

Gradient Symbolic Representations in the Output

A typology of lexical exceptions

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- ❧ the assumption of **Gradient Symbolic Representations in the Output** predicts a typology of attested lexical exception patterns
- ❧ the presence of elements with **more than two different grades of activity** predicts the complex stress system in Moses Columbia Salish
- ❧ such a representational account correctly predicts that elements with different activity behave **exceptional for more than one process**

1. Gradient Symbolic Representations

2. Case study: Moses Columbia Salish Stress

2.1 Data: Lexical stress in MCS

2.2 Analysis based on gradient activity

2.3 Further evidence: Vowel deletion asymmetries

3. Summary and Conclusion

Gradient Symbolic Representations

Background: Gradient Symbolic Representation


(=GSR; Smolensky and Goldrick, 2016; Rosen, 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
- 🦉 assumption modifying the original GSR-account: output elements can be weakly active as well (Zimmermann, 2017*a,b*): GSRO
(no explicit argument for this assumption in the MCS analysis)

Gradient Symbolic Representations and HG

- any **change in activity is a faithfulness violation**
- every marked structure M violates a markedness constraint by the number that equals M 's activity
- grammatical computation inside **Harmonic Grammar**
(Legendre et al., 1990; Potts et al., 2010)

(1)

$b_1a_1t_1-p_{0.5}$	$*CC]_{\sigma}$ 3	DEP 2	MAX 1	
a. $b_1a_1t_1p_{0.5}$	-0.5			-1.5
 b. $b_1a_1t_1$			-0.5	-0.5
c. $b_1a_1p_{0.5}$			-1	-1
d. $b_1a_1t_1\ominus_1p_{0.5}$		-1		-2
e. $b_1a_1t_1p_1$	-1	-0.5		-4

Gradience in the output: Predicted typology of exceptions

UNDERLYING	PHON.	OUTPUT	e.g.
1. Exceptional repair: Weak element not realized			
$A_1 + B_{0.6}$	*AB	A_1	Nuuchahnulth unstable C's (Kim, 2003)
$A_1 + B_1$		$A_1 B_1$	
2. Exceptional repair: Weak element realized			
$A_1 B_{0.6} + A_1$	*AA	$A_1 B_{0.6} A_1$	Catalan exceptional u-realization (Bonet et al., 2007)
$A_1 B_{0.6} + C_1$		$A_1 C_1$	
3. Exceptional non-trigger: Weak element not repaired			
$A_1 + B_{0.6}$	*AB	$A_1 B_{0.6}$	Cl. Manchu exceptional non-triggers for ATR-harmony (Smith, 2017)
$A_1 + B_1$		$A_1 C_1$	
4. Exceptional non-target: Weak element does not change			
$A_1^A + B_{0.6}$	*X ^A	$A_1 B_{0.6}$	SMG Mixtec exceptional non-hosts for floating tones; GSRO analysis in (Zimmermann, 2017a,b)
$A_1^A + B_1$		$A_1 A_1$	
5. Lexical support			
$A_1 B_{0.6}$	*WEAK!	A_1	Japanese Rendaku voicing only if stem and suffix trigger it; GSR analysis in Rosen (2016)
$A_1 B_{0.6} + B_{0.6}$		$A_1 B_{0.6}$	
6. True competition			
$A_{0.8} + C_1$	1ELEM!	C_1	→ MCS case study
$A_{0.8} + B_{0.6}$		$A_{0.8}$	

Argument 1: More than two grades of activity

- ✎ in most accounts that directly implement some concept of strength, only a **binary** division into strong and weak is relevant (Inkelas, 2015; Vaxman, 2016*a,b*; Sande, 2017)
- ➔ true **gradience** of activity is argued to account for the stress system of Moses Columbia Salish where **feet with 5 different degrees of activity** compete for realization

Argument 2: Exceptionality for more than one process

- such a representational account where exceptionality follows from a property of the underlying representation predicts that **elements can be exceptional for multiple phonological processes**
- borne out in the case study of MCS where vowel deletion treats the same morpheme types differently as stress assignment

(2)

	Fully active consonant Affix 1: /-k ₁ /	Exceptional weak consonant Affix 2: /-p _{0.5} /
Epenthesis	/b ₁ a ₁ t ₁ -k ₁ / [batə ^k]	/b ₁ a ₁ t ₁ -p _{0.5} / [batp]
Nasal Ass.	/t ₁ u ₁ n ₁ -k ₁ -o ₁ / [tuŋko]	/t ₁ u ₁ n ₁ -p _{0.5} -o ₁ / [tunpo]

Case study: *Moses Columbia Salish Stress*

Moses Columbia Salish

(Kinkade, 1982; Czaykowska-Higgins, 1985, 1993*a,b*, 2011; Willett, 2003, =MCS)

- a **single main-stressed** syllable in every word
- the default-stress position is the **rightmost** syllable for stems in isolation (3-a+b)
- **prefixes are never stressed**; even if they contain the only full V (3-c)

(3) *Default stress (Czaykowska-Higgins, 1993a, 205+225)*

- a. hananík
'jackrabbit'
- b. q'aláχ
'fence'
- c. niʔwəp wəpəlqs
niʔ-wp~wp=lqs
Loc-RED-hair=nose
'hair in nose'

Vowel epenthesis and deletion

🦋 there is vowel **epenthesis**:

- e.g. weak CC-roots always have an epenthetic V between stem-C's
- e.g. epenthesis before /ʔ/
- quality predictable: e.g. i/___j, a/___ʔ, ə elsewhere,...

(4) nq'ij'apánaʔ
 n-q'j'=ap=anʔ
 Loc-write=bottom=ear
 'branded on the cheek' (215)

🦋 unstressed V's are **deleted** if they follow the stressed V

(5) kaʃhújʃnmncn
 kaʃ-huj=ʃin-min-t-ʃi-n
 unrealized-irritate=mouth-relational-TR-2SG.O-1SG.S
 'I'm going to bother you (by mouth)' (202)

(stem=underlined)

Lexically determined stress in Salish

- hierarchy of stress-preferences based on a lexical two-way-distinction for stems and affixes into:
 - dominant 'D' and recessive 'R' suffixes
 - strong 'S' and weak 'W' stems
- **D-Sfx** \gg **S-stem** \gg **{R-Sfx, W-stem}**
- very similar systems in all Interior Salishan languages except Lillooet (Idsardi, 1991; Czaykowska-Higgins and Kinkade, 1998)

Lexically determined stress in MCS

- (6) a. p'iftł'aʔákft (S-**Đ**)
 p'iftł'ɪ=akft
 big.PL=hand
 'big hands' (229)
- b. ʃatʃím'xəx^w (Š-R)
 ʃatʃ-ɪim'x-mix
 IPFV-move-IPFV
 'he's moving' (208)
- c. ʃatʃím'xəx^w (S-**Đ**-R)
 kaʃ-p'iq=ʃin-ʃut-mix
 unrealized-cook=food-REFL-IPFV
 'he's going to cook' (209)

Further distinction for stems: E-stems

- 👉 E-stems are stressed if directly followed by one D-suffix
- 👉 but loose stress to a D-suffix if at least **one other suffix intervenes**

- (7) a. japk^Wánkʃn (SÉ-D)
 jap-k^Wan=akʃt-n-t-ø-n
 Loc-grab=hand-CTRL-TR-3.O-1Sg.S
 'I grab so. by the hand' (229)
- b. kʔk^Wntʃnákʃn (SE-D-Ď)
 kʔ-k^Wan=tʃin=akʃt-n-t-ø-n
 Loc-grab=mouth=hand-CTRL-TR-3.O-1Sg.S
 'I grab so. by wrist' (231)
- c. xatmʃtʃút (SE-R-Ď)
 xat-min-ʃtu-tʃút
 raise-relational-CAUS-REFL
 'he's raising up' (271)

Lexically determined stress: Interim summary

(8)

	S	W	SE	WE
a.	Ŝ (-R)-R	W(-R)- Ŕ	SÉ (-R)-R	WÉ -R
b.	S- Ď	W- Ď	SÉ -D	WÉ -D
c.	S- Ď -R(-R)	W- Ď -R(-R)	SÉ -D-R(-R)	
d.	S-D(-D)- Ď	W-D(-D)- Ď	SE-D(-D)- Ď	WE-D(-D)- Ď
e.			SE-R- Ď	

Asymmetry: Intervening suffix between E-stem and D or not

- 👉 hierarchy: SE/WE ~ **D** \gg **S** \gg {**R**, **W**}
- 👉 multiple suffixes of the type that should be stressed: the **rightmost** one receives stress

Additional suffix-type R*: Stress-attracting R-suffixes

- two suffixes behave like R-suffixes except that they **attract stress even though they are not the rightmost** in a sequence of R-suffixes

- (9) a. $k^w u \dot{t} n m n$ (Š-R*)
 $k^w u \dot{t} n - \text{min} - t - \emptyset - n$
 borrow-relational-CTR-TR-3.O-1SG.S
 ‘I’m borrowing it’ (251)
- b. $tʃqənaʔqimntʃn$ (W-D-Ď-R*)
 $tʃq = \text{an} \dot{t} = \text{qin} - \text{min} - t - \text{ʃi} - n$
 hear=ear=head-relational-TR-2SG.O-1SG.S
 ‘I heard about you’ (251)
- c. $jərmiftm$ (W-R*-R)
 $j_r - \text{min} - \text{ʃtu} - \emptyset - n$
 push-relational-CAUS-3.O-1PL.S
 ‘We push him’ (252)

Additional suffix-type D*: Stress-attracting D-suffixes

- ☛ D*-suffixes behave like D-suffixes except that **they are stressed when adjacent to an SE/WE-stem**

- (10)
- a. ptχujútijaʔfn (S-**Đ***-R)
ptiχuj=utjʔ-ftu-ø-n
 spit=?-CAUS-3.O-1SG.S
 'I spittled on them' (270)
- b. wak^wtúʔn (SE-**Đ***)
wak^w-tuʔ-t-ø-n
 hide-redirective-TR-3.O-1SG.S
 'I hid it from s.o.' (256)
- c. t'əʔwíl'x (WE-**Đ***)
t'ʔ-wíl'x
 dirty-inch
 'sth. used until it got dirty' (256)

Lexically determined stress: Summary

(11)

	S	W	SE	WE	
a.	\acute{S} (-R)-R	W(-R)- \acute{R}	$\acute{S}\acute{E}$ (-R)-R	$\acute{W}\acute{E}$ -R	(D, R)
b.	S- \acute{D}	W- \acute{D}	$\acute{S}\acute{E}$ -D	$\acute{W}\acute{E}$ -D	
c.	S- \acute{D} -R(-R)	W- \acute{D} -R(-R)	$\acute{S}\acute{E}$ -D-R(-R)		
d.	S-D(-D)- \acute{D}	W-D(-D)- \acute{D}	SE-D(-D)- \acute{D}	WE-D(-D)- \acute{D}	
e.			SE-R- \acute{D}		
f.	\acute{S} -R*	W- \acute{R} *			(D, R, R*)
g.		W- \acute{R} *-R			
h.		W(-D)- \acute{D} -R*	$\acute{S}\acute{E}$ -D-R*(-R)		
i.		W-R*- \acute{D}			
j.			SE- \acute{D} *	WE- \acute{D} *	(D, R, D*)
k.			SE-D- \acute{D} *		
l.	S- \acute{D} *-R				
m.			SE- \acute{D} *-R*		(D, R, D*, R*)

D* vs. D and R* vs. R

hierarchy: $D^* \gg \underline{SE/WE} \sim D \gg S \gg R^* \gg \{R, W\}$

Summary: The challenges

- lexical stress system with a **preference hierarchy**:
 $D^* \gg \underline{SE/WE} \sim D \gg S \gg R^* \gg \{R, W\}$
- an apparent **locality threshold** for E-stems: only stressed if no D-suffix follows separated by at least one other suffix

A cyclic account in Czaykowska-Higgins (1993a)

- a cyclic account inside the metrical framework of Halle and Vergnaud (1987*a,b*)
- crucial contrast: **cyclic (=D) vs. non-cyclic (=R) suffixes**: the former trigger stress deletion and new assignment of stress
- different stress rules assigning **left- or rightmost** stress
- E-stems assign **extrametricality** to an adjacent morphemes
- R* - and D* -suffixes are **lexically accented**

The analysis in a nutshell: Competition

- morphemes have **no or underlying feet of different strengths** in their underlying representation

(difference between strong/weak stems = underlying V/only epenthetic V)

(12)

Fully active φ SE/WE		← Weaker φ →				No φ R/W	
		D*	D	S	R*		
φ_1 SE	φ_1 WE	$\varphi_{0.9}$ D*	$\varphi_{0.8}$ D	$\varphi_{0.6}$ S	$\varphi_{0.4}$ R*	R	W

- competition for φ -realization: **most active one is preferably realized**

- (13) MAX- φ :
Assign a violation mark for every input φ without an output correspondent.

Two other (opposing) stress preferences

- (14) a. \acute{V}_{STEM} ('Stress the **stem-vowel!**')
Assign a violation mark for every main-stressed vowel that is not preceded and followed by stem-segments.
- b. RM_{COL} ('Stress is **rightmost!**')
Assign a violation mark for every morphemic colour α that intervenes between the right word edge and the stressed vowel that is not of morphemic colour α .
- c. RM_V ('Stress is rightmost!')
Assign a violation mark for every V^* that intervenes between the right word edge and the stressed vowel that is not of morphemic colour α .
- two versions of RIGHTMOST: asymmetry between R- and D-suffixes and abundant V-deletion in Salish
- (*Underlying vowel. Modelled in containment theory (Prince and Smolensky, 1993; Zimmermann, 2017c)).
- **gang-effect in HG for E-stems**: stems are preferably stressed but stress can't be too far away from the right word-edge

Realization of the only underlying φ

(15)

	$\varphi_{0.8}$ W D R	MAX- φ 100	\acute{V}_{STEM} 30	RM _{COL} 30	RM _V 16	DEP- φ 5	
a.	φ_1 W D R	-0.8	-1			-1	-115
b.	$\varphi_{0.8}$ W D R		-1	-1			-60
c.	φ_1 W D R	-0.8		-2	-1	-1	-161

(epenthetic=grey background)

Preservation of the φ with the highest activity

(16)

$\varphi_{0.6}$ S	$\varphi_{0.9}$ D*	$\varphi_{0.4}$ R*	MAX- φ	\dot{V}_{STEM}	RM _{COL}	RM _V	DEP- φ	
			100	30	30	16	5	
a.	S	D*	$\varphi_{0.4}$ R*	-1.5	-1			-180
b.	S	D*	$\varphi_{0.9}$ R*	-1	-1	-1		-160
c.	S	D*	$\varphi_{0.6}$ R*	-1.3		-2	-1	-206


E-stems: A gang effect

- stress on an **E-stem** is more preferred than stress on a D-suffix by both $MAX-\varphi$ and \acute{V}_{STEM}
 - if, however, more than one suffix intervenes between an E-stem and a D-suffix, stress would be too far away from the right edge and is realized on the **D-suffix** instead
- a **gang-effect in HG**

... has a higher weight than...		
$0.2 \times MAX-\varphi + \acute{V}_{STEM}$	\ggg	$RM_{COL} + RM_V$ Cf. (17)
and		
$2 \times RM_{COL} + RM_V$	\ggg	$0.2 \times MAX-\varphi + \acute{V}_{STEM}$ Cf. (18)

Gang effect I: Stress on E-stem with one D-suffix

(17)

φ_1 SE	$\varphi_{0.8}$ D	MAX- φ 100	\dot{V}_{STEM} 30	RM _{COL} 30	RM _V 16	DEP- φ 5	
a.	$\varphi_{0.8}$ SE D	-1	-1				-130
 b.	φ_1 SE D	-0.8		-1	-1		-126

Gang effect II: Stress on D-suffix if more suffixes intervene

(18)

φ_1 SE	R	$\varphi_{0.8}$ D	MAX- φ	\dot{V}_{STEM}	RM _{COL}	RM _V	DEP- φ	
			100	30	30	16	5	
☞ a.	SE	R	$\varphi_{0.8}$ D	-1	-1			-130
b.	SE	φ_1 R	D	-1.8	-1	-1	-1	-261
c.	φ_1 SE	R	D	-0.8		-2	-1	-156

Interim Summary

- the representations (19) predict the position of main stress: Underlying feet of different activity compete for stress realization

(19)

Fully active φ		\leftarrow Weaker φ \rightarrow				No φ	
SE/WE		D*	D	S	R*	R/W	
φ_1	φ_1	$\varphi_{0.9}$	$\varphi_{0.8}$	$\varphi_{0.6}$	$\varphi_{0.4}$		
SE	WE	D*	D	S	R*	R	W

- this representational account predicts **exceptional behaviour of weakly active elements for more than one process**:
 - \rightarrow evidence from facts about vowel deletion/secondary stress that these is indeed the case

Vowel deletion asymmetry: E-stems and D-suffixes

- unstressed V's are sometimes **deleted if they precede the stressed V**
 - the unstressed V of a D-suffix is deleted between an SE-stem and a stressed D-suffix (20-a)
 - but the unstressed V of a D-suffix is only variably/for some speakers deleted between a W-stem and a stressed D-suffix (20-b)

- (20) a. $k\dot{t}tj'awlq^W qn\acute{a}kftm$ (SE-D_∅-D_∅-**Đ**)
 $k\dot{t}-tj'aw=alq^W=qin=akft-m$
 Loc-wash=pole=TOP=arm-MID
 'wash wrists' (246)
- b. $kj\grave{a}r'j\grave{a}r'qnalq^W \acute{a}kftn$ (W-D_{V/∅}-D_{V/∅}-**Đ**)
 $k-jr' \sim jr'=qin=alq^W=akft-n-t-\emptyset-n$
 Loc-RedP~roll=TOP=pole=arm-CTR-TR-3.O-1SG.S
 'roll up sleeves' (245)

Secondary stress

👉 optional secondary stress can be found on:

- stem vowels
- suffix vowels preceding the main stress

→ **in the context where vowel deletion applies optionally**

- (21) a. niʔk'əmà^ˈn'kàkst (W- $\dot{D}_{V/\emptyset}$ - \dot{D})
 niʔ-k'm=ank=akst
 Loc-surface.of=flat=hand
 'palm of hand' (246)
- b. nməq'^wàpánaʔ (W- $\dot{D}_{V/\emptyset}$ - \dot{D})
 n-mq'^w=ap=anʔ
 Loc-bulge=base=ear
 'bulge on side of face' (249)

→ secondary stress is what **saves those vowels from deletion!**

Account: Second foot blocks vowel deletion

- suffix-vowels without main stress can optionally be realized if they are integrated into a foot (=secondary stress)

(22)

Underlying form

	$\varphi_{0.8}$		$\varphi_{0.8}$
	σ	σ	
$k^w\text{ʔ}$	akʃt	n	tʃut
W	D	C	D

Option 1: D-Vowel realization

	$\varphi_{0.8}$	$\varphi_{0.8}$
σ	σ	σ
$k^w\text{a}$	ʔakʃ	ntʃut

Option 2: D-Vowel deletion

	$\varphi_{0.8}$
σ	σ
$k^w\text{a}\text{ʔ}$	kʃntʃut

Possibility of a second foot in a word

- implicit assumption so far: feet compete for realization since only a single foot is possible
(consequence from, for example, ER-L/R (McCarthy, 2003))
- if the responsible constraint is (at least optionally) lower-weighted **two feet in a word are possible**:
 - avoids vowel deletion of unstressed affix-V
 - is better for MAX- φ because more feet are realized
 - but is only possible if the secondary-stress φ is not stronger than the main-stress φ (*ASYMMETRICSTRENGTH φ)
 - and **maximally two feet** in a word are possible

Possibility of a second foot in a word

(23)

SE-D-D			W-D-(C-)D			
<i>1. Underlying</i>						
φ_1	$\varphi_{0.8}$	$\varphi_{0.8}$		$\varphi_{0.8}$		$\varphi_{0.8}$
σ	σ	σ		σ	σ	
x ^w ir	akft	atk ^w		k ^w ʔ	akft	n tʃut
<i>2. Option 1: D-Vowel deletion</i>						
φ_1		$\varphi_{0.8}$			$\varphi_{0.8}$	
σ		σ		σ	σ	
x ^w irkf		tatk ^w		k ^w aʔ	kʃntʃut	
☺ Stronger (stem)-foot realized as secondary stress			☺ Only other foot realized as secondary stress			
<i>3. Option 2: D-Vowel realization</i>						
*	$\varphi_{0.8}$	$\varphi_{0.8}$		$\varphi_{0.8}$	$\varphi_{0.8}$	
σ	σ	σ		σ	σ	
x ^w i	rakf	tatk ^w		k ^w a	ʔakf	ntʃut
☺ Weaker (affix)-foot realized as secondary stress			☺ Stronger (stem)-foot realized as secondary stress			

Only the stronger foot can become a secondary stress

- a second foot can ‘save’ a D-suffix-V following a W-stem but not one following an SE-stem: being able to save a suffix-vowel from deletion is **not a good enough reason to realize the weaker φ**

(24)

	φ_1 σ x ^w ir	$\varphi_{0.8}$ σ akft	$\varphi_{0.8}$ σ atk ^w	MAX- φ	MAX-V	
				100	10	
☞ a.	φ_1 σ x ^w irkfj	$\varphi_{0.8}$ σ tatk ^w		-0.8	-1	-90
b.	σ x ^w i	$\varphi_{0.8}$ σ rakfj	$\varphi_{0.8}$ σ tatk ^w	-1		-100

- again, simple **competition** about which φ is realized; only in another domain (=secondary stress and avoidance of vowel deletion)

Summary and Conclusion

Summary

- ❗ lexical stress system in MCS follows from assuming **6 different types of underlying foot structure** for morphemes
 - position of main stress follows from competition about φ -realization
 - exceptionality of E-stems is a threshold-effect in HG

- ❗ this representational account also predict exceptional behaviour for vowel deletion: **exceptionality for multiple processes**

(=argument against lexically indexed constraints (e.g. Alderete, 2001; Pater, 2009; Finley, 2009): It is a coincidence that at least two different constraints are indexed to the same class of (exceptional) morphemes)

- ❗ the argument for **GSR(O) is strengthened** in showing that this predicted type of exceptionality is borne out as well

Gradience in the output: Predicted typology of exceptions

UNDERLYING	PHON.	OUTPUT	e.g.
1. Exceptional repair: Weak element not realized			
$A_1 + B_{0.6}$	*AB	A_1	Nuuchahnulth unstable C's (Kim, 2003)
$A_1 + B_1$		$A_1 B_1$	
2. Exceptional repair: Weak element realized			
$A_1 B_{0.6} + A_1$	*AA	$A_1 B_{0.6} A_1$	Catalan exceptional u-realization (Bonet et al., 2007)
$A_1 B_{0.6} + C_1$		$A_1 C_1$	
3. Exceptional non-trigger: Weak element not repaired			
$A_1 + B_{0.6}$	*AB	$A_1 B_{0.6}$	Cl. Manchu exceptional non-triggers for ATR-harmony (Smith, 2017)
$A_1 + B_1$		$A_1 C_1$	
4. Exceptional non-target: Weak element does not change			
$A_1^A + B_{0.6}$	*X ^A	$A_1 B_{0.6}$	SMG Mixtec exceptional non-hosts for floating tones; GSRO analysis in (Zimmermann, 2017a,b)
$A_1^A + B_1$		$A_1 A_1$	
5. Lexical support			
$A_1 B_{0.6}$	*WEAK!	A_1	Japanese Rendaku voicing only if stem and suffix trigger it; GSR analysis in Rosen (2016)
$A_1 B_{0.6} + B_{0.6}$		$A_1 B_{0.6}$	
6. True competition			
$A_{0.8} + C_1$	1ELEM!	C_1	→ MCS case study
$A_{0.8} + B_{0.6}$		$A_{0.8}$	

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