Structure & Specification in Harmony*

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1. Background

For as long as there has been a discipline of generative phonology—and even before that—there has been heated debate over the nature of phonological representations and processes. At one end of the spectrum we find linguists who assume hierarchical structure: morae and/or onsets and rimes grouped into syllables; syllables grouped into feet; feet grouped into words. At the opposite end of the spectrum are those who, like Neeleman & van de Koot (2006), argue that one of the fundamental ways in which syntax and phonology differ is that phonology is not hierarchical but instead completely “flat.” In this paper I focus on one phenomenon, vowel harmony, which has commonly been thought to require hierarchical or tiered representations. In the first portion of the paper, I argue that vowel harmony does not require any such structure, and can be accommodated using a linear/flat model of phonology combined with simple search and copy operations which find parallels elsewhere in linguistics, and which may not even be specific to language. In the second portion of the paper, I discuss the implications of this theory for an analysis of the harmony-altering language game in Tuvan described by Harrison & Kaun (2000, 2001), concluding that this game and others like it do not involve true harmony processes.

First, let us discuss the typology of vowel harmony in terms that are as theory-neutral as possible. Vowel harmony takes the general shape in (1), taken from Turkish. A morpheme, typically a suffix, takes on a feature value—here, [a BACK]—from a vowel in the root. Thus, we see alternation in the plural suffix between [e] and [a], and in the genitive between [i] and [ɨ] depending on whether the root contains a front or back vowel.

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*This work benefited greatly from comments by audiences at Harvard, MIT, and NELS 38. Special thanks go to Cedric Boeckx, Fred Mailhot, Charles Reiss, and Donca Steriade for their generous help. All errors are of course my own.
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(1) Turkish [BACK] vowel harmony (Mailhot & Reiss 2007: 33)

<table>
<thead>
<tr>
<th></th>
<th>Nom pl.</th>
<th>Gen. sg.</th>
<th>Gen.pl.</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>ip-ler</td>
<td>ip-in</td>
<td>ip-ler-in</td>
<td>‘rope’</td>
</tr>
<tr>
<td>b)</td>
<td>kѣz-lar</td>
<td>kѣz-ѣn</td>
<td>kѣz-lar-ѣn</td>
<td>‘girl’</td>
</tr>
<tr>
<td>c)</td>
<td>sap-lar</td>
<td>sap-ѣn</td>
<td>sap-lar-ѣn</td>
<td>‘stalk’</td>
</tr>
<tr>
<td>d)</td>
<td>yѣz-ler</td>
<td>yѣz-ѣn</td>
<td>yѣz-ler-ѣn</td>
<td>‘face’</td>
</tr>
<tr>
<td>e)</td>
<td>son-lar</td>
<td>son-ѣn</td>
<td>son-lar-ѣn</td>
<td>‘end’</td>
</tr>
</tbody>
</table>

Not every case of vowel harmony is this straightforward (and in fact, as we will see, the Turkish case is itself more complicated than shown above). In some languages, there are “opaque” vowels which do not participate in harmonic alternations, and which appear to block suffixal vowels from obtaining their features from harmonic vowels in the root. Illustrated in (2) is one such case, [ATR] harmony in Tangale. In the more abstract left column, the high back vowel is represented as capital /U/ to indicate its surface alternation between [u] and [U], shown in the middle column.

(2) Tangale vowel harmony (slightly rearranged from Mailhot & Reiss 2007: 36)

a) seb-U [sebu] ‘look’ (imp.)

b) kѣn-U [kѣnu] ‘enter’ (imp.)

c) dob-Um-gU [dobumgu] ‘called us’

d) peer-na [peerna] ‘compelled’

e) ped-na [pedna] ‘untied’

f) dib-na-m-gU [dibnamgu] ‘called you (pl.)’

The forms in (2a) and (2b) act just like all the forms in (1): The suffixal vowel represented as /U/ takes on a value for [ATR] that matches the value of the root vowel to its left. In (2c) we see that when /U/ appears more than once in a word, each token winds up with the same valuation. (2d) and (2e) show that [a] does not undergo any phonetic alternation itself, regardless of the [ATR] values of the other vowels in the word. Finally, (2f) speaks to the opaque nature of [a]. When [a] comes between a [+ATR] root vowel and /U/, the suffixal vowel unexpectedly appears in its [-ATR] variant.

In (3) I present another case of [ATR] harmony, from Wolof, which provides an interesting contrast with the Tangale case. In this language, the high vowels [i] and [u] do not alternate themselves, but they are “transparent” to harmony processes. As above, capital letters in the left column represent vowels with surface alternations.

(3) Wolof vowel harmony (Mailhot & Reiss 2007: 38)

a) toxi-lEEn [toxileen] ‘go & smoke!’

b) tekki-lEEn [tekkileEn] ‘untie!’

c) seen-uw-OOn [seenuwoon] ‘tried to spot’

d) tѣr-uw-OOn [teeruwOon] ‘welcomed’

All the forms in (3) are in some sense equivalent to (2f). However, in Wolof the non-alternating vowels act as if they simply do not exist for the purposes of computing
harmony. The alternating vowels /E/ and /O/ can undergo harmony with the other mid vowels in the root, skipping over [i] and [u].

Consonants may participate in this type of alternation process as well. Here again in (4) Turkish provides an example.

(4) Turkish [BACK] harmony, now with laterals (Nevins 2004: 40)

<table>
<thead>
<tr>
<th>Nom. sg.</th>
<th>Acc. sg.</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) usul⁷</td>
<td>usul⁷-ü</td>
<td>‘system’</td>
</tr>
<tr>
<td>b) sual⁷</td>
<td>sual⁷-i</td>
<td>‘question’</td>
</tr>
<tr>
<td>c) okul</td>
<td>okul-u</td>
<td>‘school’</td>
</tr>
<tr>
<td>d) meʃgul⁷</td>
<td>meʃgul⁷-düm</td>
<td>‘busy’ (past)</td>
</tr>
</tbody>
</table>

This is the same [BACK] harmony as in (1), illustrated now with different stems and a different case form. Turkish /l/ comes in a [+BACK] version, [l], and a [-BACK] palatalized version, [ʃ]. If a root ends in one of these laterals, a suffixal vowel will take on the backness value of the lateral, regardless of the values of the vowels in the root.

What is the minimum amount of apparatus necessary to account for such phenomena? All theories of which I am aware require a few basic assumptions, like segments composed of features; without features it is difficult to explain the relationship between harmonic vowels, or between alternants (allophones) of a single phoneme. All the theories presented here also assume that alternating vowels are “underspecified” in that they lack a value for the harmonic feature. Apart from these commonalities, theories vary widely in how they choose to represent opacity, transparency, and the basic harmony process itself. In the discussion to follow, I briefly summarize four representational proposals from the literature that radically differ in the additional assumptions & representations that they require. I conclude by arguing for the proposal that provides the necessary empirical coverage with the least amount of theoretical assumptions, in accordance with overarching desiderata about the nature of PF.

2. Feature-percolation Account

Halle & Vergnaud (1981) propose a model in which a feature (here, [+F]) percolates up from the nucleus of one vowel—the one that “donates” its feature value to the alternating vowels—to the Prosodic Word (ω) node, and then down to the other vocalic nodes in the word. The upward percolation is shown in (5).

(5) Feature percolation model (Neeleman & van de Koot 2006)
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The shortcomings of this model are discussed by Neeleman & van de Koot (2006). In addition to upward percolation, it is necessary in this approach to have a mechanism of downward percolation so \( V_2, V_3, \) and \( V_4 \) end up valued \([+F]\) as well. The feature \([+F]\) must percolate up—and back down—through the syllable, foot, and word nodes, but it is not interpreted in any of those places. Another problem with this model is that it cannot account for cases in which \( V_2 \) initially carries \([+F]\), and this feature ends up being expressed only on \( V_2 \) and vowels to its right. Because \([+F]\) must percolate all the way up to the word level and then back down from there, it cannot be discriminating in where \([+F]\) is expressed; it will simply result in every vowel receiving that featural specification. Furthermore, downward percolation of features violates the principle of Inclusiveness, which requires recoverability of the properties expressed on nodes in the hierarchy (Chomsky 1995; see also Neeleman & van de Koot 2008).

In addition to the basic assumptions outlined at the end of §1, a model like this one requires a multilevel, hierarchical structure of phonological representations. As a result, it also requires some process of linearization of each C and V within a single word, akin to the linearization required to go from a syntactic tree to a linear string of words in a sentence. Finally, it needs a bidirectional mechanism of percolation with copying of the percolated feature onto each node it passes, and some notion of featural interpretability to keep the effects of \([+F]\) confined to terminal V nodes.

3. Autosegmental Accounts

A popular approach (or more properly, set of approaches) to harmony is the autosegmental one advocated by Goldsmith (1976) and many others subsequently. In this type of model, the harmonic feature \([+F]\) is on its own tier and “spreads” by associating with other vowels in the word. Some variants of autosegmental phonology prefer to keep vowels and consonants on separate tiers so that \([+F]\) can be said to target all nodes on the vocalic tier without having to ‘skip’ the intervening consonants. I show two variations of an autosegmental model of harmony in (6).

(6) Autosegmental models

(a) \[+F\]

\[
\begin{array}{cccccccc}
C & V & C & V & C & V & C & V \\
X & X & X & X & X & X & X & X
\end{array}
\]

(b) \[+F\]

\[
\begin{array}{cccccccc}
V & V & V & V & V \\
X & X & X & X & X & X & X & X
\end{array}
\]

\[
\begin{array}{cccc}
C & C & C & C
\end{array}
\]

Note that (6b) would not be able to account for cases like (4), in which consonants participate in the harmony process. This, however, is a theory-internal issue and can be ignored here. What is more important is that the success of this kind of model shows that a hierarchical structure (“phonological tree”) is not needed to capture the harmony facts.
This theory also has the added advantage over the account in §2 of being able to handle directional cases, in which the source of [+F] is not the edgemost vowel and harmony only occurs in one direction. Concretely, this is manifested by cases we have seen already like (2f) and (4a), in which vowels in the beginning of the word do not harmonize with the suffixal vowel. In (5) this could not be generated because [+F] must percolate downward to every element dominated by ω, the Word node (Neeleman & van de Koot 2006).

While the autosegmental feature-spreading approach does not require hierarchical structure or a linearization procedure—linearity falls out of the theory automatically by virtue the X (timing) tier—it requires a number of different autosegmental tiers, seemingly at least one per contrastive feature in a language, plus perhaps separate C and V tiers, and perhaps even more (though examining this in detail is beyond the purview of this paper). Rather than percolation and copying of features, it instead uses the creation of association lines linking [+F] to elements on the vocalic tier.

4. Search-based Accounts

The autosegmental approach to harmony has been dominant for a number of years. More recently, Nevins (2004) proposed a mechanism that requires less structured representations but purports to account for more data (i.e., “disharmony” and dissimilation processes). It involves a search procedure outlined in (7) that bears obvious similarities to Agree in syntax (as in, for example, Chomsky 2000):

(7) (Dis)harmony searches (Nevins 2004: 14)
(i) A newly-introduced item in the derivation needs a value for a feature in order to “converge” at the interfaces
(ii) Valuation is initiated by a search
(iii) This search attempts to minimize distance, and find the closest source of valuation
(iv) This search may be relativized to certain values of features

Defective Interveners may cause the search to terminate in failure, resulting in “default” valuation

The basic schema is as follows: a segment unspecified for [F] searches in a parameterized direction for the closest source, as defined by precedence relations (Raimy 2000), that is valued contrastively for [F]. The search can also be bounded to a particular domain, so that it will end in failure and result in default valuation for [F] if an appropriate source is not found within the domain.¹ In a harmony/assimilation process, the source value for [F] is copied onto the initiating segment. In a disharmony (dissimilation) process, the opposite of the source’s value for [F] is copied onto the initiating segment.

¹ I won’t have any more to say about this, but formally stating these conditions would be an interesting task in any theory.
“Copy the opposite” allows for a unified account of assimilation and dissimilation, but it is a non-trivial and unusual procedure. I argue that, for empirical reasons as well as this theoretical one, the postulation of such an operation is not warranted. Historical linguists have long noted that assimilation tends to be a well-behaved, Neogrammarian-style regular sound change, while dissimilation often applies sporadically (see, e.g., any basic survey of historical linguistics such as Campbell 1999 or Hock 1986). Furthermore, while assimilation can apply to virtually any type of segment, dissimilation is mostly confined to liquids and nasals. A language with “inverse vowel harmony” requiring root vowels to be dissimilar from suffixal vowels would be very strange indeed. Nor is it clear to me that the few cases of regular dissimilation we see in the literature are active synchronic processes—the Latin –al/-ar case that Nevins (2004) cites, for example. Instead of treating dissimilation like harmony, maybe we would do best to give it a Blevins (2004)-style diachronic, perceptual account: this would be like her CHANCE example of /ʔaʔ/ being misheard and subsequently mentally represented as /a/? because of an inherent bias against postulating two sources for a single feature that seems to be spread over multiple segments. If, as I have suggested, dissimilation is a very different process from harmony, then there is reason to be skeptical about Nevins’ theory. The difficulties with the “copy the opposite” procedure needed to capture dissimilation also argue for selecting a different theory. This is ultimately an empirical issue, however, and the typology of dissimilatory processes clearly requires more thorough investigation.

One way in which search-based models of harmony represent an improvement over autosegmental ones is that they can capture dependencies that run afoul of the No Line-Crossing Constraint on autosegmental representations. This constraint rules out empirically attested cases like the one in (8):

(8) Height/dorsalization harmony in Sibe (Nevins 2004: 85)
Descriptively: a [-HIGH] vowel anywhere in the root triggers uvularization of a suffix-initial dorsal consonant.

\[
\text{[CONS, DORSAL]} \quad \text{[CONS, DORSAL]} \quad \text{[CONS, DORSAL]} \quad \text{[HIGH]}
\]

The + variant of [HIGH] is somehow “invisible” to the search for a value of [HIGH] for the suffixal consonant. If line-crossing were strictly prohibited, there would be no way to account for this “skipping” in the association process given that all instances of [HIGH] are on the same tier; a search, on the other hand, can circumvent the issue by referring directly to [−HIGH], ignoring [+HIGH] entirely. The flipside of this coin is “defective intervention,” in which case a search terminates in failure when an otherwise legitimate source has a co-occurring feature that renders it unacceptable as a valuator. Importantly, intervention (following Calabrese 1995) is parametrically relativized: either all values of [F] intervene, or contrastive values of [F] intervene, or marked values of [F] intervene. Nevins ties intervention to the sonority hierarchy via an implicational universal: if a vowel of sonority \( n \) is a defective intervener, then all vowels of sonority \(< n\)
in the language are, also. In this way phonetics plays a role in defining what harmony processes are possible.

Essential to the theory is the binarity of features, since “copy opposite” would be impossible otherwise. A theory of precedence is also required so that distance can be defined for the search algorithm, which needs to find the closest instance of a particular feature. As far as the search and copy procedure itself is concerned, this requires processes of searching, copying, and some mechanism for copying a value that is the opposite of the source feature’s value. This last operation would require a fairly sophisticated mechanism, beyond what is required for ordinary copying.

5. Search and Copy

In a new paper, Mailhot & Reiss (2007; henceforth M&R) provide another way of computing harmony via a search. They begin with a theory of precedence like Raimy’s (2000) and formally define Search and Copy operations. Here in (9) and (10) is the formalism, where \( \varsigma \) and \( \gamma \) when unindexed are feature specifications, and when indexed are segment tokens with those features:

(9) Search algorithm (M&R 30)

\[
\text{Search}(\Sigma, \varsigma, \gamma, \delta)
\]

1. Find all \( x \) in \( \Sigma \) subsumed by \( \varsigma \) and index them:

\[ \varsigma_0, \varsigma_1, \ldots, \varsigma_n \]

2. For each \( i \in \{0, \ldots, n\} \):

   (a) Proceed from \( \varsigma_i \) through \( \Sigma \) in the direction \( \delta \) until an element subsumed by \( \gamma \) is found

   (b) Label this element \( \gamma_i \)

3. Return all pairs of coindexed standards and goals, \((\varsigma_i, \gamma_i)\)

(10) Copy algorithm (M&R 32)

Identify \( \alpha F \) on \( \gamma_i \) and assign \( \alpha F \) to \( \varsigma_i \) if the set of conditions \( C \) on \( \gamma_i \) are satisfied

Assuming underspecification just like the rest of the theories we have seen, only segments that do not already have a specification for the harmonic feature(s) can initiate a search, i.e., \( \varsigma \) can only be an alternating vowel. Easy cases like the Turkish [\( \text{BACK} \)] harmony in (1) thus follow straightforwardly.

Where this theory diverges most notably from previous ones is that opacity and transparency, rather than being taken as properties of vowels (or vowel systems), are properties of the rules of Search. Opaque and transparent vowels have something in common, namely they are already specified for the harmonic feature. Thus, they cannot initiate searches. This allows for a simple account of the Tangale data in (2), in which [a] is opaque: Search to the left for \( [\text{AATR}] \), then Copy \( [\text{AATR}] \) to the initiator. Crucially, this search does not fail or result in default valuation: [a] donates its own [-ATR] feature for copying. This makes an empirical prediction: the alternating vowels will always take on the harmonic value of the opaque vowel. In other words, it is no coincidence that in
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Tangale, anything to the right of the [-ATR] vowel [a] shows up as [-ATR] also. That value is not the default in any sense; it results from successful application of SEARCH and COPY just like anything else.

Transparency illustrates the independence of SEARCH and COPY, though “value opposite” is still not allowed. So for Wolof, as in (3), we have a SEARCH left for γ specified [-HIGH, aATR], but only COPY [aATR] back to ç. This is akin to the “find a red parrot” case. More complicated data need a combination of this approach plus rule ordering—multiple instances of harmony within a language, like [BACK] and [ROUND] harmony in Turkish, are treated as separate processes so it is possible for them to be ordered with respect to one another, and for unrelated rules to apply between them.

Rounding out the typology, there are cases like Kirghiz, as shown in (11):

(11) Kirghiz vowel harmony (M&R 42)

<table>
<thead>
<tr>
<th>Acc.</th>
<th>Dat.</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) taš-ti</td>
<td>taš-ka</td>
<td>‘stone’</td>
</tr>
<tr>
<td>b) iš-ti</td>
<td>iš-ke</td>
<td>‘job’</td>
</tr>
<tr>
<td>c) uč-tu</td>
<td>uč-ka</td>
<td>‘tip’</td>
</tr>
<tr>
<td>d) konok-tu</td>
<td>konok-ko</td>
<td>‘guest’</td>
</tr>
<tr>
<td>e) köz-tü</td>
<td>köz-gö</td>
<td>‘eye’</td>
</tr>
<tr>
<td>f) üy-tü</td>
<td>üy-gö</td>
<td>‘house’</td>
</tr>
</tbody>
</table>

The dative suffix, which is non-high, picks up [+ROUND] from a high back vowel, but not from a high front one. This is captured by a condition on COPY: SEARCH left for [aROUND], then COPY [aROUND] if γ is [-BACK]. As should be apparent, this is the “find a parrot, and if it’s red, find out its name” case.

Like the other search-and-copy model, this one can operate over a flat phonology. However, this model, unlike Nevins’, makes no recourse to phonetics or to any particular qualities of the vowel systems of harmonic languages. It still requires a theory of precedence relations and, of course, search and copy procedures, but it does not require the extra ability to do opposite valuation. This limits its empirical scope of the theory, but as I have argued in §4, this does not appear to be undesirable. Of all the theories we have seen, M&R’s makes the least theoretical assumptions while still maintaining the advantages that search-based theories have over autosegmental approaches to harmony.

6. Tuvan Pseudo-harmony

If we adopt M&R’s approach for the reasons I have just outlined, we are forced to the conclusion that SEARCH is only initiated when an underspecified vowel enters the derivation. How then can we account for “feature-changing” harmony processes? In (12)

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2 [BACK] is also independently harmonic.
I present data from a Tuvan language game that has been analyzed in this fashion. The Tuvan vowel inventory is paired harmonically as follows: \{i/ü, i/u, e/ö, a/o\} plus contrastive length. Descriptively, there is total reduplication and the first vowel in the reduplicant is replaced with [a], unless it is already [a], in which case it becomes [u]. Additionally, the reduplicant of a harmonic root surfaces with all [+back] vowels, while disharmonic roots can retain any front vowels.

(12) Tuvan reduplication (Harrison & Kaun 2000, 2001)

<table>
<thead>
<tr>
<th>Base</th>
<th>Base + reduplicant</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>nom</td>
<td>nom-nam</td>
</tr>
<tr>
<td>b)</td>
<td>er</td>
<td>er-ar</td>
</tr>
<tr>
<td>c)</td>
<td>at</td>
<td>at-ut</td>
</tr>
<tr>
<td>d)</td>
<td>idik</td>
<td>idik-adik</td>
</tr>
<tr>
<td>e)</td>
<td>ajbek</td>
<td>ajbek-ujbek</td>
</tr>
<tr>
<td>f)</td>
<td>tevelerim</td>
<td>tevelerim-tavalarim</td>
</tr>
</tbody>
</table>

harmonic

disharmonic

There are several logical possibilities for why harmonic & disharmonic roots behave differently in reduplicants. It could be (a) that the first syllable has intrinsically special status—that is, the ability to determine the harmonic class of the entire word, perhaps because the other vowels are all underspecified—or inherits this ability. The latter option is explored by Nevins (2004:43), who derives the first syllable’s properties via a checking process: “when a morpheme contains a segment \(T\) that is marked for checking its value of \(F\), search for the closest source, \(S\), of a value. Change the value of \(F\) on \(T\) if it is distinct from the value of \(F\) on \(S\)” The first syllable has no checker, so it defines the rest of the word. This is undesirable because in all other grammatical feature-checking processes, failure to check a feature causes a derivation to crash. A different approach (b) would be to posit a \([± \text{HARMONIC}]\) diacritic at the morpheme level, or on certain vowels (independent of underspecification), but insofar as they are merely stipulative and not explanatory, diacritics should be avoided (see Vago 1980). A third option (c) would be to specify harmonic domains (in the spirit of Cole & Kisseberth’s 1994 ‘optimal domains’) within a word: harmonic words would have one domain, while disharmonic words would have more than one, and the number of domains would persist through the reduplicative process. Such specification of domains would be redundant as it would simply recapitulate the featural content of the word’s vowels. The approach that I will take (d) is substantially different from all of the previously mentioned strategies: I argue that the Tuvan case (and others like it in Harrison & Kaun 2000, 2001) is not real harmony. It is produced by a set of rules that mimics harmony, and the difference between the two types of roots is that rule application fails disharmonic words.

I believe there are numerous reasons to think that approach (d) is the correct one. First, all other evidence (both internal to Tuvan and across languages) points to harmonic and disharmonic roots being fundamentally the same; they both locally influence

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3 The semantic effect is one of vagueness or jocularity (Harrison 1999). Some of the Tuvan informants were previously aware of the game, while others were trained on the spot. The method of training and testing is not reported in the literature.
suffixes, and all languages of which I am aware have numerous disharmonic roots. Second, there is little or no evidence in the primary linguistic input to Tuvan speakers that root vowels alternate; the process with which we are concerned is para-grammatical. I follow Inkelas (1996) in positing underspecification only in the presence of alternation, so there should be no assumption of underspecification in Tuvan roots. A third consideration follows from the second: capturing feature-changing harmony without root-internal underspecification would require adding deletion and/or overwriting capabilities to SEARCH and COPY, drastically increasing the power of the theory and severing the connection between underspecification and harmony. If we are committed to full specification in roots and the current machinery, then, the Tuvan case must not be true harmony. I will derive this “pseudo-harmony” via derivational rules, not SEARCH and COPY.

In order to account for the data, I will rely on the distinction between feature-changing and feature-filling rules (e.g., McCarthy 1994, Inkelas & Orgun 1995). Reiss (2003) proposes one way to derive this difference, the Unified Interpretive Procedure (UIP), presented below in (13). SDₐ refers to the structural description of a rule Rₐ.

\[(13) \text{ Unified interpretive procedure for structural descriptions (Reiss 2003: 207)}\]
\[\text{A representation Q is an input to rule } Rₐ \text{ if and only if } SDₐ \rightarrow αF \text{ in } Envₐ \text{ and one of the following holds:}\]
\[\text{a. } -αF \in SDₐ \text{ (SDₐ and thus each Q that satisfies SDₐ is specified } -αF) \text{ or}\]
\[\text{b. } -αF \notin Q \text{ (no Q that satisfies SDₐ is specified } -αF, \text{ and thus SDₐ is not specified } -αF, \text{ either).}\]

A rule that satisfies condition (13a) will be feature-changing, while one that satisfies (13b) will be feature-filling or will apply vacuously. If neither condition is satisfied, the rule fails to apply. This captures the generalization that a rule can be feature-changing or feature-filling, but not both. For reasons that will shortly become apparent, I propose a modification to (13a), namely that the UIP should be satisfied just in case every representation Q is specified [-αF]. The case where -αF is explicitly in SDₐ, as the UIP was originally formulated to require, is simply a special case of this. Thus, modify (13a) to (13a’):

\[(13a’) \text{ -αF } \in SDₐ \text{ (each Q that satisfies SDₐ is specified } -αF)\]

Recall now the behavior of the harmonic roots in Tuvan:

\[(14) \text{ idik } \rightarrow \text{ idik-adik; tevelerim } \rightarrow \text{ tevelerim-tavalarım}\]

Let us assume that reduplication applies first to the unaltered base. Next, the set of rules shown in (15) applies to the reduplicant.
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(15)  a) $V \rightarrow [+\text{BACK}]$

b) $V [+\text{HI}, -\text{ROUND}] \rightarrow V [+\text{HI}, +\text{ROUND}] / #(C)$

c) $V \rightarrow [-\text{HI}, -\text{ROUND}] / #(C)$ (Elsewhere Condition)

The UIP is satisfied by the forms in (14) because every vowel in the reduplicant is $-\alpha F$ (i.e., $[-\text{BACK}]$), fulfilling condition (13a’). Therefore the first rule can apply to words that formerly belonged to the front harmony class, and in this case it is feature-changing. Forms that previously belonged to the back harmony class, such as those in (12a) and (12c), will satisfy condition (13b) of the UIP, and rule (15a) will apply to them vacuously. Rules (15b) and (15c) apply disjunctively, in accordance with the Elsewhere Condition (Kiparsky 1973).

We return now to the disharmonic case:

(16) $\text{ajbek} \rightarrow \text{ajbek-ujbek}$

The revised UIP, combined with the lack of $[\text{BACK}]$ in the SD of rule (15a), ensures that the rule is applicable only to harmonic bases. This is because in a disharmonic base such as the one in (16 (=12e)), there are some input vowels that are $-\alpha F$ (i.e., $[-\text{BACK}]$) but there is also one that is $\alpha F$ (i.e., $[+\text{BACK}]$). Forms of this type satisfy neither condition of the UIP, so rule (15a) fails to apply. Thus, the different behavior of harmonic and disharmonic roots under reduplication simply falls out of conditions on rule application; the roots themselves need not be differentiated in any way for this to happen.

7. Conclusions

The success of searches over linear strings in accounting for harmony processes demonstrates that there is no need in this domain for hierarchical or tiered phonological representations. These models in fact achieve better empirical coverage than the models that depend on richer structure, with far less machinery. Within the genre of search-based theories, finer distinctions can be made. I believe the Mailhot & Reiss (2007) approach covers all the data that should be covered (i.e., harmony/assimilation but not dissimilation/disharmony) with the least amount of apparatus, and the search and copy procedures that it does require are independently motivated elsewhere in linguistics: they seem to be used widely in the syntactic module, for instance. Adopting this theory has the advantage of minimizing the demands on ‘narrow phonology,’ which is desirable given Minimalist considerations, and is in the spirit of “approaching Universal Grammar from below” (Chomsky 1995, 2007).

Taking this approach to harmony implies that not everything that looks like harmony—i.e., so called ‘feature-change harmony’ and dissimilation—actually is. We instead define harmony as driven exclusively by underspecification, which occurs only when there is observed alternation, and apply the SEARCH and COPY algorithms in these instances. The remaining synchronic processes, such as the Tuvan case in §6, can be captured using derivational rules.
The points made here about vowel harmony have potential implications for phonology as a whole. It is important to note that, at least in this one domain, very little structure is needed to provide adequate data coverage. The phenomenon can be described using machinery and principles which are arguably simple, and which find parallels elsewhere in linguistics. Investigation into other domains is therefore critical in order to see if the same is true for phonology as a whole. If we find no evidence that sophisticated, layered structure is required in this module, then this would provide a major way in which phonology is different from syntax, which clearly requires hierarchical notions like dominance rather than just linear precedence. Neeleman and van de Koot (2006) have already taken a preliminary look at various reasons why phonology has been assumed to require trees or tiers and conclude that they are unnecessary, and I believe that more research along these lines (as undertaken in Samuels 2008 and Samuels, in progress) could lead to a significant change in the way phonological representations and processes are conceived. It may well be that PF is in fact leaner than has been traditionally assumed, consisting of only a very limited set of operations over linear strings.

References


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