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*Dominance effects as trans-derivational anti-faithfulness**

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This paper presents a theory of morphophonology based on a development in the theory of faithfulness in Optimality Theory. A new constraint type, anti-faithfulness, is proposed that evaluates a pair of related words and requires an alternation in the shared stem. This constraint type is motivated initially by a set of problems, e.g. morphological deletions, segmental exchanges and non-structure preserving processes, which show that morphophonology must encompass more than markedness–faithfulness interactions. The anti-faithfulness thesis is then applied to accentual processes in which affixes idiosyncratically cause deletion of accent in a neighbouring morpheme. It is argued that anti-faithfulness both motivates the observed deletion and accounts for its properties with principles that are generally available in phonological theory. Anti-faithfulness is then shown to extend naturally to the analysis of other affix-induced alternations, including accent insertions, shifts, and retractions of stress and tone, a result which distinguishes this theory from plausible alternatives.

1 Introduction

In stress-accent and pitch-accent systems alike, affixes are often endowed with certain 'diacritic properties'. For example, in Tokyo Japanese and Modern Russian, suffixes may be specified as [+pre-accenting], which encodes an insertion of accent in the preceding syllable. Japanese and Russian also have a set of [+dominant] affixes, the principal effect of which is to trigger deletion of stress or tone in a neighbouring morpheme (sometimes called a 'dominance effect'). In addition to these diacritic markings, affixes are commonly specified for various types of accentual shifts, retractions of stress and tone, and tone spread.

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These accentual diacritics, heterogeneous and varied as they are, have attracted a lot of attention in the theoretical literature because they pose an interesting formal problem. The problem is that the diacritics are lexically idiosyncratic – that is, they require some kind of lexical marking – and yet their properties do not straightforwardly reduce to a lexical specification for accent. Consider the case of dominant affixes in Japanese as an example of the general problem.

The typical pattern of root and suffix interaction in Japanese is that a root accent takes precedence over a suffix accent, as shown by the behaviour of the first form in (1) below. In contrast, the dominant suffixes in (2) delete the accent of the root, with the effect of neutralising the accented/unaccented contrast found elsewhere in roots.

(1) *Typical root + suffix interaction in Japanese*

/yóm + tára/ → [yón-dara] 'if he reads'
/yob + tára/ → [yon-dára] 'if he calls'

(2) *Dominant suffix in Japanese*

a. *Root + dominant accented suffix*

/adá + ppó$_{\text{Dom}}$ + i/ → [ada-ppó-i] 'coquettish'
/kaze + ppó$_{\text{Dom}}$ + i/ → [kaze-ppó-i] 'sniffily'

b. *Root + dominant unaccented suffix*

/kóobe + kko$_{\text{Dom}}$/ → [koobe-kko] 'native of Kobe'
/edo + kko$_{\text{Dom}}$/ → [edo-kko] 'native of Tokyo'

The contrast between the behaviour of the normal or 'recessive' suffixes in (1) and the dominant suffixes in (2) shows that dominance must be lexically marked. However, this lexical marking does not reduce to a lexical specification for accent. Japanese has both dominant accented and dominant unaccented affixes, which shows that dominance is orthogonal to the contrast in accentedness.

In this paper, dominance effects, as well as other morphophonological alternations, are argued to follow from a development in the theory of faithfulness in Optimality Theory (OT; Prince & Smolensky 1991, 1993, McCarthy & Prince 1993a). In particular, it is argued that these alternations derive from a new constraint type, anti-faithfulness, which causes an alternation by requiring a violation of a related faithfulness constraint. Dominant affixes, for example, activate the anti-faithfulness constraint that requires a violation of MAX(Accent), the constraint that specifically prohibits deletion of accent. Obligatory violations of additional faithfulness constraints explain the properties of other morpho-accentual alternations, e.g. DEP(Accent) for accent insertions, NOFLOP(Accent) for accentual shifts, etc. It is argued that the anti-faithfulness approach is an improvement on previous approaches to accentual diacritics in that it provides a unified account of a diverse range of morpho-accentual processes, and it does so in a highly restrictive fashion.

The anti-faithfulness hypothesis is then integrated within recent theories of output–output correspondence (Burzio 1994, 1996, 1998,

Benua 1995, 1997, Kenstowicz 1996, 1997). In particular, anti-faithfulness constraints are argued to operate on a surface-to-surface correspondence relation. In doing so, TRANSDERIVATIONAL ANTI-FAITHFULNESS (TAF) theory captures the intuition implicit in many previous works, namely that morphophonological processes serve to strengthen the opposition between two morphological classes. The proposed TAF constraints evaluate a base and its related morphological derivative, and require a contrast, effectively enhancing the coding properties of the morphological categories involved. Moreover, this implementation provides the theoretical architecture for explaining the properties of morpho-accentual processes with theoretical assumptions that are generally available in phonological theory. That is, the assumptions defining the anti-faithfulness thesis will have direct applications in both accentual and non-accentual morphophonology.

The remainder of this paper is organised as follows. The next section provides the necessary background for the analyses that follow by first discussing a set of formal problems that motivate anti-faithfulness constraints and then introducing the core theoretical assumptions which underlie transderivational faithfulness and anti-faithfulness. §3 goes on to employ these assumptions in the analysis of dominance effects. In particular, dominance effects in Japanese are used as a way of illustrating the basic analysis, and the properties of this analysis are then generalised to a wider set of languages to study the cross-linguistic implications of TAF theory. The analysis is then contrasted with two plausible alternatives in §4, and it is argued that TAF theory provides a superior analysis of dominance effects for both empirical and theoretical reasons. In §5, the principles at work in the analysis of dominance effects are extended to other kinds of morpho-accentual processes, including pre- and post-accentuation (accent insertion), accent shifts and tone spread, and they are then employed in a case study of certain tone-retracting suffixes in Limburg Dutch. The last section summarises the conclusions of the paper and clarifies some questions for further research.

2 Background

2.1 Morphologically motivated phonology

2.1.1 *On the diversity of morphophonological operations*. Phonological alternations may have a morphological function in that they support an opposition between two word types (Clark 1987, Spencer 1991, 1998, Anderson 1992, Carstairs-McCarthy 1994). Morphophonological operations (MPOs) such as these are crucial to the analysis of morpho-accentual processes. Stankiewicz (1962), for example, observes that stress has an important role in marking the distinction between singular and plural forms in Russian.[1] Moreover, MPOs are equally important in the

[1] For additional MPOs involving stress and pitch accent, see Poser (1984) on Japanese, Fudge (1984) on English and Garde (1968, 1973) and Kiparsky (1973) on Indo-European in general.

analysis of segmental morphophonology. Segmental phonological processes are often called upon to mark morphological distinctions, as illustrated below.

(3) *Segmental morphophonological processes*
   a. *Slave* (Rice 1988)
      Possessed nouns are marked with voicing on stem-initial fricatives.
   b. *Chaha* (McCarthy 1983, Rose 1997)
      Verbs with objects (3rd person singular accusative) are distinguished from other verbs with labialisation of a stem segment.
   c. *Terena* (Bendor-Samuel 1960)
      1st person and 3rd person possessive forms in Terena are distinguished only by nasalisation, e.g. [ãỹõ] 'my brother' (cf. [ayo] 'his brother').

Indeed, it seems that every type of phonological feature can be exploited by morphological systems to mark contrast (as argued in Spencer 1998).

A common approach to morphologically motivated phonology is to specify the alternating feature as (part of) the lexical entry of a morpheme (Archangeli & Pulleyblank 1994, Akinlabi 1996, Rose 1997, Zoll 1998). In the examples above, the morphological function of the inserted feature is apparently like any other affix: lexically specified [+voice] marks possessed nouns in Slave, [+nasal] signals 1st person in Terena, etc. Of course, theories of featural affixation require additional principles to describe the location of the phonological alternation, e.g. that [+voice] surfaces specifically on stem-initial fricatives, but independently needed theories of feature alignment and co-occurrence seem to accomplish the task (see especially Akinlabi 1996 and Zoll 1998).

It turns out that morphophonology encompasses a much wider range of phonological processes than simple feature insertion. In addition to the insertion-type MPOs in (3), morphologically motivated phonology may take a variety of forms, as exemplified below. This fact has led a number of researchers to argue that morphophonology involves more than lexical specification of an alternating feature (Spencer 1991, 1998, Anderson 1992; cf. Stonham 1994).

(4) *Morphophonological operations*
   a. *Deletion*
      Pre-shortening suffixes in Slovak (Rubach 1993); subtractive morphology (Martin 1988, Horwood 2000); accent-deleting affixes, also known as dominant affixes.
   b. *Ablaut/consonant mutation*
      Stem vocalism in Arabic (McCarthy 1979 *et seq.*); Irish consonant mutations (Gnanadesikan 1997).

c. *Spreading*
[+nasal] spread as a marker of 1st singular in Terena (Bendor-Samuel 1960); tone spread with masculine and diminutive suffixes in Iñapari (Parker 1999).

d. *Metathesis*
As a marker of 'actual' in Saanich verbs (Montler 1986); vowel metathesis in verbs and definite adjectives in Latvian (Halle 1987).

e. *Exchanges*
Length inversion as a marker of plural verbs in Diegueño (Walker 1970, Langdon 1970); voicing exchange in plural and appertentive nouns in Luo (Gregersen 1972, Okoth-Okombo 1982).

While some examples of ablaut and consonant mutations can be treated as feature insertion, it is not clear how such an analysis would apply to cases like stem vocalisms in Arabic (4b), which implies that such alternations require a separate process. Likewise, insertion with automatic spreading of [+nasal] handles Terena, but cases like tone spread in Iñapari and Limburgian Dutch (discussed in §5.2) involve non-automatic spreading of an existing feature, which clearly goes beyond feature insertion (4c). Sprawling out further, MPOs can involve the deletion of a circumscribed segment, i.e. subtractive morphology, or the deletion of a timing unit, as with pre-shortening suffixes (4a). Segments can also switch their linear order, as in the well-documented cases of morphological metathesis (4d).[2] And lastly, feature values can be exchanged for an opposing value (4e), as in the case of voicing polarity in Luo discussed below. What is strikingly clear from these cases is that morphological systems exploit a wide range of processes to mark oppositions between word classes, processes that go beyond feature insertion.

2.1.2 *Some formal problems.* Phonology for morphological reasons is quite diverse, and it involves processes that do not reduce to a lexical specification for phonological structure. In OT terms (though this issue is not specific to OT), MPOs cannot be modelled straightforwardly as the realisation of lexically specified structure through the interaction of markedness and faithfulness constraints. Such an endeavour leads to a set of formal problems that are either intractable as markedness–faithfulness interactions or require ad hoc devices that undercut a unified account of MPOs. The argument, presented below as a series of formal problems, is thus that morphologically motivated phonology must be motivated by constraints other than markedness and faithfulness. As we shall see, this argument will serve as important impetus for the notion of anti-faithfulness.

The first problem is that MPOs may introduce structure that is generally avoided in the language; in the parlance of 1980s Lexical

[2] See also Thompson & Thompson (1969), Anderson (1992: 66ff), McCarthy (1989) for further discussion.

Phonology, they may be 'non-structure preserving'. For example, the elative construction in Javanese, a type of intensive adjective, is formed by raising the rightmost vowel of the stem (5). Importantly, this morpho-phonological process produces exceptions to an otherwise general constraint in the language that prohibits tense vowels in closed syllables.

(5) *Javanese elatives* (Dudas 1975)

	plain adjective	*elative*	
/alus/	[alʊs]	[al<u>u</u>s]	'refined, smooth'
/rosa/	[rosɔ]	[ros<u>u</u>]	'strong'
/abot/	[abɔt]	[ab<u>u</u>t]	'heavy, hard'
/aŋel/	[aŋɛl]	[aŋ<u>i</u>l]	'hard, difficult'

Two additional non-structure prserving MPOs are nasal spread in Terena, which produces nasal vowels in contexts that are predictably oral elsewhere, and [ATR] spread in Montañes Spanish count nouns, which is the only source of lax vowels in this language (McCarthy 1984).

Non-structure preserving MPOs pose a problem because the constructions in which they are found apparently suspend the effects of general well-formedness constraints in the language. In the Javanese example, the markedness differential between elatives and other Javanese words shows that vowel raising is more than simply being faithful to a lexically specified [+high]. Additional principles are needed to overcome the markedness constraint against closed syllables with tense vowels. Such markedness disparities are the primary motivation for Samek-Lodovici's (1994) MORPH-REAL, which overpowers markedness with an imperative to realise morphemes overtly in the phonology, in this case the lexical [+high], despite the consequences this has for markedness (see also Akinlabi 1996, Gnanadesikan 1997, Rose 1997, Walker 1998, 2000, Kurisu, to appear).

The need to supplement featural affixation and faithfulness is also apparent from the neutralising nature of MPOs. Most MPOs neutralise a contrast in that they suppress a structure that is present in a related form; for example, insertion of [+voice] in Slave (3a) neutralises the voicing contrasts in stem-initial fricatives. This neutralising effect of MPOs also poses a ranking problem. On the one hand, the existence of contrast in the language, e.g. voicing in stem-initials in Slave, entails that faithfulness dominates markedness. But the neutralisation of this contrast requires the opposite ordering, to prohibit the contrast in a particular corner of the morphology.

Augmenting the standard markedness–faithfulness interactions again, this pattern of neutralisation looks like a faithfulness effect, given a boost by MORPH-REAL, since an obligatory realisation of the [+voice] associated with possessed nouns will naturally have a neutralising effect. However, neutralising MPOs cannot always be handled in this way, for the simple reason that neutralisation is not always predicated on the realisation of a

lexical feature. Dominance effects provide a clear example of the problem. As illustrated in §1 for Japanese, dominant affixes involve a deletion of accent, and yet this deletion is not due to the presence of accent in the surface form, because of the behaviour of dominant unaccented affixes, e.g. /kóobe+kko/→ [koobe-kko] 'native of Kobe'. In OT terms, the presence of an accentual contrast requires faithfulness to outrank markedness for accent. But in constructions that induce dominance effects, the rank order of markedness and faithfulness must be switched, resulting in a ranking paradox. Beyond deletion-type MPOs, neutralisation by ablaut, metathesis and non-automatic spreading (4) also show that the loss of contrast is not just a consequence of the realisation of lexical structure.

For the cases discussed above, the ranking problems are such that a given construction demands a different rank order than that which is necessary for the language on a whole. Some MPOs, however, pose ranking paradoxes that are independent of the grammar of the larger language. These are the exchange processes exemplified in (4e). For example, in Luo, plurals are marked by a reversal of the lexical [voice] specification of the stem-final obstruent. This reversal entails a two-part change, where voiceless obstruents are voiced (6a) and voiced obstruents are devoiced (6b).[3]

(6) *Consonantal polarity in Luo* (Gregersen 1972, Okoth-Okombo 1982)

	singular	*plural*	
a.	bat	bed̲-e	'arm'
	luθ	luð̲-e	'walking stick'
b.	čogo	čok̲-e	'bone'
	owadu	owet̲-e	'brother'

As discussed in detail in Moreton (1996) and Prince (1997), exchange processes and circular chain shifts in general cannot be described in terms of rankings of markedness and faithfulness constraints alone. Roughly speaking, if grammars are rankings of just these constraints, input–output mappings will either be faithful to the input or improve on markedness. Exchanges like that found in Luo have two parts, and they cannot both improve on markedness. Concretely, any ranking of markedness and faithfulness that changes one obstruent class A to another B entails a markedness scale where B is less marked than A; in such a constraint system, it is impossible to produce a mapping in which B also goes to A, since B does better on markedness than A. Certain MPOs therefore produce ranking paradoxes that are intrinsic to the construction under

[3] This process also extends to the singular/singular appertentive alternations (a construction similar to the Semitic construct state): [got] 'mountain', [god-e] 'mountains', [god] 'mountain of', which demonstrates that the process is truly morphologically governed, and not, for example, a dual process of intervocalic voicing with (opaque) final devoicing.

examination, revealing a problem that stems from the very way grammars are constructed.

The conclusion that can be drawn from these observations is that phonological alternations can be motivated by constraints other than markedness. That is, Universal Grammar may have a set of constraints that trigger alternations for reasons other than markedness. Interestingly, this conclusion has been arrived at on the basis of other phonological phenomena: Baković (1996) proposes a constraint, FOOT-HARM, that requires permutation of lexically specified quantity for a three-way quantity alternation in Yup'ik, Yip (1998) employs a set of identity avoidance constraints to account for morphologically motivated alternations in reduplicative constructions, Crosswhite (1999) employs a similar notion of identity avoidance for blocking accidental homophony, and Hayes (1999) sketches a constraint formula for obligatory alternations as a way of solving certain problems which arise in learning adult grammars. All of these constraints trigger phonological alternations, but they are clearly not motivated by markedness. It seems, therefore, that converging sources of evidence require a constraint type that is formally distinct from markedness and faithfulness constraints. In the next section, the notion of anti-faithfulness constraints is developed as a way of meeting this need. Furthermore, it is shown that the notion of anti-faithfulness provides a unified analysis of the problems outlined above, i.e. non-structure preserving and neutralising MPOs and exchange processes, a result which distinguishes TAF theory from the available alternatives.

2.2 Transderivational faithfulness and anti-faithfulness

Alderete (2001a) proposes that, in addition to markedness and faithfulness constraints, UG contains a set of rankable constraints that trigger alternations in morphologically related words. These constraints, the so-called transderivational anti-faithfulness constraints, induce an alternation by requiring a violation of a related faithfulness constraint in word pairs. In the case of Luo, for example, the opposition between singular and plural forms is established by an anti-faithfulness constraint which requires a violation of IDENT[voice]. Both parts of the exchange are motivated by this constraint, which requires a full rotation of the [voice] specification in the stem segments:

(7) *Morphophonology as transderivational anti-faithfulness*

singular		*plural*
bat	≠	be<u>d</u>-e
čogo	≠	čo<u>k</u>-e

To implement this idea, the relationship between morphologically related words sketched above must be formalised, and the next subsection introduces a specific theory of output–output correspondence for this

purpose. The notion of anti-faithfulness that defines a theory of MPOs is then developed and implemented within this theory, providing an explicit formal theory of morphophonological alternations.

2.2.1 *Transderivational Correspondence Theory*. Recently, a number of researchers have argued for an extension of McCarthy & Prince's (1995) theory of correspondence to morphologically related words (Burzio 1994, 1996, 1998, Benua 1995, 1997, Kenstowicz 1996, 1997; cf. Kiparsky 1999). This development makes possible a form of surface-to-surface faithfulness that accounts for cases of unexpected similarities among words within a paradigm (i.e. 'cyclic effects'). For concreteness, I adopt Benua's model of Transderivational Correspondence Theory (TCT), comprised in the assumptions given below, but the ideas developed in this paper can be implemented in other theories as well.

(8) *Transderivational Correspondence Theory* (Benua 1997)[4]

a. *Transderivational* (*OO*) *correspondence*
Morphologically related words stand in correspondence and are regulated by OO faithfulness.

b. *Base priority*
Recursive constraint hierarchies simultaneously evaluate a word and its immediate morphological derivative, giving priority to the former, the base.

c. *Affix specificity*
Subcategorisation frames specify the OO-correspondence relation that links a base and derivative in a paradigmatic identity relation.

The first assumption (8a) involves an extension of McCarthy & Prince's notion of correspondence. In particular, words within a paradigm stand in a transderivational correspondence relation. As such, phonological similarity within a paradigm may be regulated by faithfulness constraints which are identical to input–output faithfulness constraints. Assumption (8b) accounts for the direction of OO correspondence: OO faithfulness operates from a base to a derivative, where the latter is the input for some morphological process. TCT accounts for base priority by duplicating the constraint system in a recursive structure. In this recursive hierarchy, words and their immediate morphological derivatives are evaluated in parallel, giving priority to the former, the base.

The last assumption (8c) accounts for the affix classes defined by faithfulness constraints. In particular, the subcategorisation frame for each affix specifies the OO-correspondence relations upon which distinct faithfulness constraints are defined; these constraints regulate the degree of similarity between the base and derivative. To be clear, there are no morpheme-specific faithfulness constraints in TCT. Affix classes are instead defined by correspondence relations specified in the lexicon.

[4] See Benua (1997) for more technical discussion of these core ideas and examples that show how the theory is implemented.

Distinct correspondence relations in turn embody different faithfulness properties for affixes, because of the rank order of the faithfulness constraints defined on these relations.[5] As argued in Benua (1997), this approach to construction-specific phonology is more restrictive than that offered in Lexical Phonology and its OT derivatives (Orgun 1996, Inkelas *et al*. 1997, Kiparsky 1999), in that affix classes, and morphological constructions in general, can only differ in their faithfulness properties.

It is common to speak of 'affix classes' and 'affix-triggered' processes in TCT, but it is important to understand that the inherent ideas of this theory also extend to paradigmatic effects that involve non-affixal morphology. Paradigmatic effects in TCT are faithfulness (and anti-faithfulness) effects that occur between two words. These effects may be observed between a base and output where the latter is derived through affixation or by some other morphological process. Similarity effects within a paradigm are therefore not restricted to affixal morphology; they extend to other morphological processes as well, as shown in McCarthy (2000b) for root and pattern morphology, in Benua (1997) for echo words, Itô *et al*. (1996) for secret language formation and Itô & Mester (1998) for compounding processes.

2.2.2 *Transderivational Anti-faithfulness Theory*. Anti-faithfulness constraints induce alternations by requiring a violation of a related faithfulness constraint. Phonological alternations are thus motivated by anti-faithfulness constraints, which are formulated as negations of existing faithfulness constraints. In particular, anti-faithfulness constraints involve a wide-scope negation of the propositions expressed by faithfulness constraints, as described below.

(9) *Anti-faithfulness* (Alderete 2001a)

For every faithfulness constraint F, there is a corresponding anti-faithfulness constraint $\neg F$ that is satisfied in a string S iff S has at least one violation of F.

The effect of this type of negation is to require at least one violation of the negated faithfulness constraint in related strings, as illustrated below in the analysis of the voicing exchange in Luo.

Only certain suffixes in Luo trigger the voicing exchange, and so two affix classes are needed: 'normal' affixes and exchange-inducing affixes. The latter subcategorises for the correspondence relation $\mathrm{OO}_{\mathrm{Ex}}$, where 'Ex' is simply a handy mnemonic for marking the class of exchange-inducing affixes. A lexical entry for the plural suffix *-e* therefore contains the subcategorisation frame: $[[\mathrm{Stem}]\ \_\_\ ]_{\mathrm{OO\text{-}Ex}}$, which indicates the relation upon which correspondence between the base and derived plurals is defined. With the standard formulation of featural identity constraints

[5] The notion of multiple correspondence relations has been employed in several distinct areas; see e.g. Fukazawa (1998) and Itô & Mester (1999) on distinguishing lexical strata and exceptions, Urbanczyk (1995) on multiple correspondence for classifying different reduplicative morphemes and Benua (1997) and Burzio (1998) on the definition of affix classes with multiple correspondence in general.

given below (after McCarthy & Prince 1995, 1999), the voicing exchange can now be understood as a simple consequence of ranking.

(10) *Faithfulness and anti-faithfulness for* [voice]

a. IDENT[voice]
Corresponding segments agree in the feature [voice].

b. ¬IDENT[voice]
It is not the case that corresponding segments agree in the feature [voice].

Because of the symmetrical nature of IDENT constraints, requiring agreement of a given feature regardless of its value, $\neg OO_{Ex}$-IDENT[voice] motivates both parts of the exchange. If the anti-faithfulness constraint $\neg OO_{Ex}$-IDENT[voice] outranks the related faithfulness constraint, it has the effect of causing a mutation of [voice] specification in the base–plural pairs given below.[6,7]

(11) *Voicing exchange in Luo as anti-faithfulness*

Base	Derivative	$\neg OO_{Ex}$-ID[vce]	OO_{Ex}-ID[vce]
a. /bat/	☞ i. bed-e		*
	ii. bet-e	*!	
b. /čogo/	☞ i. čok-e		*
	ii. čog-e	*!	

Note that the wide-scope negation of IDENT[voice] accounts for the fact that a single faithfulness violation is enough. A total reversal in voicing for the consonants, e.g. /bat/ → [ped-e], also satisfies the anti-faithfulness constraint, but it has a gratuitous violation of faithfulness and so is correctly ruled out.

One question that comes to mind when examining the results above is why anti-faithfulness constraints operate on OO-correspondence relations. Could input–output anti-faithfulness account for the voicing exchange in Luo? It turns out that IO anti-faithfulness is not a viable strategy for Luo or any language, but the rationale for this conclusion can only be understood once some typological ground has been covered in the

[6] Importantly, the two-way exchange does not require full specification of [voice]. Following standard definitions for featural identity (McCarthy & Prince 1995, 1999), IDENT constraints are violated when correspondent segments differ for a given feature, so if either an input or output segment is specified for [voice], and the other is not, or specified differently, such input–output pairs violate faithfulness, and in turn satisfy anti-faithfulness.

[7] The location of the mutation in this case is not predicted directly by the TAF constraint, and so other constraints in the grammar, including markedness, positional faithfulness and positional anti-faithfulness constraints, may have a role in pinpointing the affected element. In the case of Luo, however, certain principles ensuring that the mutation is local to the base-mutating affix are at work. See Alderete (2001a), Horwood (2000) and §6.2.2 for some formal proposals and details of analysis.

study of dominance effects (see especially §3.2). The short answer to this question, however, is that IO anti-faithfulness allows for the possibility of morphologically triggered alternations that affect non-stems, and yet this type of alternation does not seem to be attested. Furthermore, IO anti-faithfulness effects will be decidedly difficult to learn, considering the type of evidence they would require, and so there is reason to believe there is a natural explanation for their absence (see §6.2.1 for more discussion).

Another aspect of TAF theory worthy of mention is that TAF constraints have a certain amount of descriptive content: ¬DEP[voice] requires an insertion of [voice], ¬MAX(C) triggers a deletion of a consonant, etc. The examples given in §2.1 clearly show a need for this level of description, but it remains to be shown that the constraints themselves must carry this burden. For example, an alternative theory of anti-faithfulness might require related words to simply 'be different', and the language-particular markedness–faithfulness interactions will decide the ways in which such a difference is realised (see Urbanczyk 1998 for ideas along these lines). That is, MPOs could be motivated by a general DISTINCTFORM constraint, which simply requires related forms to be phonologically different. When embedded in a language-particular constraint hierarchy, DISTINCTFORM motivates morphophonological differences.

It turns out that there is good reason to assign this descriptive content to TAF constraints. First, as argued in detail in Horwood (2000), the 'Be Different' approach to MPOs is incapable of describing morphologically induced allomorphy with its inherent assumptions. Horwood studies the problem of allomorphy in Koasati plurals (though the issue is clearly a general one) and shows that a contentless DISTINCTFORM constraint fails to describe the two distinct patterns of subtractive morphology with a total ordering of constraints. A second problem with the Be Different theory is that it is less restrictive than TAF theory. Anti-faithfulness constraints in TAF theory are simply negations of independently motivated faithfulness constraints. A consequence of this assumption is that the effects of TAF constraints will be limited to reversals of existing faithfulness constraints (§5 discusses this prediction in detail for accentual faithfulness). The chief player in the Be Different approach, DISTINCTFORM, is not related in any way to faithfulness, and so it predicts that MPOs may be motivated in ways that do not involve faithfulness constraints (see §4.2 for further discussion and potential examples). It seems likely therefore that anti-faithfulness constraints should have a limited amount of descriptive content, encoded specifically as reversals of faithfulness constraints.

Returning to the problems outlined in §2.1, TAF theory solves the formal problem posed by exchange processes: they are handled as logical reversals of IDENT-type constraints. It turns out that each additional type of MPO surveyed in §2.1 also has an analysis in TAF theory. Insertion-style morphophonology follows from a negation of DEP constraints, requiring obligatory insertions of the features specified by a given DEP constraint. Deletion, even of the neutralising type, falls out as the negation

of MAX constraints, as explored in §3 in some detail for dominance effects, and in Horwood (2000) for subtractive morphology. Metathesis is an effect of the anti-faithfulness constraint related to LINEARITY, the faithfulness constraints for segmental precedence relations (see McCarthy & Prince 1995, 1999), and spreading and shifting MPOs are due to negations of the variety of constraints which regulate the migration of a feature from its lexical sponsor (see the analysis of tone shift in Limburgian Dutch in §5.2 as a paradigm case). Each type of mapping found in morphophonological alternations can be modelled as a reflex of the negation of an existing faithfulness constraint.[8,9]

Moreover, TAF theory solves the ranking problems outlined in §2.1.2 posed by construction-specific phonology. The assumption that MPOs are triggered by constraints, as opposed to lexical specifications, frees up certain ranking possibilities that lead to a resolution of these problems. Thus, non-structure preserving morphophonology is due to a constraint ranking in which otherwise general markedness constraints are dominated by a TAF constraint, effectively supplanting the role of MORPH-REAL (see Alderete 2001a for detailed discussion). So the case of Javanese follows from a ranking in which ¬DEP[high] dominates the constraint prohibiting tense vowels in closed syllables. Furthermore, neutralisation by deletion does not depend on any lexical or surface structure; it is predicated on the activity of the deletion-inducing ¬MAX. Therefore, this constraint may bring about non-phonological deletion. This point will be made more explicit in the analysis of dominance effects proposed in the next section.

2.3 A cluster of properties

Anti-faithfulness constraints, defined on output–output correspondence relations, define a class of morphophonological phenomena that have a cluster of properties. The list of properties below makes clear the predictions of the TAF model of morphophonological operations, and provides a set of specific hypotheses for the discussion of morpho-accentual phenomena which follows.

[8] As discussed in §2.1.1, the complexity of C and V mutations precludes an analysis in terms of the insertion of a single feature; for example, the regular relationship between active CaCaC and passive CuCiC perfective stems in Arabic is standardly analysed as the replacement of the entire vocalic melody (McCarthy 1979). While these MPOs cannot be straightforwardly approached as the effect of a single anti-faithfulness constraint, their complex nature may be accounted for with the conjunction of various anti-faithfulness constraints, with possibly different locality effects. Replacement of /a/for /u-i/, for example, may be adduced to the combined force of DEP(+high) and DEP(−back), where the former applies to the entire stem, and the latter is restricted to the final syllable.

[9] It remains to be shown that the more 'exotic' faithfulness constraints like UNIFORMITY, INTEGRITY and CONTIGUITY have anti-faithfulness analogues. Suggestive patterns which would motivate such TAF constraints include: morphological fusion or coalescence via ¬UNIFORMITY (like the merging of valence prefixes and stem-initials in Athabaskan languages; see Lamontagne & Rice 1995), morphological diphthongisation via ¬INTEGRITY or non-canonical deletion or epenthesis sites in MPOs as an effect of forced violations of contiguity constraints.

(i) LEXICALLY IDIOSYNCRATIC: MPOs are predicted to be lexically idiosyncratic because of affix specificity in TCT. Subcategorised correspondence relations and the relative ranking of a given TAF constraint determine whether or not an alternation occurs. Descriptively speaking, TAF theory predicts that said alternations are idiosyncratic properties of particular morphemes (or morphological processes if they are recognised).

(ii) MORPHOLOGICALLY TRIGGERED: alternations induced by TAF constraints always correlate with the application of a morphological process because of the nature of OO correspondence. Transderivational anti-faithfulness is a property that holds between a base and morphological derivative; TAF constraints thus always require a difference between two morphologically related words. The alternations caused by these constraints must therefore correlate with a particular morphological process.

(iii) BASE-MUTATING: also stemming from OO correspondence, mutations due to TAF constraints may only affect the morphological base of a derived form. TAF constraints assess the anti-faithfulness properties of base–derivative pairs. As a consequence, only faithfulness violations within the interval of the derivative that is shared with the base will satisfy a TAF constraint. Concretely, STRICT BASE MUTATION entails that alternations are found exclusively in the stem, simplex or complex, which serves as the base of a morphological process.

(iv) GRAMMAR-DEPENDENT: like all constraints in OT, the activity of TAF constraints, and the resulting changes, depend on the larger constraint system. TAF constraints 'narrow down' an alternation by specifying the alternating feature and the faithfulness violation required. However, several aspects of the alternation, e.g. its location, its structural change and blocking effects, are not specified by the TAF constraint and are thus determined by the ambient phonology. TAF-induced MPOs therefore bring about default structures (see Alderete *et al*. 1999) and obey the canonical faithfulness properties of the structures involved.

The characteristics listed above show that TAF theory defines a coherent class of morphophonological operations. This theory also provides a restrictive hypothesis of the nature of morphophonological alternations: said alternations must have the cluster of properties listed above. The discussion below in §3 shows how these predictions are indeed borne out in the analysis of dominance effects, and the discussion in §5 shows how they provide a set of analytical techniques for unifying a variety of morpho-accentual phenomena.

An important clarification is in order, however, before we can move on. The effects due to TAF constraints are morphologically triggered in the sense that they correlate with the application of a morphological process; as a result, TAF effects give important cues to 'derivedness' and enhance the coding properties of specific morphological categories.

There are contexts, however, in which this functional motivation for anti-faithfulness does not coincide directly with its formal implementation. Concretely, alternations may satisfy TAF constraints and yet fail to

produce a phonetically overt difference in some word types. For example, the obligatory insertion constraint DEP[voice] can trigger an insertion of [voice] in a consonant which is itself lexically specified for [voice]. This result is a consequence of the possibility that the inserted [voice] may fail to be a correspondent of the lexical [voice], so the latter has no input correspondent. This divergence between the functional spirit and formal analysis of anti-faithfulness effects has a parallel in dominance effects, as inserted accents may accidentally coincide with position of accent in the word without the dominant affix. This structural ambiguity, due to different correspondence relations, is inherent to most phonological theories, for the simple reason that there is often more than one phonological analysis of a given surface pattern (see e.g. Tesar 1998 for discussion of the ambiguous analysis of 'overt structure' in stress systems).[10]

3 Dominance effects as transderivational anti-faithfulness

The goal of this section is to illustrate the TAF theory of dominance effects and study its cross-linguistic implications. This goal is achieved by first applying the above ideas to the analysis of dominance effects in Japanese and then generalising the properties of this analysis to a wider set of cases.

3.1 Dominance effects in Tokyo Japanese

As is well known, words in Tokyo Japanese have two types of accentual contrasts: they contrast for the position of accent and the presence or absence of accent, as shown below with some forms familiar from McCawley (1968).[11]

(12) *Accentual contrasts in Japanese*

hási 'chopsticks'
hasí 'bridge'
hasi 'edge'

The issue of the representation of accent is left open since it does not bear directly on the analysis of dominance effects given here. That is, accent

[10] In this way, 'invisible anti-faithfulness' effects such as these do not actually contradict the functional motivations for anti-faithfulness, e.g. Clark's (1987) Principle of Contrast, which states 'every form contrasts in meaning'. Two phonologically distinct forms also contrast in meaning; it just turns out that their phonological analyses result in ambiguity in overt forms, which is unavoidable in any analysis.

[11] See Poser (1984) and Pierrehumbert & Beckman (1988) for discussion of the different phonetic behaviour of accented and unaccented words and the phonological representations consistent with this behaviour.

may be tonal in nature (as argued in e.g. Poser 1984), and, accordingly, the faithfulness properties for accent are described with constraints that refer to tone structure. Alternatively, these same properties can be treated with the structures representing stress (as in Haraguchi 1991, among others), which are aligned with tone structure to give the observed pitch prominences. Either representational assumption will be sufficient for our purposes.[12]

The faithfulness constraints given below govern the contrasts shown above.

(13) *Correspondence* (McCarthy & Prince 1995, 1999)
Given two strings S_1 and S_2, correspondence is a relation $\mathcal{R}$ from the elements of S_1 to those of S_2. Elements $\alpha \in S_1$ and $\beta \in S_2$ are referred to as correspondents of one another with $\alpha \mathcal{R} \beta$.

(14) *Accentual faithfulness constraints* (Alderete 2001a)
a. MAX(Accent)
An accent in the input has a corresponding accent in the output ('no deletion of accent').
b. DEP(Accent)
An accent in the output has a corresponding accent in the input ('no insertion of accent').
c. NOFLOP(Accent)
Corresponding prominences have corresponding sponsors and links ('no shift of accent').

The ordering of these constraints with the well-formedness constraints in (15) below account for the accentual contrasts of Japanese. In particular, the contrast in the position of accent is accounted for with the ranking in (16a). Here, the accentual faithfulness constraints MAX(Accent) and NOFLOP(Accent) (14a, c) outrank ALIGN-R(Accent, PrWd) (15b), allowing for a contrast in the position of accent. Another crucial ordering is the ranking of the anti-insertion constraint DEP(Accent) above CULMINATIVITY (15a). The latter constraint is responsible for the common fact that words must have an accentual prominence.[13] In this position in the hierarchy, DEP(Accent) prohibits the insertion of accent in words that are not supplied with an inherent accent. This ranking therefore accounts for the contrast in the presence or absence of accent, allowing for surface forms that lack accent altogether.

(15) *Prosodic well-formedness constraints*
a. CULMINATIVITY
An accentual phrase must have at least one pitch accent.

[12] In §5.1, the cover term 'accent' will be dispensed with in favour of more specific faithfulness constraints on stress and tone.

[13] This constraint is really a constraint bundle and is not intended as a serious proposal for the analysis of culminative accent. See Alderete (2001a) for detailed discussion of the constraints at work here.

b. ALIGN-R(Accent, PrWd)
The right edge of every accent coincides with the right edge of some prosodic word.

(16) *Constraint rankings of accentual contrasts*

a. MAX(Accent), NOFLOP(Accent) ≫ ALIGN-R
Contrast in the position of accent.

b. DEP(Accent) ≫ CULMINATIVITY
Contrast in the presence and absence of accent.

The behaviour of dominant affixes complicates the picture of Japanese accent painted above by neutralising these accentual contrasts. Dominant accented affixes, like the adjective-forming suffix /-ppó/ shown in (17), delete the accent of the root to which they attach. Because they are themselves accented, they realise their own accent. Dominant unaccented affixes, such as the suffix /-kko/, likewise delete the base accent, as exemplified in (18). Consistent with the phonology of Japanese accent, words with this affix are left fully unaccented since /-kko/ is itself unaccented.[14]

(17) *Dominant accented suffix:* /-ppó/ (Poser 1984: 49)

a. /abura + ppó + i/	→ [abura-ppó-i]	'oily'
/kaze + ppó + i/	→ [kaze-ppó-i]	'sniffily'
/kodomo + ppó + i/	→ [kodomo-ppó-i]	'childish'
b. /adá + ppó + i/	→ [ada-ppó-i]	'coquettish'
/netú + ppó + i/	→ [netu-ppó-i]	'zealous'
/kíza + ppó + i/	→ [kiza-ppó-i]	'affected'

(18) *Dominant unaccented suffix:* /-kko/ 'native of X' (Poser 1984: 72)

a. /edo + kko/	→ [edo-kko]	'native of Tokyo'
/niigata + kko/	→ [niigata-kko]	'native of Nigata'
/oosaka + kko/	→ [oosaka-kko]	'native of Osaka'
b. /kóobe + kko/	→ [koobe-kko]	'native of Kobe'
/nágoya + kko/	→ [nagoya-kko]	'native of Nagoya'
/nyuuyóoku + kko/	→ [nyuuyooku-kko]	'native of New York'

The analysis of such affix-triggered deletions follows, I argue, from the effect of a constraint which actively suppresses the accent of the base. In particular, the constraint at work in the analysis of dominance effects is the negation of the accentual faithfulness constraint MAX(Accent), as described below.

[14] Other dominant accented morphemes in Japanese include the verbal suffix /-más/, /-rási/ 'seem', /gúrai/ 'as much as a X', /rasíi/ 'like a X' (see McCawley 1968: 140ff and Poser 1984 for more examples); another dominant unaccented suffix is /-teki/, which forms adjectival nouns (see Martin 1975 for the details).

(19) ¬OO-MAX(Accent)
For x an accent, ¬[∀x ∃x′ [x ∈ S_1 → x′ ∈ S_2 & x $\mathscr{R}$ x′]] ('it is not the case that every accent in S_1 has a correspondent in S_2').

The deletion observed in words with dominant affixes is thus motivated by ¬OO-MAX(Accent), which, by a logical negation of OO-MAX(Accent), entails a loss of at least one accent. Of course not all affixes in Japanese activate this constraint, and so, consistent with the analysis of affix classes in TCT in general (see §2.2.1), dominant affixes are distinguished from recessive ones through subcategorised correspondence relations. In particular, dominant affixes subcategorise for OO_{Dom} correspondence, while recessive ones take OO_{Rec} correspondence. With these lexical specifications, dominant and recessive affixes are differentiated through constraint ranking. Concretely, if ¬OO_{Dom}-MAX(Accent) outranks the corresponding faithfulness constraint, as shown in (20a), a dominance effect is predicted. Conversely, the opposite ranking in (20b) results in no accent deletion.

(20) *Dominant* vs. *recessive contrast through constraint ranking*
a. *Dominance effect*
¬OO_{Dom}-MAX(Accent) ⪢ OO_{Dom}-MAX(Accent)
b. *No dominance effect*
OO_{Rec}-MAX(Accent) ⪢ ¬OO_{Rec}-MAX(Accent)

These effects are illustrated below in a series of tableaux. In these tableaux, the base for OO correspondence is given in the column on the left. To emphasise the effects of the TAF constraints, the related derivative is arranged vertically on the next column over. Starting with the dominant affix /-ppó/, this affix triggers OO_{Dom} correspondence, and so words with this suffix are evaluated by the TAF constraint defined on this relation. As a result, this suffix triggers a deletion of the root accent, as illustrated below.[15]

(21) *Dominance effect with dominant accented* /-ppó-/

Base	adá+ppó+i	¬OO_{Dom}-MAX(Ac)	OO_{Dom}-MAX(Ac)	IO-MAX(Ac)
a. adá	adá-ppo-i	*!		*
b. adá	ada-ppo-i		*	**!
☞ c. adá	ada-ppó-i		*	*

[15] The dominant suffix /-ppó/ is attached simultaneously with the inflection /-i/ here for ease of exposition; the inflection could trigger an additional recursion, but the consequences for dominance effects are the same in both cases. This issue, however, raises the question of what happens in words with more than one affix, either dominant or recessive. It turns out the predictions in such words is dependent on the specific model of OO correspondence; see Alderete (2001a) for a discussion of the possibilities.

The first base–output pair fails to satisfy the TAF constraint because there is no deletion, and so ¬OO_{Dom}-MAX(Accent) is violated. Of the remaining candidates, the winner is the one that both deletes the base accent and minimally violates the faithfulness constraint IO-MAX(Accent) by retaining the affix accent.

The next tableau illustrates the analysis of recessive affixes. Because these morphemes subcategorise for OO_{Rec} correspondence, they do not condition a deletion of base prosody. The TAF constraint defined on this correspondence relation is ranked below OO_{Rec}-MAX(Accent), so the winner is the one that preserves the base accent.

(22) *Lack of dominance effect with recessive accented* /-tára/

Base	yóm+tára	OO_{Rec}-MAX(Ac)	¬OO_{Rec}-MAX(Ac)
a. yón-da	yon-dára	*!	
☞ b. yón-da	yón-dara		*

In short, the distinction between dominant and recessive morphemes is determined by the rank of the TAF constraint assessing the anti-faithfulness properties of base–output pairs.

To complete the analysis, let us consider how the assumptions laid out so far apply to dominant unaccented affixes like /-kko/. As a dominant affix, /-kko/ activates the high-ranking TAF constraint. Consequently, it triggers a deletion of the base accent, which frees up certain possibilities for the de-accented form. For example, an accent can be inserted to satisfy CULMINATIVITY (23b), but this option is ruled out by high-ranking IO-DEP(Accent).[16] The winner is thus the form that deletes the base accent and also obeys the constraints which are integral to the larger grammar of accent (23c).

(23) *Dominance effect with dominant unaccented* /-kko/

Base	kóobe+kko	¬OO_{Dom}-MAX(Ac)	IO-DEP(Ac)	CULMIN
a. kóobe	kóobe-kko	*!		
b. kóobe	koobé-kko		*!	
☞ c. kóobe	koobe-kko			*

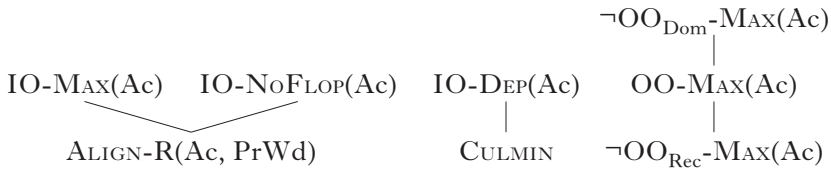
This final tableau highlights an important property of the analysis: the effect of ¬MAX(Accent) is a deletion and nothing more. The rest of the grammar predicts the ultimate outcome of this deletion, and since the faithfulness constraint IO-DEP(Accent) yields unaccented words in words

[16] Furthermore, this constraint plays an equally important role in precluding the deletion of the stem accent, only to have it re-inserted in the same position, i.e. /kóobe-kko/, where the stem accent is epenthetic; such a form is ruled out by IO-DEP(Accent), because the stem accent does not have a correspondent in the base.

that lack inherent accent, that is also the predicted pattern in derived cases such as these.

To summarise, dominance effects in Japanese are explained by incorporating the two TAF constraints in the larger grammar of Japanese accent, as shown below.

(24) *Summary rankings*



These rankings together account for the deletion of accent in affixed forms, and they derive the result of this deletion by making use of constraints like IO-DEP(Accent), which are independently needed in the grammar of accent. In this way, the TAF analysis both accounts for the basic properties of dominance effects and solves the formal problem of deriving neutralisation by non-phonological deletion. Dominance effects in TAF theory are not predicated on the presence of lexical or surface structure, and so it has no trouble with dominant unaccented affixes like /-kko/ in Japanese.

3.2 Strict base mutation explained

As alluded to in §2.3, an important property of the analysis presented above is that the deletion caused by dominant morphemes is always base-mutating. That is, dominance is a property of an affix that triggers a deletion of the accent of the base to which it attaches, as sketched in (25a). If dominance effects are always base-mutating, there are no dominant roots or complex stems which idiosyncratically induce a deletion on a neighbouring affix, as depicted in (25b).

(25) *Base-mutating dominance effects*

a. /kóobe$_{Rec}$ + kko$_{Dom}$/ → [koobe-kko] Affix-triggered dominance

b. /ROOT$_{Dom}$ + ÁF$_{Rec}$/ → [ROOT-AF] *Root-triggered dominance

Interestingly, Inkelas (1998) speculates that this is a general property of dominant morphemes cross-linguistically. In support of this conclusion, Alderete (2001a) surveys a host of related and unrelated languages, and finds evidence that corroborates this claim. This survey examines the accentual properties of various morphological categories, namely affixes, roots and stems, resulting in the chart below.

(26) *Base-mutating dominance effects*

Language[17]	*Contrasts in bases*	*Contrasts in affixes*
a. Japanese	±accent	±accent, ±dominant
b. Russian	±accent	±accent, ±dominant
c. Lithuanian	±accent	±accent, ±dominant
d. Getxo Basque	±accent	±accent, ±dominant
e. Sanskrit	±accent	±accent, ±dominant
f. Moses Columbia Salish	±accent	±accent, ±dominant
g. Modern Hebrew	±accent	±accent, ±dominant

Remarkably, every system has a dominant/recessive contrast in affixes, but no parallel contrast in roots or stems. In other words, in every system examined, a four-way contrast was found in affixes but only a two-way contrast in bases of affixation.

This finding is of considerable importance, because if dominance effects derive from transderivational anti-faithfulness, the facts could not be otherwise. To flesh out this result, the TAF approach models dominance effects as a result of the constraint ¬OO-MAX(Accent), which operates on base–derivative pairs. This constraint requires a difference between the base and related derivative that is instantiated specifically as a deletion of accent. Therefore, accent deletion in this model can only satisfy ¬OO-MAX(Accent) if an accent is deleted in an interval of the word that appears in both the base and the derivative. Deletion of an accent whose sponsor is outside of this shared string cannot satisfy the TAF constraint, because of the nature of OO correspondence: only deletion of an accent which stands in correspondence with an accent in the base will satisfy ¬OO-MAX(Accent), as shown below with a root marked as dominant.

(27) *Transderivational anti-faithfulness derives strict base mutation*

Base	RÓOT$_{Dom}$+ÁF$_{Rec}$	¬OO-MAX(Ac)	OO-MAX(Ac)
a. RÓOT	RÓOT-AF	*!	
☞ b. RÓOT	ROOT-ÁF		*

The TAF constraint is not satisfied in (27a) for the same reason it is not satisfied in (21a) in the analysis of Japanese. The accent of the base is not deleted, and so the required difference between the base and derivative is not achieved. In sum, the finding that dominance effects always delete the accent of the base follows from the inherent assumptions of TAF theory.

It is important to note in this context that if UG allowed for IO anti-faithfulness constraints, the result explained above would not hold. Thus, if the dominant root in (27) activated ¬IO-MAX(Accent), then anti-

[17] On Tokyo Japanese, see McCawley (1968) and Poser (1984), Modern Russian, Halle (1973) and Melvold (1990), Lithuanian, Halle & Vergnaud (1987) and Blevins (1993), Getxo Basque, Hualde & Bilbao (1992, 1993), Vedic Sanskrit, Kiparsky (1973, 1982), Moses-Columbia Salish, Czaykowska-Higgins (1993) and Modern Hebrew, Bat-El (1989, 1993).

faithfulness would no longer be relevant to separating the candidates, and (27a) could be preferred. The absence of such results, therefore, is confirmation of the hypothesis that anti-faithfulness constraints are defined on OO-correspondence relations, a point that will be returned to in §6.2.1.[18]

3.3 Grammar-dependence explained

A second important property of the TAF analysis of dominance effects is that the deletion instantiated by a dominant affix is always grammar-dependent, in the sense sketched in §2.3. What this means is that dominant affixes trigger a deletion, but it is the rest of the grammar which determines the structure resulting from this deletion. Returning to the case of Japanese, de-accented words are always in accordance with the faithfulness properties for accent evidenced elsewhere in the language, as illustrated with the input–output pairs below.

(28) *Grammar-dependent dominance effects in Japanese*

input	/kóobe+kko/	/hasi/
output	[koobe-kko]	[hasi]

Succinctly, Japanese words with no lexical accent surface fully unaccented, as shown by the mapping for *hasi* 'edge'. The fact that this structure is mirrored in words with unaccented affixes shows that the same principles are at work.

It turns out that grammar-dependence is a general property of dominance effects, as shown by the correlations made in (29). In a variety of languages, the behaviour of unaccented words is duplicated by the behaviour of words with dominant unaccented affixes. For example, in Russian, the typical pattern in words with an unaccented stem and an unaccented ending is stress on the first vowel of the ending, e.g. /stol+u/→[stol-ú] 'table (DAT SG).' This pattern is also observed in words with dominant affixes: /púz+ač$_{\text{Dom}}$+u/→[puz-ač-ú] 'man with paunch', showing that the constraints which give endings stress are operative in both cases.

(29) *Grammar-dependent dominance effects*

Language	[+dom, −acc] *affix*	[−acc] *words*
a. Japanese	unaccented	unaccented
b. Russian	ending	ending

[18] A final point concerns a type of stem+affix combination not anticipated in the accentual classification in (26), namely the interaction between dominant affixes and so-called 'post-accenting' stems, i.e. stems that prescribe an accent on a syllable following the stem. Since post-accenting stems do not surface with accent themselves, the prediction in TAF theory is that they will pattern with unaccented stems. See Alderete (2001a) for discussion and analysis of 'post-stressing' stems in Russian that confirm this prediction.

c. Lithuanian	initial accent	initial accent
d. Sanskrit	initial accent	initial accent
e. Getxo Basque	unaccented	unaccented
f. Moses Columbia Salish	accent on root	accent on root
g. Modern Hebrew	final accent	final accent

The available evidence therefore shows that dominant affixes simply delete an accent, and that the accentual pattern resulting from this deletion is prescribed by the larger grammar of accent. The language-particular statements of these grammars may encompass both faithfulness properties, as in the Japanese case and (29e), and prosodic well-formedness constraints, as with the case of Russian and (29c, d, f, g).

This finding is also highly significant, because, if the TAF theory of dominance effects is correct, this result is unavoidable. In the TAF story, dominance effects are deletions caused by ¬OO-MAX(Accent). This constraint only requires a deletion; it does not specify the result of this deletion. Therefore, the only way to predict the result of a dominance effect is with reference to the larger constraint system in which ¬OO-MAX(Accent) is embedded. This calculation will invariably lead to a default accentual structure and will have the canonical faithfulness properties of accent as defined by the larger grammar of accent. To close, another basic property of dominance effects follows directly from the inherent assumptions of TAF theory, providing a basis for genuine explanation of the phenomenon.

3.4 Summary of results

As summarised in the following flow chart, dominance effects have all of the properties of morphophonological operations predicted by TAF theory (from §2.3).

(30) *Dominance effects in TAF theory*

Lexically idiosyncratic	→ Subcategorised correspondence relations
Morphologically triggered	→ Transderivational anti-faithfulness
Base-mutating	→ Strict base mutation
Grammar-dependent	→ Unitary grammars in Optimality Theory

The de-accentuation triggered by dominant affixes is observed to be lexically idiosyncratic, and the analysis of this fact involved the specification of distinct correspondence relations in the subcategorisation frame of individual affixes. Furthermore, dominance effects are morphologically governed, i.e. only associated with particular morphological classes, and this fact is explained in the above analysis as an effect of the TAF constraint ¬OO_{Dom}-MAX(Accent), which operates exclusively between a base and its derivative.

Another significant property of dominant morphemes is that they are always base-mutating: there are dominant affixes which induce deletions in stems, but no analogous dominant roots or stems. This finding lends strong support to the TAF analysis of dominance effects, because, under this hypothesis, the facts could not be otherwise. Dominance effects are always base-mutating in TAF theory, because they are effects of constraints which operate on a transderivational correspondence relation, a relation which holds between two members of a paradigm. This restriction entails that anti-faithfulness constraints may only affect the interval of the word that occurs throughout the paradigm, which is the base of a morphological process.

The fourth property of dominance effects is that they are grammar-dependent, meaning that the independently attested constraints on the distribution of accent dictate the structure of the output resulting from de-accentuation. Grammar-dependence is explained in TAF theory by assuming that there is one and only one constraint system governing accent. For example, the fact that the default position for accent is the same for derived and underived words follows from the assumption that both word types are governed by the same constraint system. In Japanese, therefore, the ranking of IO-DEP(Accent) $\gg$ CULMINATIVITY holds in both morphological contexts, and as a result, unaccented words (either underlyingly or as an effect of anti-faithfulness) remain unaccented at the surface. If, on the other hand, this ranking of constraints is permuted in the analysis of different word types, this result does not hold.

Finally, we have also seen in the analysis of dominance effects in Japanese how TAF theory solves the problem of neutralisation by non-phonological deletion. The deletion of accent achieved in the TAF analysis is not due to a lexical specification of accent in the underlying form. Rather, it is an effect of a high-ranking constraint, triggered by subcategorised correspondence relations. Because of this, the neutralising effect of deletion is non-phonological in its motivation, and so it does not encounter any difficulty with dominance effects that are triggered by unaccented affixes.

To summarise, TAF theory treats dominance effects as part of a general theory of morphophonological operations. This theory predicts a clustering of properties, listed above, which is attested in a cross-linguistic study of dominance effects. Finally, TAF theory solves a formal problem in the analysis of neutralisation by deletion, because an analysis in this theory does not depend on the presence or absence of accent.

4 Discussion of alternatives

For the most part, previous analyses of dominance effects are diacritic-like, in that they mark the relevant affixes as 'dominant' in some way and then provide a set of prose statements to account for their special behaviour (Larson 1956, McCawley 1968, Carlson 1976, 1989, Kiparsky

& Halle 1977, Higurashi 1983, Fudge 1984, Payne 1990).[19] Recently, however, two theories have been developed that make more substantive claims about the nature of dominant morphemes, and it is worth examining them to see how they compare with TAF theory.

4.1 Dominance effects as positional faithfulness

One recent theory proposes that dominance effects are linked to word derivation in a fundamental way. In particular, it is sometimes observed that there is a correlation between dominant morphemes and derivational or category-changing morphemes (e.g. Blevins 1993 : n. 26 on Lithuanian). Revithiadou (1999) captures this correlation by endowing derivational affixes with a privileged faithfulness status. Building on the insights of Beckman (1998), Revithiadou (1999) proposes a set of positional faithfulness constraints for derivational affixes or morphological 'heads' in the sense of Williams (1981). With this head-sensitive faithfulness constraint top-ranked in the hierarchy, accented derivational affixes, like the Japanese adjective-forming suffix /-ppó/, will realise their inherent accent over other competing morphemes, as illustrated below.

(31) *Dominance effects as positional faithfulness* (Part 1)

adá+ppó$_{Hd}$+i	FAITHHD(Ac)	FAITH(Ac)
a. adá-ppo-i	*!	
☞ b. ada-ppó-i		*

It is worth noting that this proposal also accounts for one of the fundamental properties of dominance effects, namely that they are always base-mutating. If only derivational affixes are assigned a privileged faithfulness status, only they will bring about dominance effects.

The positional faithfulness approach accounts for accented dominant affixes by boosting the faithfulness properties of certain affixes. However, this conception of the problem, as essentially a matter of competing faithfulness constraints, leads to a major problem for this theory. Concretely, it does not extend to unaccented morphemes that also produce a deletion in the base of affixation, as we have seen with the place-name suffix /-kko/ in Japanese. Enhancing the faithfulness properties of unaccented morphemes will not help in such contexts, as shown below.

(32) *Dominance effects as positional faithfulness* (Part 2)

kóobe+kko$_{Hd}$	FAITHHD(Ac)	FAITH(Ac)
a. koobe-kko		*!
☞ b. kóobe-kko		

[19] Two notable exceptions are Prince (1983), which approaches dominance effects as a consequence of prominence on the grid, and Halle & Vergnaud (1987), which associates dominance with cyclicity in a subtle way. See Alderete (2001a) for discussion of these proposals.

Put another way, the positional faithfulness approach treats de-accentuation as an effect of culminativity: two morphemes are lexically specified for accent, and because only a single accent may be preserved at the surface, one of them, the non-head accent, must lose. However, dominance effects are clearly not culminativity effects, because unaccented morphemes may also condition a deletion.[20]

It turns out that there is additional cause for doubt of the positional faithfulness analysis when one considers the predictions of its inherent assumptions. While the idea that derivational affixes have privileged faithfulness may have some currency in languages like Lithuanian, it does not seem to constitute a cross-linguistic theory of dominance effects. The basic problem is that the predicted correlation between dominance effects and derivational morphology breaks down both ways. First, there are dominant affixes which are clearly inflectional; see e.g. Alderete (2001a) on the plural ending /-a/ in Russian, and Inkelas (1998) on derivational and inflectional dominant affixes in Hausa. Further, derivational affixes are not always dominant, as is abundantly clear in a great many languages; see Alderete (2001a) for discussion of Russian and Japanese. It seems therefore that the idea which serves as the basis for analysis in the Positional Faithfulness analysis has little cross-linguistic support.

4.2 Dominance effects as co-phonologies

Inkelas (1996, 1998) gives structure to an alternative theory of dominance effects by attributing them to construction-specific phonological mappings. Drawing on the results of Sign-Based Morphology (Orgun 1996), Construction Grammar (Koenig 1994) and Head-driven Phrase Structure Grammar (Pollard & Sag 1994), this theory develops a notion of 'co-phonology', defined as a phonological mapping between a mother node of a given morphological construction and its subordinate daughter nodes. Interpreted in OT, this theory entails that the ranking of constraints for a morphologically composed unit is not the same as the constraint rankings relevant for the subparts of the composed unit. In other words, the phonology of one morphological construction may be different from the phonology of another, and when one finds divergences, certain constructions are characterised by special processes. Applying this idea to dominance effects, the co-phonology of words with dominant morphemes is such that the accent of the base does not survive, as illustrated below.

[20] This problem can be side-stepped by espousing an absolute neutralisation analysis whereby a floating accent conditions a deletion, as in Revithiadou's analysis of Russian dominant unaccented affixes. However, in the case of Japanese, this assumption would entail a floating feature whose only role in the analysis is to condition a deletion, since words with unaccented dominant affixes surface fully unaccented.

(33) *Dominance effects as co-phonologies*

f_{Dom}(kóobe, kko) = koobe-kko

kóobe kko

To flesh out the analysis, what is required for Japanese is that stems formed by /-kko/ surface without the pitch accent of the base of affixation; the loss of tone in the base is the job of f_{Dom}, the function characterising the dominance co-phonology. This objective can be satisfied in a host of ways: the markedness constraints prohibiting pitch accent may be promoted in words with this suffix to render the base toneless, the suffix may assert a particular tonal profile consistent with unaccented words (as in Inkelas' 1998 analysis of Hausa tonology), etc. The basic idea is thus that the grammar of words with dominant morphemes is different from the grammar of other words, and providing the details of both can yield dominance effects.

Despite the lack of explicit details in the co-phonology theory of dominance effects, it is possible to distinguish it from the TAF theory in specific ways. One initial difference between the two is that the co-phonology theory does not ensure that dominance effects are base-mutating. As currently understood, a co-phonology is a specification for the grammar of a given construction, and so it is typical for the morphology which is associated with the morphological category introduced by that construction, like an affix, to be assigned the properties of the larger unit. However, roots and stems must also have specifications for co-phonologies to account for cases where these units contribute to the mapping of the larger morphological structure. Consider for example the theory of lexical stratification based on distinctions in stem class proposed in Fukazawa (1998) and Itô & Mester (1999), Inkelas & Zoll's (2000) approach to distinguishing stems in reduplicative constructions and Pater's (1994) analysis of exceptional stress patterns in English through stem-induced ranking differences. All of these theories require distinct grammatical classes for stems, which shows that the base of a morphological process will also require a co-phonology. Because the inherent properties of the base must be factored in the co-phonology of the larger construction in which it is inserted, bases may also induce a deletion of accent on a neighbouring affix, contrary to the observed pattern of strict base mutation.[21]

A second difference between TAF and co-phonology theory is that the inherent assumptions of the latter preclude a natural account of the

[21] Furthermore, even though the phonological properties of the base are static in simplex forms, making its influence difficult to detect, morpheme concatenation with other units creates new syntagmatic opportunities, producing observable alternations. For example, Yamato and non-Yamato stems show static differences in the possibility of a sequence of voiced obstruents, but these same effects can, in principle, be found dynamically through affixation.

grammar-dependent nature of dominance effects. In TAF theory, the fact that deletion results in a default accentual pattern and obeys the canonical faithfulness properties found elsewhere in the language follows from the assumption that there is a single grammar for the entire language. When the obligatory deletion constraint ¬OO-MAX(Accent) triggers a deletion, the resulting form will naturally obey the other constraints in the language, because the TAF constraint is embedded in the larger constraint system. On the co-phonology view, however, the result of the deletion of the base accent does not automatically obey these constraints, because the motivation for the deletion is a modification of the grammar itself, i.e. a re-ranking of constraints in OT. It is therefore not clear how the co-phonologies will explain the parallels between the output of a dominance effect and words that are unaccented underlyingly (i.e. the parallels shown in (29)). Moreover, while it is certainly possible to introduce further restrictions on the mappings between a mother node and its internal constituents, e.g. a co-phonology interpretation of the Strong Domains Hypothesis (Kiparsky 1984, Myers 1991), such restrictions come as imposition on the basic theory, and so they will not help in explaining the phenomenon of grammar-dependence.

One objection to the above argument is that construction-specific phonology, of which dominance effects exhibit just one type, is not grammar-dependent, and so co-phonologies provide the descriptive power for non-grammar-dependent morphophonology. For example, the study of dominance effects in §3.1 showed that the output of accent deletion in Japanese is a fully unaccented word, but there are other constructions with different 'default' accentual patterns. For example, verbs are either accented or unaccented, and in the former case, accent always falls on the syllable with the penultimate mora, a pattern also found in verb–verb compounds. Furthermore, the first member of a noun–noun compound prefers accent on the rightmost syllable, as do many deverbal nouns, while the second member of noun–noun compounds prefers initial accent.[22] How does the grammar of Japanese assign a unique accentual pattern in each case?

Rather than representing an intractable formal challenge for TAF theory, the plurality of accentual patterns shows that there is an explicit role for the morphosyntactic structure of words in the analysis of accent. For example, as argued in detail in Smith (1998), nouns have a privileged faithfulness status over non-nouns, and so it is not a surprise that the positional contrast is lost in verbs. The set of possible contrasts in verbs may be winnowed down to unaccented and penultimate accent, but there is no direct evidence for one over the other in terms of markedness. Compounds present another morphosyntactic twist, as they have a structural organisation for more than one stem, a combination that is not found elsewhere. The differences found in compounds can thus be

[22] See especially Poser (1984), and references therein, for the full descriptions of these constructions.

attributed to this structure, as argued in detail in Alderete (2001a) for Japanese, which accounts for these patterns through the alignment of morphosyntactic and prosodic structure. Returning to the larger issue, to say that the plurality of accentual patterns in these constructions shows that construction-specific accentual processes may be non-grammar-dependent is to ignore the morphosyntactic differences among these constructions. The extent to which the differences in morphosyntactic structure can be employed in the analysis of these different accentual patterns shows that these constructions do in fact have default structure, but, in order to understand them, one must pay attention to more than just the phonology.

Finally, as will be made more explicit in the following section, the two theories differ in how the analysis of dominance effects fits into a larger typology of morpho-accentual processes. As will be illustrated in the next section, TAF theory predicts a very restricted typology of such processes, essentially limited to deletions (also known as dominance effects), insertions (pre- or post-accentuation) and accentual shift or 'flop'. This result follows from the assumption that morpho-accentual processes are the effects of anti-faithfulness constraints, and since these constraints are reversals of existing faithfulness constraints, morpho-accentual processes are essentially limited to forced violations of specifically these faithfulness constraints. In co-phonology theory, on the other hand, there are no substantive limits on the types of morpho-accentual processes, because there are no substantive limits on the degree of variation between the co-phonology of one construction and that of another. A construction-specific process can be triggered by any constraint in an OT grammar, or any other formal tool for modelling a process (e.g. rules, representations, etc.). In a nutshell, co-phonologies can bring about construction-specific phonology that does not involve faithfulness, which is not the case in TAF theory. The following section is therefore an extended argument in favour of the TAF theory of dominance effects, because it gives a highly restrictive theory of morpho-accentual processes.[23]

5 Towards a general theory of morpho-accentual processes

An important assumption in TAF theory is that there is an anti-faithfulness constraint for every faithfulness constraint. This assumption is shown in §2.2 to provide the right tools for the analysis of a varied set

[23] Another difference still between co-phonologies and TAF theory is that only the latter provides a principled means of capturing locality effects. Anti-faithfulness violations are localised in a specific unit in TAF theory, and therefore, through conjunction with other constraints, the locality of the mutation and the triggering morpheme can be accounted for (see §6.2.2 for the details). By modelling construction-specific phonology as separate grammars, co-phonology theory makes no predictions for locality effects.

of morphophonological operations. The formal symmetry between faithfulness and anti-faithfulness constraints also defines a restrictive theory of morpho-accentual processes. To sketch this theory, we require better motivation for faithfulness constraints for stress and tone, as done directly below. With this constraint set, a typology of morpho-accentual processes will be predicted. The rest of the section goes on to support this theory with a range of examples.

5.1 Faithfulness and anti-faithfulness for accent

The case study of Japanese in §3.1 uses a general set of accentual faithfulness for both pitch-accent and stress-accent languages (where the former is understood as a kind of defective tonal system), because the specific assumptions involved are not relevant to the analysis of dominance effects. However, for the purpose of constructing linguistic typologies, the cover term 'accent' is not appropriate, because it refers to different types of prosodic structure. Tone and stress are formally distinct in most theories of stress and pitch accent, and it is therefore not a surprise that they have different faithfulness properties. For example, there are languages with contrastive tone but predictable stress, and *vice versa* (see van der Hulst & Smith 1988 for a range of cases). Furthermore, tone may spread from its lexical sponsor onto a neighbouring tone-bearing unit, but this property is never found in stress systems (Hayes 1995). Clearly, stress and tone represent different phonological structures, and the faithfulness constraints below distinguish them accordingly.

(34) *Stress faithfulness* (Alderete 2001a)[24]
   a. MAX(Prom)
      No deletion of prominence.
   b. DEP(Prom)
      No insertion of prominence.
   c. NOFLOP(Prom)
      Corresponding prominences have corresponding sponsors and links.

(35) *Tone faithfulness* (see Myers 1997, Zoll 1997, Yip 1999)
   a. MAX(Tone)
      No deletion of tone.
   b. DEP(Tone)
      No insertion of tone.

[24] See Alderete (2001a, b) for formal definitions and Itô *et al.* (1996), Inkelas (1999), McCarthy (2000a, b) and Pater (2000) for different characterisations of faithfulness to lexical stress.

c. NoSpread(Tone)
No insertion of links.

d. NoFlop(Tone)
Corresponding tones have corresponding sponsors and links.

The stress faithfulness constraints refer to prominence structure in grid-based theories (e.g. Prince 1983, Selkirk 1984, Hammond 1986, 1989, Halle & Vergnaud 1987, Hayes 1995) and entail that this prominence structure is maintained in input–output mappings. The tone faithfulness constraints refer to paradigmatic tone structure and demand faithful mappings in which correspondent tones, links and associated sponsors match in the required way.

These constraints, when ranked in relation to other well-formedness constraints, account for the presence or absence of various contrasts, as sketched below:

(i) inherently stressed/unstressed: relative rank of Max(Prom)/ Dep(Prom);

(ii) position of inherent stress: relative rank of NoFlop(Prom);

(iii) tonally marked *vs.* toneless: relative rank of Max(Tone)/ Dep(Tone);

(iv) position of marked tone: relative rank of NoFlop(Tone)/ NoSpread(Tone).

One important type of contrast is in the presence or absence of accent (= stress or tone), e.g. between inherently stressed and unstressed or between marked and unmarked tone. If the Max and Dep constraints dominate the constraints that neutralise such a contrast, then the accented/ unaccented contrast is a part of the inventory of accentual patterns. Conversely, this contrast is neutralised if these faithfulness constraints are dominated. The ability for stress prominences or tones to migrate from their lexical sponsors is governed by the NoFlop constraints. Thus, if NoFlop is high-ranking in the grammar, then a word with *n*-numbered sponsors for accent will have at least *n* number of accentual contrasts, because the lexical position of accent must be maintained (an additional contrast can also be made through the presence or absence of accent, due to the ranking of Max and Dep). Finally, spreading of tone (but not stress) is regulated by NoSpread(Tone), which preserves the lexical association of tone by prohibiting the insertion of links at the surface.

With these faithfulness constraints on stress and tone, a typology of morpho-accentual MPOs can now be constructed. TAF theory predicts that morpho-accentual processes should be limited to deletion, insertion and shift of stress or tone, and also spreading of just tone. This result follows from the basic tenets of this theory: the faithfulness constraints predict the corresponding anti-faithfulness constraints given below.

(36) *Stress anti-faithfulness*

a. ¬Max(Prom)
Obligatory deletion of prominence (dominance effects for stress).

b. ¬DEP(Prom)
Obligatory insertion of prominence (pre- and post-accentuation processes for stress).

c. ¬NOFLOP(Prom)
It is not the case that corresponding prominences have corresponding sponsors and links (morphological stress shift).

(37) *Tone anti-faithfulness*

a. ¬MAX(Tone)
Obligatory deletion of tone (dominance effects for tone).

b. ¬DEP(Tone)
Obligatory insertion of tone (pre- and post-accentuation processes for tone).

c. ¬NOSPREAD(Tone)
Obligatory insertion of links (morphological tone spread).

d. ¬NOFLOP(Tone)
It is not the case that corresponding tones have corresponding sponsors and links (morphological tone shift).

If MPOs for stress and tone are limited to reflexes of the above constraints, then morpho-accentual processes are restricted to processes that specifically violate faithfulness constraints. Morpho-accentual processes motivated purely by markedness constraints are logically possible, but not predicted in this theory. To illustrate with a concrete example, no affix can change the rank order of the Weight-to-Stress Principle (Prince 1990) and consequently induce obedience to or allow violations of this constraint in affixed forms in a way that is inconsistent with its ranking in the language on a whole. In summary, morphologically motivated accentual processes that do not involve faithfulness are systematically ruled out in TAF theory.

While the predicted typology of morpho-accentual processes is restrictive, TAF theory also has the descriptive power to account for the MPOs commonly found in morphological accent systems. As illustrated below, several distinct morpho-accentual processes fall within the scope of the TAF constraint types listed in (36)–(37). Starting first with MPOs for stress, we see that each of the predicted patterns is well documented.

(38) *Morphophonological operations for stress*

a. *Dominance effects*

Russian	Halle 1973, Melvold 1990, Alderete 2001a
Salishian	Carlson 1976, 1989, Czaykowska-Higgins 1993, Black 1996
Vedic Sanskrit	Kiparsky 1973, 1982

b. *Pre- and post-accentuation for stress*

Cupeño	Hill 1967, Hill & Hill 1968, Alderete 2001a
Russian	Halle 1973, Melvold 1990, Alderete 2001a
Dutch	Kager 1989, 1996

c. *Stress shift*

Tiberian Hebrew	McCarthy 1979, Alderete 2001a

The role of ¬MAX(Prom) in the analysis of stress-deleting processes has already been sketched for Russian; these same principles apply with equal force to the analysis of so-called strong suffixes in Salishan languages, analysed in Czaykowska-Higgins (1993) as [+dominant], and similar affix classes found in Vedic Sanskrit. The inverse constraint, ¬DEP(Prom), requires an insertion of stress in the base of a morphological process. This insertion is the principal phonological consequence of so-called pre-stressing suffixes and post-stressing prefixes; see Alderete (2001a) for a TAF-theoretic analysis of both Russian and Cupeño along these lines.[25] Perhaps less obvious, but equally important, are morphological processes that trigger a shift of stress, like the case of perfective and imperfective pairs in Tiberian Hebrew consecutives. Such morphological shifts are motivated by ¬NOFLOP(Prom), which simply requires a displacement of the stress of a related word.

Likewise for tone, the TAF constraints predict well-attested types of morpho-accentual processes, as exemplified below.

(39) *Morphophonological operations for tone*

a. *Dominance effects*

Japanese	McCawley 1968, Poser 1984, Alderete 2001a
Lithuanian	Halle & Vergnaud 1987, Blevins 1993
Getxo Basque	Hualde & Bilbao 1992, 1993

b. *Pre-and post-accentuation for tone*

Japanese	McCawley 1968, Poser 1984, Alderete 2001a
Lithuanian	Halle & Vergnaud 1987, Blevins 1993
Getxo Basque	Hualde & Bilbao 1992, 1993

c. *Tone shift*

Limburg Dutch	Hermans 1991, 1999, Alderete 2001a
Japanese	Poser 1984, Alderete 2001a
Aguaruna	Larson 1956, Payne 1990, Alderete 2001a

d. *Tone spread*

Iñapari	Parker 1999

Dominance effects in Japanese, Lithuanian and Getxo Basque are due to ¬MAX(Tone) in TAF theory, like their analogues in stress systems above.

[25] Note that ¬DEP(Prom) has nothing to say about the so-called post-stressing stems of Russian (also known as oxytone stems), which Alderete (2001a) shows are best analysed as an effect of Alignment between prominence and stem structure.

Continuing the parallel, tonal accent systems frequently exhibit processes that insert a tone in the morphological base, which provides the tonal analogue to pre- and post-stressing suffixes and hence the motivation for ¬DEP(Tone). Tone systems also have morphological shifts, like the so-called 'dependent' suffixes of Tokyo Japanese, the accent-shifting suffixes of Aguaruna and the tone-retracting suffixes in Limburg Dutch discussed in §5.2 below. Such tonal shifts provide evidence for ¬NOFLOP(Tone) and fill out the predicted typology of MPOs for tone. The final tonal MPO expected in TAF theory is a morphological spreading of tone, i.e. a tonal parallel to Terena 1st person possessives (see (3)). One case of such a process seems to be documented in the Maipuran language Iñapari. In this language, certain suffixes may cause spreading of a lexically specified high tone to the penultimate syllable, as with the masculine accusative suffix/-ri/ and the diminutive suffixes/-hɨ/ and /-si/ shown below.

(40) *Affix-triggered tone spread in Iñapari* (Parker 1999)[26]

/iyupaʔíma + ri/	→ [iyupaʔímá-ri]	'he is piercing or crushing it'
/uteíro + hɨ/	→ [uteíró-hɨ]	'knife'
/huteári + si/	→ [huteárí-si]	'pebbles, small stones'

This morphological pattern of tone spread is exactly the one predicted by the TAF constraint ¬NOSPREAD(Tone). A lexically marked affix class triggers a mutation of the base of affixation and, further, this mutation takes the form of spreading a lexical tone. Like the stress MPOs, morphophonological tone mutations also seem to accord well with the types of MPOs predicted in TAF theory.

The larger picture here is one in which a range of morpho-accentual alternations, formerly attributed to an ad hoc set of diacritics, now reduce to forced violations of faithfulness constraints. TAF theory therefore constitutes a formally rigorous theory of the morpho-accentual processes commonly found in accent systems. What is more, this theory explains the properties of these accentual processes in the same way it explains the properties of dominance effects. MPOs in TAF theory are the effect of anti-faithfulness constraints that are triggered by subcategorised correspondence relations. It is not a surprise that the MPOs are lexically idiosyncratic properties of affixes, as they are with dominant affixes. Furthermore, the stress and tone-related MPOs are morphological in nature, because, under TAF theory, they are employed as a way of contrasting two morphological classes. Further still, these MPOs are base-mutating: they are accentual mutations of the morphological base of a form and do not affect non-base material like affixes. There are pre-

[26] As noted in Parker (1999: 22), this imperative to spread is somewhat lexicalised, meaning that, while it is the 'preferred option' with the tone-spreading suffixes, there are some forms with these suffixes which do not have spreading.

stressing and tone-shifting suffixes but no parallel cases in which stems trigger a process that affects a neighbouring affix (see Alderete 2001a for discussion of some apparent counterexamples to this claim). The final characteristic of MPOs in TAF theory is that they are grammar-dependent; their output has default structure and canonical faithfulness properties. It is not possible to demonstrate convincingly in this paper that the MPOs in (38)–(39) are in fact grammar-dependent, because such an illustration would entail proposing a grammar for the accentual system of each language. The next best thing, however, is to examine one of the examples above in some detail, to test this hypothesis in a careful way, which is the purpose of the following subsection.

5.2 Case study: dragging tone mutation in Limburg Dutch

This section further develops the argument that TAF theory constitutes a general theory of morpho-accentual processes by constructing an analysis of certain tone-retracting suffixes in Limburg Dutch. This analysis makes clear how transderivational anti-faithfulness explains the motivation for the retraction, as well as the ways in which the larger grammatical system has a say in the precise details of the process.[27]

5.2.1 *Data and observations.* Most dialects of Limburg Dutch (LD) show a contrast between a 'falling tone' and a 'dragging tone', which is exemplified in (41). Phonetically, the falling tone has a high tonal target at the onset of its syllable, and, after reaching this peak, F0 falls swiftly. The dragging tone, on the other hand, is essentially a level high tone, except that it has a 'concave' shape utterance-finally with a slight drop and rise in F0.

(41) *Contrastive accent in Limburg Dutch*

a. *Falling tone*	b. *Dragging tone*
bíi 'bee'	bíí 'at'
zúa 'right!'	zúá 'like that'
bǽl 'to ring'	bǽĺ 'last name'
wíis 'melody'	wíís 'wise'

The main constraint on the distribution of the tonal contrast relevant to the present discussion is that the falling/dragging tone contrast is only found in syllables with at least two sonorants beyond the onset cluster. In the examples above, the contrast is observed in syllables with two vowel slots or in syllables with a vowel plus a sonorant consonant, but not in

[27] All of the data and many important analytical insights into the system come from Hermans (1991, 1999), which present and analyse the results of extensive fieldwork on the Maasbracht dialect of Dutch Limburg.

syllables with a single sonorant. Hermans (1991) therefore characterises LD as a 'mora-accenting' language like Lithuanian, because the distribution of accent in moraic subconstituents of the syllable is distinctive.

In addition to this phonological restriction on the dragging/falling contrast, there is also a morphological restriction. As exemplified below, certain suffixes cause the dragging tone of the base to become a falling tone. These suffixes include the masculine singular suffix /-ə/ (a schwa-like vowel) which is added to adjectives (MASC), the feminine counterpart to this suffix (FEM), which is often segmentally null, and the comparative suffix /-ər/.[28]

(42) *Dragging tone mutation in derived environments*

	masculine	*feminine*	*comparative*	
wíís	wíiz-ə	wíis	wíiz-ər	'wise'
stíif	stíiv-ə	stíif	stíiv-ər	'stiff'
káál	káal-ə	káal	káal-ər	'bald'
láám	láam-ə	láam	láam-ər	'paralysed'
fíín	fíin-ə	fíin	fíin-ər	'refined'

An important point is that this mutation is one-way. For example, the masculine singular form for /stúur/ 'tough (of people)' is /stúur-ə/, so both forms have a falling tone. Thus, while the dragging tone becomes a falling tone in this morphological context, the falling tone does not become the dragging tone, or a different tone, in the same context. To summarise, the inventory of underived words have both falling and dragging tone; this contrast is neutralised, however, in certain derived environments because of the mutation of the dragging tone.[29]

5.2.2 *Tone in monomorphemic words.* The tone specifications yielding the tonal contrast are tropic to a single syllable, referred to here as the tonic, and so in polysyllabic forms there is only one contrast between the falling and dragging tones. While this assumption is not central to this paper, I follow the spirit of Hermans' analysis in assuming that the distribution of tone is governed by constraints both on tone and stress, where the larger constraint system requires tone to appear in the head of the main stress foot (see Hermans 1991: 337ff). In terms of the input–

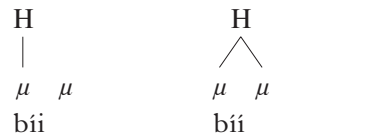
[28] There is a further phonological restriction on the falling tone, in both derived and underived contexts, which can block the dragging tone mutation: the falling tone is prohibited in bimoraic syllables ending in a sonorant+voiceless obstruent combination (see Hermans 1991: 312ff for extensive discussion and analysis). This restriction is clearly orthogonal to the analysis of the morphological motivation for the dragging tone mutation, since it is a general restriction in the language.

[29] The dragging tone mutation only affects the stem-final syllable (Ben Hermans, personal communication). This fact shows that the mutation is like many morpho-accentual processes in that there are locality conditions on the alternation; see Alderete (2001a) and §6.2.3 for a general interpretation of this type of locality.

output maps assumed in OT, we may say that the distribution of tone is free in the input, but the constraint system prohibits tone structure outside of the head syllable of the main stress foot. One way of achieving this result is to assume that faithfulness to stressed positions licenses tone on the stressed syllable (Beckman 1997, 1998, Alderete 1999), and that the markedness constraints against tone prohibit the occurrence of tone in all unstressed positions (see Yip 1999 for an application of this proposal to Chinese languages).

In the analysis of the LD tonal inventory, I assume that the basic contrast is represented through the association of a high (H) tone. Thus, following Blevins' (1993) analysis of Lithuanian, the falling tone has a H tone over the first sonorant, as shown below. On the other hand, the dragging tone is represented as a doubly linked H tone, a structure argued for in many Bantu languages (see Odden 1995 and references therein) and for the Kyungsang dialects of Korean (Kim 1996). The tone-bearing units (TBUs) here are moras, and so I assume that only sonorants are moraic, because only sonorants can bear tones.

(43) *Tonal inventory in underived words*



Concerning the context-dependent realisation of the dragging tone, I assume that the observed concave structure utterance-finally is due to a boundary tone, presumably a phrase-final H, that accounts for the elevated pitch curve phrase-finally. As for the falling tone, I assume that its fall in F0 is due to a phonetic implementation rule which produces a marked fall with single H tones in tonic syllables, though nothing crucially hinges on this analysis.

One type of accentual pattern commonly found in mora-counting languages, such as Greek and Lithuanian, is missing in LD, namely a 'rising' accent in which a H target appears only on the second TBU of an accented syllable. The following constraint, formulated in the theory of Generalised Alignment (McCarthy & Prince 1993b), accounts for this basic distributional gap.

(44) ALIGN-L(H, σ)
The left edge of every H tone must coincide with the left edge of some syllable.

The representations for the falling and dragging tones will not violate ALIGN-L(H, σ), because both accentual types have a left-aligned H tone.

On the other hand, rising tones such as **bií* are systematically ruled out by this constraint because they require an initial mora without a H tone. This same constraint is probably at work in Tokyo Japanese, where accented syllables always have accent on the initial mora (Haraguchi 1991). In mora-accenting languages with rising tones, I assume that this constraint is dominated by the relevant tone faithfulness constraints.

The analysis as it has been sketched thus far is consistent with a number of analyses of African languages (see e.g. Pulleyblank 1986, Myers 1987, 1997, Zoll 1997) in which the tone structure of a form is described purely in terms of high tonal targets, with low (L) tones, if needed at all, being filled in 'by default'. Conceived in terms of markedness and faithfulness constraints, a language with only surface H tones entails that L tones are more marked than H tones, as derived by the following markedness subhierarchy.

(45) *Tonal markedness subhierarchy* (Myers 1997, Zoll 1997)
*L ⩥ *H

The grammar of a system with only surface Hs is constructed by ranking the tone faithfulness constraints (34) between these two markedness constraints. Together with the rankings given below, this ordering accounts for the basic tonal inventory of Limburg Dutch.

(46) *Rankings for Limburg Dutch*
a. *L ⩥ MAX(Tone)
No lexical contrast for L tones.
b. MAX(Tone), NOFLOP(Tone) ⩥ *H
Lexical associations for H tones are faithfully mapped onto output forms (in head syllables).
c. ALIGN-L(H, σ) ⩥ NOFLOP(Tone)
Input H tones not linked to the first mora of syllable will be linked to the first mora in the output.

The effects of these constraint rankings are illustrated in the tableau below. First, with the tonal markedness constraint *L ranking above TONE-FAITH, specifically above MAX(Tone), surface forms only have H tones. Therefore, if an input has a lexical L tone, as in (47a) below (L tones here are marked with a grave accent), then this tone is deleted in the output because of high-ranking *L. Second, the Alignment constraint ALIGN-L(H, σ) rules out syllables without an initial H tone, as shown in the IO-mapping in (47c). Finally, the TONE-FAITH constraints outrank *H, and as a result, doubly associated H tones (i.e. the dragging tones) are faithfully mapped onto related outputs. In particular, because NOFLOP(Tone) dominates *H, the association of the lexical H to the second TBU is maintained in the surface form, as shown in (47b).

(47) *Illustration of results for inventory of underived words*

Input	Output	ALIGN-L	*L	TONE-FAITH	*H
a. /bíì/	☞ i. bíi			*(MAX)	*
	ii. *bíì		*!		*
b. /bíí/	☞ i. bíí				**
	ii. *bíi			*(NOFLOP)!	*
c. /bií/	☞ i. bíi			*(NOFLOP)	*
	ii. *bií	*!			*

To give an interim summary, an accent is required in the head syllable of the main stress foot. The realisation of this accent tonally is governed further by ALIGN-L(H, σ) and the tonal markedness and faithfulness constraints. The interaction of these constraints accounts for the inventory of tonal contrasts.

5.2.3 *Tonal mutation in derived environments as* ¬NOFLOP(Tone). We can now move to the treatment of derived forms, which is relevant to the character of the anti-faithfulness constraint employed in the analysis of tone retraction. As illustrated below, the tonal inventory in certain derived words is more restricted because of the mutation of the dragging tone.

(48) *Tonal inventory in derived words (with accent-mutating suffixes)*
a. kɑ́ɑ́l ~ kɑ́al-ə (Mutation: dragging → falling)
b. stúur ~ stúur-ə (No mutation)

Any analysis of accent in LD will therefore need to account for the observed neutralisation of contrast in these derived forms.

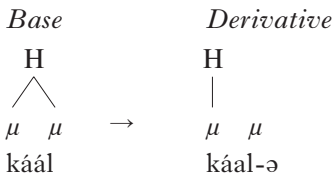
The operation observed in the dragging tone mutation is the obligatory loss of an autosegmental link. Since NOFLOP(Tone) governs faithfulness to this tone-to-sponsor affiliation, it follows that the negation of NOFLOP(Tone) will give the desired outcome, as spelled out below.[30]

(49) ¬NOFLOP(Tone)
¬[∀x ∀y ∀z, x ∈ tone, y ∈ sponsor, z ∈ link, if x and y are associated by z in S_1, then ∃x′ ∃y′ ∃z′ s.t. (x, y, z) $\mathscr{R}$ (x′, y′, z′) and x′ and y′ are associated by z′ in S_2.]

[30] Following Itô *et al.* (1995) correspondence relations may refer to associations (as in PARSE-LINK and FILL-LINK). See Alderete (2001a) for formal definitions of faithfulness constraints that refer to the associations between sponsor and autosegmental stress and tone.

While ¬NoFlop(Tone) can be satisfied by a shift of a tone to a neighbouring TBU, this constraint is also satisfied when a doubly linked structure loses a link, which is exactly the observed pattern in LD. This result is illustrated below, with explicit representations for the tone structures involved.

(50) *Structural characteristics of dragging tone mutation*



The second mora (dominating the second vowel) in the base stands in correspondence with the second mora of the derivative. The H tones likewise stand in correspondence. Since the base H is associated with the second mora, the loss of the link to the corresponding mora in the derivative violates NoFlop(Tone) as defined in §5.1. Therefore, this loss of a link to a base H tone satisfies the negation of this tone faithfulness constraint, ¬NoFlop(Tone).

As a TAF constraint, ¬OO-NoFlop(Tone) will operate on base–derivative pairs. Using the standard ranking logic, the following schematic rankings predict the presence or absence of a tone-flop mutation.

(51) *Schematic rankings*

a. Obligatory tone flop: ¬OO-NoFlop(Tone) ⩾ OO-NoFlop(Tone)

b. No tone flop: OO-NoFlop(Tone) ⩾ ¬OO-NoFlop (Tone)

The dragging to falling tone alternation can thus be explained by stipulating that the accent-mutating suffixes shown above subcategorise for an OO-correspondence relation, and upon this relation, the ranking in (51a) holds. This result is illustrated in the following tableau.

(52) *Tone in derived words* (Part 1)*: mutate dragging to falling*

Base	káál-ə	Align-L	¬OO-NoFlop(Tone)	OO-NoFlop(Tone)
☞ a. káál	káal-ə			*
b. káál	káál-ə		*!	
c. káál	kaál-ə	*!		*

The faithful mapping shown in (52b) is ruled out because it violates the TAF constraint ¬OO-NoFlop(Tone), and this constraint dominates the

tone faithfulness constraint OO-NoFlop(Tone). The remaining candidates mutate the tonal structure of the base in different ways: candidate (52a) loses the link between the H tone and the second mora, while candidate (52c) loses the link to the first mora. The latter option can be ruled out in a principled fashion because this candidate violates an independently attested constraint in the grammar, namely Align-L (H, σ). In other words, the mutation of the dragging tone to a rising tone is ruled out because this mapping would produce a structure that is generally avoided in the language.

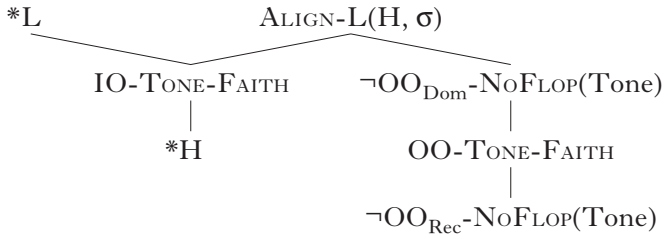
The next step in the analysis is to account for the lack of mutation in mappings in which the base has a falling tone. The same basic constraints are at work in this case too, except that a lower-ranking OO tone-faithfulness constraint decides the final outcome. Thus, given a base with a falling tone, the derivative cannot shift the H tone one mora to the right, as in (53c), because this mapping gives a rising tonal contour, and such configurations are not allowed. In particular, the absence of such a mutation shows that Align-L(H, σ) dominates the TAF constraint. The remaining two candidates, (53a) and (b), fail to mutate the derived form in the required way, as neither brings about a loss of an association with the base sponsor of the H tone. Lower-ranking tone faithfulness therefore decides the competition between these two candidates, favouring the faithful candidate because it avoids a violation of the anti-spreading constraint for tones.

(53) *Tone in derived words* (Part 2)*: don't mutate falling to dragging*

Base	stúur-ə	Align-L	¬OO-NoFlop(Tone)	OO-NoSpread(Tone)
☞ a. stúur	stúur-ə		*	
b. stúur	stúúr-ə		*	*!
c. stúur	stuúr-ə	*!		(*)

Said differently, the integration of the TAF constraint with the larger constraint system yields a flopping mutation only when the change exhibited in the base–derivative pair does not violate the high-ranking Alignment constraint. When the mutation would require a violation of this constraint, the system opts not to change the derivative at all. The analysis therefore shows another form of grammar-dependence in that high-ranking constraints in the grammar predict both the specific pattern of anti-faithfulness observed in the system (52), and whether or not the mutation takes place at all, as shown in (53). Thus, in addition to governing the ultimate outcome of a process, a top-ranked constraint may actually block a process altogether. These results are reflected in the constraint rankings below, in which the Alignment constraint is top-ranked.

(54) *Summary rankings for accent shift in Limburg Dutch*



To summarise these results, I propose an analysis of a morphological pattern of tone retraction that makes crucial use of faithfulness and anti-faithfulness constraints for tone structure. This analysis explains all of the basic properties of this pattern, i.e. that it is lexically idiosyncratic, morphologically triggered, base-mutating and importantly, grammar-dependent. Furthermore, the same basic mechanisms at work in the analysis of tone flop in Limburg Dutch are also employed in the analysis of dominance effects discussed in §3. In both cases, the descriptive content of the alternation is understood as forced violations of an existing faithfulness constraint.

6 Conclusion

6.1 Summary of results

This paper has shown that the TAF theory of dominance effects explains the properties of dominant morphemes with assumptions that are motivated in other areas in phonology. Dominance effects are lexically idiosyncratic, which follows from subcategorised correspondence relations generally needed in Transderivational Correspondence Theory. The fact that dominance effects are always morphologically triggered and base-mutating also follows from TCT: the nature of base–derivative relations in this theory specifically predicts anti-faithfulness effects in the base of a morphological process. Finally, the TAF analysis explains the property of grammar-dependence in dominance effects. The TAF constraint ¬Max(Accent) only requires a deletion; the outcome of this deletion therefore depends on the larger constraint system in which it is embedded.

This paper has also shown that transderivational anti-faithfulness is more than just a theory of accent-deleting morphemes. In addition, TAF theory suggests tractable lines of analysis for many important morpho-accentual processes. Processes as distinct as tone retraction and spread, accentual shifts and various types of accent insertion and deletion are all understood in terms of obligatory violations of independently motivated faithfulness constraints. This theory therefore unifies a diverse range of accentual phenomena that have resisted an integrated analysis in previous theories.

The TAF theory of dominance effects is also motivated by contrasting it with other plausible alternatives. In particular, it has been shown that these alternatives either do not successfully account for the properties of dominant morphemes or do so in a way that fails to generalise to other types of morpho-accentual phenomena. One point of difference was with accent-deleting affixes that result in fully unaccented words, like the de-accentuation found in Tokyo Japanese. This type of dominance effect poses an empirical problem to the positional faithfulness theory of dominance effects, where dominant affixes are accented and force a phonological deletion because they have special faithfulness privileges (§4.1). The phenomena of strict base mutation and grammar-dependence provide a basis for contrasting the TAF approach with the co-phonologies approach to dominance effects: the inherent assumptions of the latter fail to account for base-mutating and grammar-dependent dominance effects (§4.2). Moreover, the remaining discussion serves as an extended argument against the alternative approaches, as these approaches do not predict the restricted typology of morpho-accentual processes developed here. Finally, as is clear from the connections made between segmental and suprasegmental morphophonology, the ideas which motivate anti-faithfulness for morpho-accentual phenomena are equally useful, and indeed indispensable in some cases, in the analysis of non-accentual morphophonological alternations. These parallels attest to the generality of TAF theory, which also distinguishes it from the available alternatives.

6.2 Research questions clarified

6.2.1 *Generality of anti-faithfulness*. One issue that these conclusions raise is: how general is anti-faithfulness? Concretely, if there is an anti-faithfulness constraint for every faithfulness constraint, as stated in §2.2.2, then there should be anti-faithfulness constraints defined on other types of correspondence relations, not just the OO-correspondence relations employed here. In support of a broad application of anti-faithfulness is the fact that faithfulness reversals are also observed in base–reduplicant relations. As pointed out in McCarthy & Prince (1986), and explored further in McCarthy & Prince (1995, 1999), Yip (1992, 1998) and Alderete *et al*. (1999), reduplicative constructions and echo words frequently require an overt phonological difference between the base and the copied part. For example, echo words in English formed with *shm-*, e.g. *table-shmable*, are blocked when the base word also begins with this sequence: **shmuck-shmuck*. Reduplication of adjectives in Turkish likewise shows an avoidance of repetition between base–reduplicant pairs: the coda may be one consonant from the set /p s m r/, but certain consonants are blocked when they would mimic the consonantism of the base, e.g. *kap-kara* 'jet black', not **kar-kara*. And as argued in detail in Yip (1998), the mutations observed in Javanese echo words also require 'identity avoidance', a notion with obvious relevance for anti-faithfulness. Finally, Urbanczyk

(1998) observes that certain non-automatic alternations serve to distinguish the base from the reduplicant in Halq'eméylem, again suggesting that the phonology serves a morphological function. In sum, these examples exhibit morphophonological operations in reduplicative constructions, and this observation can be captured by extending anti-faithfulness to base–reduplicant correspondence.

An unconstrained method of constructing anti-faithfulness constraints also yields input–output anti-faithfulness, a set of constraints that would yield purely phonological mutations. In contrast to OO and BR anti-faithfulness, there is not much empirical support for this type of anti-faithfulness. Indeed, if Anderson & Browne's (1973) generalisation is correct, and exchange processes are always morphological, then exchanges of the type found in Luo (§2.2.2) should be completely ruled out in lexical-to-surface mappings. In other words, there should not be phonological analogues to the case of Luo where an exchange of two structural classes is triggered in IO mappings. For these reasons, it appears to be necessary to stipulate that anti-faithfulness operates exclusively in surface-to-surface correspondence, defined in a way that includes base–output and base–reduplicant correspondence but excludes input–output correspondence (see Benua 1997, McCarthy & Prince 1995, 1999). Such a move would not be unprecedented, as faithfulness to syllabic positions appears to be limited to surface-to-surface correspondence as well. While faithfulness to syllabic role appears to be crucial in the analysis of base–reduplicative correspondence, like McCarthy & Prince's (1994) treatment of the failure of base–reduplicant copying in Makassarese, it is never a contrastive feature in syllable inventories, which would require input–output correspondence. Thus, as with faithfulness to syllabic positions, anti-faithfulness appears to be limited to output pairs which have an overt surface realisation in both members of the pair.

There may be a deeper reason for this finding, however, stemming from the properties inherent to Optimality Theory and the way morphophonology is learned generally. The parallelist inclination in Optimality Theory entails that there are no intermediate steps or levels in the mapping from the lexical to the surface form. With this assumption, a purely phonological exchange is in fact indistinguishable from a fully faithful mapping from input to output.[31] Thus, if /A/ goes to [B] and /B/ to [A], and there is not an intermediate step which can further apply to the output of this exchange, then the result is an inventory that contains both

[31] This result is not guaranteed in a serialist model of OT incorporating the levels of Lexical Phonology (see Kiparsky 1999). From the learner's point of view, however, it is equally consistent with the assumption that only surface forms may provide evidence in grammar learning, since the output of an intermediate level is not available as evidence for learning.

[A] and [B]. This result is of course the same in the absence of a phonological exchange: a fully faithful mapping of /A/ and /B/ yields the same inventory. The same result holds for circular chain shifts as well; as long as candidate forms are evaluated in parallel, the result of a shifted series will have the same consequences for the inventory as if they are unshifted. The question one must ask at this point is: why would a child learning a language bother to reverse the specification of a given phonological class? If there are no overt alternations showing that the lexical form has changed, why would the learner go to the trouble of undoing an exchange in positing lexical forms when a far more simpler alternative is available, namely to assume that the overt structure is the actual input? These questions need to be answered in a specific model of language acquisition, but the basic point is clear: in the absence of overt structure providing evidence of an exchange, there is little, if any, incentive to learn a purely phonological exchange, which may explain the apparent gap in the generality of anti-faithfulness constraints observed here.

6.2.2 *Grammar-dependence and locality*. A unifying theme throughout this paper is that morpho-accentual processes are grammar-dependent in the sense that the changes they instantiate depend on the larger constraint system governing accent. The survey of dominant affixes in a variety of languages given in §3.3 strongly suggests that the output of this accentual process is directly tied to language-particular grammars. Broadening the scope of the project, the next question to ask is: are other morpho-accentual alternations likewise grammar-dependent? Aside from the methodological issues that typically accompany linguistic classification, the TAF theory makes some very clear predictions. All else being equal, morpho-accentual processes like pre- and post-accentuation and accent flops should be grammar-dependent in the same sense that dominance effects are grammar-dependent. That is, the TAF constraints responsible for these alternations require a certain type of change, e.g. a shift or insertion of accent, but the resulting changes should obey the constraints governing faithfulness and well-formedness for accent.

As with any claim of this scope, there is some evidence that seems to run counter to these expectations. Interestingly, however, a well-defined set of cases reveals a general trend in morpho-accentual processes, namely that they may be subject to certain locality requirements on the distance between the alternation-inducing affix and the site of the accentual change. To contextualise the discussion, consider the problem posed by a pattern of affix-triggered accent insertion in Tokyo Japanese. Japanese has a set of prefixes, like /ma-/ 'exactly', which trigger an insertion of accent on the first syllable of the stem to which it attaches, e.g. /ma + yonaká/ → [ma-yónaka] 'dead of night'. This is a pattern of base-mutating accent insertion found in many systems (see §5.1 for a list of examples). However, the case of Japanese is special in that the site of insertion cannot be attributed to other independently motivated constraints on the distribution of accent. In particular, the behaviour of

noun–noun compounds shows that the default position for inserted accent of this class is the final syllable of the prosodic word (see Alderete 2001a for the details of the analysis). Therefore, post-accentuation in Japanese is apparently not like other languages, in that it is not grammar-dependent; the site of the mutation is in a non-default position for accent, according to the language-particular grammar of accent.

The case of post-accentuation in Japanese, rather than constituting a valid counterexample, is one of many cases in which the site of the mutation must be local to the base-mutating affix. Concretely, the accent contributed by the post-accenting prefix is bound to the immediately following syllable. It turns out that this type of locality is found in every type of morpho-accentual process examined in this paper. In addition to the case of accent insertion in Japanese, there is evidence for boundedness in accent deletions. For example, the genitive particle /no/ in Japanese causes a dominance effect in the stems that precede it, but only if the stem accent is in the final mora, showing that the dominance effect due to /no/ must be in the adjacent mora (see Poser 1984 and Alderete 2001a). Locality conditions are also in effect in accent-shifting suffixes: in Limburgian (§4), the mutation of the dragging tone is limited to the syllable directly preceding the tone-retracting suffix. A similar restriction is observed in accent shifts in Aguaruna, though the bounded constituent is the prosodic foot (see Alderete 2001a). What all of these cases have in common is that the site of the mutation must be 'close enough' to the base-mutating affix.

The proposal developed in Alderete (2001a) for this type of locality is that the TAF constraint requiring the change may be locally conjoined (in the sense of Smolensky 1993) with a constraint enforcing MCat-to-PCat Anchoring (following a proposal in Łubowicz 1999; see McCarthy 2000b and McCarthy & Prince 1995 for definitions of anchoring constraints and Smolensky 1995 for local conjunction). In particular, the conjoined constraint is violated only if the derived form fails to satisfy the TAF constraint in the constituent that is imperfectly anchored through affixation. Thus, the constraint operative in the Japanese case is a conjunction of ¬OO-Dep(Accent) and Anchor-L(Stem, PrWd) in the domain of the syllable; the latter constraint requires that the leftmost segment in the stem is also leftmost in the prosodic word. Roughly speaking, the complex constraint says that it is unacceptable to both de-anchor (through prefixation) and fail to mutate the stem-initial syllable, which correctly sorts the candidate set shown below.

(55) *Syllable adjacency in Japanese post-accentuation* (Alderete 2001a)

Base	ma´+yonaká	¬OO-Dep(Ac)$_\sigma$	OO-Dep(Ac)	Align-R
a. yonaká	ma-[yo]naká	*!		
b. yonaká	ma-[yo]náka	*!	*	*
☞ c. yonaká	ma-[yó]naka		*	**

The locally conjoined TAF constraint thus prescribes an insertion of

accent in the de-anchored portion of the stem within the domain of the locally conjoined constraints (shown in square brackets), which yields the stem-initial syllable as the site of insertion.

The case above reveals an antagonism between the well-formedness constraints that form a part of the larger grammar, e.g. ALIGN-R in the above case, and the locality requirements intrinsic to the locally conjoined TAF constraint. The locality requirement forces a local insertion, while the ALIGN-R encourages default word-final accent, which may be non-local. In general, this refinement of TAF theory leads to a modification of predictions concerning the realisation of morpho-accentual processes, which are listed below.

(56) *Consequences of local conjunction in TAF theory*

a. *Prediction 1*: when an affix-triggered alternation is local, it is bound to either a prosodic or a morphological category adjacent to the affix.

b. *Prediction 2*: when an affix-triggered alternation is not subject to a (stringent) locality requirement, it must be grammar-dependent.

Smolensky's local conjunction specifies a domain for metering the violation of the two constraints. The combined force of a TAF constraint and an anchoring constraint therefore must be localised in some morphological or prosodic domain, hence the boundedness to some PCat or MCat in (56a). It is also possible that a TAF constraint is unconjoined, and so it has no locality conditions, or that its conjunction with an Anchoring constraint does not eliminate all the possible candidates, as it does above in (55). In such a context, the actual change that satisfies the TAF constraint is directly dictated by the constraint system as a whole, i.e. it is grammar-dependent (56b).

To summarise these results, the predictions of TAF theory clarify an important role for locality in the realisation of morpho-accentual processes, and this type of locality is evidenced in all the morpho-accentual processes discussed here. The specific hypothesis for this type of locality developed in TAF theory makes clear predictions that limit the range of possible morpho-accentual processes.

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