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Violable principles and typological variation[*]

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Abstract

In the Government-based literature, all structural principles supplied by UG are, without exception, assumed to exert their influence over every well-formed representation. We do find cases, however, where two principles that appear to be universally applicable make opposing predictions as to the grammaticality of a given structure. To resolve such instances of principle clash, I propose a localised form of principle ranking whereby a principle may be violated in order to allow a more highly ranked principle to make its contribution to grammaticality. I show how the incorporation of ranking into a principles-based model can make useful predictions concerning typological variation within ATR harmony systems.

1 Grammaticality as structural well-formedness

From the assumption that phonological processes play a role in determining the overall shape of representations, it follows that one of the primary functions of an explanatory theory must be to impose limits on the ways in which a structure can be manipulated by the phonology. Without establishing such limits, a theory would inevitably fail to account for the finite nature of phonological knowledge. However, this task of defining the boundaries of structural change presupposes a more fundamental role undertaken by the grammar — that of predicting the form of a possible representation. Specifically, a grammar must establish what kinds of structure may potentially serve as the input to, and the output of, a phonological operation. Indeed, the capacity for distinguishing between well-formed and ill-formed structures is traditionally seen as the cornerstone of the generative view of language.

Here I maintain this basic tenet of the generative approach, where the grammar is presented as a device for creating well-formed representations to the exclusion of

[*]This discussion forms part of a broader study of tongue root harmony systems to be found in Backley (1998). I am most grateful to John Harris for his comments on the material presented here.

everything else — whether such representations are specified as lexical objects or as the output of phonological processes. But how can grammaticality be gauged? What factors determine whether or not a representation is well-formed? One response to this question comes from the principles-based position advanced by Kaye, Lowenstamm & Vergnaud (1985, 1990) and subsequently developed in the Government Phonology literature.[1] According to this view, all languages must conform to a core set of very general principles of structure which preside over the form of phonological objects. Such universal conditions regulate all aspects of representation and derivation, including prosodic constituency, empty structure, melodic interpretation, locality and structure preservation.

Although universal principles provide an appropriate means of capturing the structural characteristics that are shared by all languages, we cannot ignore the (limited degree of) variation which is nevertheless observed between different systems. In the case of syllable structure, for example, while an onset constituent is always licensed by a nucleus to its right, languages do differ with respect to the number of timing slots that can be supported by that licensed onset. Given that the choice is regularly restricted to one of only two possible options (either a single or a binary branching constituent), the facts of cross-linguistic variation can, in this instance, be neatly accommodated by the introduction of a parameter — essentially, a 'switch' device that offers a limited number of choices or 'settings' within a given area of variation. Parameters themselves are assumed to co-exist alongside the set of structural principles as statements of Universal Grammar, their language-specific settings becoming fixed during acquisition.

In the Government-based literature, the notion of parametric variation occupies a central position within the overall view of grammar construction, as emphasized by its alternative description as a 'Principles-and-Parameters' approach. Recently, however, the suitability of parameters as a means of encoding cross-linguistic variation has been called into question (Polgárdi 1996), and investigations are under way into the possibility of exploiting the language-specific ranking of universal principles instead. In a move which reflects the advances made within Optimality Theory (Prince & Smolensky 1993) and its more recent manifestations, the assumption that representational diversity is based on a selection between various parametric options has given way to an alternative approach which claims that all statements of grammar relating to phonological well-formedness are both prescriptive (i.e. without parametric choice) and universal. The structural

[1]See Brockhaus (1995), Charette (1991), Harris (1994a), Harris & Lindsey (1995) and Kaye (1989, 1995).

differences between language systems are then captured by assuming that individual principles (or 'constraints' — the favoured term within the OT literature) may be violated, specifically to ensure that other principles are satisfied within the same language. To identify precisely which constraints are susceptible to violation in any given system, the theory makes appeal to a language-particular constraint hierarchy which establishes a series of dominance relations holding between all the members of the set of universal constraints.

In the analysis that follows, I explore how the notion of principle ranking — which is forced by a situation where two or more principles make conflicting predictions as to the grammaticality of a single representation type — may be successfully incorporated into an otherwise principles-based description. What this hybrid phonology highlights, above all else, is the potential benefit to be gained from blurring the conventional boundaries that mark the assumed incompatibility between different theoretical models.

2 Theoretical context

Here I adopt the model of Tier Geometry developed in Backley (1995, 1998), Backley & Takahashi (1998) and Takahashi (in prep). Taking as its point of departure the triangular Element Theory view of vowel composition, the Tier Geometry approach demonstrates how the explanatory potential of the basic A-I-U set may be enhanced by the introduction of an intra-segmental geometry of element tiers. It proposes that such a configuration be constructed according to the same general principles of licensing that control the well-formedness of prosodic structure. In this way, we can identify a unified representational hierarchy that highlights the interrelatedness between the various melodic and prosodic components of the phonological structure. The melodic geometry of a language is built around a small set of parametric choices controlling (i) tier sharing and division, (ii) the structural dependency relations holding between elements, and (iii) the licensing of a complement tier (where the latter effectively replaces the notion of melodic headship). An active complement tier has the effect of enhancing the saliency of its head tier: for example, the contrast between **e** and **ɛ** may be encoded by the active versus inactive status of an [I]-tier complement.

A language's sub-segmental tier structure — defined according to a limited number of configurational options and latently present within every nuclear position — provides a melodic template which delimits the range of oppositions each position may support.

Before elemental material can be phonetically realized, however, the relevant melodic tier(s) must be identified by the lexicon as a potential target for interpretation. The model proposes, therefore, that the melodic template interacts with a single kind of lexical activation instruction, ACTIVATE [α] (Backley & Takahashi 1996), which typically applies at the skeletal level to give the kinds of 'segmental' contrasts found universally. In addition to lexical conditions, there are also prosodic conditions which need to be satisfied before an element can be successfully interpreted. Specifically, the melodic structure in question must receive an adequate amount of licensing potential. Following Harris (1998), I assume that the flow of licensing potential is controlled via a mechanism of Licensing Inheritance, which applies throughout the unified melodic-prosodic structure and predicts various dynamic phenomena and distributional asymmetries linked to prosodic strength and structural complexity.

In this paper I focus on the behaviour of ATR harmony systems, and in particular, on two of the most frequently occurring areas of cross-linguistic variation found within this typological set. The tier-geometric representation of harmony is achieved by optionally specifying lexical activation at higher prosodic levels such as the foot and the prosodic word. This results in the 'wide scope' interpretation of any given melodic property: for example, a word-level instruction ACTIVATE [A] describes the kind of vowel height agreement found in languages such as Chicheŵa (Harris 1994b), word-level ACTIVATE [I] gives palatal harmony as found in the Altaic languages, while the word-level activation of a complement tier predicts harmony involving tongue root properties. I begin in §3 by offering a brief outline of the way in which tongue root harmony may be described within the tier-geometric model. This forms the basis of a more detailed discussion of the ways in which the model might accommodate areas of typological variation such as the behaviour of neutral vowels and the representational differences between 9 and 10 vowel systems. I propose that such issues may be successfully accommodated by the introduction of a restrictive form of principle ranking.

3 A tier-geometric view of ATR harmony

The means of representing tongue root harmony within the tier-geometric model is fully motivated in Backley & Takahashi (1998). In this section I offer only an outline of the basic mechanism involved, which should nevertheless provide the necessary background to allow the analysis in §4 to be followed without the need for additional explanation. Here I illustrate harmonic behaviour with examples from Turkana (an Eastern Nilotic

language, spoken in Kenya), which has been the focus of a number of different analyses in the recent literature — see Dimmendaal (1983), van der Hulst and Smith (1986), Noske (1990) and Vago and Leder (1987), from which my data have been taken.

The nine vowel system of Turkana may be divided into two harmonic sets, distinguished on the basis of ATR.

(1) *harmonic groupings in Turkana*

ATR:	i, u, e, o
non-ATR:	ɪ, ʊ, ɛ, ɔ, a

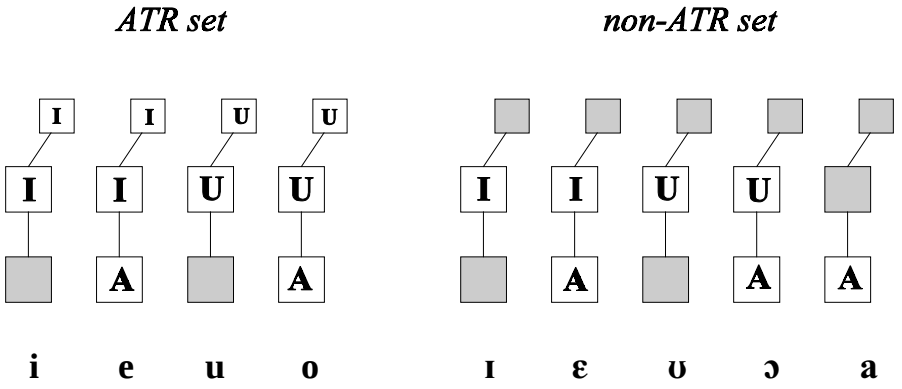
In keeping with the expected distributional characteristics of an ATR harmony language, it is generally the case that all vowels within any given word domain must be taken exclusively from one of the harmonic sets in (1). The choice between the ATR and the non-ATR set in Turkana is determined by the lexical marking on either the root portion or the suffix portion of each concatenated form. To illustrate the operation of root-controlled harmony, consider the following:

(2)	a.	ɛ-ɛm-ɪ	3rd person-'fear'-aspectual	'(s)he will fear'
	b.	e-los-i	3rd person-'go'-aspectual	'(s)he will go'

Here, an alternation is observed with respect to both affixes, such that the vowel of each is interpreted as ATR when attached to an ATR verb root, but is otherwise interpreted as the corresponding non-ATR vowel. For example, the aspectual suffix *-I* manifests itself as ATR **i** under the influence of the ATR root *los* 'go'.

The relevant phonological oppositions are set out in (3) below, arranged according to their harmonic groupings. The geometric configuration given here involves the addition of a colour tier complement — as a means of encoding tongue root distinctions — to a two-tier structure of the sort employed in five-vowel systems such as Spanish, which is built around the colour versus aperture split.

(3)



As (3) demonstrates, the vowel inventory of Turkana is generated by exploiting all possible permutations of the lexical activation instructions made available by the melodic template; in other words, all potential contrasts generated by the structure are utilized in the phonology of the language. The two harmonic sets are distinguished on the basis of the active or inactive status of the complement tier, where the lexical instruction **ACTIVATE [COMP]** identifies a natural class of sounds comprising exclusively ATR vowels. It may be noted that the inability of the low vowel to participate in tongue root alternations is, in fact, a predicted characteristic of vowel systems using this particular melodic template. In view of a structural condition that is independently motivated in Backley (1995), whereby an active complement tier can only be licensed by an *active* head tier, it would appear impossible for the vowel **a** — which lacks an active colour tier — to pattern with the ATR harmonic set, or to show the same tongue root alternations that are observed elsewhere in the same system. So, an inactive [I/U]-tier entails a (phonologically) non-ATR expression.

Building on the representational structure shown in (3), I now focus briefly on the behaviour of tongue root properties in Turkana. Of particular interest is the systematic way in which ATR is specified as a word-level property, resulting in the harmonic characteristics illustrated in (2) above. I shall claim that the effects of ATR harmony can be formalized by referring to the lexical operation **ACTIVATE [COMP]**, but by ruling that this instruction be specified not within the bounds of any minimal prosodic domain — that is, not in terms of a single unit of the 'core' or 'skeletal' tier, which I assume defines the scope of most instances of lexical contrast — but instead, at the level of the prosodic

word.[2] Indeed, I suggest that it is this word-level activation of [comp] which gives Turkana its particular harmonic properties.

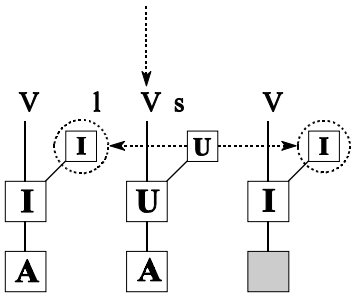
To illustrate how an account of ATR agreement as [comp] harmony might proceed within the present model, let us consider the example of root-controlled harmony given in (2). The structures employed in the phonological representation of the affixes *E-* (3rd person) and *-I* (aspectual marker) contain a colour tier complement, by virtue of this [comp] unit being included in the melodic template for the language as a whole. As shown in (4), the complement tier is inactive in the respective lexical forms of these affixes. This is encoded in terms of the absence of any **ACTIVATE [COMP]** instruction.

(4) a. *E-* (3rd person) b. *-I* (aspectual)

However, when these forms are attached to an ATR root in the formation of a prosodic word, the complement tier in the affix vowels is activated, due to the presence of an active [comp] in the verb root. Specifically, it is the *word-level* instruction to activate the complement tier which brings about the harmonic agreement observed. The harmonic effects resulting from **ACTIVATE [COMP]** in Turkana are demonstrated in (5), where dotted arrows indicate the transfer of the word-level activation instruction.

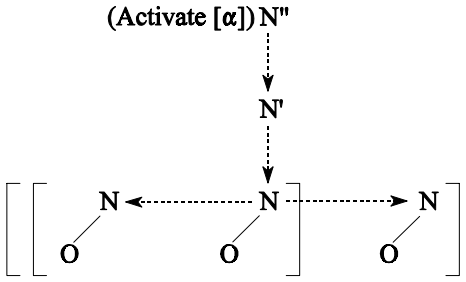
[2]The motivation behind the specification of melodic properties at higher levels of the prosodic hierarchy is formalized in Cole and Kisseberth (1994) as the Principle of Extension. This is discussed in §4.2 below.

(5) e-los-i '(s)he will go'



The representation in (5) illustrates how wide-scope activation — that is, activation affecting a domain larger than that defined by a single nucleus — gives rise to melodic agreement. I assume that the word-level activation instruction is borne initially by the nucleus which acts as the head of the word domain, specified lexically as a property of the N'' constituent. At the lowest level of nuclear projection, the instruction is then transmitted (bi-directionally, in the default case) via a chain of local inter-nuclear relations throughout the extent of the harmonic span, as depicted in (6).

(6) *'horizontal' transmission of word-level activation instruction*



The word-level ATR harmony of Turkana, then, may be captured in representational terms by identifying an extended span of activation along the complement tier, the scope of this span being defined with reference to the prosodic word domain. In other words, the lexical instruction **ACTIVATE [COMP]** is characterized as a word-level (N'') specification in Turkana, and manifests itself melodically throughout the phonological string contained within that domain.

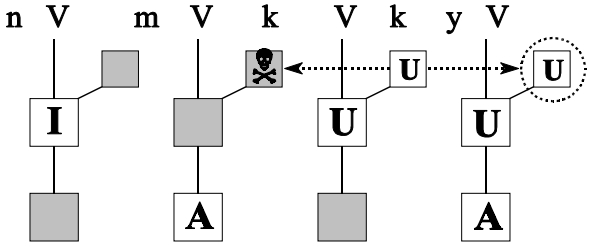
An additional property of this language refers to the behaviour of its low vowel **a**,

which exhibits a blocking effect on the propagation of harmony across a word domain; this opacity is illustrated in the following examples:

(7)	a.	ɛ-makuk	(*e-makuk)	'chair' (singular)
	b.	ŋɪ-makuk-yo	(*ŋi-makuk-yo)	'chair' (plural)
	c.	ŋɪ-kɪŋɪm-aan-ot-in	(*ŋi-kiŋim-aan-ot-in)	'deaf'-hab-deverb-pl.

We can assume that the noun root in (7a) is lexically ATR, in view of the advanced high vowel **u** which it contains. However, this ATR specification is unable to trigger harmony on the prefix vowel, owing to the presence of the opaque low vowel in the leftmost nucleus of the root. The form in (7b) confirms the status of **a** as a harmonic blocker: the prefix vowel is, once again, prevented from harmonizing to the ATR root, whereas the suffix vowel *can* undergo harmony, since there is no low vowel in the rightmost nucleus to block the rightward propagation of ATR agreement. The blocking effect of **a** is illustrated below.

(8) ŋɪ-makuk-yo 'chair' (pl.)



In (8), the noun root *makuk* 'chair' is lexically defined as an ATR morpheme — its phonological description includes the word-level lexical instruction **ACTIVATE [COMP]**. Given the status of this instruction as a word-level specification, we expect alignment in terms of an active [comp] throughout the relevant domain, resulting in ATR agreement. However, the low vowel is unable to comply with this melodic requirement, and therefore fails to alternate. In addition, this failure has repercussions for other vowels within the same word domain, owing to the way in which [comp] activation is transmitted from one position to the next: at the particular point (marked by ☠ above) in the phonological string where [comp] cannot be interpreted, the chain of local inter-nuclear relations is effectively broken, thereby interrupting the span of activation and

halting the further progress of the activation instruction. On this basis, we express harmonic alignment in terms of an *unbroken* span of activation along a given melodic plane.

From this short overview of tongue root harmony and the way in which the general pattern may be represented within the Tier Geometry model, I now consider several aspects of harmonic behaviour that appear in only a subset of the languages belonging to this typological group. As already indicated, this systemic diversity will be shown to fall out from the different localised rankings arising from cases of principle clash.

4 Variations on a theme: accounting for systemic diversity

4.1 Introduction

As Clements points out, the study of related languages can offer 'interesting possibilities for observing minimal patterns of variation across the same or very similar structural conditions' (1991:37). In the case of the ATR-harmony systems to be described here we can identify a number of shared structural conditions, such as (i) the use of a melodic template identical to that proposed for Turkana, and (ii) the assumption that the lexical instruction **ACTIVATE [COMP]** is specified as a word-level property. Despite these structural similarities, however, we must also allow for some degree of typological variation within the group of languages displaying tongue root harmony. Here, I focus on two particular areas of variation that are among the most frequently observed: first, I consider the option of recognizing low vowel transparency, as opposed to the opacity observed in Turkana; and second, I explore the possibility of making an apparent tongue root distinction in low vowels. The analysis of Kinande in §4.3 will provide an illustration of the proposed grammatical distinction between transparency and opacity, while systems featuring an alternating low vowel are discussed with reference to the Eastern Nilotic language Bari in §4.4. It is inevitable that the harmonic systems of these ATR languages will each involve additional complexities and idiosyncrasies which are not immediately relevant to the present discussion; the fact that such details are omitted here does not affect the validity of the points being made.

As already indicated, the analyses to be offered in this section represent something of a departure from the standard Government-based view. While I continue to assume that phonological structure is controlled by a set of very general principles controlling well-

formedness,[3] and that cross-linguistic variation is typically captured by means of language-specific parameter settings, I also explore the possibility of allowing such principles to be violated, specifically in order that other, more influential principles may be satisfied. This kind of approach is by no means new to the Government-based literature. Charette (1990) proposes to account for cross-linguistic differences in the behaviour of word-internal empty nuclei in terms of the relative influence of one principle of licensing over another. More recently, Polgárdi (1996) has adopted a similar approach to the question of the licensing of domain-final empty nuclei, where she incorporates the notion of ranking into an otherwise principles-driven account as an alternative to the established idea of parametric control. Indeed, the latter work highlights the degree of theoretical overlap between, on the one hand, a representationally-oriented model based on principles and parameters, and on the other hand, a derivationally motivated (although non-serial) approach such as Optimality Theory (Prince and Smolensky 1993) built around the notions of constraint ranking and constraint interaction. As Polgárdi (1996) points out, both are concerned with the formulation of a constraint-based grammar, and differ only with respect to the role that such constraints are thought to play in determining well-formedness:

> GP [Government Phonology] concentrates on issues of representation, while OT on issues concerning derivation. Or in other words, GP deals with the nature of constraints, while OT with their ranking. Since these issues are inter-connected, paying attention to both can only be to one's advantage (1996: 596).

In view of this common ground shared by the two approaches, I shall offer analyses of low vowel transparency in Kinande and the **a**~**ə** alternation in Bari which incorporate aspects of both theoretical viewpoints: while the principles themselves are identified primarily on the basis of representational well-formedness, I propose that the interaction of different principles — and in particular, the conflicting grammaticality predictions that arise from instances of principle 'clashes' — provides evidence to support the postulation of dominance relations between principles, determined on a system-specific basis. I begin by motivating the relevant principles.

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[3]See Kaye (1989) for an overview of the principles/parameters approach to grammatical organisation. For a more detailed treatment, the reader is referred to Kaye *et al*. (1990) and Harris (1994a).

4.2 Dramatis personae

To account for the two areas of variation under analysis, it will be necessary to refer to three principles relating to structural well-formedness. These are given in (9):

(9) a. INHERENT STRUCTURE PRESERVATION (ISP)
b. PRINCIPLE OF STRUCTURAL ECONOMY (PSE)
c. PRINCIPLE OF EXTENSION (PEx)

The first of these has already been motivated in Backley & Takahashi (1998), where we proposed a restrictive interpretation of SP as a means of undermining the notion of head agreement as a mechanism for describing ATR harmony. Following the claim that the constraining effects of SP should be observed at all levels of structure, we offered the following generalized formulation:

(10) **Inherent Structure Preservation**
Lexical head-complement relations must be retained throughout derivation

The 'relations' referred to in (10) — which are established in the lexicon, typically via licensing or government — may hold between any phonological units, whether prosodic (e.g. syllabic positions, projected nuclear heads) or melodic (e.g. element tiers, complement tiers); and there is ample evidence[4] for the need to control the ways in which existing asymmetric relations can be manipulated within a structure. I maintain that the responsibility for this control rests with the principle ISP, although it will become evident that in some languages the ideal of preserving lexical structure may be overridden in certain circumstances.

A particular case in point is the interaction of ISP with another principle, the PSE, which I introduce here. PSE amounts to the formal instantiation of a very general criterion of representational simplicity, which I express as follows:

(11) **Principle of Structural Economy**
All structural units must be independently motivated

The PSE effectively acts as a guard against representational redundancy, ensuring that

[4]See Harris (1994a) and Kaye (1995).

the presence of every structural object in a representation is appropriately sanctioned.[5] This is usually achieved in one of two ways: either the object is identified by the phonology as a target for lexical activation or for some particular dynamic process, or it plays an active role in maintaining the well-formedness of the structure as a whole (e.g. by acting as a licensor for another unit). At the level of melodic organisation, which is the focus of the analyses below, we observe both of these possibilities for motivating individual units: the appearance of a melodic tier or complement tier in a structure may be justified either on the strength of its lexical specification (i.e. **ACTIVATE [α]**) or otherwise on the grounds that it dominates another (independently sanctioned) tier positioned immediately below it on the sub-segmental hierarchy.

In (12a), for example, both the [A]-tier and the [comp] fail to conform to PSE — neither is lexically active, and neither serves as a licensor for anything else; consequently, these units lack the required functional status prescribed by PSE, and we expect the simplification of structure illustrated. In (12b), on the other hand, the inactive colour tier is present as a functional unit in the structure — it passes on licensing potential to the active [A]-tier — and must therefore be retained. In this case, economy of structure is achieved by the elimination of [comp] alone.

(12)

a. b.

I assume the notion of structural economy to play an essential role in the construction of all restrictive representational models of phonology — if not overtly, then at least implicitly. What PSE amounts to is no more than a formal expression of this general

[5]The sanctioning of phonological units is, of course, carried out initially by the principles of licensing. What the PSE performs is essentially a 'checking' and 'streamlining' operation whereby output structures (resulting from the potential effects of dynamic phonological phenomena) are monitored for redundant properties.

maxim, to the effect that structural simplicity be expressed as a universal principle on representational well-formedness. My claim, then, is that the influence of PSE may potentially motivate a simplification of structure, thereby dispensing with those parts of a representation deemed superfluous. Clearly, some degree of incompatibility is evident between the two principles motivated here — while ISP is hell-bent on preserving lexical structure, the PSE strives to eliminate it. I will argue in §4.3 that the two possible solutions to this conflict of interests will define the typological difference between an ATR harmony system with low vowel opacity (Turkana) and one exhibiting low vowel transparency (Kinande).

Besides the question of opacity versus transparency, however, this discussion also aims to account for another form of typological variation within ATR harmony languages — namely, the grammatical distinction between 9-vowel and 10-vowel systems. To this end, I introduce a third principle, the Principle of Extension (henceforth PEx), which is presented in Cole & Kisseberth (1994) as the motivation behind the specification of melodic properties at higher levels of the prosodic hierarchy. Within the context of their Optimal Domains Theory (ODT), the authors assume that the key role of melodic primes is to mark contrast, and that primes should therefore be perceptible in order to fulfill that function. They then argue that many properties of phonology, including harmonic agreement, may be viewed as contributing to the enhancement of perceptibility. Specifically, they claim that an individual melodic property should be interpreted over a relatively long span if the criterion of perceptibility is to be satisfied.[6]

In an ODT grammar, the Principle of Extension is realized by the family of ALIGN constraints termed Wide Scope Alignment (WSA), which match the interpretation span of a melodic property with a morphologically or prosodically defined domain. Harmony then arises from the interaction of WSA with an independent constraint termed Expression, which ensures that the harmonic feature in question is associated to every potential target within the domain. In the spirit of this ODT view, I acknowledge the validity of a Principle of Extension, which I formulate as (13):

(13) **Principle of Extension**
Extend the domain of **ACTIVATE [α]** to enhance element interpretability

[6]Cole and Kisseberth (1994) argue that the notion of articulator stability is also an influential factor in the construction of harmonic domains; however, the presence of intervening consonantal material between harmonizing vowels would seem to invalidate this suggestion.

The function of PEx broadly corresponds to WSA, to the extent that PEx and WSA are both responsible for the interpretation of melodic units across domains larger than the segment. On the basis of (13), we may assume that languages exhibiting vowel harmony possess their harmonic characteristics by virtue of the dominant influence of PEx in their respective grammars: to achieve an extended span of [α]-activation in the phonological string, the relevant lexical activation instruction must be specified at a higher prosodic level such as the *foot* or *word*. In §4.4 I shall demonstrate how PEx interacts with ISP to create a formal distinction between the 9-vowel system of Turkana and a corresponding 10-vowel system (Bari) containing an advanced low vowel. A conflict of interests arises once again, which can only be resolved in one of two ways, thus defining the observed typological variation.

Finally, while the principles PSE and PEx are both seen to interact independently with ISP, the ATR harmony systems considered here provide no evidence to indicate any direct involvement between the two principles themselves.[7] The lack of antagonism between PSE and PEx makes their relative rankings inconsequential, with the result that the following 4-way typology is expected on the basis of the three principles in question:

(14)

	neutral ***a***	***a*~*ə* *alternation***	*language*
ISP > PSE, PEx	opaque	NO: 9-vowel system	Turkana
PEx > ISP > PSE	opaque	YES: 10-vowel system	Bari
PSE > ISP > PEx	transparent	NO: 9-vowel system	Kinande
PEx, PSE > ISP	transparent	YES: 10-vowel system	?

I complete the discussion in §4.5 by providing empirical backing for the final principle ranking shown in (14), where low vowel transparency derives from the dominance of PSE over ISP (as in Kinande) and the ranking of PEx over ISP is responsible for the same **a**~**ə** alternation found in Bari.

[7]However, see the analyses of Wolof and Yoruba in Backley (1998) for instances of principle conflict involving PSE and PEx.

4.3 Kinande

The Kinande language[8] of Zaire displays a system of tongue root harmony which has much in common with that of Turkana, already described in §3 above. The same 9-vowel inventory is exploited, the same harmonic groupings prevail, and the low vowel **a** is neutral with respect to harmony — it fails to participate in harmonic alternations, either as a trigger or a target. However, (15) illustrates a difference in the behaviour of **a** between the two systems, where the examples of opacity in Turkana shown in (15a) are compared with cases of low vowel transparency in Kinande.[9] In both languages, roots containing only a low vowel are consistently non-ATR, and therefore take affixes with non-advanced vowels. The Kinande forms are taken from Archangeli & Pulleyblank (1994) — henceforth referred to as A&P.

(15) a. *low vowel opacity (Turkana)*

ŋɪ-makuk-yo	(*ŋi-makuk-yo)	'chair' (plural)
ŋɪ-kɪŋɪm-aan-ot-in	(*ŋi-kiŋim-aan-ot-in)	'deaf'-hab-deverb-pl.
ɛ-maɲ		'liver'

b. *low vowel transparency (Kinande)*

tu-ka-ki-lim-a	(*tʊ-ka-ki-lim-a)	'we exterminate it'
tu-ka-ki-huk-a	(*tʊ-ka-ki-huk-a)	'we cook it'
ɛ-mɪ-hamba		'knives'

In (15a) the low vowel has the effect of bringing to an end the span of ATR harmony. The noun root in *ŋɪ-makuk-yo* is lexically ATR, and we expect its tongue root properties to associate to all of the vowels within the word domain. However, the presence of **a** in the leftmost nucleus of the root causes a break in the chain of local harmonic relations along the complement tier and prevents ATRness from progressing further leftwards to the prefix, thus demonstrating the opaque behaviour of the low vowel in this language.

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[8]See Hyman (1989), Valinande (1984), Mutaka (1991), and references therein.

[9]In the absence of any information to the contrary, I shall assume that the vowel **a** retains its 'lowness' in ATR spans, rather than alternating with (a non-contrastive) **ə**.

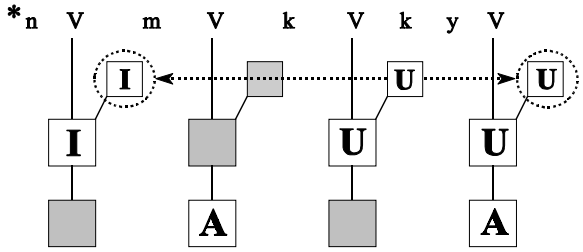
Similarly, in *ŋɪ-kɪŋɪm-aan-ot-in* a dominant ATR suffix has no harmonizing effect on the portion of the string to the left of *-aan* (habitual suffix), which contains a low vowel and consequently acts as a harmonic blocker.

The situation in Turkana may be directly compared with that in Kinande, where the low vowel in (15b) has the opposite effect with regard to the progress of harmony across the domain. In the Kinande forms, the verb roots *lim* 'exterminate' and *huk* 'cook' are both ATR, and trigger harmony on other vowels sharing the same domain. In these cases, however, tongue root agreement is observed on *all* potentially alternating vowels, despite the presence of a word-medial low vowel in the prefix *ka-*. In this language, then, ATR harmony is permitted to radiate from the root throughout the entire word domain, effectively 'passing through' the non-harmonizing low vowels *en route*. So, how should this difference between opacity and transparency be treated in the phonology?

There is an extensive body of literature which addresses this question, offering a broad range of solutions conceived from both melodic and prosodic angles. Some of these — including Hyman (1989), Archangeli & Pulleyblank (1994), Odden (1994) and Cole & Kisseberth (1994) — are reviewed in Backley (1998), to which the reader is directed for a fuller picture of the relevant issues. Here, however, I restrict the discussion to a principles-based (i.e. a tier-geometric) approach to the facts relating to the opacity~transparency distinction. Despite the apparent theoretical differences separating the constraint-based OT view from the principles-based view described in §1, I shall argue that their respective approaches to the question of neutral **a** are founded on the same fundamental notion — namely, the relative dominance and influence of one general principle over another.

In §3 above I argued that harmonic agreement could be achieved via a series of harmonic relations, each holding between adjacent positions along a given melodic plane. As already noted, this requirement amounts to a specific instantiation of a more general condition on locality, the violation of which proves sufficient to render the configuration in (16) ungrammatical in the grammar of Turkana. The ill-formed status of **ŋi-makuk-yo* (grammatical form *ŋɪ-makuk-yo*) manifests itself as an interruption in the span of activation along the complement tier, as illustrated:

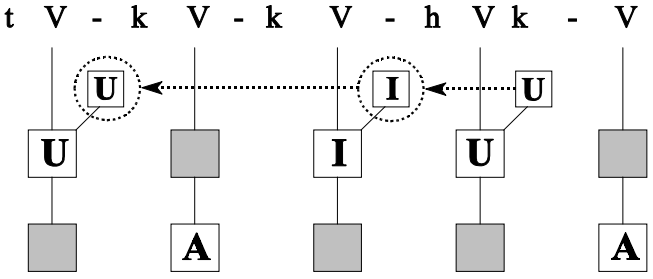
(16) *ŋi-makuk-yo 'chair' (plural)



Here, this violation of locality corresponds to a breakdown in the transmission of the lexical activation instruction, the absence of an active [comp] in the low vowel being responsible for such a breakdown. And yet, it seems that the ungrammatical structure in (16) is exactly the kind of representation which is required for the well-formed strings involving transparent **a** in Kinande: recall the grammatical status of attested forms such as *tu-ka-ki-huk-a* 'we cook it'. So, how should we best approach the apparently paradoxical nature of structures such as (16)?

The goal would seem to be one of capturing low vowel transparency in such a way that locality is preserved, and yet, one in which the span of [comp] activation can still effectively 'skip over' the harmonically neutral low vowel **a**. I suggest that this may be achieved by assuming the structure in (17). In the spirit of parametric adjacency (Odden 1994), the burden of explanation is borne by (the relations holding between) the harmonizing units, rather than by any of the properties of the intervening neutral **a** segment.

(17) *tu-ka-ki-huk-a* 'we cook it'



In this configuration, the active [U]-comp and active [I]-comp of the two high vowel prefixes are adjacent on their melodic tier. The absence of any [comp] slot in the melodic template of the intervening low vowel **a** allows the lexical activation instruction to construct a harmonic span right up to the left edge of the word domain; crucially, this is achieved without any violation of the condition on locality. However, assuming that the configuration in (17) constitutes a well-formed structure in Kinande, the following question must be addressed: how does the grammar of this language generate a melodic template for low vowels which differs from the template which has been established for other vocalic expressions?

(18) a. opaque **a** b. transparent **a**

I propose that the structure in (18b) — the representation of the transparent low vowel in Kinande — demonstrates the effects of the PSE given in (9) above, such that any structural unit which fails to be phonologically motivated, is eliminated. The PSE may be viewed as the formal instantiation of a very general criterion of representational simplicity. In the case of the colour complement belonging to the structure in (18b), the 'independent motivation' prescribed by the PSE fails to be observed; the [comp] of a low vowel does not license anything else, and furthermore, it can never be activated, since its licensor (the colour tier) is necessarily inactive itself. I shall claim that, in Kinande, the selection of the structure in (18b) over that in (18a) as the appropriate representation of the low vowel is determined on the basis of the dominant behaviour of the PSE in that language. So, the difference between the behaviour of the low vowel in Turkana and the behaviour of the same vowel in Kinande reflects the choice between a full melodic template and a truncated one, respectively. I shall claim that a grammar in which the latter is permitted (e.g. Kinande) must be more strongly influenced by the PSE than an otherwise similar grammar in which the full melodic template is maintained throughout.

Furthermore, I claim that, in the grammar of Kinande, the pressure to conform to the

PSE — which is achieved by eradicating the redundant complement tier from the representation of low vowels, resulting in the configuration in (18b) — leads directly to a violation of ISP, brought about by the destruction of a lexically established licensing relation between the colour tier and its [comp]. In contrast, a language such as Turkana, which features low vowel opacity, employs the structure in (18a) to represent the low vowel. While successfully conforming to ISP — since all relations holding lexically are retained at all levels — this is achieved at the expense of a PSE violation, where the structural unit [comp] is preserved in the representation.

The relevant distinction between the grammars of Kinande and Turkana may be formalized in terms of the following principle rankings:

(19) Kinande (transparent **a**): PSE >> ISP
Turkana (opaque **a**): ISP >> PSE

This approach highlights the antagonistic nature of the relationship between the two principles under scrutiny, ISP and the PSE. While the majority of the well-formedness principles — such as the OCP, Licensing Inheritance, and other principles controlling phonological licensing — are free to operate independently of each other (i.e. the effects of one principle do not interfere with the effects of another), the same cannot be said of ISP and the PSE. What we observe is a tension between the two, which stems from the opposing predictions each one makes as to the overall grammaticality of a given structure. Pulling in one direction is the influence of ISP, which disallows any modification of the lexically established melodic template, while pulling in the opposite direction we find the effects of the PSE, which induces structure simplification.

I assume that both principles have universal application — i.e. that they are necessarily present in the grammars of all languages — and that, in the majority of cases, their respective predictions do not create any observable conflict. In some systems, however, we encounter instances where ISP and the PSE do interact, each generating a different grammatical outcome. In these cases, the tension between the two principles must be somehow resolved: one must be relaxed (i.e. become subject to violation) in order that the other may be allowed to make its contribution to overall well-formedness, since only one of the potentially generated structures will match the attested facts. I claim that, in languages exhibiting low vowel opacity (e.g. Turkana), the conflict between ISP and the PSE is resolved by allowing the former to dominate, thereby suppressing the effects of the PSE. If the PSE is prevented from exerting any influence on the shape of the generated structure in this way, then no simplification procedure will operate, even on

those units deemed representationally redundant. As a direct result, low vowel structures such as that in (18a) are created, which act as harmonic blockers. Conversely, in systems such as Kinande, it is the PSE which is favoured over ISP;[10] this allows the elimination of redundant material, causing all low vowels to be represented as in (18b), and thereby assigning them their transparent properties.

4.4 Bari

While the previous section has highlighted the kind of cross-linguistic variation we can expect to find with regard to the behaviour of neutral vowels, this subsection aims to account for another area of divergence observed between (otherwise very similar) tongue root harmony systems. I refer to the option of recognizing an ATR counterpart of the low vowel, thereby creating a symmetrical 10-vowel system. Given the incompatibility within a tier-geometric approach between an active [comp] and an inactive colour tier, I shall argue below for the analysis of this apparently ATR low vowel as the manifestation of a melodically empty nuclear position. A 10-vowel system characterizes a number of languages, including Vata (Kaye 1982), Okpe (Pulleyblank 1986) and Akan (Clements 1981). The Eastern Nilotic language Bari — a close relation of Turkana — is also a member of this set, and will be used here to exemplify the structural differences under investigation.

The vowel harmony system of Bari is described in Steinberger and Vago (1987), from which my data has been taken.[11] The issues I address here arise from the division of the Bari vowel inventory into the following harmonic groupings, where each member of the non-ATR group recognizes an ATR counterpart with which it alternates:

(20) *harmonic groupings in Bari*

ATR:	i, u, e, o, ə
non-ATR:	ɪ, ʊ, ɛ, ɔ, a

[10]The effects of the dominated ISP will, of course, be observable whenever this principle is not in conflict with a higher-ranked principle; this ensures a ban against non-structure-preserving events such as resyllabification.

[11]Particular aspects of this language's harmonic properties are also considered in van der Hulst & Smith (1986).

In terms of vocalic distribution, Bari is distinguished from Turkana by the presence of an additional (tenth) vowel — the ATR correlate of **a** — which I represent as **ə**.[12] The harmonic behaviour of the vowel pair **a**/**ə** parallels that of other alternating pairs, where **ə** occurs in ATR domains while **a** appears in non-ATR environments. Below, I examine the relation between **a** and **ə** in this language, and attempt to account for the phonological properties of these vowels within the context of the model assumed here.

Harmonic patterning in Bari closely resembles that observed in Turkana, as illustrated below. (21a) shows the alternating behaviour of a prefix vowel within the context of a verb root which is lexically ATR, while (21b) highlights the effects of a dominant ATR suffix on a lexically non-ATR noun root:

(21) a. tɔ-mɔk 'embrace'
to-muk 'cover each other'

b. kɔrɔdɔʔ 'rubbish'
korodo-ti 'a piece of rubbish'

As in Turkana, the low vowel in Bari shows opaque properties: **a** in (22) does not alternate (i.e. it can co-occur with ATR vowels in the same morpheme); furthermore, it blocks the advancement of ATR harmony across the domain.

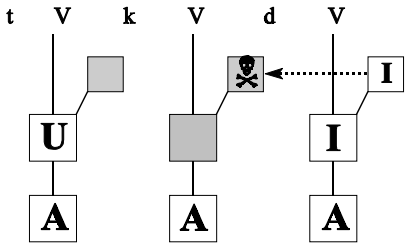
(22)	a.	kaɗe	'different'	lɛlɛ	'bald'
	b.	kaɗel-ək	'different' (pl.)	lɛly-ak	'bald' (pl.)
	c.	tɔ-kaɗe	'difference'	tɔ-lɛlɛ	'baldness'

(22a) compares an inherently non-ATR morpheme *lɛlɛ* 'bald' with a root which is lexically ATR (the presence of an ATR mid vowel in *kaɗe* 'different' is indicative of ATR status). This difference is confirmed by (22b), in which the ATR alternant of the plural suffix is selected by the ATR form, to give *kaɗel-ək* 'different (pl.)', whereas the non-ATR alternant is chosen by *lɛlɛ*, resulting in the form *lɛly-ak* 'bald (pl.)'. I shall

[12]Steinberger and Vago (1987) describe this sound as a centralized low vowel, for which they use the Bari orthographic symbol **ö**. In an effort to mirror the phonological properties of this vowel, I shall employ the symbol **ə** here, although **ä** may be equally appropriate.

discuss below the nature of the **a**~**ə** alternation which is highlighted by this plural suffix. In (22c), however, we find that both adjectives take the non-ATR form of the alternating prefix *tɔ-*. In the case of *tɔ-kaɗe* 'difference', we may assume that this results from the opaque behaviour of **a** in this language, which blocks the leftward propagation of ATR harmony. This is captured in (23):

(23) tɔ-kaɗe (*to-kaɗe) 'difference'



On the strength of the examples considered so far, it might seem appropriate to analyse vowel harmony in Bari using grammatical and structural conditions identical to those assumed in the case of Turkana above. Yet clearly, the alternating suffix in (22b) fails to support this approach; instead, the **a**~**ə** alternation highlights an additional complexity in the phonology of Bari — namely, the frequent (though not entirely systematic) interpretation as **ə** in exclusively ATR contexts. While unobserved in prefixes, this centralized vowel is widespread in suffixes:

(24)

ATR domain		*non-ATR domain*	
mʊg-gə	'cover' (indef.)	mʊg-ga	'store' (indef.)
mʊk-ə	'be covered'	mʊk-a	'be stored'
kaɗɛl-ək	'different' (pl.)	lɛly-ak	'bald' (pl.)

As (24) shows, the alternation between **a** and **ə** operates on the same basis as any alternating pair of non-low vowels: the central vowel belonging to the ATR harmonic

set appears in an ATR domain, while its non-ATR counterpart **a** appears elsewhere.[13] The inclusion of an ATR low vowel in the phonological system of a language such as Bari presents immediate problems for an analysis based on the fixed melodic template assumed throughout this discussion. As a result of the way in which the template is configured, the possibility of licensing an active complement tier (i.e. the phonological manifestation of ATRness in this system) in an expression involving only an active [A] element is categorically ruled out.

So, how should the ATR low vowel of Bari be incorporated into the grammar? One potential solution may derive from the possibility that the melodic template proposed for this language is *not* identical to that assumed for Turkana — but rather, that the vowel system of Bari is generated by an altogether different configuration which *can* represent the alternation involving **a** and **ə**. I suggest that, on the whole, the evidence does not weigh in its favour. Setting aside the question of the central vowel **ə**, the two systems appear to have much in common phonologically: they exploit a similar set of vowel contrasts and adopt the same basic pattern of harmonic distribution; historically, they are closely related languages, and there is no indication of one system being any more marked or less marked than the other. All in all, there seems ample justification in assuming that both are appropriately described by referring to the same melodic template.

This being the case, I shall claim that there remains only one feasible approach to the analysis of the **a~ə** alternation in Bari — which is to assume that the central vowel **ə** is not, in terms of its melodic composition, the ATR counterpart of **a**. Instead, I propose that **ə** may be treated as the phonetic manifestation of a phonologically 'empty' nuclear position (i.e. one in which all lexically specified activation instructions fail to be interpreted) — a situation arising, once again, from a conflict between the well-formedness predictions made by two very general structural principles. In this instance, the principles in question are ISP — which, I have already argued, plays a crucial role in the distinction between low vowel transparency and opacity — and the Principle of Extension (PEx), motivated above in connection with element activation in larger prosodic domains. Recall that the PEx, which is fundamental to the ODT (Cole & Kisseberth 1994) account of harmony, acts as the driving force behind the construction of harmonic domains extending beyond the scope of a minimal prosodic unit (such as the

[13]Although the **a~ə** alternation operates systematically in suffixes, there are several examples of disharmonic roots in Bari where **a** is interpreted within a form lexically specified as ATR: e.g. *kaḍe* 'different'.

word-level domains under scrutiny here), stating that a melodic property should be extended over longer strings of sound in order to enhance its interpretability. Here, I follow ODT in assuming that the harmonic characteristics of systems such as Bari stem from the overriding influence of PEx in the grammars of these languages.

In Backley (1998) it is argued that, within the tier-geometric model, the successful interpretation of an element depends on both melodic and structural conditions being met: in order to interpret a low vowel **a**, for example, the lexical instruction **ACTIVATE [A]** must be specified, and additionally, the relevant tier in the melodic configuration must be licensed to be active. Accordingly, we can identify only an indirect relationship between the activation of [α] and the interpretation of [α] — while interpretation necessarily entails activation, the reverse does not hold. As a result of this partial independence between the activation of an element and its interpretation, there are no grounds for ruling out the possibility of an individual lexical entry such as that given in (25a), which contains an activation instruction which is not readily interpretable using the structure available:

(25) a. ACTIVATE [A]
ACTIVATE [COMP]
▽
▽
kət 'clear away'

b. ACTIVATE [A]
▽
▽
▽
jam 'talk'

We must assume that the lexical specification for *kət* 'clear away' includes the instruction **ACTIVATE [COMP]**, since this root contains a vowel belonging to the ATR harmonic set, and furthermore, it triggers [comp] harmony on affixes (e.g. *kət-ə-niʔ* 'be cleared away'). Yet, in the absence of any lexical instruction to activate either [I] or [U], the *contrastive* potential of **ACTIVATE [COMP]** is effectively lost, owing to the lack of a suitable licensor for [comp] (i.e. the necessary structural conditions for the activation of the complement tier fail to be met).[14] In the case of a system such as Bari, I claim that the melodic distinction between (25a) and (25b) may be accounted for in terms of the dominant influence of PEx.

[14]In a 9-vowel system such as Turkana, we can predict that this situation would result in a neutralisation of the two lexical expressions given in (25a) and (25b), so that the vowels of the hypothetical forms *kat* (ATR) and *jam* (non-ATR) would be indistinguishable.

Following Cole and Kisseberth (1994), I assume that the notion of interpretability is central to the formulation of PEx: given that the primary role of melodic properties is to create phonological contrast, we should expect those individual properties to be easily interpretable — and to that end, should be active over a sufficiently long span. However, looking at the two activation instructions specified in the lexical form of (25a), we predict that the active [comp] will have no contrastive effects at all, in view of the limitations on element combination imposed by the melodic template. I propose that this result must constitute a violation of PEx, since [comp] is uninterpretable even on the vowel of the verb root,[15] let alone across a larger domain. While it is clear that this situation can be tolerated in the grammar of a language such as Turkana (where the low vowel does not alternate), it is equally apparent that the same outcome is deemed ill-formed in Bari. The evidence comes in the form of an alternation between **a** and **ə**, where the latter identifies a lexically low vowel within an ATR domain.

I shall claim that it is the relative influence of PEx on overall well-formedness which is responsible for the typological difference between a 9-vowel system like Turkana and a 10-vowel system such as Bari. In Turkana it appears that PEx is relatively weak, and its violation is permitted under certain circumstances (to be defined below); hence, the low vowel **a** is not compelled to alternate, simply in order to register the presence of an ATR domain. In contrast, the influence of PEx in Bari is rather stronger, as illustrated by the way in which the low vowel can encode the difference between active [comp] and inactive [comp], thus ensuring that a potential opposition is not neutralized. Now, two questions remain unanswered. First, if the vowel **ə** is not a genuine ATR counterpart of **a**, then how is it to be represented phonologically? And second, what motivates the claim that PEx has a stronger or a weaker influence in one grammar than it does in another? I address both of these issues below.

Given that PEx enjoys a relatively high profile in the grammar of Bari (in OT terms, it occupies a highly ranked position in the constraint hierarchy), it seems important that we identify a melodic configuration for **ə** which does not bring about the neutralization of any existing lexical vowel contrasts.[16] If the representation of **ə** must correspond to a

[15]While it may be argued that the contrastive properties of [comp] will be observed in affix vowels, this cannot be guaranteed — affixes are equally likely to contain only a low vowel.

[16]If it were claimed that **ə** consisted of, for example, active [I] and active [A] — which already describes the non-ATR mid vowel **ɛ** — then the analysis would be of little explanatory value, since this would constitute a violation of PEx in much the same way as a non-alternating low vowel would.

melodic structure not exploited elsewhere in the phonological system of this language, then it seems that only one possibility presents itself: in the context of the proposed melodic template, the vowel transcribed as **ə** must be the interpretation of a phonologically empty position, since all other melodic configurations define lexically contrastive vowels.

Evidence to support this analysis of **ə** comes from the fact that the phonetic quality of the 'tenth vowel' (i.e. the 'ATR' counterpart of **a**) in other 10-vowel ATR harmony languages is subject to a significant degree of cross-linguistic variation. While a centralized low vowel **ä** is observed in Bari, a phonologically empty nucleus in Maasai suffixes is interpreted as **o** (Wallace-Gadsden 1983). In Akan, on the other hand, we find a range of different interpretations according to dialect, including **æ**, **ɛ**, **e** and **ɜ**.[17] I suggest that the absence of stable or uniform phonetic properties in the ATR low vowel of these systems is indicative of this vowel's true phonological identity as a melodically unspecified expression. This argument builds on the assumption established in the Element Theory literature, that the precise phonetic manifestation of a phonologically empty nucleus is determined on a language-particular basis.

In melodic terms, then, the distribution of **a** and **ə** in Bari involves the alternation of an active [A] element with zero. But what is the grammatical mechanism underlying this alternation? How, for example, can the suffix form in (26b) be derived from its non-ATR counterpart in (26a)?

(26) a. mʊg-ga 'store' (indef.)
b. mʊg-gə 'cover' (indef.)

Here, I propose that the overriding influence of one general well-formedness principle over another is, once again, responsible for the observed pattern; and, in a way that mirrors the analysis of transparency versus opacity in §4.3 above, I claim that the dominant behaviour of one particular principle — in this case, the PEx — comes about as a result of the need to resolve a conflict between different grammaticality predictions. I return below to the question of how the interaction of PEx with ISP can account for the typological variation between systems comprising 9 and 10 vowels.

I have argued that the Principle of Extension plays a crucial role in the grammar of Bari, ensuring that an individual element (or, in this case, [comp]) is ideally interpreted

[17] See Stewart (1967) and Clements (1981).

over a relatively long span. This motivates the **a**~**ə** alternation, by which ATRness can still be encoded in morphemes containing only low vowels. In order to capture the phonological difference between **a** and **ə**, the lexical instruction **ACTIVATE [A]** must be suppressed in ATR contexts. In representational terms, this might manifest itself in one of the following ways:

(27) a. b.

One possibility is to postulate the configuration in (27a) for the vowel **ə**, where the full melodic template is preserved, but **ACTIVATE [A]** is deleted from the structure. This move would effectively require the operation of a counter-instruction — such as **DE-ACTIVATE [α]**, for instance — which is not proposed as a viable solution here. As an alternative approach to the representation of **ə** in Bari, I suggest the structure in (27b). Here, the lexical instruction to activate [A] remains intact, but the licensing relation between the colour tier and its dependent aperture tier is severed.[18] Recall that both melodic and prosodic conditions must be satisfied before an element can be interpreted: while the lexicon may make the necessary melodic contribution (i.e. **ACTIVATE [A]**), the element in question is required to reside on a licensed tier (its licensed status being dependent on sufficient licensing potential having been received from its licensing tier, in accordance with Licensing Inheritance). Residing on an unlicensed tier, the [A] element in (27b) cannot be interpreted. From this failure of [A]-interpretation, coupled with the fact that no other melodic material has been lexically activated, it follows that the resulting structure must be phonologically 'empty' (i.e. melodically unspecified), and that any interpretation of the low vowel within an ATR context must amount to the phonetic manifestation of an empty position. My claim is that the central vowel of Bari does correspond to the melodically empty structure given in (27b). But how does this

[18]Following the removal of this inter-tier licensing relation, I assume that the unlicensed [A]-tier is subsequently deleted from the structure in accordance with the general notion of Stray Erasure. See Itô (1986) for a discussion of this operation in relation to unsyllabified melodic material.

structure come about? What theoretical motivation is there for the removal of the licensing relation between the two tiers?

Recall that, in order to satisfy PEx, the two vowels **a** and **ə** must be distinguished phonologically — specifically, a neutralisation of the ATR opposition on low vowels would be inconsistent with the predictions of PEx, in that an active [comp] would no longer be perceived as a potentially contrastive property in this environment. While it remains clear that the representation of **a** corresponds to the expected structure of a low vowel, it is perhaps less evident why the precise phonological identity of the central vowel should match the structure in (27b). Given the fact that the two sounds in question are seen to alternate, we anticipate that one should be derived phonologically from the other. However, the scope for deriving the representation of **ə** from the low vowel configuration, for example, is clearly limited: [comp] cannot become active, as no suitable licensor is available; the colour tier may not become active either, since there is no legitimate source — either lexical or phonological — for the activation of [I] or [U];[19] and the licensed aperture tier cannot act as a licensor for [comp], as this does not square with the melodic template established for the language. Ultimately, it seems that only one option will create the required alternation effect, a move which interferes with the lexically established licensing relations holding within the structure of **a**. More specifically, this option involves the loss of the only significant licensing relation in the structure, that holding between the [I/U]-tier and the [A]-tier. By severing this asymmetric relation, the (dependent) aperture tier effectively becomes an unlicensed unit. As a result, the licensing path is broken, the licensing potential required for successful element interpretation fails to reach this point in the melodic structure, and the [A] element is suppressed.

As illustrated in the case of Kinande transparency, the destruction of a licensing relation established in the lexicon must be treated as a violation of ISP. Yet it appears that the grammar of Bari will tolerate such a violation, in case this ensures that another structural principle, PEx, will be satisfied. Once again, I propose that the dominance of one principle over another emerges as the result of a grammaticality conflict. On the one

[19]Element epenthesis, by which an expression gains additional melodic material originating from a non-local source, may be suggested as a means of accounting for the phonetic variety observed cross-linguistically in the interpretation of empty positions: **ɛ** in Akan may involve epenthetic-[I], for example, whereas **o** in Maasai may result from epenthetic-[U]. As a *deus ex machina* device, epenthesis of this sort will inevitably have negative implications for generative restrictiveness.

hand, ISP requires that a full melodic template be retained under every position, leading to the successful interpretation of [A] whenever it is lexically specified (i.e. no change in the interpretation of the low vowel in ATR domains); and on the other hand, PEx forces an ATR versus non-ATR distinction on low vowels, in order to indicate the presence of an ATR harmony span. As already encountered in the analysis of Kinande, an antagonistic relationship of this kind created by the conflicting predictions of two independent well-formedness principles must be settled in favour of one generalisation or the other — both cannot be satisfied by the same representation. The alternation facts suggest that, in the grammar of Bari, the conflict is resolved by allowing PEx to override ISP in terms of its influence on the grammatical outcome.[20] I propose that this ordering must amount to a reversal of the principle ranking found in the grammar of Turkana. ISP is undominated in the latter system, ensuring the preservation of all licensing relations — including the relation holding between the colour tier and the aperture tier — which results in the ability of LI to supply the necessary licensing potential to the [A]-tier in low vowels, allowing the [A] element to be interpreted whenever lexically specified. Without any suppression of the [A] element, no **a**~**ə** alternation is predicted, and we observe the expected 9-vowel system of contrast.

4.5 Typological predictions

The following dominance relations summarize the typological variations considered so far:

(28) Turkana: ISP > PSE, PEX
Kinande: PSE > ISP > PEX
Bari: PEX > ISP > PSE

As the table in (14) shows, however, the expected typology also includes a fourth

[20]In view of the opaque behaviour of low vowels in Bari, it may be assumed that this language follows Turkana in allowing ISP to dominate the PSE. Recall from §4.3 that an undominated PSE will cause an inactive [comp] to be dropped from the melodic structure, resulting in transparency with respect to [comp] harmony. In Turkana and Bari, on the other hand, any tendency towards structural simplification appears to be overridden (giving low vowel opacity), presumably by the need to retain lexically established structural relations (i.e. ISP) at all levels.

possibility, in which both PEX and PSE are positioned higher than ISP in the principle ranking. Accordingly, we should ideally be able to identify a tongue root harmony language consisting of a symmetrical 10-vowel system (predicted by the hierarchical relation PEX > ISP) which also exhibits low vowel transparency (owing to the ranking PSE > ISP). Here, I shall show how the Eastern Kru language Vata (Kaye 1982) satisfies these criteria, thus fulfilling the predictions of the proposed principles and, in turn, lending support to the notion of principle-ranking as a credible means of accounting for this range of cross-linguistic variation.

The 'tenth' vowel of Vata — the advanced counterpart of **a** — is typically transcribed as **ʌ**, and appears exclusively in ATR environments. As with **ə** in Bari, I assume the vowel **ʌ** in Vata indicates the absence of active melodic material. The expected **a**~**ʌ** alternation is observed in the interrogative suffix *-aa*/*-ʌʌ*:

(29)	a.	n ka ɲakpɪ-aa	(*ɲakpɪ-ʌʌ)	'Do you have some medicine?'
	b.	n ka ɲlu-ʌʌ	(*ɲlu-aa)	'Do you have a chicken?'

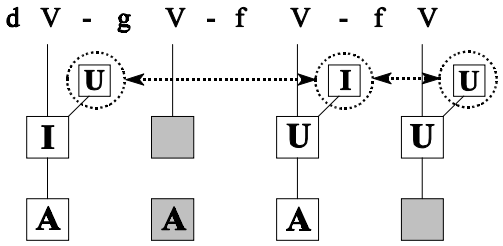
This low vowel alternation may be treated in a way which parallels the analysis proposed for Bari in §4.4. Specifically, I assume that the well-formed status of the phrase *ɲlu-ʌʌ* in (29b) results from the dominance of PEX over ISP, where the pressure from PEX to extend the ATR domain to the suffix vowel overrides the non-structure-preserving effects (i.e. the destruction of lexically established inter-tier licensing relations) that this move entails.

Turning to the question of low vowel transparency, the following forms confirm that the advanced low vowel **ʌ** is indeed transparent to ATR agreement in Vata:

(30)	a.	k^wlʌgʌsu	'tree bush'	(compound noun: k^wla + gʌsu)
	b.	degʌfofu	'lung'	(*dɛgʌfofu)
	c.	o kʌ zʌ pi	'he will cook food'	(lexical form: ɔ ka za pi)

This transparent behaviour follows the pattern observed in Kinande, which was analysed in terms of the principle ranking PSE > ISP. Again, the need to preserve lexical structure is overridden by the influence of another (conflicting) principle — in this case the PSE, which eliminates all redundant units of structure from the representation.

(31) degʌfofu (*dɛgʌfofu) 'lung'



By removing the (potentially opaque) [comp] from the structure of the low vowel in (31), the PSE allows the harmonically active property to extend across the entire word domain. I shall argue that this transparent behaviour exhibited by the low vowel, together with the **a**~**ʌ** alternation illustrated in (29), provides adequate motivation for the proposed principle hierarchy. Moreover, by matching this particular principle ranking with the empirical facts of melodic distribution in Vata, I have shown that the typological predictions made by the proposed principles are indeed borne out.

5 Summary

Having outlined a Tier Geometry approach to ATR harmony, where Tier Geometry may be seen as a representationally-oriented model that recognises a set of very general principles of structural well-formedness supplied by UG, I have proceeded to show how some degree of variation in the precise nature of harmonic patterning may be introduced via localised ranking. Although these structural principles are not generally subject to violation, an exception is brought to light in cases where two principles make conflicting predictions, as observed in the interaction between, for example, ISP and the PSE in some ATR harmony systems.

The 'antagonism' existing between these two principles — which are both independently motivated in the grammar — must be resolved on a language-by-language basis, ruling in favour of one principle over the other as the dominant criterion in any given system. So, the choice between low vowel transparency and low vowel opacity in harmony systems is ultimately as random as the choice between, for example, left-headedness and right-headedness in sentence structure, where it is not possible for both — or neither — to hold within any one language. A system conforming to both ISP and

the PSE must select one or the other as the favoured characteristic in determining overall well-formedness: because their respective grammaticality predictions inevitably conflict, the effects of one principle must ultimately override the effects of the other.

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