Exceptional non-triggers are weak: The case of Molinos Mixtec

Eva Zimmermann
Leipzig University

UNIVERSITÄT
LEIPZIG

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Main Claim

The present case study of tones in San Pedro Molinos Mixtec shows that:

- the original Gradient Symbolic Representation system should be modified and assume **gradient activity in the output**.
- exceptional elements can be **exceptional for more than one phonological process** which is a strong argument for a representational account.
  (Cf., for example, Lieber (1987); Zoll (1996); Wolf (2007))
- **exceptional non-triggers** indeed exist.
  (Cf., for example, Smith (2017); Hout (2017) and vs. Finley (2010))

1. Gradient Symbolic Representations

2. Data

3. Analysis
3.1 Asymmetry 1: Exceptional non-trigger for H-spreading
3.2 Asymmetry 2: Exceptional non-undergoer for H-overwriting

4. Summary

Gradient Symbolic Representations

Gradient Symbolic Representation (=GSR; Smolensky and Goldrick, 2016)

- symbols in a linguistic representation can have **different degrees of presence** or numerical activities
- this can predict **lexical exceptions**: elements in the underlying representation of a morpheme can be exceptionally weak:
  - liaison consonants in French (Smolensky and Goldrick, 2016)
  - semi-regularity of Japanese Rendaku (Rosen, 2016)
  - allomorphy in Modern Hebrew (Faust and Smolensky, 2017)
  - lexical accent in Lithuanian (Kushnir, 2017)
  - lexical stress in Moses Columbian Salishan (Zimmermann, 2017*b*,*c*)
  - tone sandhi in Oku (Nformi and Worbs, 2017)
  - tone allomorphy in San Miguel el Grande Mixtec (Zimmermann, 2017*a*,*d*)

Gradient Symbolic Representations and HG

- grammatical computation inside **Harmonic Grammar**
  (Legendre et al., 1990; Potts et al., 2010)

- any **change in activity is a faithfulness violation**

(1)

$b_1a_1t_1$-$p_{0.5}$	Max 5	
a. batp		0
b. bap	-1	-5
☞ c. bat	-0.5	-2.5

Prediction

Elements active to a lesser degree are **easier to delete**: unstable elements, allomorphs, exceptional repairs,...

Gradient Symbolic Representations in the Output (Zimmermann, 2017*a*,*d*)

- output elements can be weakly active as well
- every marked structure M violates a markedness constraint *M by **M's combined activity** (= $\frac{\text{sum of activities of all its elements}}{\text{number of all its elements}}$)

(2)

$b_1a_1t_1$-$p_{0.5}$	*CC]$_\sigma$ 3	Dep 2	Max 1	
a. $b_1a_1t_1p_1$	-1	-0.5		-4
b. $b_1a_1t_1p_{0.5}$	-0.75			-2.25
☞ c. $b_1a_1t_1$			-0.5	-0.5

Prediction

Elements active to a lesser degree are not **as bad a markedness problem or not as good a markedness solution**: Exceptional non-triggers

Data

Molinos Mixtec

- San Pedro Molinos (=MOL), a variety of Mixtec/Otomanguean, was spoken by 700 speakers according to Hunter and Pike (1969)
- variety closely related to San Miguel el Grande Mixtec
  (Cf. Pike (1944); Mak (1950); Hollenbach (2003); McKendry (2013); theoretical accounts in Goldsmith (1990); Tranel (1995); Zimmermann (2016))
- all the data in the following comes from Hunter and Pike (1969)

Background: Tones in MOL

- three level tones high (H; á), mid (M; ā), and low (L; à)
- only a single tone on one syllable (CV_1V_1=bisyllabic)
- basic morphological unit in Mixtecan: a binary CVCV or CVV unit (=‘couplet’)

(3) *Tonal contrasts in MOL (Hunter and Pike, 1969, 27)*

tātá-są́	tūtą̄-są́	tūtù-są́
‘my father’	‘my firewood’	‘my paper’
ʔùù ríkī	ʔùù kītī	ʔùù híī
‘two woodpeckers’	‘two animals’	‘two fists’

Tone perturbation

- as in basically all Otomanguean languages, MOL has ‘perturbing’ morphemes that trigger a change for the tone(s) of a following morpheme (Dürr, 1987; Pike, 1944; Mak, 1950; Hollenbach, 2003; McKendry, 2013)
- some morphemes trigger an **additional H** that overwrites underlying M or L of the initial TBU of a following morpheme

(4) H-overwriting

$$XX^{H}\ XX \rightarrow XX\ \mathbf{H}X$$

Tone Perturbation

(5) (Hunter and Pike, 1969, 35-36)

	M1	M2	Surface	Tones
Non-perturbing morphemes				
a.	ʔùʃì ‘ten’	rīŋkī ‘mouse’	ʔùʃì rīŋkī ‘ten mice’	LL MM→LL MM
b.	ʔḭ̄ḭ̄ ‘one’	sùʧī^{H} ‘child’	ʔḭ̄ḭ̄ sùʧī ‘one child’	MM+LM^{H}→MM LM
Perturbing morphemes				
c.	kṵ̀ṵ̀^{H} ‘four’	ʧìká ‘baskets’	kṵ̀ṵ̀ ʧ**í**ká ‘four baskets’	LL^{H} LH→LL **H**H
d.	ʒāʔā^{H} ‘chiles’	ʒìʧí ‘dry’	ʒāʔā ʒ**í**ʧí ‘dry chiles’	MM^{H} LH→MM **H**H
e.	síví^{H} ‘name’	tèē ‘man’	síví t**é**ē ‘name of the man’	HH^{H} LM→HH **H**M
f.	kītī^{H} ‘animal’	kūù ‘to die’	kītī k**ú**ù ‘the animal will die’	MM^{H} ML→MM **H**L

Tone perturbation & spreading

- if a perturbing morpheme precedes a morpheme that ends in an M-toned TBU and is also perturbing, both TBU's of this morpheme become high

(6) H-overwriting and spreading

$$\mathrm{XX}^{\mathrm{H}}\ \mathrm{XM}^{\mathrm{H}} \rightarrow \mathrm{XX}\ \mathbf{HH}$$

Tone perturbation & spreading

(7) (Hunter and Pike, 1969, 35-36)

	M1	M2	Surface	Tones
H-overwriting and spreading				
a.	síví^{H} ‘name’	sùʧī^{H} ‘child’	síví s**ú**ʧ**í** ‘name of the child’	HH^{H}+LM^{H}→HH **HH**
b.	síví^{H} ‘name’	kītī^{H} ‘animal’	síví k**ítí** ‘name of the animal’	HH^{H}+MM^{H}→HH **HH**
c.	kītī^{H} ‘animal’	kāā^{H} ‘to eat’	kītī k**áá** ‘the animal will eat’	MM^{H}+MM^{H}→MM **HH**
No spreading if M2 is not M-final				
d.	kų̀ų̀^{H} ‘four’	ʒòò^{H} ‘mont(H)’	kų̀ų̀ ʒ**ó**ò ‘four months’	LL^{H}+LL^{H}→LL **H**L
No spreading if M2 has no floating H				
e.	síví^{H} ‘name’	tèē ‘man’	síví t**é**ē ‘name of the man’	HH^{H}+LM→HH **H**M

Optionally perturbing morphemes

- there are three classes of morphemes in MOL:
  1. non-perturbing ones (cf. (5)-a+b): XX
  2. perturbing ones (cf. (5)-c-g; (7)): XX^{H}
  3. **optionally perturbing** ones: $XX^{(H)}$

Optionally perturbing morphemes

(8) (Hunter and Pike, 1969, 35-36)

	M1	M2	Surface	Tones
a.	hìkī$^{(H)}$ ‘fist, paw’	tèē ‘man’	hìkī t**é**ē∼tèē ‘the man’s fist’	LM$^{(H)}$+LM→LM **H**M∼LM
b.	hìkī$^{(H)}$ ‘fist, paw’	ʧį̀ʔį̄ ‘skunk’	hìkī ʧ**į́**ʔį̄∼ʧį̀ʔį̄ ‘the skunk’s paw’	LM$^{(H)}$+LM→LM **H**M∼LM
c.	ñùtī$^{(H)}$ ‘sand’	ʒìʧí ‘dry’	ñùtī ʒ**í**ʧí∼ʒìʧí ‘dry sand’	LM$^{(H)}$+LH→LM **H**H∼LH

Optionally perturbing morphemes and H-spreading

- if they are (optionally) realized, however, they **undergo** it
- optionally perturbing morphemes **never trigger** H-spreading

Optionally perturbing morphemes and H-spreading

(9) (Hunter and Pike, 1969, 36)

	M1	M2	Surface	Tones
Never a trigger…				
a.	síví^{H} ‘name’	ʧḭ̀ʔḭ̄$^{(H)}$ ‘skunk’	síví ʧ**ḭ́**ʔḭ̄ ‘name of the skunk’	HH^{H}+LM$^{(H)}$→HH **H**M
b.	hìkī$^{(H)}$ ‘fist, paw’	ʧḭ̀ʔḭ̄$^{(H)}$ ‘skunk’	hìkī ʧ**ḭ́**ʔḭ̄∼ʧḭ̀ʔḭ̄ ‘the skunk’s paw’	LM$^{(H)}$+LM$^{(H)}$→LM **H**M∼LM
…but always an undergoer (if realized)				
c.	ʧḭ̀ʔḭ̄$^{(H)}$ ‘skunk’	kāā^{H} ‘to eat’	ʧḭ̀ʔḭ̄ k**áá**∼kāā ‘the skunk will eat (it)’	LM$^{(H)}$+MM^{H}→LM **HH**∼MM
d.	hìkī$^{(H)}$ ‘fist’	sùʧī^{H} ‘child’	hìkī s**ú**ʧ**í**∼sùʧī ‘the child’s fist’	LM$^{(H)}$+LM^{H}→LM **HH**∼LM

Perturbing morphemes: Summary

(10)

M2 / M1	XX	$XM^{(H)}$	XM^{H}
XX	no change	no change	no change
$XX^{(H)}$	no change or H-OW	no change or H-OW	no change or H-OW+Spr
XX^{H}	H-OW	H-OW	H-OW+Spr

$XX^{(H)}$ ⇒ **Sometimes H-OW trigger**

XX^{H} ⇒ **Always H-OW trigger**

$XM^{(H)}$ ⇓ **Never H-Spr trigger**

XM^{H} ⇓ **Always H-Spr trigger**

Perturbing morphemes: Summary

- the optionally perturbing morphemes are **exceptional for two processes**:
  - they are only optionally realized: **Exceptional optional non-undergoer**
  - they never trigger H-Spr: **Exceptional non-trigger**

➙ not simply a variation between behaving as a perturbing morpheme/a non-perturbing one but a true asymmetric mixture of properties

Analysis

Analysis in a nutshell

Representational assumption

1. Some morphemes in MOL end in an **unassociated (=floating) H-tone**
2. The floating H of some morphemes is **fully active**: H_1
3. The floating H of other morphemes is **partially active**: $H_{0.4}$
    1. the weakly active $H_{0.4}$ is not a bad enough problem for *FLT and is not always associated
    2. the weakly active $H_{0.4}$ is not a bad enough problem for the markedness constraint triggering H-spreading

Basic floating tone realization

- unassociated floating tones violate *FLT (11-a) and realization of a H-tone (=MAX_H, (11-b)) is more important than any other tone
- overwriting results since two tones on one TBU are impossible (11-c)
- and floating tones must associate to another morpheme (11-d)

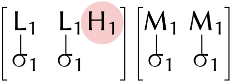
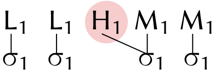
(11) a. *FLT: Assign X violation for every tone T_1 that is not associated to a TBU where X is the activity of T_1.

b. MAX_T: Assign violation X for any tonal activity X in the input that is not present in the output.

c. *CONT: Assign X violation for every TBU_1 associated to tones T_2 and T_3 where X is the shared activity of TBU_1, T_2, and T_3.

d. ALT: Assign X violation for every new association between a TBU and a tone of the same morphological affiliation.

Overwriting: Floating H_1

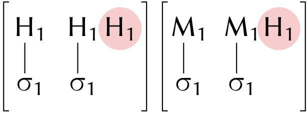
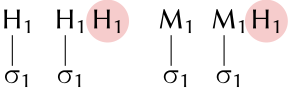
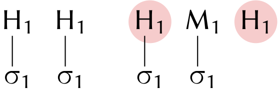
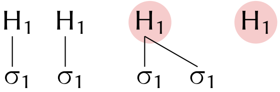
(12) 	MAX$_H$ 100	*CONT 100	ALT 100	*FLT 71	MAX$_T$ 24	
a. 				-1		-71
b. 	-1				-1	-124
c. 		-1				-100
d. 			-1		-1	-124
☞ e. 					-1	-24

H-Spreading is avoidance of a marked tone sequence

- triggered by a markedness constraint against sequences of MH-tones inside a morpheme

(13) *[MH]: Assign X violation for every morpheme-internal sequence of M_1 and H_2 where X is the shared activity of M_1 and H_2.

Spreading triggered by a fully active H_1

(14) 	Max_H 100	$*F_{LT}$ 71	$*[MH]$ 28	Max_T 24	
a. 		-2	-1		-170
b. 		-1	-1	-1	-123
☞ c. 		-1		-2	-119

No repair possible for *[MH] without a floating H

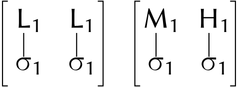
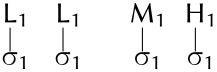
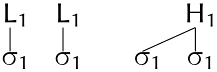
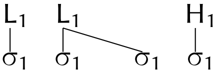
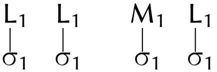
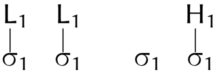
- simply deleting a tone is excluded by SPECIFY (=SPEC)
- deleting a tone and inserting one is excluded by DEPT
- spreading an underlying tone of the same morpheme is excluded by ALTERNATION
- spreading an underlyingly associated tone of a preceding morpheme is excluded by $^{*}\textsc{Long}_{\textsc{MBound}}$ (15)

(15) a. $^{*}\textsc{LgT}_{M}$: Assign X violations for every tone T_1 that is associated to two TBU's τ_2 and τ_3 of different morphological affiliations where X is the shared activity of T_1, τ_2, and τ_3.

b. SPEC: Assign 1-X violations for every TBU τ_1 where X is the activity of tone(s) associated to τ_1.

No repair possible for *[MH] without a floating H

(16)

	Alt 100	*LgT$_M$ 100	Dep$_T$ 100	*[MH] 28	Max$_T$ 24	Spec 7	
☞ a. 				-1			-28
b. 	-1				-1		-124
c. 		-1			-1		-124
d. 			-1		-1		-124
e. 				-1		-1	-31

No spreading triggered by a partially active $H_{0.4}$

- partially active $H_{0.4}$ only triggers a -0.7 violation of *[MH] if it follows a base ending in M

Weighting argument: Too weak to be a trigger

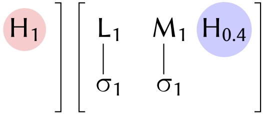
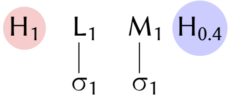
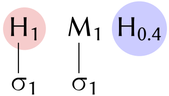
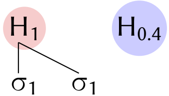
(17) Fully active H_1
$*[MH] \gg \textsc{Max}_T$

(18) Partially active $H_{0.4}$
$\textsc{Max}_T \gg 0.7x*[MH]$

➙ the gradient violation of a **markedness** constraint is crucial: impossible under the original GSR proposal and only possible if elements can remain weakly active in the output

No spreading triggered by a partially active $H_{0.4}$

(19)

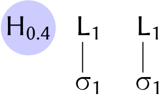
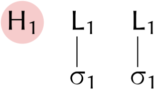
		Max_{H}	$^{*}\text{F}_{LT}$	$^{*}[\text{MH}]$	Max_{T}	
		100	71	28	24	
a.			-1.4	-0.7		-119
☞ b.			-0.4	-0.7		-48
c.			-0.4		-1	-52,4

Partially active $H_{0.4}$ is only optionally realized

- crucial contrast: Unassociated H_1 violates *Flt by 1; unassociated $H_{0.4}$ only by 0.4

➙ an unassociated partially active tone is **not as bad a problem** as a fully active one

(20)

	Max$_H$ 100	*Flt 71	*[MH] 28	Max$_T$ 24	
a. 		-0.4			-28,4
a. 		-1			-71

Intermezzo: Variation and constraint-based grammar models

(Coetzee and Pater, 2011; Hayes, 2017)

- variability in OT: partial rankings (Kiparsky, 1993; Anttila, 1997; Anttila and Cho, 1998) or stochastic OT (Boersma, 1997, 1998; Boersma and Hayes, n.d.)
- variability in HG: Noisy Harmonic Grammar (Boersma and Weenink, 1992-2018; Boersma and Pater, 2016) or Maximum Entropy models (Johnson, 2002; Goldwater and Johnson, 2003; Wilson, 2006)
- the following is a MaxEnt-HG implementation where well-formedness is interpreted as **probability**
  - ➞ only reasonable to some degree: no frequency/probalistic data for MOL

Maxent grammar for MOL

- calculated with the UCLA Maxent Grammar Tool (Hayes, 2009)

Constraint weights for MOL

(21)

$\textsc{Max}_H$	*Flt	*[MH]	$\textsc{Max}_T$	Spec	*HMH
113.00	71,00	28.06	24.07	6.80	1.56

- only three relevant candidates are shown in the following:
  - **a.** leaving the floating H unassociated: FL
  - **b.** associating the floating H to one TBU: OW
  - **c.** associating the floating H to both TBU's: OW+Spr
- all other candidates (e.g. those violating $\textsc{Max}_H$) have probabilities below 0,01

Partially active $H_{0.4}$ is only optionally realized

Weighting argument: Too weak to be realized

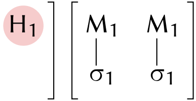
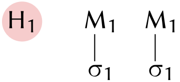
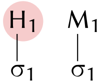
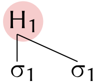
- realization of $H_{0.4}$ is not as important (for *FLT) as realization of H_1
- and realization of $H_{0.4}$ induces additional -0.6 violations of SPEC

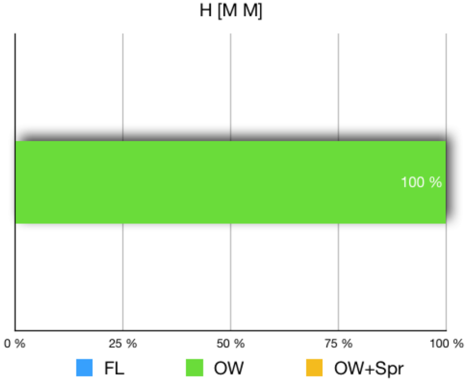
(22) Realization of fully active H_1
$*\text{FLT} \gg \text{MAX}_T$

(23) (Non-)Realization of partially active $H_{0.4}$
$0.4\text{x}*\text{FLT} \sim 0.6\text{xSPEC} + \text{MAX}_T$

Fully active H_1 is realized: Maxent probabilities

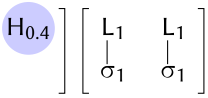
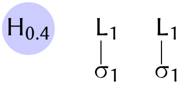
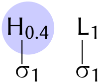
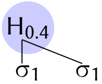
(24)

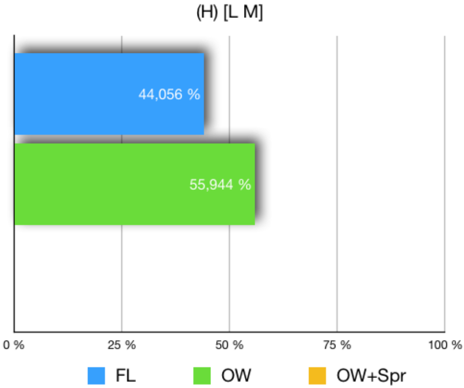
	*H*	Probability
a. 	-71,0	4,20E-21
☞ b. 	-24,08	0,9999
c. 	-48,16	3,49E-11



Partially active $H_{0.4}$ is only optionally realized

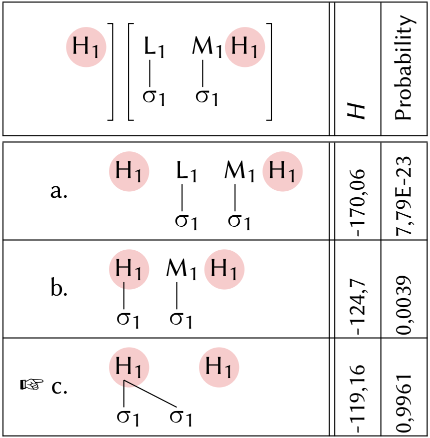
(25)

	*H*	Probability
☞ a. 	-28,4	0,4406
☞ b. 	-28,16	0,5594
c. 	-34,5	3,29E-13

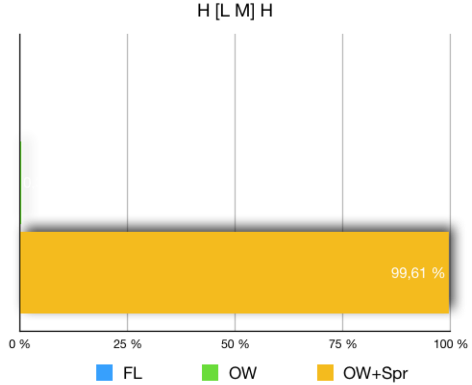


Fully active H_1 as trigger for H-spreading

(26)

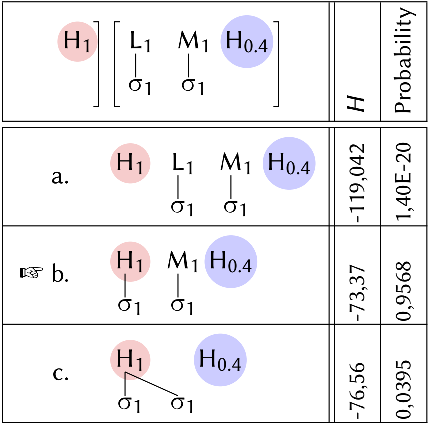


H_1] [L_1 M_1 H_1] σ_1 σ_1	*H*	Probability
a. H_1 L_1 M_1 H_1 σ_1 σ_1	-170,06	7,79E-23
b. H_1 M_1 H_1 σ_1 σ_1	-124,7	0,0039
☞ c. H_1 H_1 σ_1 σ_1	-119,16	0,9961

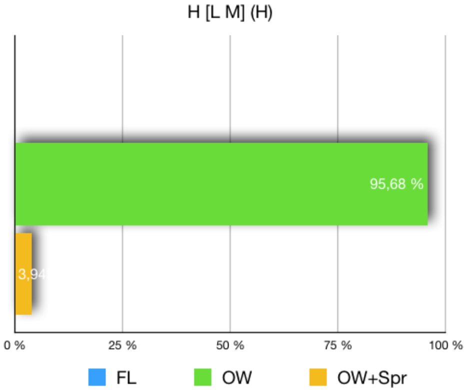


Partially active $H_{0.4}$ as non-trigger for H-spreading (of H_1)

(27)



	H_1] [L_1 M_1 $H_{0.4}$] σ_1 σ_1	*H*	Probability
a.	H_1 L_1 M_1 $H_{0.4}$ σ_1 σ_1	-119,042	1,40E-20
☞ b.	H_1 M_1 $H_{0.4}$ σ_1 σ_1	-73,37	0,9568
c.	H_1 $H_{0.4}$ σ_1 σ_1	-76,56	0,0395



Summary

Summary

- the optionally perturbing morphemes in MOL are **exceptional for more than one phonological process**
  - Strong argument for a **representational account** and vs. an account based on morpheme-specific constraints or constructions
    (=argument against lexically indexed constraints (e.g. Alderete, 2001; Pater, 2009; Finley, 2009)
  - MaxEnt can predict the asymmetry between being an exceptional **obligatory non-trigger** for one process and an exceptional **optional undergoer** for another one
- strengthened the argument for **Gradient Symbolic Representations in the Output**: the crucial trigger for the H-spreading is a markedness constraint

`Eva.Zimmermann@uni-leipzig.de`

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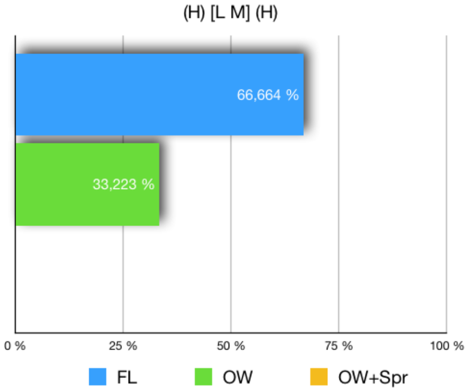
Appendix: Partially active $H_{0.4}$ as non-trigger for H-spreading (of $H_{0.4}$)

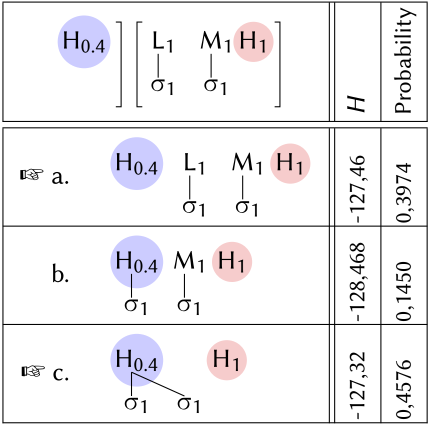
(28)

$H_{0.4}$] [L_1 M_1 $H_{0.4}$] σ_1 σ_1	*H*	Probability
☞ a. $H_{0.4}$ L_1 M_1 $H_{0.4}$ σ_1 σ_1	-764,42	0,6666
☞ b. $H_{0.4}$ M_1 $H_{0.4}$ σ_1 σ_1	-77,138	0,3322
c. $H_{0.4}$ $H_{0.4}$ σ_1 σ_1	-84,72	1,69E-4

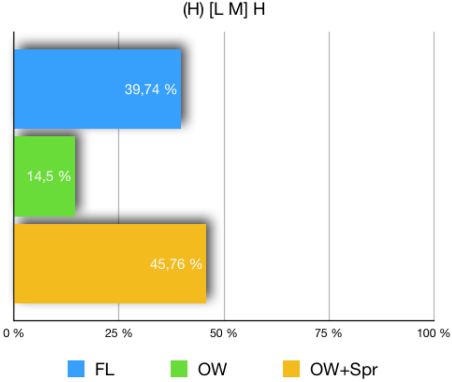


Appendix: Partially active $H_{0.4}$ as regular (?) undergoer of spreading

(29)



$H_{0.4}$] [L_1 M_1 H_1] σ_1 σ_1	*H*	Probability
☞ a. $H_{0.4}$ L_1 M_1 H_1 σ_1 σ_1	-127,46	0,3974
b. $H_{0.4}$ M_1 H_1 σ_1 σ_1	-128,468	0,1450
☞ c. $H_{0.4}$ H_1 σ_1 σ_1	-127,32	0,4576



Appendix: Tone perturbation on the second TBU

- CVCV-ML bases and CVCV-LL couplets become MH

(30) (Hunter and Pike, 1969, 36)

	M1	M2	Surface	Tones
a.	síví^{H}	ʃīʃì-są́	síví ʃīʃí-są́	HH^{H}+ML-H→HH M**H**-H
	‘name’	‘my aunt’	‘my aunt’s name’	
b.	ndūtē^{H}	ʔùvà	ndūtē ʔūvá	MM^{H}+LL→MM **MH**
	‘water’	‘bitter’	‘bitter water’	
c.	ʃų̀ʔų̄^{H}	stōò-są́	ʃų̀ʔų̄ stóò-są́	LM^{H}+ML-H→LM **H**L-H
	‘money’	‘my uncle’	‘my uncle’s money’	
d.	kītī^{H}	kūù	kītī kúù	MM^{H}+ML→MM **H**L
	‘animal’	‘to die’	‘the animal will die’	

Appendix: Markendess constraints and GSRO

(31) *M

Assign X violation for every configuration M where X is the combined activity of all elements that are non-contextual parts of this configuration.

(32) M!

Assign 1-X violation for every configuration N where X is the activity of structure M in N.

Appendix: Surface restrictions for tones

- three types of morphemes: A, B, and minor class B’
- MH is among the less frequent tone specifications for couplets…(but M-final ones with floating tones are very well possible)

(33) *Morpheme classes and their tones*

<table>
<tr><th>A</th><th>B</th><th>B’</th></tr>
<tr><td colspan="3">LM</td></tr>
<tr><td colspan="2">HH
MM
LL</td><td></td></tr>
<tr><td>MH
LH
HM
HL
ML</td><td></td><td></td></tr>
</table>