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An Optimal Domains Theory of Harmony

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In this paper we propose an alternative to the autosegmental view of assimilation as spreading. Adopting the non-derivational, constraint-based grammars of OT, we model harmony in terms of harmony domains—structures which are defined by universal constraints, and which are explicitly encoded in phonological representation. Transparency and opacity develop from the interaction between constraints that align harmony domains and constraints on the occurrence of the harmony feature within the domain. The proposed analysis assumes privative features, and avoids the stipulatory use of feature underspecification or feature geometry which characterizes many autosegmental accounts of opacity and transparency.

1 Introduction

Since the advent of Autosegmental Phonology (AP), the prevailing model of harmony has been that of autosegmental spreading. Underspecification is central to the analysis, serving to distinguish targets and transparent segments from opaque segments. Yet the disparate and often contradictory patterns of transparency and opacity across harmony systems resist a unified treatment in AP. There have been a variety of proposals to extend AP by manipulating feature geometry or underspecification on a language-by-language basis, in an attempt to preserve the basic claim of the AP approach, namely that harmonic behavior, including transparency and opacity, follows from the properties of the representation. There have been some recent positive developments, such as Archangeli & Pulleyblank's (1993) work on the role of feature co-occurrence constraints in harmony systems, but overall, AP has not yet provided a unified, principled account of harmony that is sufficiently general to yield fruitful analyses of the full range of harmony systems.

The AP analysis of harmony is inherently derivational, and typically relies on extrinsic rule ordering in which harmony spreading is ordered between redundancy rules that fill out underspecified representations. As such, it provides an analysis of harmony that can not be directly incorporated in non-derivational frameworks, such as Optimality Theory.

In this paper we propose an alternative to the AP analysis. Adopting the constraint-based grammars of OT, we model harmony in terms of harmony domains—structures which are defined by universal constraints, and which are explicitly encoded in phonological representation. This approach is termed *Optimal Domains Theory*, or ODT. ODT provides a general characterization of transparency and opacity that yields interesting new analyses for a wide variety of harmony systems. A core motivation for ODT is our rejection of the AP claim that given the "right" representations, the properties of harmony systems follow. In our view, AP has failed to deliver sufficiently motivated principles of feature specification and feature geometry that are needed to select the "right" representations. ODT does not invoke underspecification or feature geometry as key factors in the analysis of harmony systems. More specifically, ODT departs from (standard) AP in adopting the following assumptions:

- Features are privative (Steriade 1993). A partial set of features used in the ODT analysis of harmony include: Round, Palatal ([-back]), Velar ([+back]), High, Low, Non-peripheral ([-high,-low]), Nasal, Sonorant, Obstruent.

- In underlying representation, segments are fully specified, to the extent that there is any evidence at all for an underlying underspecification.[1]

- There is no need for multiple association between anchors and features in the analysis of transparency and opacity. From this it follows that harmony is not modelled as autosegmental spreading.

- Feature geometry is not explicitly encoded in the phonological representations which define underlying and surface forms. Feature geometry may exist as a part of the theory, but it does no work in the ODT analysis of harmony. A corollary of this assumption is that only terminal features harmonize.[2]

- Features are anchored in prosodic units of timing, such as the X-slot or mora.[3]

[1]Underspecification is allowed only when the surface specification is *always* determined by an external source, such as the case of suffix vowels in Turkish, whose specification for Palatal/Velar is always determined by a stem vowel via harmony. The suffix vowels never stand alone in a form without a harmony trigger.

[2]Halle (1993) reaches the same conclusion, based on the analysis of a range of assimilation phenomena within framework of AP.

[3]Our view is that individual features combine by affiliating to an anchor, characterizing the phonetic properties of that anchor. The anchor alone represents a bare segment, a unit which, in OT terminology, may be inserted, parsed, or underparsed. An anchor may *sponsor* features in UR, or may become affiliated with features that are sponsored by other anchors. For the ODT analysis of harmony it is not necessary to specify any hierarchic or geometric properties in the relation between features and anchors. We leave open the possibility that there may be other phenomena which motivate the expression of dependency between features or between features and their anchors, in which case additional structure may be imposed on the representations themselves.

2 The principles of the ODT approach

The ODT account of harmony involves the following two claims:

(1) **Harmony is the requirement that a feature [F] be uniformly realized on anchors in a F-domain.**

(2) **F-domains are explicit aspects of phonological structure, with the same status as structures for the syllable, foot, word, etc.**

Two basic questions the theory must address are: What principles give rise to licit F-domains? What principles govern the realization of a feature in its F-domain? The answers to these questions determine the particular details of the constraint grammars for harmony systems. But beyond the mechanics of the analysis, we also attempt to answer the more fundamental question of what functional and phonetic factors motivate harmony in the first place. This broader question is forced, in a sense, by the requirements of OT, since only universal constraints can be invoked to derive the domain structures and feature insertion of the ODT analysis, and the constraints should ideally be grounded in basic considerations of the physical and functional requirements of speech.

Before laying out the basic constraint grammar for harmony, we summarize a few key points of OT.[4] A grammar in OT consists of a set of universal constraints, present in every language, which define surface well-formedness. **Gen**(erator) is a function which maps each underlying form to an (unbounded) set of candidate surface forms, by freely inserting features, freely parsing or failing to parse material (structure and features), and freely generating domain structure of every type. Gen is constrained by the Faithfulness conditions ***Insert** and *$< \alpha >$, which prohibit insertion and underparsing of phonological material. Constraints are violable, and thus reflect only general trends and tendencies in a phonological system, rather than absolute truths about surface well-formedness. Constraints are ranked, and ranking determines which of two constraints will be upheld when they impose mutually incompatible requirements.

Within ODT, harmony occurs when a constraint that builds a wide harmony domain is ranked above a constraint that builds a narrow domain. More generally, we claim:

(3) **Harmony reflects the optimization of constraints on the structure of F-domains with other constraints on the realization of [F].**

In a language with no harmony, the F-domain for the feature [F] is properly aligned with the underlying F-bearing anchor by a set of constraints termed **Basic Alignment**, given in (4). BA says that every *sponsoring* anchor of [F] (Anchor-s) is aligned with the edge of a F-domain. An anchor *sponsors* [F] if it is affiliated with [F] in underlying representation. Non-sponsoring anchors are those anchors that come to be affiliated with [F] in the mapping form underlying to surface form, by the operations of Gen.[5] Sponsors may be X-slots or moras, for so-called “linked” features, or morphological constituents, for so-called “floating” or morpheme-level features.

[4]The reader who is unfamiliar with this theory is referred to McCarthy & Prince (1993a,b) and Prince & Smolensky (1993) for a more detailed presentation of the theory.

[5]We are considering here only those cases where harmony is triggered by an underlying feature specification. There is reason to believe that a less restricted version of BA (and Wide Scope Alignment—see below) is active in languages where an inserted feature can also trigger assimilation.

(4) **Basic Alignment**:

BA-left Align(Anchor-s,L; F-domain,L)

BA-right Align(Anchor-s,R; F-domain,R)

Harmony occurs when BA is violated in favor of constraints which dictate larger F-domains. Before stating those alignment constraints, we pause to consider their underlying motivation. What factors drive the existence of larger F-domains? We offer the following two principles:

(5)

Perceptibility: Features should be perceptible.

Articulator stability: Minimize changes from the neutral, steady state of the articulators.

Perceptibility derives from the fact that features serve to mark contrast, and must be perceptible to fulfill their function. Many properties of phonology and phonetics can be attributed to the goal of enhancing perceptibility. Articulator Stability reflects that fact that features are implemented by an articulatory system which imposes its own constraints on the realization of features. Both principles are best satisfied whenever a feature is realized over a relatively long span, which is expressed in the principle of Extension.

(6)

Extension: Extend a feature over longer stretches of sound in order to maximize Perceptibility and Articulator Stability.

There is an inherent tension between the principle of Extension and the functional role of a feature to mark contrasts, since when a F-domain is extended, the possibility of contrast between [F] and its absence is eliminated in all positions within the extended domain. We believe that languages resolve this tension differently, through the ranking of harmony-inducing constraints on F-domains with Faithfulness constraints that preserve underlying contrasts, giving rise to the complex typology of harmony systems.

The principle of Extension is realized in the constraint-grammar by the family of constraints we term **Wide Scope Alignment** (WSA), which extend an F-domain to the edge of a morphological or prosodic constituent. For example, in languages with rightward [F]-harmony, the WSA-right constraint is ranked above BA-right; leftward harmony ranks WSA-left above BA-left; and bidirectional harmony ranks both WSA constraints above both BA constraints.

(7) **Wide Scope Alignment** (WSA)

WSA-left Align(F-domain,L; P-Cat/M-Cat,L)

WSA-right Align(F-domain,R; P-Cat/M-Cat,R)

Harmony domains are licensed by the alignment constraints, but alignment alone does not force the realization of the harmony feature within the domain. That job is done by an independent constraint termed Expression.[6]

(8) **Expression:** [F] must be affiliated with every anchor in an F-domain.

Like all constraints, Expression may be violated. Violations derive from restrictions on the insertion or affiliation of [F]. The most basic constraint of this sort is *Insert [F].[7] Harmony occurs when a language ranks Expression over *Insert [F]. With the opposite ranking, no harmony will be possible at all, though the domains may be constructed.[8]

(9)

Harmony:	WSA, Expression >> *Insert [F]
No Harmony:	*Insert [F] >> WSA, Expression

Expression may also be violated in the presence of highly ranked constraints on feature occurrence. For example, constraints such as [ATR]*rightarrow*[vocalic] impose distributional restrictions on the realization of features, in this case restricting [ATR] to vowels. In a ATR harmony system, this feature occurrence constraint would serve to identify only vowels as potential anchors for ATR. Another type of constraint is the feature co-occurrence constraint, termed **CLASH** constraint here, which marks certain feature combinations as ill-formed. For example, *[ATR, Low] disfavors low, ATR vowels, and can prevent ATR from being inserted on an anchor which is specified Low, and vice-versa.

In short, wide F-domains arise when a language ranks WSA over BA. The harmony feature is realized in the F-domain due to the Expression constraint, which must be ranked over *Insert [F]. Feature occurrence constraints may also be ranked over Expression, creating situations in which some elements in the P- or M-domain for harmony will not undergo harmony. We claim that it is this situation which derives transparency and opacity in ODT. Specifically, we propose that transparency and opacity follow from the following constraint rankings:

(10)

Transparency:	F-Occurrence, WSA >> Expression
Opacity:	F-Occurrence, Expression >> WSA

3 Transparency and opacity in tongue root harmony

The ODT approach to harmony sketched above is illustrated here with the analysis of opacity and transparency in two tongue root harmony systems. We contrast the behavior of two languages, Idealized Pulaar and Idealized Kinande, which have in common an underlying inventory of nine vowels in which the features ATR/RTR are contrastive only among the

[6]Expression can be satisfied either by inserting individual tokens of [F] on each anchor in an F-domain, or by establishing multiple associations between a string of anchors and a single token of [F], as in the standard autosegmental representation. The ODT analysis of harmony simply does not require multiple associations to account for transparency or opacity; however, we allow that there may be independent reasons to include multiply linked features in the set of well-formed representations.

[7]We assume that the general constraint *Insert is expoded into a family of constraints, one for each feature and each type of structure in the set of phonological primitives.

[8]While we do not explicitly rule out this scenario, it is likely that such a grammar does not exist. There would be no surface cues for the existence of a wide scope F-domain if it never induces F-harmony due to the ranking of *Insert [F] over Expression.

non-low vowels: [ATR] /i,e,o,u/ and [RTR] /ị,ẹ,ọ,ụ/ and /ạ/.[9] The absence of an ATR, low vowel in both languages can be attributed to the CLASH constraint *[ATR,Low]. In both languages, ATR extends leftward from a high or mid vowel to the beginning of the word. In Idealized Pulaar, ATR harmony is blocked by a low vowel, as shown in examples (e,f) in the following data:

(11) Idealized Pulaar: opaque /ạ/

	underlying	*surface*	
a.	pẹẹc-i	peec-i	'fente' Pl.
b.	pẹẹc-ọn	pẹẹc-ọn	'fente' Dim.Pl.
c.	dọg-ọọ-ru	dog-oo-ru	'coureur' Sg.
d.	dọg-ọ-w-ọn	dọg-ọ-w-ọn	'coureur' Dim.Pl.
e.	bọọt-ạạ-ri	bọọt-ạạ-ri	'dîner' (*bootaari, *bootạạri)
f.	pọọf-ạạ-li	pọọf-ạạ-li	'respirations' (*poofaali, *poofạạli)

This system can be characterized with the following constraint grammar:

(12) Constraint grammar for Idealized Pulaar:

CLASH:	*[Low,ATR]
BA-rt:	Align(Anchor-s,R;[ATR]-domain,R)
Express:	Express[ATR]
WSA-lf:	Align([ATR]-domain,L; Word,L)
BA-lf:	Align(Anchor-s,L;[ATR]-domain,L)

ranking: CLASH, BA-rt, Express >> WSA-lf >> BA-lf

The following tableaux illustrate the evaluation of an underlying sequence with an opaque vowel (the first candidate set), and a fully harmonizing sequence (the second candidate set), based on the grammar in (12). Note that the sponsoring anchor (the trigger for ATR harmony) is the rightmost vowel in both words.

(13) Evaluation: Idealized Pulaar

	UR: CṿC-ạ-Cv	CLASH	BA-rt	Express	WSA-lf	BA-lf
#	a. CṿC-ạ-(Cv)				*	
	b. (CvC-a-Cv)	!*				*
	c. CṿC-ạ-Cṿ		!*			*
	d. (CvC-ạ-Cv)			!*		*
	UR: CṿC-v					
#	a. (CvC-v)					*
	b. CṿC-ṿ		!*			*
	c. (CṿC-v)			!*		
	d. CṿC-(v)				!*	

[9]The harmony systems of actual Pulaar and Kinande involve additional complications which do not affect the demonstration that is the focus of this discussion. See Archangeli & Pulleyblank 1993 for discussion and comparison of these two harmony systems within an extended autosegmental framework. The characterization of Pulaar and Kinande below is based on the data presented in that work.

In the first candidate set, the (a) candidate wins—even though it violates Wide Scope Alignment, it is the only candidate to satisify the three more highly ranked constraints. In the (b) candidate the low vowel undergoes harmony, violating CLASH. The (c) candidate has no harmony, and there is no domain for the underlying ATR feature. The (d) candidate allows the low vowel to be transparent in the middle of a harmony domain, violating Expression. In the second candidate set, the winning candidate builds fully satisfies Wide Scope Alignment and all three of the highest-ranked constraints.

In Idealized Kindande, the low vowel is transparent to ATR harmony, as the following forms show (tone is omitted, and capital vowels are used to represent vowels with undetermined underlying values for ATR/RTR):

(14) Idealized Kinande: transparent /ạ/

	underlying	*surface*	
a.	tU-kạ-kI-lim-ạ	tukạkilimạ	'we exterminate it'
b.	tU-kạ-kI-lịm-ạ	tụkạkịlịmạ	'we cultivate it'
c.	tU-kạ-kI-huk-ạ	tukạkihukạ	'we cook it'
d.	tU-kạ-mU-hụm-ạ	tụkạmụhụmạ	'we beat him'

Transparency in Idealized Kinande can be accounted for with the following grammar:

(15) Constraint grammar for Idealized Kinande:

CLASH: *[Low,ATR]
BA-rt: Align(Anchor-s,R;[ATR]-domain,R)
WSA-lf: Align([ATR]-domain,L; Word,L)
Express: Express[ATR]
BA-lf: Align(Anchor-s,L;[ATR]-domain,L)

ranking: CLASH, BA-rt, WSA-lf >> Express >> BA-lf

The tableaux below illustrate evaluation for two schematized examples: the first set with an underlying transparent low vowel, and the second set with no transparent vowel. In both examples, the sponsoring anchor of [ATR] is again the rightmost vowel.

(16) Evaluation: Idealized Kinande

	UR:CV-kạ-Cv	CLASH	BA-rt	WSA-lf	Express	BA-lf
#	a. (Cv-kạ-Cv)				*	*
	b. (Cv-ka-Cv)	!*				*
	c. Cṿ-kạ-Cṿ		!*			*
	d. Cṿ-kạ-(Cv)			!*		

	UR: CV-Cv					
#	a. (Cv-Cv)					*
	b. Cṿ-Cṿ		!*			*
	c. Cṿ-(Cv)			!*		
	d. (Cṿ-Cv)				!*	*

The analyses of Idealized Pulaar and Kinande show that the same constraint set, ranked differently, yields both transparency and opacity of the low vowel in tonge root harmonies.

The ODT approach differs from Archangeli & Pulleyblank's autosegmental approach most substantially in the treatment of transparency. A&P adopt the No Gapping Constraint, which states that a multiply-linked feature cannot skip over a potential target; thus, transparent segments *cannot* be within the domain of a spreading feature in phonological representations.[10] In contrast, in the ODT analysis of transparency, a transparent segment is within the F-domain of harmony, but is simply immune from realizing the feature [F] due to a highly ranked feature occurrence constraint. The No Gapping Constraint plays no role in the ODT analysis of harmony, and is really only meaningful under the assumption that harmony involves association of a single token of the harmony feature to multiple anchors. As noted earlier, the ODT analysis does not require multiple association—but it is clear that if multiple association is allowed, and if the No Gapping constraint is part of universal grammar, then the ODT analysis of transparency would lead to a violation of the No Gapping Constraint.[11]

4 Opacity in round harmony

With this much in the way of background, let us turn now to exemplification of ODT in the analysis of round harmony. Many round harmony systems show an asymmetrical harmony of [Round] across high and low vowels. For example, in Turkish, [Round] extends rightward across a sequence of high vowels and is blocked when it encounters a low vowel (Clements & Sezer 1982).

(17) Turkish Round Harmony

gen.sg.	*gen.pl.*	
ip-in	ip-ler-in	'rope'
yüz-ün	yüz-ler-in	'face'
k*i*z-*i*n	k*i*z-lar-*i*n	'girl'
pul-un	pul-lar-*i*n	'stamp'

The opaque behavior of low vowels can be accounted for by the CLASH constraint *[Rd,Low]. Although the round low vowel /o/ appears in underlying representations, it is never derived in the round harmony system. To explain why underlying low round vowels surface, despite the presence of the CLASH constraint in the grammar, it suffices to rank Parse[Rd] and Parse[Low] above *[Rd,Low], as shown in the following tableau, which evaluates surface candidates for a schematic underlying form *CoC*.

[10] A&P treat transparency in Kinande at the level of phonetic implementation. Low vowels are targets for the phonological ATR harmony, but only variably realize the feature [ATR]. They propose that a late, phonetic principle allows [ATR] to be realized on a low vowel under special prosodic conditions. Elsewhere, a [+ATR] specification on a low vowel will simply fail to be realized. Thus, there is really no transparency at the phonological level in Kinande. However, they acknowledge genuine phonological transparency, as in their analysis of Wolof, in which case the No Gapping constraint rules out the sort of treatment proposed in ODT.

[11] Our current position is that there is no clear need for the No Gapping constraint in ODT, and therefore it is not adopted. The larger issue to be addressed here is the role of locality as a condition on the statement of phonological constraints. Akinlabi (this volume) and Kirchner 1993 propose an OT treatment of harmony which maintains the No Gapping constraint. Although, neither proposal addresses the treatment of transparency, we imagine that it would be possible to violate No Gapping by allowing multiple association to skip over a transparent segment. Differences between their OT approach and the domains-based approach advocated here would arise in the analysis of systems which manifest *both* transparency and opacity, and are considered in more detail in our work in progress.

(18) Ranking *[Rd,Low]

	UR: CoC	Parse[Rd]	Parse[Low]	*[Rd,Low]
#	a. CoC			*
	b. CaC	!*		
	c. CuC		!*	

Ranking the CLASH constraint and Expression above WSA derives the opacity of the low vowels, in exactly the same way that opaque low vowels are derived in the ATR harmony of Idealized Pulaar. An illustrative tableau is shown below, where surface candidates for a schematic underlying sequence of /*o...A...I*/ are evaluated.[12]

(19) Evaluation: opaque low vowels in Turkish round harmony

	UR: o A I	BA-lf	Prs[Rd]	Prs[Lo]	*[Rd,Low]	Expr	WSA-rt
#	a. (o) a *i*				*		*a,*i*
	b. (a a *i*)		!*	!*			
	c. (o o u)				*!*		
	d. (o a u)				*	!*	

Note that the CLASH constraint *[Round,Low] is violated by candidates (a,c,d), because of the specification of these two features on the underlying root vowel /o/. Only (b) satisfies CLASH, but fails since the underlying feature specifications are not parsed into F-domains. Candidate (c) violates CLASH twice: once for the root vowel, and a second time by realizing [Round] on the low suffix vowel. In this case (a) wins, even though it has failed to satisfy WSA, and has only a narrow harmony domain.

5 Parasitic domains in round harmony

Consider next the round harmony system of Kazakh, as described in Korn 1969. Like Turkish, Kazakh has a palatal/velar harmony that extends left-to-right across the word. But the Kazakh system is a little more complicated than Turkish, because the round harmony operates differently in palatal and velar harmonic words. In velar harmonic words, low vowels are opaque to round harmony, just as in Turkish. Licit and illicit vowel sequences are listed below:

(20) Kazakh round harmony: velar harmonic words

[12] Capital letters represent unspecified suffix vowels. Since in Turkish the suffix vowels are *always* in the domain of root-controlled harmony, there is no evidence for any underlying specification for the features Palatal, Velar, or Round. In cases like this, we allow the possibility that the harmonizing vowels are unspecified in underlying form, as suggested by Steriade (1993). The alternative would be to arbitrarily assign some underlying features to the suffix vowels. In that case, the constraint grammar would have to be constructed so that the features [Round], [Palatal], and [Velar] on a suffix are realized *only* when they are in the same F-domain as the root vowel. This approach would also require separating the Parse constraints into two groups: Parse[F] for root vowels, and Parse[F] for suffix vowels. The latter set would have to be ranked below the WSA constraint that gives rise to the large harmony domain, forcing a suffix vowel to lose its underlying specification in favor of realizing the harmony feature in the wide scope F-domain. On the other hand, the Parse constraints for root vowels would have to be ranked above WSA, to ensure that an underlying feature specification on a root vowel is always parsed, and always triggers harmony. (This discussion ignores the treatment of disharmonic roots, which however pose no problem for the ODT approach.)

	underlying		*surface*	
Low targets:	u A	⟶	u a	(*u o)
	o A	⟶	o a	(*o o)
Hi targets:	u I	⟶	u u	(*u i)
	o I	⟶	o u	(*o i)

The CLASH constraint *[Rd,Low] can derive opacity here, just as in Turkish, with the same grammar, repeated in (21).

(21) Kazakh grammar (preliminary)
*[Rd,Low], Expression >> WSA-rt

Now, observe that in palatal harmonic words there is uniform round harmony—both high and low vowels are targets, as seen in (22).

(22) Kazakh round harmony: palatal harmonic words

	underlying		*surface*	
Low targets:	ü A	⟶	ü ö	(*ü e)
	ö A	⟶	ö ö	(*ö e)
Hi targets:	ü I	⟶	ü ü	(*ü i)
	ö I	⟶	ö ü	(*ö i)

Clearly, the *[Rd,Low] constraint is violated in the surface forms of some palatal harmonic words. We analyze this as a case of parasitic harmony, where one feature spreads within an F-domain defined by another feature. The Parasitic constraint, formulated in (23), requires the round domain to be co-extensive with the palatal domain of the sponsoring anchor.

(23) **Parasitic(Rd,Pal):** If two anchors are in the same [Pal]-domain then they must be in the same [Rd]-domain.

Parasitic(Rd,Pal) is ranked above *[Rd,Low] with the result that *[Rd,Low] will be violated in palatal harmonic words in order to satisfy the Parasitic constraint. The following tableau demonstrates the effects of these two ranked constraints.

(24) Evaluation: Kazakh round harmony in palatal harmonic words

	UR: ü A	Paras.	Express	*[Rd,Low]	WSA-rt
#	(ü ọ)			*	
	(ü) e	!*			*e
	(ü e)		!*		
	UR: ü I				
#	(ü ü)				
	(ü) i	!*			
	(ü i)		!*		

The grammar with the Parasitic(Rd,Low) constraint succeeds in selecting the correct surface candidate. Of course, ODT must explain the underlying motivation for the Parasitic constraint, and determine which features may be dependent on one another in this fashion. We suggest that the Parasitic constraint is motivated in this case by the marked status of the feature combination [Rd,Pal]. In general terms, the Parasitic constraint provides a mechanism for extending a marked feature combination, thereby increasing perceptibility. In terms of the principles discussed earlier, the Parasitic constraint instantiates the Extension principle in the constraint grammar, by prolonging marked configurations.[13] We leave it for future research to explore the full set of Parasitic constraints, and to determine whether all cases of parasitic harmony involve marked feature combinations.[14]

6 Faithfulness vs. harmony

Lastly, we turn our attention to Uyghur, described in Hahn (1991). In this language round harmony targets only the high epenthetic vowel, as shown in (25a). Both epenthetic and suffix vowels undergo palatal/velar harmony, but suffix vowels never harmonize with the root vowel in roundness, as shown in (25b). (25c) shows that suffix vowels may be inherently round.

(25) Uyghur round harmony

a.	*underlying*	*surface*	
	üzm-m	üzümüm	'my grape'
	klub-	kulup	'club'
	čöml-š	čömölüš	'my immersion'
b.	küč-I	küči	'its power'
	kön,l-dIn	kön,üldin	'from the heart'
	yüz-m-dIn	yüzümdin	'from my face'
c.	kiy-gU	kiygü	'wear'DECID.
	kät-gU	kätkü	'go'DECID.
	qat-gU	qatqu	'harden'DECID.
	qur-gU	qurğu	'dry'DECID.

The asymmetry in the harmonic behavior of underlying and epenthetic vowels is accounted for in ODT by appealing to the Faithfulness condition. We explode the *Insert[Rd] constraint into two separate constraints:

(26) Exploding Faithfulness
(a) *Insert[Rd] on an underlying anchor
(b) *Insert[Rd] on an anchor

The (a) constraint is more restricted, and has no effect on insertion on an epenthetic anchor. The basic idea here is that epenthetic elements contain no underlying structure which the Faithfulness constraints *Insert and Parse must preserve. This makes epenthetic elements better servents to feature extension. The two *Insert constraints are in an 'elsewhere' ranking, (a) >> (b). In Uyghur, the Expression constraint that drives round harmony is ranked between the two *Insert constraints, which means that [Rd] will never be inserted

[13] Our account of parasitic harmony as the principled extension of a marked feature combination is inspired by a suggestion in Steriade (1993).

[14] Preliminary results are promising. In addition to Kazakh, Yawelmani round harmony can be analyzed with the use of Parasitic constraints involving [Rd,Low] and [Rd,Hi].

on an underlying anchor, but may be inserted on an epenthetic anchor to satisfy harmony. The ranked constraints are as follows:

(27) Constraint grammar for Uyghur round harmony
*Insert[Rd]-(a) >> BA-lf, Express[Rd] >> WSA-rt >> *Insert[Rd]-(b)

The analysis of these facts in AP, which has no analogue of Faithfulness, is extremely problematic. It would seem to require either an ad-hoc specification of [-Rd] on unrounded suffix vowels, with epenthetic vowels unspecified, or a restriction on round harmony to the effect that it can apply only to a completely featureless vowel.

7 Summary

We have proposed ODT as an alternative to the autosegmental view of assimilation as spreading. In the ODT approach, a feature [F] is realized within a phonological constituent, termed F-domain. An F-domain is restricted to the span of the sponsoring anchor in the unmarked case, but in cases of F-harmony the domain has wide scope, defined in terms of prosodic or morphological constituents. The Expression constraint requires that within an F-domain all anchors should be specified for [F]; however, this constraint may conflict with feature occurrence constraints that restrict the affiliation of [F]. The ranking of the constraints on alignment of F-domains with the Expression and feature occurrence constraints gives rise to a typology of harmony systems with different properties of transparency and opacity. These results are achieved without any appeal to feature underspecification or feature geometry, because harmony is not viewed as autosegmental spreading. Finally, we see that the Faithfulness condition in ODT provides an account for why epenthetic elements may undergo harmony processes that do not affect underlying segments.

8 Notes

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