

T_x → Phonological behavior 1

WEAKER: THRESHOLD 1

$T_{x\text{-}y}$ → Phonological behavior 2

WEAKER: THRESHOLD 2

$T_{x\text{-}y\text{-}z}$ → Phonological behavior 3

Monotonicity excludes XYX pattern

(37) Attested OCP repairs across layers

	Moro	Shona	Chitonga	Tiriki	Dagaare	Kishambaa	Tswana	Bari
1	Del	Fus	Fus	OW	OW	Fus	Fus	–
2	–	Del	Del	OW	DS	DS	Fus	OW
3	–	–	–	–	–	DS	DS	OW

(38) Unattested OCP repairs across layers: XYX-patterns

	*Monga	*Shori	*Ciriki	*Tirire	*Dagaba	*Kishana	*Tswari	*Barimba
1	Del	Fus	OW	OW	OW	Fus	Fus	–
2	–	Del	Del	–	DS	DS	Del	OW
3	Del	Fus	OW	OW	OW	Fus	Fus	–

No XYX patterns: Weighting paradox

(39) *Shori in HLT: Impossible

		Necessary weighting relations		
1	Fus	$\textsc{Max}_H$	>	$\lVert\textsc{Unif}\rVert$
2	Del	$\lVert\textsc{Unif}\rVert$	>	$0.8\text{x}\textsc{Max}_H$
3	Fus	$0.6\text{x}\textsc{Max}_H$	>	$\lVert\textsc{Unif}\rVert$

(40) *Tirire in HLT: Impossible

		Necessary weighting relations		
1	OW	0.8xOCP_H	>	$\lVert\textsc{Max}_H\rVert + \lVert\textsc{Dep}_L\rVert$
2	–	$\lVert\textsc{Max}_H\rVert + \lVert\textsc{Dep}_L\rVert$	>	0.6xOCP_H
3	OW	0.4xOCP_H	>	$\lVert\textsc{Max}_H\rVert + \lVert\textsc{Dep}_L\rVert$

HLT vs. stratal OT

(41) *Shori in stratal OT: Easily possible

		Necessary rankings		
1	Fus	OCP, MAXH	≫	UNIF
2	Del	OCP, UNIF	≫	MAXH
3	Fus	OCP, MAXH	≫	UNIF

(42) *Tirire in stratal OT: Easily possible

		Necessary rankings		
1	OW	OCP	≫	MAXH, DEPL
2	–	MAXH, DEPL	≫	OCP
3	OW	OCP	≫	MAXH, DEPL

Conclusion

Conclusion and outlook

- the representative typology of different OCP repairs across layers is predicted under HLT whereas unattested XYX patterns are excluded
- the next questions:
  - Are XYX patterns indeed unattested?
    (e.g. vowel deletion in Seri (Cole, 1986)? – Trommer (to appear) reanalysis as ghost vowels)
  - Is this the best version of HLT?
    (e.g. Zerbian and Kügler (2023) on Tswana: no DS between phonological phrases and four levels)
- will be answered by:
  - extending the OCP typology
  - extending the HLT argument to other tonal behaviour: Spreading, morphological tone realization

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Appendix

24. Mai 2024

Bari I

- Yokwe (1986)
- Stem Level:
  - No H-dissimilation
  - No Local H-Spreading
  - Toneless σ's trigger unbounded spreading
  - morphemes:
    - All segmental verb derivation
    - Some tonal verb derivation
    - Singulative -tat
    - Plural -a
- Word Level:
  - H-dissimilation
  - No Local H-Spreading
  - Toneless σ's trigger polar epenthesis
  - morphemes:
    - Associative prefixes

Bari II

- Some tonal verb derivation
- Plural -jin
- Instrumental plural -iʔ

- Phrase Level: Toneless σ's get default L-tone
  - H-dissimilation
  - Local H-Spreading
  - (No toneless σ's?)
  - morphemes: Verbal proclitics (e.g., Future)
- dissimilation is indeed insertion of L since relevant difference between L-toned and toneless TBU's

(43) No OCP-repair at 1
/bójí-tát/
bójí-tát
'trap net'

Bari III

(44) L-Overwriting at 2
/dép-es-íʔ/
hold-INSTR-PL
dép-és-ìʔ/

(45) L-Overwriting at 3
/dók kópò/
dók kòpò
'fetched cup'

Tiriki I

- Paster and Kim (2011)
-

Chitonga I

- Bickmore and Mkochi (2018)
- word level: H-doubling (not across words)
- 3 H-doubling even creates OCP violations

Chitonga: OCP repairs

(46) Three optimal strategies

Input	Optimal at 1 Fus	Optimal at 2 Del	Optimal at 3 –
H H	H	H	H H
	• H	H •	H H

HLT account in a nutshell: Gradual weakening by 0.2

- fusion is the default repair for an OCP violation; in contrast to Shona, the fused H only surfaces on one TBU (due to ‖*LongH‖ +AlignR)
- if the tones get weaker, deletion becomes possible (and ‖Del2!‖ favours deletion of the second H)
- the weakest tone doesn't trigger any OCP repair

Chitonga: HLT tableaux

1

	$H_{1.0}$ $H_{1.0}$		OCP• 10	Max_H 8	$\lVert$Unif$\rVert$ 5	$\lVert \text{Max}_l \rVert$ 1	$\mathcal{H}$
a.	$H_{0.8}$ $H_{0.8}$	–	-0.8				-8
☞ b.	• $H_{0.8}$	Fus			-1.0	-1.0	-6
c.	$H_{0.8}$ •	Del		-1.0		-1.0	-9

2

	$H_{0.8}$ $H_{0.8}$		OCP• 10	Max_H 8	$\lVert$Unif$\rVert$ 5	$\lVert \text{Max}_l \rVert$ 1	$\mathcal{H}$
a.	$H_{0.6}$ $H_{0.6}$	–	-0.8				-8
☞ b.	• $H_{0.6}$	Fus			-1.0	-1.0	-6
c.	$H_{0.6}$ •	Del		-1.0		-1.0	-9

2

	$H_{0.6}$ $H_{0.6}$		OCP• 10	Max_H 8	$\lVert$Unif$\rVert$ 5	$\lVert \text{Max}_l \rVert$ 1	$\mathcal{H}$
a.	$H_{0.4}$ $H_{0.4}$	–	-0.8				-8
☞ b.	• $H_{0.4}$	Fus			-1.0	-1.0	-6
c.	$H_{0.4}$ •	Del		-1.0		-1.0	-9

Tswana I

- Zerbian and Kügler (2023):
  - ‘sequences of singly-linked adjacent high tones are allowed but sequences of multiply-linked adjacent high tones are not allowed (Mmusi 1992)’
  - Mmusi suggests that separate lexical H’s are fused
  - OCP also blocks HSpread
    (it’s not about underlyingly multiply linked tones!?)
  - OCP-violations above the word are repaired by DS but only within phonological phrases (their study!)
    (more data from Southern Sotho)
- Zerbian (2015)
  - H on subject/object prefix and stem are realized
  - ‘across certain word-internal junctures’, however, deletion takes place; resp. ‘left-branch delinking’
- ZerbianKuegler:2015

Tswana II

- the OCP causes 'either the blocking of high tone spread [...], the fusion of two singly-linked tones [...] or the delinking of a high tone'

(47) Fusion within words

a. ó-réká nama
sc1-buy meat
'She is buying meat' (Zerbian and Kügler, 2023, 364)

b. go-é-rékisa
sc15-oc9-sell
'to sell it' (Zerbian, 2015)

(48) Deletion within words

a. ó-ká-reká
sc1-ASP-buy
'S/he is able to buy' (Zerbian, 2015)

(49) H-Spread blocked

Tswana III

a. ó-a-réká
SC1-ASP-buy
'She is buying' (Zerbian and Kügler, 2023, 364)

(50) Downstep across words (within phrase)

a. Ba-rwá ꜜbá-thúsá ba-lemi
NP2-son SC2-help NP2-farmer
'The sons help the farmers' (Zerbian and Kügler, 2023, 368)

b. Ba-ńná ꜜbá-a-húma
NP2-man SC2-ASP-become.rich
'The men are becoming rich' (Zerbian and Kügler, 2023, 368)

Kishambaa

- Atlantic-Congo ➝ East Bantu ➝ Northeast Savanna Bantu
- spoken in Tanzania
- sources for data and generalizations: Myers (1997)

Kishambaa: OCP data

(51) Fusion at 1 (and spread at 3), p.883

ni[kááng-é] nyáma	cf. ku-[kááng-a]
1stsg-fry-perfect meat	*infinitive-fry-term*
I fried meat	to fry

[kááng-á]
fry-term
Fry!

(52) OCP tolerated at 3, p.880

a.	nwáná 'child'	dú 'only'	nwánáꜝdú 'only a child'
b.	kúi 'dog'	ní 'cop'	níꜝkúi 'it is a dog'

(53) OCP tolerated at (2 /) 3, fed by spreading, p.883

ní-kí-[ꜝchí-kómá]
1stsg.-progressive-it-kill
I was killing it (Cl. 7)

Kishambaa: Spreading data

(54) Spreading at (2/) 3, p.880

a. ku-ví̲-ghóshó-a — cf. ku-ghosho-a
to do them (Cl. 8) — *to do*

b. ni-té̲-ghóshó-a
I have done (verb-focus)

(55) Spreading at 3, p.880

nyumbá̲ zá-wá-ghánga — cf. za-wa-ghanga
house of the doctors — *of the doctors*

(56) Spreading at 3, creating OCP-violation (=DS), p.881

ni-on-í̲yé̲ má-!kú̲i — cf. ni-on-í̲yé̲, — ma-kú̲i
I saw dogs — *1stsg-see-perfect* — *6-dog*
I saw

ni-on-í̲yé̲ nyú!mbá̲ — cf. ni-on-í̲yé̲, — nyumbá̲
I saw the house — *1stsg-see-perfect* — house
I saw

Kishambaa: Object prefixes

(57) No fusion for Obj in penult/stressed position at [2], p.883

ku-[chí̱-ꜜjá̱]
infinitive-it(7)-eat
to eat it (Class 7)

ni-té̱-[ꜜí̱-ꜜnywá̱]
1stsg-past-it(9)-drink
I drank it (Class 9)

(58) Fusion for Obj in unstressed position at [2], p.883

ku-[wá̱-kó̱má]	cf. ku-[kó̱má]
infinitive-them-kill	*infinitive-kill*
to kill them	to kill

ní̱-kí-[ꜜchí̱-kó̱má]
1stsg.-progressive-it-kill
I was killing it (Cl. 7)

Kishambaa: Subjunctive

(59) Lowering in the subjunctive, 2, p.884

né ní-[wa-kaang-iy-e]	cf. ku-[kááng-a]
I will fry for them (soon)	to fry
ní-[wa-kom-e]	cf. ku-[kóm-á]
I should kill them	to kill

Constraints

(60) $*^{!}$H: Assign -x violation for every H_x preceded by a floating L.

(61) $\|$UNIF$\|$: Assign -1 violation for every pair of input tones corresponding to the same output tone.

GSR: Broader Context

- that linguistic elements are not categorical but have strength differences is **not a new** idea
  (e.g. Rizzi (1986) and Koster (1986) for functional categories in syntax, Garde (1965): some lexical accent system are based on scalar grades of accent strength,...)
- other work on non-categorical elements in **neural networks**
  (e.g. Corina (1994) on induction of prosodic categories in neural networks)
- can also predict **phonetic gradience**
  (e.g. subphonemic gradience in word-final devoicing, nasal place assimilation, flapping (e.g. Braver, 2013), vowel harmony is gradient (McCollum, 2018),...)
- **different from a binary** distinction into strong/weak
  (Inkelas, 2015; Vaxman, 2016*a*,*b*; Sande, 2017)

→ here: predictions of **gradient (=numerical) phonological strength in an OT-system** as explanation for 'exceptional' behaviour

General Arguments for GSR

1. Embedded in a general **computational architecture for cognition**
   (=Gradient Symbolic Computation, Smolensky and Goldrick, 2016)
2. A **unified account** for different exceptional phonological behaviours:
   - liaison consonants in French (Smolensky and Goldrick, 2016)
   - semi-regularity of voicing in Japanese Rendaku (Rosen, 2016)
   - allomorphy in Modern Hebrew (Faust and Smolensky, 2017)
   - lexical accent in Lithuanian (Kushnir, 2017)
   - tone sandhi in Oku (Nformi and Worbs, 2017)
   - tone allomorphy in San Miguel el Grande Mixtec (Zimmermann, 2017*a*,*b*)
   - lexical stress in Moses Columbian Salishan (Zimmermann, 2018*d*)
   - exceptional tone (non)spreading in San Molinos Mixtec (Zimmermann, 2018*b*)
   - interaction of phonological/lexical gemination/lenition in Italian (Amato, 2018)
   - compound stress in Sino-Japanese (Rosen, 2018)
   - (interacting) ghost segments in Welsh (Zimmermann, 2018*c*)
   - ...