Harmony in Harmonic Grammar by Reevaluating Faithfulness

Charlie O'Hara- charleso@usc.edu - University of Southern California

Overview The weighted constraints of parallel Harmonic Grammar (HG; Legendre *et al.* 1990; Pater 2009) have been argued to be necessary in order to model many language processes that classic Optimality Theory cannot with ranked constraints. Ironically, HG is poorly suited for modeling languages with harmony processes. Rather than modeling unbounded stem-control harmony, HG predicts an infinite number of bounded harmony languages (Pater *et al.* , 2007; Bane & Riggle, 2009). This paper argues that by adopting DEPLINK and DEP/MAX(F) constraints for featural faithfulness rather than IDENT(F), parallel HG can evade these pathologies, without resorting to serialism (c.f. Kimper 2011)

Weighted vs. Ranked Constraints In HG candidates are evaluated according to the number of violations per constraint times the weight of that constraint. Thus, multiple violations of one or more lower valued constraints can outweigh the violation of just one higher valued constraint. These trade-offs have been used to successfully analyze systems that cannot be easily analyzed with ranked constraints. (Bane & Riggle (2009) contains a summary of several examples).

However, this same effect can be problematic when applied to unbounded harmony processes. In Tuvan, suffix vowels alternate to match the backness of the stem (Rose & Walker, 2011). In standard OT this unbounded stem control harmony can be modeled using positional faithfulness constraints (Beckman, 1998).

(1) *Tuvan Back Harmony in OT*

/is-tar-ɯm-dan/	AGREE(BACK)	IDENT(BACK)/STEM	IDENT(BACK)
☞ a. isterimden			***
b. ɯstarɯmdan		*	*

In HG, for a stem control harmony candidate to win, the cumulative weight of the ID(BACK) violations cannot outweigh ID(BACK)/STEM. Here ID(BACK)/STEM must be greater than double ID(BACK). If we let the weights be 5 and 2 respectively this holds, but does not hold if the word was one syllable longer, as in (2). Thus, harmony is bounded at three syllables with such a weighting.

(2) *Tuvan Back Harmony fails in HG*

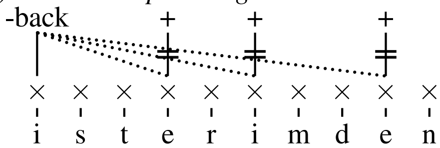
	$w = 10$	$w = 5$	$w = 2$	
/is-tar-ɯm-dan/	AGREE(BACK)	IDENT(BACK)/STEM	IDENT(BACK)	H
☞ a. isterimden			-3	-6
b. ɯstarɯmdan		-1	-1	-7
/is-tar-ɯm-dan-tan/	AGREE(BACK)	IDENT(BACK)/STEM	IDENT(BACK)	H
☜ c. isterimdenten			-4	-8
d. ɯstarɯmdantan		-1	-1	-7

For any integer n, a weighting can be found creating a language where harmony is bounded at n syllables, creating an infinite number of differently bounded harmony languages. Further, we cannot create unbounded languages, since for any weights of ID(BACK)/STEM and ID(BACK) (both greater than 0), there must exist an n so that $nw(\text{ID(BACK)}) > w(\text{ID(BACK)/STEM})$, thus bounding the harmony system at n. Both of these results are pathological.

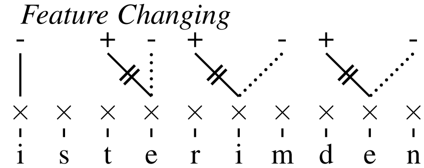
Reevaluating Faithfulness The problem here is that one violation of ID(BACK)/STEM can trade off with an arbitrary number of violations of ID(BACK), depending on the length of a word. To resolve this we need to prevent this tradeoff. Pater *et al.* (2007) does this by bounding the number of violations on a constraint, Kimper (2011) does this by using serialism, where we can only get one faithfulness violation per iteration.

This paper argues that by returning to an autosegmental representation (Goldsmith, 1990), we can avoid any deep modifications to our framework. Spreading differs from feature changing- in (2), 3 association lines are deleted and 3 are added, but in (3), three new [-back] nodes are also added.

(3) *Feature Spreading*



(4) *Feature Changing*



This paper proposes using DEPLINK, which is violated by an addition of a new association line to militate against spreading. (Similar constraints have been used previously by Itô *et al.* (1995); Pulleyblank (1996); Blaho (2008), among others.) (2) and (3) would not differ on violations of DEPLINK, but rather on DEP(-BACK) or a similar constraint. With this constraint, if no features are shared in the input, the candidate (4-b) shares the same violations of DEPLINK and DEP(-BACK) as the winner, so is harmonically bounded. Inspired by McCarthy (2004), our markedness constraint must punish the number of spans, differentiating between [(isterimden)] and [(is)(te)(rim)(den)], even though that difference is surface invisible. Thus, *A-SPAN(BK) is violated if two adjacent syllables are not linked to the same [BACK] feature.

(5) *Tuvan Back Harmony with DepLink*

	$w = 3$	$w = 2$	$w = 1$	$w = 1$	
/is-tar-ɯm-dan/	*A-SPAN(BK)	DEPLINK/STEM	DEPLINK	DEP(BK)	H
☞ a. (isterimden)			-3		-3
b. (ɯstarɯmdan)		-1	-3		-5
c. (is)(tarɯmdan)	-1		-2		-5
d. (is)(ta)(rɯm)(dan)	-3				-9
e. (is)(te)(rim)(den)	-3		-3	-3	-15

Implications Using a different set of constraints than OT, HG can predict a more restricted typology, and not necessarily predict a superset of the languages OT predicts (Jesney, to appear). In this vein, this paper shows that it is not an inherent property of HG that causes infinite pathological languages to be created with harmony, but rather an interaction of HG and a certain set of faithfulness constraints. With revisions to CON, HG can avoid one-to-many tradeoffs without changes to its framework.

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