A problem for *Map faithfulness constraints

Benjamin Storme
CNRS, SFL
59/61, rue Pouchet, 75017 Paris
benjastorme@hotmail.com

Abstract This squib shows that *Map faithfulness constraints, which have been used to model saltations (Hayes & White 2015), make problematic predictions. They predict that input-output changes may happen without any markedness constraints motivating them: this derives unattested phonological patterns such as intervocalic devoicing. By contrast, an approach based on Segment Faithfulness (Burzio 2000) is more restrictive and therefore preferrable: it predicts that input-output changes must always be motivated by markedness constraints.

Keywords: phonology; Optimality Theory; derived environments; saltations

1 Phonologically-derived environment effects

Phonologically-derived environment effects (PDEEs) describe patterns where a phonological process P applies only if fed by another phonological process P' (Kiparsky 1993). For instance, in Campidanian Sardinian, lenition applies in word-initial position only if fed by voicing: intervocalic lenition applies to underlyingly voiceless stops /p t k/ voiced through intervocalic voicing (1a), but not to underlyingly voiced stops /b d ɡ/ (1b). PDEEs give rise to saltations (White 2013), i.e. alternations where an underlying string leaps over an intermediary form and this intermediary form does not alternate. In Campidanian Sardinian, the saltatory alternation involving stops in word-initial position is depicted in (2) for velars: underlying /k/ goes to [ɣ] leaping over [ɡ] whereas underlying /ɡ/ is mapped to itself.

(1) Campidanian Sardinian lenition (Bolognesi 1998: 30-40)

a. Word-initial voiceless stops are voiced and lenited intervocalically
/**k**uatːru/ 'four' [dɛ **ɣ**uatːru] 'of four'

b. Word-initial voiced stops are not lenited intervocalically
/**ɡ**ɔma/ 'rubber' [dɛ **ɡ**ɔma] 'of rubber'

(2) Campidanian Sardinian lenition as saltation
Context: word-initial position between vowels

$$\begin{tikzcd} \text{k} \arrow[rr, bend left] & \text{g} \arrow[loop above] & \text{ɣ} \end{tikzcd}$$

$$\begin{bmatrix}\text{-cont}\\ \text{-voice}\end{bmatrix} \quad \begin{bmatrix}\text{-cont}\\ \text{+voice}\end{bmatrix} \quad \begin{bmatrix}\text{+cont}\\ \text{+voice}\end{bmatrix}$$

PDEEs are challenging for classical Optimality Theory (OT; Prince & Smolensky 1993): they involve interactions of feature changes that cannot be modeled with classic faithfulness and markedness constraints. For instance, the fact that a change in continuancy entails a change in voicing in Campidanian Sardinian cannot be modeled with simple faithfulness constraints like Ident(voice) and Ident(cont) and simple markedness constraints like $*VC_{[\text{-voice}]}V$ and $*VC_{[\text{-cont}]}V$. The four systems that these constraints can derive for the realizations of intervocalic /k/ and /g/ are shown in (3). The saltation in (2) is not among them.

(3) a. Ident(voice) $\gg$ $*VC_{[\text{-voice}]}V$ and Ident(cont) $\gg$ $*VC_{[\text{-cont}]}V$
/k/ $\rightarrow$ [k]/V_V
/g/ $\rightarrow$ [g]/V_V
b. $*VC_{[\text{-voice}]}V$ $\gg$ Ident(voice) and $*VC_{[\text{-cont}]}V$ $\gg$ Ident(cont)
/k/ $\rightarrow$ [ɣ]/V_V
/g/ $\rightarrow$ [ɣ]/V_V
c. Ident(voice) $\gg$ $*VC_{[\text{-voice}]}V$ and $*VC_{[\text{-cont}]}V$ $\gg$ Ident(cont)
/k/ $\rightarrow$ [x]/V_V
/g/ $\rightarrow$ [ɣ]/V_V
d. $*VC_{[\text{-voice}]}V$ $\gg$ Ident(voice) and Ident(cont) $\gg$ $*VC_{[\text{-cont}]}V$
/k/ $\rightarrow$ [g]/V_V
/g/ $\rightarrow$ [g]/V_V

2 *Map faithfulness vs. Segment Faithfulness

Recently, an approach based on *Map faithfulness constraints has been proposed to derive PDEEs (White 2013; Hayes & White 2015; White 2017). A constraint of the form *Map(x,y) assesses a violation to a candidate if an input segment /x/ is mapped to an output segment [y]. *Map constraints differ from classic faithfulness constraints in two respects: (i) instead of requiring identity of the input and the output, they ban mappings from input structures to specific output structures, and (ii) they do not operate on features but on segments. Property (i) is the real innovation of this approach. Property (ii) is shared with Burzio's (2000) Segment Faithfulness.

In Burzio's framework, a faithfulness constraint of the form Faith(x) assesses a violation to an output candidate if an input segment /x/ is not mapped to [x] in the output.

In the *Map approach, Campidanian Sardinian can be derived if (a) $*VC_{[\text{-voice}]}V$ and $*VC_{[\text{-cont}]}V$ outrank *Map(k,ɣ), but (b) $*VC_{[\text{-cont}]}V$ is outranked by *Map(g,ɣ). The former ranking derives intervocalic lenition and intervocalic voicing of underlyingly voiceless velars (4a). The latter ranking protects underlying voiced velars against intervocalic lenition (4b).

(4) Deriving PDEEs with *Map faithfulness constraints and two markedness constraints

a. Voicing feeds lenition

/a#ka/	$*VC_{[\text{-voice}]}V$	*Map(g,ɣ)	$*VC_{[\text{-cont}]}V$	*Map(k,ɣ)
aka	*		*	
aga			*	
axa	*			
☞ aɣa				*

b. Underlyingly voiced stops do not lenite

/a#ga/	$*VC_{[\text{-voice}]}V$	*Map(g,ɣ)	$*VC_{[\text{-cont}]}V$	*Map(k,ɣ)
☞ aga			*	
aɣa		*		

This is not the only way to derive the Sardinian pattern, though. Due to property (i), a *Map faithfulness constraint can conspire with a markedness constraint to trigger a change that is not directly motivated by any markedness constraint. For instance, it is also possible to derive the Sardinian pattern without any reference to $*VC_{[\text{-voice}]}V$, under the following ranking: *Map(g,ɣ) $\gg$ *Map(k,x), $*VC_{[\text{-cont}]}V \gg$ *Map(k,ɣ). In that case, voicing of underlying /k/ is due to the interaction of *Map(k,x) (which penalizes the candidate with only lenition) and $*VC_{[\text{-cont}]}V$ (which penalizes the fully faithful candidate and the candidate with only voicing) (5a). It is not due to the markedness constraint $*VC_{[\text{-voice}]}V$. Underlyingly voiced velars are protected against intervocalic lenition for the same reason as above (5b).

(5) Deriving PDEEs with *Map faithfulness constraints and a single markedness constraint

a. Voicing feeds lenition

/a#ka/	*Map(k,x)	$*VC_{[\text{-cont}]}V$	*Map(k,ɣ)
aka		*	
aga		*	
axa	*		
☞ aɣa			*

b. Underlyingly voiced stops do not lenite

	/a#ga/	*Map(g,ɣ)	*VC$_{[\text{-cont}]}$V
☞	aga		*
	aɣa	*	

This feature of *Map constraints turns out to be problematic in general: it makes it possible to derive unattested phonological processes. For instance, the ranking *Map(g,ɣ), *VC$_{[\text{-cont}]}$V $\gg$ *Map(g,x) will produce intervocalic devoicing (6), an unattested phonological process. *Map(g,ɣ) penalizes the candidate with only lenition and *VC$_{[\text{-cont}]}$V penalizes the fully faithful candidate. As a consequence, the candidate with two changes (lenition and devoicing) wins. This happens without any markedness constraint favoring intervocalic devoicing.

(6) Deriving intervocalic devoicing with *Map faithfulness constraints

	/a#ga/	*Map(g,ɣ)	*VC$_{[\text{-cont}]}$V	*Map(g,x)
	aga		*	
	aɣa	*		
☞	axa			*

In Burzio's approach, Campidanian Sardinian lenition is derived if (a) *VC$_{[\text{-voice}]}$V and *VC$_{[\text{-cont}]}$V outrank Ident(voice) and Ident(cont), but (b) *VC$_{[\text{-cont}]}$V is outranked by Faith(g). The former ranking derives intervocalic voicing and intervocalic lenition of underlyingly voiceless velars (7a). The latter ranking protects underlying voiced velars against intervocalic lenition (7b). Faith(g) penalizes any unfaithful mapping from input segment /g/ equally.

(7) Deriving PDEEs with Segment Faithfulness

a. Voicing feeds lenition

	/a#ka/	*VC$_{[\text{-voice}]}$V	Faith(g)	*VC$_{[\text{-cont}]}$V	Ident(voice)	Ident(cont)
	aka	*		*		
	axa	*				*
	aga			*	*	
☞	aɣa				*	*

b. Underlyingly voiced stops do not lenite

	/a#ga/	*VC$_{[\text{-voice}]}$V	Faith(g)	*VC$_{[\text{-cont}]}$V	Ident(voice)	Ident(cont)
☞	aga			*		
	aɣa		*			*
	aka	*	*	*	*	
	axa	*	*		*	*

For the input /a#ga/ (7b), the candidate [axa] with devoicing and lenition is harmonically bound by the candidate [aɣa] with lenition alone: it violates a strict superset of the constraints violated by [aɣa]. As a consequence, intervocalic devoicing is impossible without any markedness constraint triggering it. The crucial difference with *Map faithfulness constraints is the following. Because Faith(ɡ) penalizes any unfaithful mapping from input segment /ɡ/ equally, it cannot favor an unfaithful candidate over another one. Only a markedness constraint can favor an unfaithful mapping: intervocalic devoicing is impossible as long as there is no constraint $^*VC_{[+voice]}V$ or as long as this constraint is ranked below the constraint favoring intervocalic voicing, $^*VC_{[-voice]}V$. By contrast, *Map(ɡ,ɣ) in (6) prefers the unfaithful mapping /ɡ/ $\rightarrow$ [x] over the unfaithful mapping /ɡ/ $\rightarrow$ [ɣ] and can therefore favor intervocalic devoicing, even in the absence of a markedness constraint $^*VC_{[+voice]}V$ or even if this constraint is ranked low and below $^*VC_{[-voice]}V$.

3 Conclusion

Two conclusions can be drawn from this squib. First, the central property of *Map faithfulness, i.e. the fact that faithfulness constraints penalize specific input-output mappings, is not needed to derive PDEEs: Burzio's Segment Faithfulness does not have this property and yet is able to derive PDEEs. In both approaches, what is crucial to derive PDEEs is the possibility for faithfulness constraints to refer to segments rather than to individual features. Second, the property that is specific to *Map faithfulness turns out to be problematic: changes are not necessarily motivated by markedness constraints and this predicts unattested phonological processes. Segment Faithfulness is more restrictive: both changes interacting in PDEEs need to be motivated by markedness constraints. As a consequence, Segment Faithfulness should be preferred over *Map faithfulness to derive PDEEs.

References

Bolognesi, Roberto. 1998. *The phonology of Campidanian Sardinian: A unitary account of self-organizing structure*. The Hague: Holland Academics.

Burzio, Luigi. 2000. Cycles, non-derived-environment-blocking, and correspondence. In Joost Dekkers, Frank van der Leeuw & Jeroen van de Weijer (eds.), *Optimality theory: Phonology, syntax, and acquisition*, Cambridge: Cambridge University Press.

Hayes, Bruce & James White. 2015. Saltation and the P-map. *Phonology* 32. 267–302. http://dx.doi.org/10.1017/S0952675715000159.

Kiparsky, Paul. 1993. Blocking in nonderived environments. In Sharon Hargun, & Ellen M. Kaisse (eds.), *Phonetics and phonology 4: Studies in lexical phonology*, 277–313. San Diego, CA: Acamedic Press.

Prince, Alan & Paul Smolensky. 1993. *Optimality theory: Constraint interaction in generative grammar*. New Brunswick, NJ: Rutgers Center for Cognitive Science, Rutgers University.

White, James. 2013. *Bias in phonological learning: Evidence from saltation*. Los Angeles, CA: University of California dissertation.

White, James. 2017. Accounting for the learnability of saltation in phonological theory: A maximum entropy model with a P-map bias. *Language* 93. 1–36. http://dx.doi.org/10.1353/lan.2017.0001.