Stronger and thus more beautiful: The phonological strength of templates

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Main Claim

- Different morphological templates of a language can reflect the same prosodic category but can still be phonologically different.
- The shape of a prosodic node with **more activity is stronger restricted by markedness** than one with weaker activity which predicts different templates within the same language .
- A case study of templates in **Ibibio** shows how the assumption of three different strength-specifications for feet avoids the assumption of morpheme-specific constraints (Akinlabi and Urua, 2002).

Morphological templates

Templatic requirements about the prosodic shape of (parts of) a word

Play an important role in the productive morphology of many languages.

(1) Morphological templates in Ibibio

Imperative		Negative: HL	
sé	'look'	nsé:ɣé	'I am not looking'
wè:m	'flowing'	wè:mé	'…not flowing'

Emergence of the Unmarked (=TETU) and templates

- early work in Prosodic Morphology: Explicit prosodic specifications for different templates (e.g. McCarthy and Prince, 1986; Archangeli, 1991)

- rise of OT (Prince and Smolensky, 1993/2002): Markedness constraints are obeyed in a template that can be violated outside of the template and **unmarked structure emerges**

  (McCarthy and Prince, 1994; Downing, 2006; Urbanczyk, 2006)

The TETU perspective and morphologically distinct templates

- morphologically distinct templates of the same prosodic category in a single language are excluded: There is **only a single unmarked shape** for every prosodic category
- But they do exist!
  - Arabic (McCarthy and Prince, 1990; McCarthy, 1993), Southern Sierra Miwok (Broadbent, 1964), German (Wiese, 2001), Ibibio (cf. below),…

(2) More templates in Ibibio

	Imperative		Negative: HL	
a.	sé	‘look’	nsé:ɣé	‘I am not looking’
	wè:m	‘flowing’	wè:mé	‘…not flowing’
	Imperative		**Reflexive: LL**	
b.	kɔ́	‘gather’	kɔ́ɣɔ́	‘be gathered’
	dɔ́:n	‘talk smoothly’	dɔ́nɔ́	‘be smooth’

Plan

Theoretical Proposal: Gradient Symbolic Representations

Gradient Symbolic Representation (=GSR)

- All linguistic symbols have **activity** that can **gradiently** differ with 1=fully active. (Smolensky and Goldrick, 2016; Rosen, 2016)
- Any change in activity is a faithfulness violation – different activities result in **gradient violations of faithfulness**.
- Elements can be weakly active in the output and thus violate **markedness gradiently**.
  (Zimmermann, 2017*a*,*b*; 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)

GSR: Gradient Constraint Violations

(Cf. Walker (2019) for potential problems and scaling factors as an alternative)

- Weakly active segments:
  - they are **easier to delete** than 'normal' segments
    (=MaxS violated to a lesser degree in (3-d) than (3-c))
  - it is **costly to realize** them
    (=activity inserted (3-a) or weak activity in the output (3-b+c))
  - they **tolerate more marked structures**
    (=cluster is 'worse' in (3-a) than in (3-b)

(3) Gradient Activity=gradient constraint violations

	$b_1a_1t_1$-$p_{0.5}$	Full! 10	MaxS 10	DepS 10	*CC 10		
a.	$b_1a_1t_1p_1$			**-0.5**	**-1**	-15	Only fully active S
b.	$b_1a_1t_1p_{0.5}$	**-0.5**			**-0.75**	-12.5	Faithful realization of weak S
c.	$b_1a_1p_{0.5}$	-0.5	**-1**			-15	Deletion of fully active S
☞ d.	$b_1a_1t_1$		**-0.5**			-5	Deletion of weakly active S

(4) Full!: Assign violation 1-X for every output element with activity X.

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*c*)
   - exceptional tone (non)spreading in San Molinos Mixtec (Zimmermann, 2018*a*)
   - interaction of phonological/lexical gemination/lenition in Italian (Amato, 2018)
   - compound stress in Sino-Japanese (Rosen, 2018)
   - stress-syncope interaction in Levantine Arabic (Trommer, 2018*a*)
   - (interacting) ghost segments in Welsh (Zimmermann, 2018*b*)
   - …

Ibibio

Ibibio

(Benue-Congo/Lower-Cross; Harris and Urua (2001); Akinlabi and Urua (2002); Hyman (2015))

- no stress prominence: evidence for **trochaic feet** from templates and phonotactic constraints:
  - φ-initial σ shows greater C-and V-**inventory contrasts**
  - φ-medial CC-sequences **assimilate** (e.g. $(VpkV)_{\varphi}$ –> $(Vp\textrm{ː}V)_{\varphi}$)
  - φ-medial **lenition** for stops (e.g. $(VkV)_{\varphi}$ –> $(V\gamma V)_{\varphi}$
- φ are left-aligned with **left edge of a stem**

Ibibio Templates

- **no minimality** condition on surface forms for monosyllabic stems (5-a)
- but a restriction to (relatively) unmarked trochaic LL or HL feet for bisyllabic stems (5-b): ***LH**

(5) Surface forms for verb roots: Imperative

a.	CV	wà	'sacrifice'
	CVC	wàt	'paddle'
	CVVC	wààk	'tear'
b.	CVCV	sàŋá	'walk'
	CVC꞉V	dáp꞉á	'dream' (vb)
	CV꞉CV	fá꞉ŋá	'argue'

Ibibio Templates: Negative

(6) Example for HL: Negative

a. CV_1 –> CV_1ːɣV_1

sé	'look'	n-séːɣé	'I am not looking'
nɔ̀	'give'	n-nɔ̀ːɣó	'I am not giving'

b. CV_1C –> CV_1CːV_1

dép	'buy'	í-dépːé	's/he is not buying'
dóm	'bite'	n-dómːó	'I'm not biting'

c. CVːC –> CV_1ːC_1V_1

wèːm	'flowing'	wèːmé	'…not flowing'
kóːt	'read/call'	kóːró	'…not reading/calling'

- /-ɣV́/ suffixed and first stem σ is **heavy** (VL in (6-a))
- superheavy σ avoided by C-deletion rather than V-shortening (6-c)

Ibibio Templates: Reflexive

(7) LL: Reflexive/Passive

a. CV_1 –> CV_1ɣ$\acute{V}_1$

kɔ́	‘gather’	kɔ́ɣɔ́	‘be gathered’

b. CV_1C –> $CV_1C\acute{V}_1$

yàt	‘wear a hat’	yàrá	‘wear a hat on oneself’
bót	‘create/mold’	bóró	‘be shaped’

c. CVːC –> CV_1C_1ːV́$_1$

wàːk	‘tear’	wàɣá	‘be torn to pieces’
dɔ́ːn	‘talk smoothly’	dɔ́nɔ́	‘be smooth’

- /-ɣV́/ is suffixed and first stem σ is **light** (V-shortening in (7-c) and affix-C-deletion in (7-b+c))
- (7-a) is in fact avoided; it’s the form given when forced to use suffix

Ibibio Templates: Overview

(8)

		Imp	Neg	Refl
			HL; /-kV́/	LL; /-ɤV́/
a.	CV	wà	nsé:ɤé	kɔ́ɤɔ́
	CVC	wàt	í-dép:é	yàrá
	CV:C	wààk	wè:mé	wàɤá
b.	CVCV	sàŋá	sàŋáké	sàŋá
	CVC:VC	dáp:á	dáp:áké	dáp:á
	CV:CV	fá:ŋá	fá:ŋáké	fá:ŋá
	CVCV:	sàŋá	sàŋáké	sàŋá

V-Lengthening | V-Shortening | C-Deletion | C-Deletion+V-Shortening

Ibibio: GSR account in a nutshell

Feet with different activities

- φ with default activity φ_1 tolerates sub-minimal monomoraic feet but not *LH-feet
- NEG: a φ with activity φ_2 that only tolerates unmarked HL trochees
  → LL feet violate STW×2
- REFL: a φ with activity $\varphi_{0.5}$ that doesn't license a heavy foot-head
  → HL feet violate WTS×0.5

The (exemplifying) weights in the following are calculates with the MaxEnt grammar tool (Hayes, 2009)

Constraints I

(9) Faithfulness

a. $\text{ID}_{\text{LG}}\text{V}$
Assign -X violation for every input-vowel$_X$ with a different length in the output.

b. MaxS
Assign -X violation for every segment S_x that is present in the input but not the output.

c. DepS
Assign -X violation for every segment S_x that is present in the output but not the input.

(10) Markedness

a. *V:
Assign -X violation for every long vowel V_X.

b. *C:
Assign -X violation for every long consonant C_X.

Constraints II

(11) Markedness

a. FtB
Assign -X violation for every φ_X that is not binary.

b. StW
Assign -X violation for every φ_X that does not have a heavy σ in its head position.

c. WtS
Assign -1-X violation for every heavy σ that is not in the head position of $\varphi_{X\geq 1}$.

- (11-b) is violated more if the head in a more active φ is not heavy
- (11-c) is not fully satisfied if a heavy σ is only in a weak φ

Constraints III

- (12) are not given in the following tableaux – there are no superheavy (medial) syllables, no unassimilated intervocalic CC sequences, or non-geminate intervocalic stops
- underspecified V's get their segmental content via copying of preceding vowel features

(12)
a. AGREEC
Assign -X violation for every consonant C_X that is immediately followed by a consonant with different feature specifications.
b. $^*\sigma_{\mu\mu\mu}$
Assign -X violation for every σ_X that dominates more than 2 moras.
c. *STOP
Assign -X violation for every stop consonant C_X.

Foot with activity 1: Sub-minimal CV tolerated

(13)

wà	WtS 40	DepS 22	StW 14	IdLgV 14	*V: 7	*C: 7	MaxS 4	FtB 1	
☞ a. (wà)φ1			-1					-1	-8
b. (wà:)φ1				-1	-1				-21
c. (wàʔ)φ1		-1							-22

(14) a. $\text{IdLg}V + {}^{*}V: > \text{StW} + \text{FtB}$

b. $\text{DepS} > \text{StW} + \text{FtB}$

Foot with activity 1: Marked LH-trochee excluded

(15)

sàŋáː	WTS 40	DEPS 22	STW 14	IDLGV 14	*Vː 7	*Cː 7	MAXS 4	FTB 1	
a. (sàŋáː)φ1	**-1**		-1		-1				-61
☞ b. (sàŋá)φ1			-1	**-1**					-28
c. (sàːŋá)φ1				-2	-1				-35

(16) a. WTS + *Vː > STW + IDLGV
b. IDLGV + *Vː > STW

- V-shortening avoids *LH
- V-lengthening does not create unmarked HL

Negative Foot with activity 2: Unmarked (HL) for CVC

(17)

dép + kV́		WtS 40	DepS 22	StW 14	IdLgV 14	*V: 7	*C: 7	MaxS 4	FtB 1	
☞ a.	(dép:é)$_{\varphi 2}$						-1			-7
b.	(dé:pé)$_{\varphi 2}$				-1	-1		-1		-25

(18) $\text{Id}_{\text{LG}}\text{V} + {}^{*}\text{V:} + \text{MaxS} > {}^{*}\text{C:}$

- realization of the suffix (+C-assimiliation and V-copy) results in perfect HL-trochee

Negative Foot with activity 2: Unmarked (HL) created for CVVC

(19)

wèːm + kV́		WTS 40	DEPS 22	STW 14	IDLGV 14	*VːS 7	*CːS 7	MAXS 4	FTB 1	
☞ a.	(wèːmé)$_{\varphi 2}$					-1		-1		-11
b.	(wèmːé)$_{\varphi 2}$				-1		-1			-21

(20) IDLGV + *Cː > MAXS + *Vː

- superheavy syllables is rather avoided by C-deletion than V-shortening

Negative Foot with activity 2: Unmarked (HL) created for CV

(21)

	φ2 sé + kV́	WTS 40	DEPS 22	STW 14	IDLG V 14	*V: 7	*C: 7	MAXS 4	FTB 1	
	a. (séɣé)φ2			-2						-28
☞	b. (séːɣé)φ2				-1	-1				-21
	c. (séɣːé)φ2		-1				-1			-29

(22) a. $2\times$STW $>$ IDLG V + *V:

b. DEPS + *C: $>$ IDLG V + *V:

☙ VL to create unmarked LH-trochee

Interim Summary: Two different feet

(23) Default φ_1: StW violation tolerated (15)
Id_{LG}V + *V: > StW

(24) Negative φ_2: More activity results in more StW violations (21)
2×StW > Id_{LG}V + *V:

→ the default φ_1 remains sub-optimal LL but the stronger negative φ needs to be LH

Reflexive foot with activity 0.5: A heavy head is not tolerated

(25)

kɔ́ + ɣV́		WTS 40	DEPS 22	STW 14	IDLGV 14	*V: 7	*C: 7	MAXS 4	FTB 1	
☞ a.	$(kɔ́ɣɔ́)_{\varphi 0.5}$			**-0.5**						-7
b.	$(kɔ́ːɣɔ́)_{\varphi 0.5}$	**-0.5**			-1	-1				-41
c.	$(kɔ́ɣːɔ́)_{\varphi 0.5}$	**-0.5**	-1				-1			-49

(26) a. $0.5\times$WTS + IDLGV + *V: $>$ $0.5\times$STW

b. $0.5\times$WTS + DEPS + *C: $>$ $0.5\times$STW

- no heavy head-syllable is created: the weak $\varphi_{0.5}$ does not license it

Reflexive foot with activity 0.5: A heavy head is not tolerated

(27)

yàt + $\varphi_{0.5}$ ɤV́	WtS 40	DepS 22	StW 14	Id_{LG}V 14	*V: 7	*C: 7	MaxS 4	FtB 1	
a. (yàt:á)$_{\varphi 0.5}$	**-0.5**					-1			-27
☞ b. (yàrá)$_{\varphi 0.5}$			-0.5				-1		-11
c. (yà:rá)$_{\varphi 0.5}$	**-0.5**			-1	-1		-1		-45

(28) a. $0.5\times$WtS + *C: $>$ $0.5\times$StW + MaxS

b. $0.5\times$WtS + *V: + Id_{LG}V $>$ $0.5\times$StW

- C-deletion to avoid a heavy head in a weak $\varphi_{0.5}$

Reflexive foot with activity 0.5: A heavy head is not tolerated

(29)

wàːk+ ɣV́	φ0.5	WtS 40	DepS 22	StW 14	IdLgV 14	*Vː 7	*Cː 7	MaxS 4	FtB 1	
a.	(wàːɣá)φ0.5	**-0.5**				-1		-1		-31
b.	(wàkːá)φ0.5	**-0.5**			-1		-1			-41
☞ c.	(wàɣá)φ0.5			-0.5	-1			-1		-24

(30) a. $0.5\times$WtS + *Vː $>$ $0.5\times$StW + Id_{LG}V

b. $0.5\times$WtS + *Cː $>$ $0.5\times$StW + MaxS

- C-deletion and V-shortening to avoid a heavy head in a weak $\varphi_{0.5}$

Ibibio: Summary

Reflexive foot $\varphi_{0.5}$

- does not tolerate heavy σ-head: C-deletion for CVC, V-shortening and C-deletion for CVVC

Default foot φ_1

- tolerates to be sub-minimal: No V-lengthening/epenthesis for CV
- does not tolerate marked LH: V-shortening for (hypothetical) CVCVVC

Negative foot φ_2

- must have unmarked shape HL: V-lengthening for CV
- C-deletion for CVVC to avoid a superheavy σ

Ibibio Templates: Bisyllabic stems

Negative

- no templates effect and /-ké/ added
- follows since high-ranked AlignR/L(stem,φ) is necessarily violated: affixed φ cannot be realized if it is not perfectly aligned with stem[a]
- no V-copying since Integrity-violations are only possible in edge syllables: /e/ is default segment

[a] Copied stem-V in suffix is as 'stem'.

Reflexive

- no surface effect for bisyllabic stems
- follows since high-ranked AlignL(stem,φ) is necessarily violated: affixed φ cannot be realized if it is not perfectly aligned with stem
- no content for the suffix since it is already integrated under the φ-node: If the foot cannot be realized, the segmental content will vanish as well

Ibibio Templates: Alternative Akinlabi and Urua (2002)

- based on **morpheme-specific templatic constraints**
- immunity of bisyllabic stems: those are stems + high-ranked IDENT$_{STEM}$

(31)

a. INFLSTEM (p.127)
The inflectional stem is a heavy-light trochee.

b. REFLSTEM (p.140)
The reflexive/passive stem is a light-light trochee.

c. IDENT$_{STEM}$ (p.138)
Input-Output forms of 'stems' remain unchanged.

More morphologically distinct templates

German Allomorphy (Wiese, 2001)

Past participle allomorphy /gə-/

a.	gə–ˈzuːxt	'searched'	gə–**(ˈσ)φ**	b.	ʃmaˈʀɔtst	'freeloaded'	*gə–(σ)φ(ˈσ)φ
	gə–ˈhaɪʀaːtət	'married'	gə–**(ˈσσσ)φ**		dɪskuˈtiːʊt	'discussed'	*gə–(σσ)φ(ˈσ)φ

- /gə–/ only if the base contains a single foot (mono-, bi-, or trisyllabic)
- → preferred past participle allomorph /gəφ$_{1.5}$/ **licenses mono-, bi-, or trisyllabic trochees**

Nominalizer allomorphy /-k͡aɪt/ ∼ /-h͡aɪt/

a.	ˈhøːflɪç–k͡aɪt	'courtesy'	**(ˈσσ)φ**–k͡aɪt	b.	ˈʃøːn–h͡aɪt	'beauty'
	gəˈleːʊzam–k͡aɪt	'eruditeness'	(σ)φ**(ˈσσ)φ**–k͡aɪt		ɪntəʀəˈsant–h͡aɪt	'interestingness'

- /k͡aɪt/ suffixes to a **bisyllabic trochee** only; else /h͡aɪt/
- → Preferred nominalizer allomorph /φ$_2$ k͡aɪt/ licenses mono-, bi-, or trisyllabic trochees

Nuu-Chah-Nulth reduplication

(e.g. Ahousaht (Kim, 2003*b*,*a*, 2008; Zimmermann, 2017*c*))

- different monosyllabic prefixing reduplicants:
  - V: short, long, copy of base
  - coda: copied or not

(32) Prosodic affixation account: Syllable strength

σ_1 μ coda short V	σ_1 μ μ coda long V	σ_1 coda length of base
$\sigma_{1.5}$ μ no coda short V	$\sigma_{1.5}$ μ μ no coda long V	$\sigma_{1.5}$ no coda length of base

Summary

Morphologically distinct templates: Prediction about markedness reduction

(33)

	*Marked Structure A	*Marked Structure B	*Marked Structure C
Weak, e.g. $\varphi_{0.5}$	✔	✔	✔
Default, e.g. φ_1	✔	✔	✖
Strong, e.g. $\varphi_{1.5}$	✔	✖	✖
Stronger, e.g. φ_2	✖	✖	✖

→ **the more active, the less marked**

Morphologically distinct templates: Patterns impossible from gradient strength/markedness reduction

(34)

	*Marked Structure A	*Marked Structure B	*Marked Structure C
Weak, e.g. $\varphi_{0.5}$	✔	✔	✔
Default, e.g. φ_{1}	✔	✔	✖
Strong, e.g. $\varphi_{1.5}$	✔	✖	✖
???	✔	✖	✔

→ **implicational relations** between markedness reduction is predicted

Summary

- The assumption of GSR predicts morphologically distinct templates: Within one language, the same prosodic category can license **different degrees of markedness** depending on its activity
- This claim crucially relies on activity in the output and hence **gradient markedness violations**
- GSR predicts an inventory of prosodic templates with **implicational markedness differences** for every language.

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Appendix: GSR and true gradience

- no inherent restriction on gradient contrasts within a language
  - 3 types of segments in Welsh:
    /$k_{1.0}$/ - /$r_{0.6}$/ - /$g_{0.2}$/
  - 3 types of association lines in Oku (Trommer and Zimmermann, 2018):
    /H$-_{1.0}$•/ - /H$-_{0.6}$•/ - /H$-_{0.4}$•/
  - 4 (derived) segment types in Levantine Arabic (Trommer, 2018*b*):
    /$i_{0.7}$/ - /$i_{0.6}$/ - /$i_{0.5}$/ - /$i_{0.3}$/
  - 5 types of feet in Moses Columbian Salish (Zimmermann, 2018*c*):
    /$\varphi_{1.0}$/ - /$\varphi_{0.9}$/ - /$\varphi_{0.8}$/ - /$\varphi_{0.6}$/ - /$\varphi_{0.4}$/
- vs. alternatives
  - most accounts based on autosegmental defectivity that only allow a binary distinction into [±defective] (e.g. Hyman, 1985; Noske, 1985; Kenstowicz and Rubach, 1987; Sloan, 1991; Yearley, 1995; Tranel, 1996; Zoll, 1996)
  - accounts that adopt 'strength' as a binary division (Inkelas, 2015; Vaxman, 2016*a*,*b*; Sande, 2017)

GSR: Surface activity and phonetic interpretation

- phonetic gradience in phonology:
  - subphonemic gradience in word-final devoicing, nasal place assimilation, flapping (Braver, 2013, e.g.)
  - vowel harmony is gradient; gets weaker the farther it spreads (McCollum, 2018)

→ a convincing example would be one where phonetic gradience and exceptional phonological behaviour stemming from underlying weakness coincide

Open Question: The source for strength in GSR

- lexical contrast for phonological elements
- lexical contrast for whole morphemes (Faust and Smolensky, 2017)
- **derived in the phonology**:
  - 'Gradient representations can mature or decay across layers' (Trommer, 2018*b*)
  - stress strengthens elements (Faust and Smolensky, 2017; Amato, 2018; Trommer, 2018*b*)
  - floating strength strengthens elements (Amato, 2018)
  - fission is weakening/distribution of activity (Zimmermann, 2019)
  - certain features have an inherent strength and feature change thus implies strength adjustment (Walker, 2019)