Nothing is better than being unfaithful in multiple ways*

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1 Introduction

Strict domination, one of the key tenets of optimality theory (OT; Prince & Smolensky 1993/2004), holds that the satisfaction of multiple lower-ranked constraints cannot make up for violation of a high-ranked constraint; that is, a candidate that violates a high-ranked constraint, even if only once, is less harmonic than a candidate that violates multiple lower-ranked constraints. Strict domination eliminates the possibility that multiple low-ranked constraints can gang up on a higher ranked constraint. In recent research, however, it has been shown that gang effects, also called cumulative constraint interactions, do occur in both phonology and syntax (Itô and Mester 1998; Keller 2005; Jäger & Rosenbach 2006; Kager & Shatzman 2007; Pater, Bhatt & Potts 2007a; Pater, Jesney & Tessier 2007b; Tesar 2007; Jesney & Tessier 2008; Coetzee & Pater to appear). In a gang effect, two otherwise low-ranked constraints conspire to eliminate a candidate that violates them both, preferring instead a candidate that violates a higher-ranked constraint only once. The fact that these effects are attested in a variety of languages and language domains presents a problem for OT.

The extent to which cumulative constraint interactions occur has yet to be documented. The greater part of the discussion of cumulativity has focused on the cumulative interaction of markedness constraints: two low-ranked markedness constraints gang up to eliminate one candidate in favor of another candidate that violates a higher-ranked constraint (e.g., Itô & Mester 1998; Pater et al. 2007a). Cumulative interactions among faithfulness constraints, here called *cumulative faithfulness effects (CFEs)*, have often been overlooked. If cumulative interactions are real, however, we expect it to be typologically possible that faithfulness constraints could undergo the same range of cumulative interactions that we see in markedness constraints. CFEs are thus predicted in any theory that allows for cumulative markedness effects, but if constraint-based theories are to account for them, some accommodation must be made.

Local constraint conjunction (LC; e.g., Kirchner 1996; Smolensky 1995) is an augmentation of standard OT that has been proposed to deal with cumulative effects; two constraints can be conjoined such that violation of both conjuncts results in violation of the higher-ranked conjoined constraint. This allows the

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grammar to rule out just those structures that are too marked (with the conjunction of two or more markedness constraints) or too unfaithful (with the conjunction of two or more faithfulness constraints). Farris-Trimble (2008b) shows that CFEs can be accounted for in LC, but the solution encounters a number of problems, illustrating several valid criticisms of LC that have been made by others. The domain of conjunction must be specified, and if the domain is too large, unattested grammars are predicted (for examples, see McCarthy 2003; Pater et al. 2007a). Moreover, the provenance of LC constraints is at issue; there is debate as to whether all constraints are conjoined (recursively or not) as part of Con, or whether Con simply includes an operation of local conjunction. These questions make an LC account of cumulativity effects problematic.

Harmonic Grammar (HG; e.g., Legendre et al. 1990a,b; Smolensky & Legendre 2006), a precursor to OT, provides an alternative to LC. In short (and discussed in more detail below), HG consists of weighted, rather than ranked, constraints, and the harmony of a given candidate is determined by the sum of the weights of its constraint violations. Typically, a high constraint weight parallels a high ranking in OT. In some cases, though, the combined weight of violations of two lower-weight constraints can "gang up" on a higher-weight constraint, allowing for exactly the type of cumulativity effects discussed above. Furthermore, as no domains are necessary in HG, the problem of defining the domain does not arise; likewise, HG does not predict the unlikely grammars mentioned above (Pater et al. 2007a).

The following sections illustrate that CFEs do occur, and that the types of constraints that can do the ganging-up may differ. Because of the many criticisms of LC, this paper will explore HG accounts of CFEs. Data from Kikuyu and Greek are used to demonstrate the CFEs and their accounts. The existence of these cumulative interactions is important to the present state of phonological knowledge because of its impact on phonological theory. If cumulative interactions are more common than previously believed, and if ranked-constraint approaches cannot account for them, then the case for a weighted-constraint approach to grammar is stronger. Constraints that can be assigned numerical values are more in line with the current focus on computational models of phonological acquisition and constraint interaction; thus arguments for weighted constraint theories are in demand.

2 Kikuyu

This section introduces a prototypical example of a CFE that exemplifies certain characteristics common to CFEs. In Kikuyu, (Archangeli, Moll & Ohno 1998; Peng 2003, 2008) a Bantu language spoken primarily in Kenya, a CFE arises in the pattern of nasal prefixing.[1] Nasal prefixes are used in a number of grammatical morphemes, including noun plurals, denominal adjectives, and the

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[1] For alternative analyses of these Kikuyu data within an OT framework, see Archangeli et al. (1998) and Peng (2008).

first person object. Kikuyu disallows sequences of a nasal consonant followed by a voiceless obstruent, as well as sequences of a nasal consonant followed by a fricative.[2] The different repair processes used when these sequences are derived morphologically are shown in (1). In each display, the words in the left-hand column show the root morpheme without a nasal prefix, and the words in the middle column show the root when a nasal prefix has been added. The data in (1a) illustrate the post-nasal voicing pattern: an underlyingly voiceless stop is realized as voiced when it follows a nasal. The data in (1b) demonstrate the post-nasal stopping pattern: underlying voiced continuants (including fricatives, glides, and the sonorant [r]) are realized as stops post-nasally. The data in (1c) show what happens when a voiceless continuant follows the nasal. Given the voicing and stopping patterns illustrated in (1a) and (1b), the expected repairs for a nasal+voiceless continuant sequence would be voicing and stopping; instead, the nasal is deleted in these cases, leaving the voiceless fricative unchanged.

(1) Kikuyu nasal prefixes (data from Peng 2008)

a. Post-nasal voicing

o-kɛnu	ŋ-gɛnu	‘happiness/happy’
ko-a-tuur-a	koo-n-duur-a	‘to ache him/me’
ro-cuθe	ɲ-juθe	‘backbone/backbones’

b. Post-nasal stopping

o-βuθu	m-buθu	‘rottenness/rotten’
a-re-et-ɛ	n-de-et-ɛ	‘he/I have eaten’
ko-mo-yur-i-a	koo-ɲ-jur-i-a	‘to let him/me fill’
ɣor-eet-ɛ	ŋ-gor-eet-ɛ	‘he/I has bought’

c. Nasals delete before a voiceless fricative[3]

o-θɛru	θɛru	*ndɛru	‘brightness/bright’
a-θɛk-ɛɛt-ɛ	θɛk-ɛɛt-ɛ	*ndɛk-ɛɛt-ɛ	‘he/I have laughed’
a-θɔɔm-ɛɛt-ɛ	θɔɔm-ɛɛt-ɛ	*ndɔɔm-ɛɛt-ɛ	‘he/I have read’

Kikuyu’s grammar allows the unfaithful mapping of a voiceless stop to a voiced stop, as well as the unfaithful mapping of a voiced fricative to a voiced stop. However, when both of those mappings could be combined, that is, mapping a voiceless fricative to a voiced stop, the unfaithfulness is too great and the multiple repairs fail. Instead, a third unfaithful mapping, the deletion of the nasal,

[2] In fact, many Bantu languages share the restrictions on NC clusters, as do languages from other families (e.g., Pater 1999) and even first-language acquisition (e.g., Smith 1973).

[3] The nasal consonant also deletes before the voiceless fricative [h]. While [h] follows the same pattern as [θ], it is unclear what the result of voicing and stopping the [h] would be, and so these data are not included.

does away with the doubly-marked structure.[4] The input structure is doubly-marked because it violates two markedness constraints: the constraint against a nasal followed by a voiceless obstruent and the constraint against a nasal followed by a fricative. Using Kikuyu as a model, we can now define a CFE. A CFE occurs when a language allows multiple independent unfaithful mappings to repair singly-marked structures, but in the case of a doubly-marked structure, the combination of those unfaithful mappings is not allowed, and so a third, independent unfaithful fell-swoop mapping intervenes, avoiding the cumulatively unfaithful mapping and eliminating the doubly-marked structure.

If we examine a rule-based account of Kikuyu, we see that the outputs produced are transparent and that the rules participate in an overlapping set of conspiracies. Three rules are necessary to account for Kikuyu. The first rule, Voicing, requires that all obstruents be voiced after nasals. The second rule, Stopping, causes all obstruents to be realized as [-continuant] following a nasal. These two rules are independent of one another because there are cases in which Voicing applies (e.g., 1a) and cases in which Stopping applies (e.g., 1b), but no cases, as we will see, in which Stopping and Voicing both apply. This is due to the third rule, Nasal Deletion, which deletes nasals before voiceless fricatives. Note that the Nasal Deletion rule is much more specific than that of either of the other rules, which can apply to any post-nasal obstruent. Nasal Deletion, on the other hand, deletes a nasal only when it falls before a voiceless fricative. We will call such a rule with a narrowly-defined structural description the *specific* rule or the *fell-swoop* rule (because it resolves two marked structures in one fell swoop), and as we will see, it plays a particular role in a CFE.

In order to derive the correct Kikuyu outputs, it is necessary to order the Nasal Deletion rule before both Voicing and Stopping. With this order, Nasal Deletion removes the nasal from the representation, bleeding both Voicing and Stopping. If the rules had been in the opposite order, Voicing or Stopping would bleed Nasal Deletion. Note that the Voicing and Stopping rules need not be ordered relative to one another, but the order of those rules relative to Nasal Deletion is crucial. Though they produce transparent outputs, mutual bleeding relationships are sometimes problematic for OT (e.g., Itô & Mester 2003), in that one of the possible outputs is attainable by constraint ranking, but the other is not. We will see in (3) below that this is also the case for mutual bleeding CFEs.

The rules necessary to achieve a CFE are not only in a mutual bleeding relationship, but they also typically participate in overlapping conspiracies. In a conspiracy, multiple different processes work together to disallow a certain marked output, whether actively eliminating the marked output or passively failing to apply in the instances in which the rule's application would bring about the marked output (Kisseberth 1970; Kiparsky 1976). In the Kikuyu CFE,

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[4] Deletion of the voiceless continuant, rather than the nasal, would also repair the doubly-marked structure in a single step, as would replacing the nasal with, for instance, a nasalized vowel. We assume these repairs violate other high-ranked constraints in the language.

Stopping and Nasal Deletion work together to eliminate sequences of a nasal followed by a fricative, and Voicing and Nasal Deletion work together to repair sequences of a nasal followed by a voiceless obstruent. Nasal Deletion, the fell-swoop rule, is thus active in both conspiracies.

Because two of the hallmarks of OT are its ability to account for transparent rule interactions and its simplification of conspiracy accounts, we would expect OT to provide a straightforward solution to the Kikuyu CFE. The necessary constraints are given in (2). Markedness constraints ban the two marked structures mentioned above, the sequences of a nasal followed by a voiceless obstruent and a nasal followed by a continuant. The voicing and stopping error patterns violate the faithfulness constraints IDENT[voice] and IDENT[continuant], respectively, and the deletion of the nasal consonant violates the faithfulness constraint MAX.

(2) Constraints necessary for the Kikuyu CFE
- *NC̥: Nasal+voiceless obstruent sequences are banned
- *NFRIC: Nasal+continuant consonant sequences are banned
- IDENT[voice]: Input and output correspondents have the same value for the feature [voice]
- IDENT[continuant]: Input and output correspondents have the same value for the feature [continuant]
- MAX: Input segments have output correspondents

A ranking paradox arises between MAX and the IDENT constraints, as shown in the tableaux in (3). In order for a voiceless stop to be realized as voiced after a nasal, rather than deleted, MAX must be ranked above IDENT[voice], as in (3a). Likewise, MAX must be ranked above IDENT[continuant] so that a voiced continuant is realized as a stop after a nasal, instead of being deleted, as in (3b). However, ranking both of the IDENT constraints below MAX means that a voiceless continuant will undergo post-nasal stopping and voicing, rather than nasal deletion, as in (3c).[5] Note that the rightward-pointing manual indicator (☞) shows the winner chosen by the grammar, while the left-ward pointing manual indicator (☜) shows an incorrectly eliminated candidate.

(3) Standard OT fails to account for Kikuyu

a. MAX >> IDENT[voice]

/N-kɛnu/ 'happy'	*NC̥	*NFRIC	MAX	ID[voice]	ID[cont]
a. ŋkɛnu	*!				
b. ☞ ŋgɛnu				*	
c. kɛnu			*!		

[5] A candidate in which the nasal+voiceless continuant sequence is repaired by deletion of the voiceless continuant, rather than the nasal, is left out of this and subsequent tableaux. Such a candidate could be eliminated, however, by a high-ranked MAX[root] constraint, militating against deletion of a root consonant.

b. MAX >> IDENT[continuant]

/N-βuθu/ ‘rotten’	*NC̥	*NFRIC	MAX	ID[voice]	ID[cont]
a. mβuθu		*!			
b. ☞ mbuθu					*
c. βuθu			*!		

c. Ranking paradox

/N-θɛru/ ‘bright’	*NC̥	*NFRIC	MAX	ID[voice]	ID[cont]
a. nθɛru	*!	*			
b. nðɛru		*!			
c. ntɛru	*!				
d. ☞ ndɛru				*	*
e. ☜ θɛru			*!		

The OT account of Kikuyu fails because two low-ranked constraints, IDENT[voice] and IDENT[continuant], have no way of joining together to gang up on the higher-weight constraint MAX. That is, there is no way for constraints to behave cumulatively. This problem can be solved in an HG account, where constraints are weighted rather than ranked and cumulativity is expressed as the sum of the weights of multiple constraints. In Kikuyu, the marked outputs are banned by high-weight markedness constraints. Because Kikuyu prefers featural changes to segmental deletion in the singly-derived cases, MAX must outweigh both IDENT[voice] and IDENT[continuant]. In the case where deletion is preferred, however, the sum of the weights of IDENT[voice] and IDENT[continuant] must outweigh a single violation of MAX.

The consequences of these weightings are shown in the HG tableaux in (4), which differ from OT tableaux in a number of ways. The weight of each constraint is listed under the constraint name. Weights are always positive real numbers. Following Legendre et al. (2006), violations are shown as negative numbers that correspond to the number of violations of a constraint incurred by a given candidate. (This allows for the possibility of constraints which may reward candidates with positive violations rather than penalizing them with negative ones.) For each candidate, the relative harmony (H) is calculated as follows: each violation is multiplied by the weight of the constraint violated, and the resulting weighted violations are summed across constraints. The most crucial weightings among faithfulness constraints are shown above each tableau. The tableaux in (4a) and (4b) illustrate the necessity of assigning MAX a heavier weight than each of the IDENT constraints, so that the featurally unfaithful candidates are preferred to the deletion candidates. The tableau in (4c), however, shows that the cumulative weight of the IDENT constraints is sufficient to exclude the doubly-derived, featurally unfaithful candidate in favor of the deletion candidate.

(4) HG account of Kikuyu CFE

a. $W_{\text{MAX}} > W_{\text{ID[voice]}}$

/N-kɛnu/ ‘happy’	*NC̥ w=2	*NFRIC w=2	MAX w=1.5	ID[voice] w=1	ID[cont] w=1	H
a. ŋkɛnu	-1					-2
b. ☞ ŋgɛnu				-1		-1
c. kɛnu			-1			-1.5

b. $W_{\text{MAX}} > W_{\text{ID[continuant]}}$

/N-βuθu/ ‘rotten’	*NC̥ w=2	*NFRIC w=2	MAX w=1.5	ID[voice] w=1	ID[cont] w=1	H
a. mβuθu		-1				-2
b. ☞ mbuθu					-1	-1
c. βuθu			-1			-1.5

c. $W_{\text{MAX}} < W_{\text{ID[voice]}} + W_{\text{ID[continuant]}}$

/N-θɛru/ ‘bright’	*NC̥ w=2	*NFRIC w=2	MAX w=1.5	ID[voice] w=1	ID[cont] w=1	H
a. nθɛru	-1	-1				-4
b. nðɛru		-1		-1		-3
c. ntɛru	-1				-1	-3
d. ndɛru				-1	-1	-2
e. ☞ θɛru			-1			-1.5

In the Kikuyu CFE, the violations of two different faithfulness constraints trade off for the violation of a third, such that the Kikuyu phonology prefers to delete a segment rather than change both its [voice] and [continuant] specifications. Though OT could not account for the CFE, HG’s weighted constraints were successful in eliminating output candidates that were too unfaithful in terms of cumulative faithfulness violations. In the next section, we turn to a slightly different type of CFE.

3 Greek

3.1 A Greek CFE

In the Kikuyu CFE above, the violations of two faithfulness constraints traded off for the violation of a third. Because constraints may be violated more than once in a grammar, however, it is possible that two violations of a single faithfulness constraint may trade off for the violation of a different faithfulness constraint. An example comes from Greek (Newton 1972; Pater 1996). Relevant data are given in (5). In Greek, adjacent obstruents agree in voice, as in (5a). This is true both of underlying and derived obstruent sequences. Moreover, as in Kikuyu, post-nasal obstruents must be voiced, as in (5b). Given active processes of voice assimilation and post-nasal voicing, the expected repair for a cluster like /mps/ would be [mbz], in which post-nasal voicing feeds voice assimilation. Instead, the nasal consonant is deleted, a fell-swoop process that eliminates the need for two other rules to apply. This is true of derived word-medial clusters (5c) and, in certain dialects (Chios, Rhodes, Cyprus, Lesbos, Samos), across word boundaries (5d). Note that this deletion is not due to a general ban on three-element clusters; the language contains words with clusters like [skn], [spr], [mbl], [ndr], and [xtr]. Moreover, the inputs in (5c) are not doubly-marked; they only contain a single marked structure: a nasal followed by a voiceless obstruent. However, the standard repair for that structure, voicing (as demonstrated in (5b), would create a second marked structure: adjacent obstruents that differ in voicing. We can thus think of these inputs as *potentially doubly-marked*.

(5) Greek nasal-obstruent-obstruent clusters

a. Adjacent obstruents agree in voice (all dialects)

[ráftis]	‘tailor’	cf. [rávo]	‘I sew’
[kurástika]	‘I am tired’	cf. [kurázo]	‘I tire’
[avɣó]	‘egg’	[péfko]	‘pine’

b. Postnasal obstruents are voiced (all dialects)

/ton + topo/	[tondopo]	‘the place’	cf. [topo]	‘place’
[kumbí]	‘button’	[émboros]	‘merchant’	
[pénde]	‘five’	[ándras]	‘man’	
[aɲgʲía]	‘pots’	[siɲgʲenís]	‘relative’	

c. CFE across morpheme boundaries (all dialects)

/e-peNp-s-a/	[épepsa]	‘I send, aorist’	cf. [pémbo]	‘I send’
/e-sfiNk-s-a/	[ésfiksa]	‘I squeeze, aorist’	cf. [sfiŋgo]	‘I squeeze’
/laNp-si/	[lápsi]	‘flash’	cf. [lámbo]	‘shine’

d. CFE across word boundaries (Chios, Rhodes, Cyprus, Lesbos, Samos)

/ton + psefti/	[topséfti]	‘the liar’	*[tombzéfti][6]
/ton + kseno/	[tokséno]	‘the foreigner’	*[toŋgzéno]
/tin + tsimba/	[titsimbá]	‘he pinches her’	*[tindᶻimbáyi]

In a rule-based framework, the Greek CFE requires three rules: Post-Nasal Voicing, Obstruent Voice Assimilation, and Nasal Deletion. Nasal Deletion is the most specific rule, requiring that nasals delete only when they precede two obstruents. In order to get the attested outputs, Nasal Deletion would be ordered

[6] Greek also exhibits a process of nasal place assimilation, which is not relevant to the current CFE and will not be discussed further.

first, bleeding the two voicing rules. If either of the voicing rules were ordered before Nasal Deletion, then Nasal Deletion would be bled. The Greek CFE is characterized by a mutual bleeding relationship, like Kikuyu. Moreover, this CFE also reflects overlapping conspiracies. The Post-Nasal Voicing and Nasal Deletion processes conspire to eliminate sequences of a nasal followed by a voiceless obstruent, and the Obstruent Voice Assimilation and Nasal Deletion processes conspire to avoid sequences of adjacent voiced and voiceless obstruents. (The participation of Nasal Deletion in this second part of the conspiracy is not immediately obvious, but the Nasal Deletion process essentially occurs to avoid creating a sequence of a voiced obstruent followed by a voiceless one. That is, Nasal Deletion contributes to the conspiracy by making sure that disagreeing clusters do not arise, while Obstruent Voice Assimilation repairs these sequences when they do arise.)

The constraints necessary to account for the Greek CFE are listed in (6). As in Kikuyu, a markedness constraint bans sequences of a nasal followed by a voiceless obstruent. Another markedness constraint bans adjacent obstruents that differ in [voice] specification. Faithfulness constraints require identity in the feature [voice] and militate against deletion.

(6) Constraints relevant for the Greek CFE
*NC̥: Sequences of a nasal followed by a voiceless obstruent are banned
AGREE[voice]: Adjacent obstruents that differ in [voice] are banned
IDENT[voice]: Input and output correspondents have the same value for the feature [voice]
MAX: Input segments have output correspondents

In standard OT, a ranking paradox arises between MAX and IDENT[voice]. The tableaux in (7) illustrate the paradox. (7a) shows that for an input with adjacent obstruents that differ in the voice feature, it is crucial for MAX to be ranked above IDENT[voice] in order to get assimilation rather than deletion. Likewise, MAX must be ranked above IDENT[voice] to achieve post-nasal voicing in an NC̥ sequence instead of deletion, as in (7b). However, ranking MAX above IDENT[voice] prohibits the attested deletion candidate in (7c). Candidate c., which violates IDENT[voice] twice, once for the post-nasal consonant and again for the following consonant, is incorrectly predicted to win.

(7) Standard OT fails to account for Greek
a. MAX >> IDENT[voice]

/rávtis/ 'tailor'	*NC̥	AGREE[voice]	MAX	ID[voice]
a. rávtis		*!		
b. ☞ ráftis				*
c. rávis			*!	

b. MAX >> IDENT[voice]

/ton + topo/ 'the place'	*NC̥	AGREE[voice]	MAX	ID[voice]
a. tontopo	*!			
b. ☞ tondopo				*
c. totopo			*!	

c. Ranking paradox

/ton + psefti/ 'the liar'	*NC̥	AGREE[voice]	MAX	ID[voice]
a. tompsefti	*!			
b. tombsefti		*!		
c. ☞ tombzefti				**
d. ☜ topsefti			*!	

The predicted winner in (7c), in which both of the underlyingly voiceless obstruents have undergone voicing, violates IDENT[voice] twice but is not eliminated by those violations because IDENT[voice] is too low-ranked, and there is no mechanism in standard OT by which those multiple violations of IDENT[voice] can gang up on the higher-weight MAX. In an HG account, however, the cumulative violations of IDENT[voice] can gang up on MAX, eliminating candidate c. in favor of candidate d.

HG tableaux are in (8). The high weight of the markedness constraints rules out any candidate that has not repaired marked structures. MAX has a weight of 1.5 and IDENT[voice] a weight of 1. When a candidate with a single violation of MAX competes with a candidate with a single violation of IDENT[voice], as in (8a,b), the higher weight of MAX eliminates the deletion candidate. When a candidate with a single violation of MAX competes with a candidate with two violations of IDENT[voice], as in (8c), the cumulative weight of the IDENT[voice] violations is enough to avoid that candidate in favor of the deletion candidate.

(8) HG account of Greek CFE

a. $W_{MAX} > W_{IDENT[voice]}$

/rávtis/ 'tailor'	*NC̥ w=2	AGREE[voi] w=2	MAX w=1.5	ID[voi] w=1	H
a. rávtis		-1			-2
b. ☞ ráftis				-1	-1
c. rátis			-1		-1.5

b. $W_{MAX} > W_{IDENT[voice]}$

/ton + topo/ 'the place'	*NC̥ w=2	AGREE[voi] w=2	MAX w=1.5	ID[voi] w=1	H
a. tontopo	-1				-2
b. ☞ tondopo				-1	-1
c. totopo			-1		-1.5

c. $W_{MAX} < W_{IDENT[voice]} + W_{IDENT[voice]}$

/ton + psefti/ 'the liar'	*NC̥ w=2	AGREE[voi] w=2	MAX w=1.5	ID[voi] w=1	H
a. tompsefti	-1				-2
b. tombsefti		-1			-2
c. tombzefti				-2	-2
d. ☞ topsefti			-1		-1.5

The Greek CFE differs from the Kikuyu CFE in that two low-ranked faithfulness constraints do not gang up on a third; instead, the multiple violations of a single low-weight faithfulness constraint, IDENT[voice], trade off for a single violation of a higher-weight constraint, MAX. This illustrates that it is not simply the violation of too many different faithfulness constraints that is problematic; it is the cumulative violation of all faithfulness constraints, whether that refers to multiple violations of one constraint or single violations of multiple constraints. In Greek, as in Kikuyu, being too unfaithful, as measured by the cumulative weight of all faithfulness constraints, is disallowed.

It is important to note that HG does not exclude languages in which outputs do violate multiple faithfulness constraints, as is true, for instance, in examples of feeding or counterbleeding interactions. In the next section, we examine another dialect of Greek, one in which multiply-unfaithful outputs are allowed.

3.2 Peloponnesian Greek feeding interaction

The Greek CFE discussed above occurs within word boundaries in all dialects of Greek and across word boundaries in certain dialects, namely Chios, Rhodes, Cyprus, Lesbos, and Samos. In other dialects, however, particularly a set of Peloponnesian dialects, the across-word-boundaries condition actually yields a feeding interaction. We do not attempt to explain here why these Peloponnesian dialects have the CFE within word boundaries but not across word boundaries; clearly constraints that differentiate the two situations are necessary. Here we focus on the across-word-boundaries cases in the Peloponnesian dialects, which differ from the other dialects in having a feeding interaction instead of a CFE. Peloponnesian Greek exhibits the same voice assimilation and postnasal voicing as the dialects of Greek discussed in §3.1. The data in (9), however, show that for Peloponnesian Greek, the concatenation of a word that ends in a nasal with another word that begins in a voiceless cluster triggers a feeding interaction where postnasal voicing feeds voice assimilation.

(9) Greek feeding interaction: feeding across word boundaries (some Peloponnesian dialects)
/ton + psefti/ [tombzéfti] 'the liar' /ton + kseno/ [toŋgzéno] 'the foreigner'
/tin + tsimba/ [tindᶻimbáyi] 'he pinches her'

The OT account of Greek in above was hindered by a ranking paradox. The outputs achieved by the OT account, which were incorrect for the dialects of Greek discussed in §3.1, are the outputs attested in Peloponnesian Greek, so it is clear that OT can account for the feeding interaction. More importantly, HG can also account for Peloponnesian Greek with the exact same set of constraints needed for the Greek CFE. The HG tableaux in (10) illustrate the weighting necessary to achieve the feeding relationship. The high weight of the two markedness constraints effectively rules out any marked candidate. MAX, with a weight of 1.5, outweighs both of the other faithfulness constraints, each of which has a weight of 0.5. In tableaux (10a,b), in which singly-derived repairs are shown, the deletion candidate is ruled out by its violation of MAX, just as it would be in a CFE. The difference between a feeding relationship and a CFE is obvious in tableau (13c), however. The deletion candidate (candidate d.) has a lower cumulative harmony than the feeding candidate c., even though candidate d. violates IDENT[voice] twice. Thus the greater weighting of MAX eliminates the deletion candidate, which could have served as the fell-swoop repair for the potentially doubly-marked structure /nps/ in the input in (10c). We must also assume that other fell-swoop repairs, like vowel epenthesis, would be eliminated by high-weight constraints. Note that the feeding dialects are identical to the CFE dialects except for the relative weight of MAX and IDENT[voice]. In the CFE dialects of Greek, MAX had a weight of 1.5 and IDENT[voice] a weight of 1, so that two violations of IDENT[voice] summed up to a greater weight than one violation of MAX. In the feeding dialects of Greek, on the other hand, MAX still has a weight of 1.5, but IDENT[voice] has a weight of 0.5, so that two violations of IDENT[voice] is still a smaller cumulative weight than a single violation of MAX. The feeding effect occurs, then, because the language's constraint weighting does not allow for another alternative to eliminate the marked structure.

(10) HG account of Greek feeding interaction

a. $W_{\text{MAX}} > W_{\text{IDENT[voice]}}$

/rávtis/ 'tailor'	*NC̥ w=2	AGREE[voi] w=2	MAX w=1.5	ID[voi] w=0.5	H
a. rávtis		-1			-2
b. ☞ ráftis				-1	-0.5
c. rávis			-1		-1.5

b. $W_{\text{MAX}} > W_{\text{IDENT[voice]}}$

/ton + topo/ ‘the place’	*NC̥ w=2	AGREE[voi] w=2	MAX w=1.5	ID[voi] w=0.5	H
a. tontopo	-1				-2
b. ☞ tondopo				-1	-0.5
c. totopo			-1		-1.5

c. $W_{\text{MAX}} > W_{\text{IDENT[voice]}} + W_{\text{IDENT[voice]}}$

/ton + psefti/ ‘the liar’	*NC̥ w=2	AGREE[voi] w=2	MAX w=1.5	ID[voi] w=0.5	H
a. tompsefti	-1				-2
b. tombsefti		-1			-2
c. ☞ tombzefti				-2	-1
d. topsefti			-1		-1.5

The claim here is that languages prefer their outputs to be as faithful as possible, but that sometimes there is no way to avoid multiple unfaithfulness. This occurs when the constraint that may have allowed the grammar to bypass multiple faithfulness violations (i.e., the constraint corresponding to the fell-swoop repair) has too great a weight. In such a case, a multiply-unfaithful output is preferable to an output that violates the high-weight faithfulness constraint.

4 Conclusion

Though cumulative constraint interactions cannot be achieved in standard OT, they are more common than previously believed. Cumulative markedness effects have been shown to occur, and this paper illustrates two of many CFEs discussed by Farris-Trimble (2008a,b). Though these effects result in ranking paradoxes in OT, they can easily be accounted for in HG. The opposite type of effect, in which a marked structure is repaired no matter how unfaithful the resulting output must be, also has an account in HG. In both Kikuyu and Greek, segmental deletion occurs only when the alternative repair for the underlying marked structure is too unfaithful, with faithfulness measured by cumulative faithfulness violation. That is, segmental deletion is preferable to being unfaithful in multiple ways. In Peloponnesian Greek, the cumulative faithfulness of a candidate that violates two IDENT constraints is still less than that of the candidate in which a segment has been deleted, and so the doubly-derived repair is allowed to surface.

Several questions remain unanswered in this paper. First, what other types of gang effects occur? We have shown here that two faithfulness constraints, whether different or the same, can gang up on another faithfulness constraint. It is also possible that two faithfulness constraints can gang up on a markedness constraint; this sort of CFE is illustrated by Farris-Trimble (2008a). When the ganged-up-on constraint is a markedness constraint, then the result is that a marked structure is allowed to surface only when its repair would violate two faithfulness constraints. A second relevant question is what other processes can act as fell-swoop processes? Segmental deletion occurs in both Kikuyu and Greek, but can featural deletion or epenthesis repair multiple marked structures at once? This question is also addressed by Farris-Trimble (2008a). Finally, in what other language domains do CFEs occur? Farris-Trimble (2008a) provides examples of CFEs in first-language acquisition and loanword adaptation.

In sum, cumulative constraint interactions do occur, and the lack of a feasible account in standard OT presents problems for that theory. HG is a viable alternative, and may also provide better accounts of other phenomena, such as first-language acquisition (e.g., Pater, Jesney & Tessier, 2007; Jesney & Tessier, 2008). The exploration of other uses for HG's weighted constraint formulation is a necessary next step to a fuller understanding of constraint interactions.

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