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Non-transparent Constraint Effects in Gere: From Cycles to Derivations

CAROLE PARADIS

1. Introduction

This chapter addresses the case of a constraint in Gere which holds across the board—that is, an undominated (unviolated) constraint in Optimality Theory’s (OT) terms—but whose effects are none the less non-transparent on the surface in some cases, although easily recoverable in a derivational framework. I will show that the often non-transparent effects of this constraint evidence the need for a cyclic application of constraints, and support more generally a derivational approach as advocated in Paradis (1995, 1996). More precisely, I aim at showing that phonological rules / constraints may refer to phonological properties that never come to the surface, which is in essence one of the claims of the cyclicity hypothesis in Lexical Phonology (see e.g. Booij, Chapter 8 above). We will see that evidence in favor of such a hypothesis questions the adequacy of non-derivational constraint-based theories. The argumentation will be partially based on a comparison between the Theory of Constraints and Repair Strategies (TCRS; see e.g. Paradis, 1988a; 1988b; 1993), a derivational framework, and OT (Prince and Smolensky, 1993; McCarthy and Prince, 1993), a non-derivational one.

The chapter is organized as follows. In section 2 I present the relevant facts of Gere. The effects of four interacting constraints will be described. It will be shown how the effects of these constraints, which include the non-transparent ones, can be handled straightforwardly in a derivational constraint-based theory such as TCRS. In section 3 we will see why non-transparent constraint effects such as those found in Gere are problematic for a non-derivational approach like OT. These effects force a cyclic application of constraints, which, we will see, is problematic for OT in many respects. The usual OT alternatives to constraint cyclicity such as levels of constraint application, the Identity constraints, and Alignment will be considered and rejected in section 4. Section 5 is devoted to showing that even constraint cyclicity, if it were compatible with OT’s view, might not be sufficient, and
emphasizes the need for a derivational constraint-based approach as a whole. A conclusion is offered in section 6.

2. Relevant Facts in Gere

2.1. General phonological information

Gere is a Kru language spoken in the Ivory Coast. It has nine oral vowels (i, u, e, o, ɛ, ɔ, e, ɔ, a), each with a phonemic nasal counterpart. Gere also allows phonemic and non-phonemic diphthongs, which will prove important for the analysis proposed in this article. The consonant inventory of Gere is presented in (1).

(1) | Labial | Denial | Palatal | Velar | Complex |
--- | --- | --- | --- | --- | --- |
Stops | p b t d c j k g kp gb gʷ |
Nasals | m n ñ ñ | ñ | ñ |
Glides | f v s z |
Liquids | w j |

Gere’s maximal syllable is (C)(C)(G)V, where the glide, if present, forms a diphthong with the following vowel.1 Vowel sequences of long vowels are automatically heterosyllabic. The shape of non-compound words is either monosyllabic (C)(C)(G)V or bisyllabic (C)(G)V(C)V.2 Diphthongs and branching onsets are systematically limited to the first syllable of words. Gere has also four lexical tones: High (H), Mid-High (MH), Middle (M), and Low (L), which can combine, and yield tautosyllabic sequences (see Paradis 1983a; 1983b for more details on the language).

2.2. Four phonological constraints in Gere: the TCRS view

The constraint we will focus on, the Sonority Constraint, is presented in (2a), and also discussed in Paradis (1990). It requires that the second member of a diphthong be more sonorous than the first one, i.e. Gere allows rising diphthongs only or, in negative constraint-based terms, prohibits non-rising ones. The Sonority Constraint holds without exception, although its effect is often obscured by the effects of other constraints in Gere, the Height Constraint and the Tone Constraint, presented in (2b) and (2c) respectively. The Height Constraint, also discussed in Paradis and Prunet (1990), prohibits sequences of non-high vowels, while the Tone Constraint disallows tautosyllabic falling-tone sequences ending with a non-low tone.

(2) Central constraints in Gere

a) Sonority Constraint Non-rising diphthongs?
Gere: no (e.g. *ɛw, *ɔw)

b) Height Constraint Sequences of non-high vowels?
Gere: no (e.g. *ɛɛ, *ɔɔ)

c) Tone Constraint Tautosyllabic falling-tone sequences?
Gere: no* (e.g. *H/MH-M)

The fourth relevant constraint is a very common constraint across African languages: it prohibits the glide w or labialized consonants from being followed by a round vowel (i.e. u, o, and ɔ). This restriction on sequences of round segments can be interpreted, as shown in (3), as an effect of the Obligatory Contour Principle (OCP), activated tautosyllabically on the [round] tier in Gere. Note that ɔ in Gere does not behave as a round vowel, since sequences such as wɔ, ɣɔ, etc. are permitted and commonplace. It is thus assumed that the vowel is labial but not round, at least not underranging.3 The exact representation of the vowel, however, is irrelevant here; for our purpose, it suffices to know that it is not targeted by the constraint below.

(3) OCP Constraint on Labial: *[round] ([round] (wɔ, ɣɔ, etc.)

Constraints will be handled by the derivational constraint-based framework of TCRS, where violations are fixed up by repair strategies. The application of

1 Paradis and Prunet (1990) suggest that the constraint is in fact the following: Height Contstraint. 2 [High] [High]. This constraint, which can be interpreted as an effect of the Obligatory Contour Principle on [high], prohibits adjacent [high] values but also adjacent [+high] ones. It is claimed that, since vowels are underspecified for their [high] value underranging, and that [high] is inserted only after the constraint has been deactivated, the Height Constraint has no apparent effect on the latter sequences. The exact formulation of the constraint is, however, orthogonal to the analysis presented here; we will therefore not be concerned with it any longer.

2 It is not uncommon for languages to have restrictions on combinations of phonological elements (consonants, vowels, tones) within a syllabic constituent. (2c) is a constraint of that sort, which limits falling tone sequences within a nucleus to the deepest level of fall. This constraint, whose formulation is actually simplified here (hence its language-specific aspect), is likely to result from several parameter settings—like those suggested below—as in the case of vowel and consonant inventories in general, which might be in some languages asymmetrical too (see Paradis, 1982c; Paradis and Prunet, 1998 on combinations of parameter settings as an explanation for the so-called language-specific constraints) (answers in brackets relate to Gere): Tautosyllabic tone sequences? (yes); All types? (no); Rising? (yes); All types? (yes); Falling? (yes); All types? (no); Any first tone? (yes); Any last tone? (no); Last tone is low? (yes—deepest fall); Last tone other than low? (no).

3 It might be that the vowel [ɔ] is of underranging, i.e. an unrounded low back vowel, or that Gere speakers have a mental organization of rounded vowels which is not in total accordance with the phonetics, not an uncommon behavior (see Kenstowicz, 1994: 1-11 on phonetic illusions and the differences as well as the occasional discrepancies between phonetics and phonology).
repair strategies is governed by universal principles such as the Minimality
and the Preservation principles, presented in section 5. Constraints them-
selves are principles, like the OCP, or (negative) parameter settings, like
those in (2). In sections 2 and 3 I will be mainly concerned with the
derivational aspect of the framework, rather than with the way repair stra-
tegies apply. This latter issue will be briefly addressed in section 5 (see also
Paradis and LaCharité, 1993; 1995; 1997 for detailed descriptions and dis-
cussions). In TCMS, morphological operations are monitored by phonological
constraints at all stages. None the less, a constraint can be deactivated at
some level, either lexical or postlexical, provided its domain of activation is
specified as a set of continuous strata. While active at a given level or levels, a
constraint's application is cyclic. That is, each violation by a morphological
operation is detected immediately and repaired at once, before another mor-
phological operation can apply. Repairs are limited to two strategies: insert or
delete, where z stands for any phonological material (features, nodes, links,
timing slots, etc.).

2.3. Transparent versus non-transparent constraint effects

There are three 3sg. suffix pronouns in Gere, e, o, w—selected according to
nominal class—and a 3pl. suffix, i. As shown in (4), suffixed pronouns in non-
causative declarative verbal forms systematically create a diphthong with the
preceding stem-final vowel (see directly below for justification).

(4) High stem vowel (non-causative forms)

a) /kmw-3-w’/ → kmw'[w’] 'I bite it'
b) /f的态度-3-w’/ → [dj][w’] 'I eat it'

The MH tone at the end of the clitic object pronoun is what Paradis (1983a;
1983b) has called the Intransitive suffix. It systematically appears after a
single-vowel pronoun object (i.e. a clitic), or after plain intransitive verbs.
The diphthong results from the attachment of the pronoun vowel—which
has no timing slot of its own—to the timing slot of the stem vowel, as
illustrated in (5a). This yields a weak diphthong in the sense of Kaye and
Lowenstamm (1980), i.e. a sequence of two nuclear segments attached to a
single timing unit (x) or, in moraic theory, to a single mora (see also Harris

(5) a. diphthongization b. representation of a weak diphthong

[X-overglide on left of diphthongs in (4) constitutes the weak member
of the diphthongs: recall that Gere allows (sonority) rising diphthongs only.
The fact that, when the stem and suffix vowel are identical, as in (6), what is
heard is crucially a short monophthong—not a long vowel or a rising
diphthong—suggests that the pronoun vowel is slot-less, and that the represen-
tation in (5b) accounts well for the facts in Gere.

(6) Identical vowel sequences

a) /kmw-3-w’/ → [kmw’][kmw’] [kmw’] 'I catch it'
b) /f的态度-3-w’/ → [dj][w’] [dj][w’] 'I eat them'

Now if we observe in (7) suffixation in verbal stems which end in a non-high
vowel, we see that the stem vowel is raised. It is assumed that the mid vowels
in Gere are conditionally [- high] (see Paradis and Prunet, 1990 for argu-
ments). Raising—which will become more evident with the causative forms in
(8) and the non-causative forms in (13)—is triggered by the Sonority Con-
straint in (2a).

(7) Non-high stem vowel (non-causative forms)

a) /rz3-3-w’/ → [rz3][w’] 'I begin it'
b) /pj3-3-w’/ → [pj3][w’] 'I sell it'

The first two causative forms in (8) constitute minimal pairs with those in (7).

(8) Causative forms with a non-high suffix vowel

a) /rz3-CAUS-3-w’/ → [rz3][w’] 'I make it beg'
b) /pj3-CAUS-3-w’/ → [pj3][w’] 'I make it sell'
c) /rz3-CAUS-3-w’/ → [rz3][w’] 'I make the dog beg'
(a grave accent on a vowel represents a L tone)

The stem vowel in (8) is not realized as an on-gliding as in (7) because it does
not constitute the weak member of a diphthong, i.e. a complex nuclear
structure. The vowel sequences in (8) are clearly disyllabic. As already men-

6 See the Stratum Domain Hypothesis of Pullayblank (1986: 6), a modified version of Moha-
nan's (1986: 21).

7 The realization of the two vowels as one monophthong could not be attributed to a general
OCP effect—an attractive alternative at first sight—since sequences such as /j/ and long vowels
such as /u/ are /l/ (e.g. /j’/ to /fl/, /d’l/ 'chest', /fl/ 'crumpled') are common in Gere (see Paradis

8 A non-ATT high vowel always harmonizes with an ATT high one.

9 The fact that the pronoun vowel anchors despite the resulting violation of the Sonority
Constraint will be discussed in section 5.

10 A L-tone is raised when followed by the MH intransitive tone.
in 2.1, sequences of vowels—as opposed to on-glide vowel sequences—and long vowels are always heterosyllabic in Gere (see Paradis, 1983a; 1983b, and Paradis and Prunet, 1990 for arguments). This is due to the fact that the causative suffix consists of a bare timing slot, which allows the slotless pronoun vowel to anchor, and thus to form a new syllable, as in (9a) and (8b). Therefore, diphthongization does not occur. When there is no pronoun suffix vowel, the stem vowel simply lengthens, as seen in (8c). Anchoring of the suffix vowel and lengthening of the stem vowel in causative formation are shown in (9a) and (9b), respectively.

(9) a. Anchoring of the suffix vowel b. Lengthening of the stem vowel

\[
\begin{align*}
X & \rightarrow X \quad \text{(caus.)} \\
V & \rightarrow V
\end{align*}
\]

One could object, however, that vowel-raising in (8) is due not to the Sonority Constraint, as in (7), but to the Height Constraint in (2b), which prohibits sequences with two distinct non-high vowels. This is evident from the fact that if the pronoun vowel is already high, as in (10), the stem vowel is not raised (for more examples and detailed derivations, see Paradis 1983a: 125 ff.). 11

(10) Causative forms with a high suffix vowel

a. \( /z\&5\text{-CAUS-1'} / \rightarrow [\text{z}\&5\&] *[\text{z}\&5\&] \quad \text{'(I) make them shout'}
\]
b. \( /z\&5\text{-CAUS-0'}/ \rightarrow [\text{z}\&5\&0\&] *[\text{z}\&5\&0\&] \quad \text{'(I) make it shout'}
\]

Failure of the vowel to raise in causative formation is due to the fact that the causative, which is suffixed before the pronoun vowel, provides an x-slot to which the pronoun vowel can anchor. As in (8), provision of an x-slot prevents the vowel from having to go through an ill-formed diphthong stage. The derivation of (10a) is provided in (11), where it can be seen that the causative slot associates with the suffix vowel before the latter anchors in the stem slot (11b). 12

The derivations proposed here are slightly different from those in Paradis (1983a; 1983b), who assumed that single-vowel pronouns were anchored. As a consequence, arbitrary x-slot deletion rules had to be invoked to account for the formation of diphthongs.

11 The derivations proposed here are slightly different from those in Paradis (1983a; 1983b), who assumed that single-vowel pronouns were anchored. As a consequence, arbitrary x-slot deletion rules had to be invoked to account for the formation of diphthongs.

12 Note that whether the stem vowel anchors or not in the Causative suffix before the suffix vowel is associated with it has no bearing on the analysis here. In any case, delinking of the stem vowel once the suffix vowel is associated with the causative slot would be permissible, since it does not result in vowel loss, given that the stem vowel is already anchored.

(11) a. Causative suffixation b. Anchoring of the suffix vowel

\[
\begin{align*}
\text{(11a) } & \quad X \quad \text{(caus.)} \\
\text{(11b) } & \quad X \quad \text{(caus.)}
\end{align*}
\]

(12) a. \( /w\&5\text{-CAUS-1'} / \rightarrow [\text{w}\&5\&] *[\text{w}\&5\&] \quad \text{'(I) make them shout'}
\]
b. \( /w\&5\text{-CAUS-0'}/ \rightarrow [\text{w}\&5\&0\&] *[\text{w}\&5\&0\&] \quad \text{'(I) make it shout'}
\]

Now compare the examples in (12) with those in (13) where, interestingly, the stem vowel is raised in spite of the fact that the pronoun vowel is high and the vowel sequence syllabic, as in (10) and (12). These examples, which are crucial to the point I want to make here regarding non-transparent constraint effects, are commonplace in Gere (see Paradis, 1983a: 141 ff.).

(13) a. \( /w\&5\text{-1} / \rightarrow [g\&5\&] *[g\&5\&] \quad \text{'(I) shout them'}
\]
b. \( /w\&5\text{-0'}/ \rightarrow [g\&5\&0\&] *[g\&5\&0\&] \quad \text{'(I) shout it'}
\]

Paradis (1983a; 1983b) shows that raising of the stem vowel is well accounted for if it is assumed that the surface syllabic vowel sequences in (13) go through a (deeper-level monosyllabic) diphthong stage, as in (14), on p. 536. As already shown, a floating pronoun vowel, lacking a slot of its own, links to that of the stem vowel, thus forming a diphthong (14a). In the case at hand, the result is a violation of the Sonority Constraint, which prohibits non-rising diphthongs. To satisfy the Sonority Constraint, the stem vowel raises (14b); however in so doing, it violates the OCP on [round] (see (3)), since high back vowels—in Gere as in most languages—are automatically [+round]. Repairing that violation is accomplished by delinking the feature [+round] from the onset consonant, yielding an unrounded \( w \), represented here by \( g \) (14c). When the Intransitive suffix MH is suffixed, it violates yet another constraint, the Tone Constraint in (2c) against tautosyllabic falling

13 Like OCP, constraints in TCRS can trigger repairs (see Kaisse, 1987; Yip, 1988 for numerous examples of OCP yielding repairs) in addition to acting as blockers. As stated in Paradis (1988a; 1988b; 1993), repairs are caused by constraint violations, whose internal sources are: underspecification of the type \( \emptyset \rightarrow [+\text{round}]/[+\text{back}]/[−\text{low}]\);
tide sequences (14d). To remedy the Tone Constraint violation, the Intransitive suffix MH is dissociated from the stem vowel slot, and linked to an epenthetic slot that yields, perforce, a distinct syllable (14e). This newly formed syllable is subsequently filled by the closest available vowel, here the second member of the diphthong. This analysis straightforwardly handles the fact that the stem vowel is raised in (13), despite the fact that the surface form is disyllabic, i.e. diphthongless, and the pronoun vowel [+ high].

(14) a. Suffixation of the pronoun and formation of an ill-formed diphthong (Sonority Constraint)
   b. Stem vowel-raising (repair): dissociation of [+ high] and default delinking (repair)
   c. OCP on [round] (see (3)); [round] insertion of [+ high]17

H
\[x\][x]  w o - t
[+ high] [+ high] Labial Dorsal

H
\[x\][x]  w o - t
[+ high] Labial Dorsal

H
\[x\][x]  w o - t
[+ high] Labial Dorsal

H
\[x\][x]  w o - t
[+ high] Labial Dorsal

H
\[x\][x]  w o - t
[+ high] Labial Dorsal

What is of particular interest about the data in (13) and (15) is that there is no surface motivation for vowel-raising. Without positing an intermediate stage where the vowel sequences are diphthongized, the examples in (13) and (15) would be unexplainable. On the one hand, the vowel’s not being diphthongized on the surface eliminates the Sonority Constraint as a potential cause at that level. On the other hand, the second vowel of the sequence being high precludes a potential effect of the Height Constraint. Indeed, the examples in (13) and (15) stand in marked contrast to the pattern observed in (10) and (12). In the latter, a non-high stem vowel does not raise when an autonomous high pronoun vowel (i.e. one with its own timing slot) is suffixed. One might conclude that vowel-raising in Gere is unsystematic, i.e. that the numerous forms of the kind exemplified in (13) and (15) are simply exceptions to the rule. However, this conclusion would be most unsatisfactory, since raising and non-raising are clearly conditioned in a very predictable way by tonal patterns and by the floating versus anchored status of the pronoun vowels, on the surface as well as during intermediate stages.

3. Derivational versus Non-derivational Constraint-Based Approaches

Non-transparent constraint effects such as those of the Sonority Constraint in (13) and (15) are unproblematic in a derivational constraint-based approach like TCNS. The cyclic application of constraints—here the Sonority Constraint—handles the intermediate stage at which a diphthong is formed in those examples, as well as accounting for the heterosyllabicity of the vowel sequences on the surface, without additional tools. Now the question is: how can a filter-based theory such as OT, where constraints are typically
uninvolved in the generation of forms (candidates), account in a principled way for vowel-raising in (13) and (15)? As shown in (16), Eval (/\Con/) in OT is the set of universal phonological filters which evaluate the whole candidate set generated by Gen, i.e., the place where phonological processes apply or, if one prefers, where inputs undergo modifications.

(16) The organization of phonology in OT

Input (underlying forms) \[ \downarrow \]

Gen (creation of candidates) \[ \downarrow \]

Eval (evaluation of candidates by the ranked constraints)

Eval, being a set of filters, has by definition no control over the phonological processes applying in Gen since it deals only with outputs of Gen.

3.1. One-step assessment of Eval

Let us first consider the possibility of having a one-step assessment, that is a constraint evaluation of the postlexical outputs. To select the good candidate in (13a), which is go\( \tilde{t} \) (\( w\tilde{s} - t^-/t^- \)), the whole candidate set would have to be assessed globally, as in (17), by the filters of Eval. These are ranked on the left in the following tableaux for reasons of space. Note that Parse means 'no deletion' and Fill 'no insertion'; the tie bar under the vowels indicates a diphthong.

(17) One-step assessment \( \rightarrow \) wrong candidate

<table>
<thead>
<tr>
<th>input: ( w\tilde{s} - t^-/t^- )</th>
<th>( g\tilde{o}t )</th>
<th>( w\tilde{s} )</th>
<th>( w\tilde{\delta} )</th>
<th>( g\tilde{\delta}t )</th>
<th>( w\tilde{s}/w\tilde{\delta} )</th>
<th>( w\tilde{\delta}t )</th>
<th>( g\tilde{\delta}t )</th>
<th>( g\tilde{\delta} )</th>
<th>( \Rightarrow w\delta )</th>
<th>( g\delta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone Constraint</td>
<td>( +)</td>
<td>( -)</td>
<td>( -)</td>
<td>( -)</td>
<td>( -)</td>
<td>( -)</td>
<td>( -)</td>
<td>( -)</td>
<td>( -)</td>
<td>( -)</td>
</tr>
<tr>
<td>Parse (non-features)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
</tr>
<tr>
<td>Sonority Constraint</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
</tr>
<tr>
<td>OCP on round</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
<td>( +)</td>
</tr>
<tr>
<td>Fill (slot)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parse (features)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This yields in both cases \( w\delta \) as the winning candidate, which is, as already mentioned, the wrong candidate.

3.2. Two-step assessment of Eval

3.2.1. Assessment on a cyclic basis

Now let us examine whether a cyclic application of Eval would solve the problem, i.e., would be able to account for the non-transparent effects of the Sonority Constraint. For this, let us assume that Eval applies right after the pronoun suffix is suffixed, i.e., before the intransitive tone is inserted. The selection of go\( \tilde{t} \) in (14c) would work as in (19).

\( ^{18} \) "Parse non-features" is a simplified version of Parse tones, root nodes, and x-slots.

\( ^{19} \) Whether inputs are underspecified or not in OT has no bearing on the argument here, however, since the unparsed feature \( [-\text{high}] \) is underlying in one way or the other. If underspecification were to be disallowed, only the formulation of the Height Constraint would have to be slightly modified (see n. 3).
(19) First cycle assessment

<table>
<thead>
<tr>
<th>/wɔ - i/</th>
<th>gɔt</th>
<th>wɔt</th>
<th>gɔt</th>
<th>wɔ / w</th>
<th>wɔt</th>
<th>⇒ gɔt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill (slot)</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parse (non-features)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sonority Constraint</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCP on round</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parse (features)</td>
<td></td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The constraint ranking in (19)—where Fill is now the highest-ranked constraint—allows one to select the correct candidate, gɔt, on the first cycle. This candidate is the one which violates only the lowest-ranked constraint in the constraint hierarchy. Parse features, while the other candidates all violate another constraint, ranked higher in the hierarchy.

(20) Second cycle assessment

<table>
<thead>
<tr>
<th>/gɔt - i/</th>
<th>/gɔt/</th>
<th>gɔt</th>
<th>⇒ gɔt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone Constraint</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parse (non-features)</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>Fill (slot)</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
</tbody>
</table>

The selected candidate, gɔt, is the correct one, i.e. that with a H-MH heterosyllabic tone sequence. Thus a two-step application of Eval in terms of cycles seems to be able to account for the facts in Gere. This solution is not cost-free, however. First, a cyclic application of Eval renders OT more derivational (serial). Proponents of OT agree that a cyclic application of constraints would be a way of incorporating traditional derivational notions of phonology into OT. As stated by McCarthy (pers. comm.), this would be 'antithetical' to OT's programme. Second, the cyclic solution entails that Eval would have to apply to a non-surface-true form since gɔt never surfaces as is, i.e. without the intransitive tone. It would be surprising, to say the least, for a filter-based framework to even consider outputs which are not surface-true. It follows from the fact that constraints can be outranked in OT that only a small number of constraints in Eval, i.e. the undominated ones, are expected to be surface-true. However, the candidates selected by Eval must all obligatorily be surface-true, given the non-serialism commitment of OT.

The cyclic option might have to face another (less apparent) problem. Notice that, no matter how Parse is split up in (19), Fill is ranked above all the Parse constraints. However, to derive the final output with the correct tone sequence on the second cycle in (20), this ordering has to be reversed. From the cyclic solution's perspective, this constitutes a ranking paradox akin to the ordering paradoxes that used to afflict standard theory. Recall that even in more traditional lexical approaches, rules are ordered in a given way within a reasonably broad lexical domain (i.e. a whole level at least), and no rule reordering is allowed to take place within that domain.

Of course, the reordering problem for the cyclic option disappears if a broader range of Parse constraints is posited. However, is such a solution really available or even desirable in the case at hand? One could argue that the Parse constraint involved in (20) is different from that in (19), since in (20) it targets tones, while in (19) the Parse constraints apply to root nodes and features. In other words, it could be argued that Parse segments (Parse non-features in (19)) and Parse tones (Parse non-features in (20)) are two different constraints, in which case their different ordering with respect to Fill would not be so surprising. Admittedly, Parse segments might be distinguished from Parse features, with the first one ranked higher since features are assembled into segments. But this is not the case with lexical tones and segments: tones are not part of segments, nor segments part of tones: both are independent and autonomous entities, equally basic and persistent. Dividing a constraint into several constraints inevitably increases the generative power of a grammar, since it multiplies the number of constraint ranking possibilities. Constraint-splitting, when it is unavoidable, must thus be done in a principled way. In the case at hand, it is therefore important to know whether the difference of ranking between Parse segments and Parse tones can be justified on independent grounds or if it is just a convenient descriptive device. After all, Parse means 'preservation of the phonological information contained in or morphologically attached to the input'. Why should segments be more prone to preservation than lexical tones? At least, in the absence of a cogent answer to this question, constraint-splitting—here and elsewhere—should be supported on typological grounds. In other words, one could ask here whether it is a general tendency across languages or in some given languages to give precedence to segment preservation over tone preservation, or if this would have to be an idiosyncrasy of Gere. At this stage, the options in the cyclic solution's perspective appear to be: (1) divide Parse into Parse segments and Parse tones, an alternative which would avoid the ranking paradox under discussion, but which remains to be independently justified in spite of the established use of constraint splitting in OT, or (2) rerank the constraints involved in (19) and (20) cyclically. No doubt this latter option would increase dramatically the derivational power of OT to an extent never reached even by standard Lexical Phonology, in addition to diminishing significantly the predictive power of the framework.
3.2.2. Assessment on a level-ordered basis

A partial solution would be to equate the cycles in (19) and (20) with distinct lexical/postlexical levels, since it is admitted by the proponents of OT that Eval can be sensitive to lexical levels: "each level constitutes a separate mini-phonology, just as in ordinary rule-based Lexical Phonology . . . Each level selects the candidate form that best satisfies its parochial constraint hierarchy" (McCarthy and Prince, 1993: 24).

However, this solution entails problems too. The first problem is empirical: there is no indication that lexical levels exist independently in Gere. As far as I know, these levels would have to be maintained for the sole purpose of the analysis here. Nor is there any indication that one of the suffixes could be concatenated at the lexical level and the other at the postlexical one. As mentioned in 2.3, the intransitive tone is suffixed at the end of intransitive verbs as well as transitive verbs with a clitic object pronoun. It is never found at the end of other objects, which indicates that clitic object pronouns and the intransitive suffix are closely related, and hence are very likely to be both concatenated at the same level, which seriously challenges the level-ordered option.

However, let us assume the level-ordered option, just for the sake of argument. Eval would still have to apply to a non-surface-true form. As previously stated, the selected candidate on the first cycle, 6̃og, never surfaces as is. This is why equating the cycles postulated in (19) and (20) with lexical/postlexical levels would represent only a partial solution for OT in the sense that it would indeed limit the amount of derivationality within OT but would not solve the non-transparency problem, i.e. the fact that the output of the first-step assessment is a non-surface-true form. The level-ordered option also raises a more fundamental question: what are the principled reasons to authorize Eval to apply at the end of levels but not cycles? Why the former morphological domain but not the latter? As far as I know, there is no formal reason ever invoked for doing so, but the obvious fact that a cyclic application of Eval would render the framework even more derivational (serial) than it currently is with the level-ordered option. The current tolerance threshold to ‘derivations’ (serialism) in OT thus seems arbitrary, i.e. a subjective limit to derivation quantity. None the less, it must be clear that either option, cyclic or level-ordered, constitutes a two-step evaluation which is a ‘derivational residue’.

4. Alternatives to Cycles and Levels in OT

It has been argued hitherto that resorting to multi-step constraint application in OT—although partly successful in describing the Gere facts—is not free of practical and conceptual problems, given OT’s commitment to non-serialism.

Several attempts have been made in the last few years to get rid of serialism in OT, be it in the form of cycles or of levels. In the main, two devices have been resorted to—Alignment (e.g. McCarthy and Prince, 1994) and Identity constraints (e.g. Kenstowicz, 1995)—which I will consider in turn. It will be shown that both devices fail to handle the opaque effects of the undominated Sonority Constraint.

4.1. Alignment

Generalized Alignment is a family of constraints which deal with the correspondences between prosodic and morphological constituents. These constraints are often resorted to in OT to account for (apparent) cyclic effects (see the references in McCarthy and Prince, 1994: 2). Thus one could argue that problematic vowel-raising in (13) is due to the fact that the stem is not aligned with the morphological constituent because of the affixes appended. However, this solution could not be maintained here, since there is alignment in none of the examples under consideration, causative or non-causative. In other words, there is a systematic morphological break between the stem vowel and the pronoun vowel in all cases. More precisely, there is no more or less alignment in the examples in (13) than in those in (7)—if the comparison is to be made with non-causative forms—or those in (12)—if the comparison is to be made with causative forms. Since, on the one hand, vowel-raising applies in the examples in (7), which are monosyllabic, as it does in the examples (13), which are bisyllabic, and, on the other hand, vowel-raising fails to apply in the examples in (12), which are bisyllabic exactly like those in (13), the syllabic differences between all these forms cannot be adequately captured by OT. Syllabic differences are crucial for the derivational TCGR analysis provided in 2.3 but irrelevant to OT, since Eval—being confined to outputs—cannot make the connection between the number of syllables and vowel raising at the intermediate stages.

4.2. Head Identity

One might consider replacing cycles or levels with co-phonologies where Head Identity would be ranked differently in each co-phonology. Head identity, like all Identity constraints, is an anti-alemmorphy constraint or, put differently, a correspondence constraint which compares an output with another output, and requires that the head of a non-derived output be identical to that of a morphologically derived one. Thus one could argue that the causative forms pertain to a co-phonology where Head Identity is highly ranked (thus complied with), whereas the non-causative forms, be they monosyllabic as in (7) or bisyllabic as in (13), pertain to another co-phonology where Head Identity is ranked lower. This is exemplified in (21).
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(21) a. Co-phonology with Head Identity unviolated: the causative forms in (12) derived surface form: [wɔː] undervived surface head: wɔ

b. Co-phonology with Head Identity violated: the non-causative forms in (13) derived surface form: [gɔː] undervived surface head: wɔ

This account would face several problems, though. First, Head Identity is not respected in the causative forms where the pronoun vowel is not high (cf. (8), where /zɔː - CAUS - o - 'o - [zɔːe]). Second, vowel-raising fails to apply in non-causative bisyllables where the pronoun vowel is high. As shown in (22), the behavior of non-causative bisyllables and causatives is identical from this respect.

(22) a. Causatives

With a high pronoun vowel: no vowel-raising

\[ wɔː - CAUS - t - ʔ \rightarrow [wɔːt] \quad *[wɔː]\]
\( 'I\) make them shout'

With a non-high pronoun vowel: vowel-raising

\[ wɔː - CAUS - o - ʔ \rightarrow [wɔːo] \quad *[wɔːo]\]
\( 'I\) make it shout'

b. Non-causative bisyllables

With a high pronoun vowel: no vowel-raising

\[ ðe - t - ʔ \rightarrow [ðe]\quad *[dt]\]
\( 'I begin them'

With a non-high pronoun vowel: vowel-raising

\[ ðe - o - ʔ \rightarrow [ðo] \quad *[ðo]\]
\( 'I begin it'

The link between the causatives and the non-causative bisyllables would be missed by the co-phonology solution, whereas it is straightforwardly handled by the TCRS derivational analysis proposed in 2.3. Non-causative bisyllables do not undergo vowel-raising when the pronoun vowel is high, because they, like causatives, do not go through a diphthong stage, i.e. the stem and pronoun vowels can each anchor in an independent slot. When the pronoun vowel is not high, raising occurs because of the height constraint, not the sorority constraint. For the co-phonology solution, however, the facts in (8) and (22) would represent insurmountable problems.

5. Cycles/Levels versus A Global Derivational Approach

It thus appears that recourse to the first device examined to account for the Gere facts, i.e. cyclicity, is—although problematic in many respects for OT—hardly avoidable. Now the question is: is such recourse even sufficient? In other words, does allowing Eval to assess candidates on a cycle or even a level basis suffice, or do we need an approach which is more globally derivational? The facts reported by Goldsmith (1995) suggest that an openly derivational constraint-based theory might be more adequate than one which declares itself to be non-derivational and allows serialism only through a constraint evaluation per level. Cycles or levels can account for multi-step assessment within morphologically complex forms, but is unable to handle multi-step assessment within morphologically undervived ones. Yet such cases exist. Goldsmith (1995) addresses the case of a tonal constraint in Mbitu, a Bantu language, which does not hold at the surface. He cogently showed that its violation is not an example of a constraint simply failing to hold, i.e. an outranked constraint in OT's terms. As demonstrated by Goldsmith, the constraint does hold, exceptionlessly—it just does not hold on the surface: it holds at a slightly more abstract level. What is of particular interest about this case in Mbitu is that the constraint in question applies intramorphemically, and has to be ordered with respect to another constraint which also applies intramorphemically. Thus recourse to cycles or lexical / postlexical levels as well as to typical OT alternatives such as Identity constraints and Alignment would be useless in this case, since no morphological break whatever is involved.

Even if the level-ordered option with constraint splitting and reranking—the solution most compatible with the OT framework—did not meet the problems pointed out above, it is not obvious that a plainly derivational constraint-based theory like TCRS is not better fitted to handle the facts in Gere, i.e. more explanatory. For the sake of the exposition, let us reconsider the constraint-splitting issue. As already mentioned in section 3.2.1, extrinsic constraint-rerankings on a cycle or level basis could be avoided if a principled reason for splitting Parse into Parse segments and Parse tones could be advanced. Therefore no constraint-reranking would be necessitated. In a more general perspective, the question behind this problem—which is as valid for TCRS as for OT—is why is a floating tone more entitled or prone to receive its own timing unit (see (14e)), which violates Fill, than a floating segment (see (14b)), which abides by Fill? Why is the nature of the tone not merely changed, i.e. why is the MF intransitive tone not replaced with a L tone, for instance, which would yield a permitted falling tone sequence—similarly to what happens to the vowels involved in an ill-formed diphthong—instead of being anchored in an epenthetic slot? As seen, a mid vowel is raised when it constitutes the first element of a diphthong. While OT would most likely resort to constraint-splitting to handle the differences of behaviour between tones and segments—a powerful and essentially descriptive device as long as it is not independently justified—the reason for such differences of behaviour might lie in the fact that segments are decomposable entities, i.e. they are made of nodes and features which can be modified, while tones are generally assumed not to be. In this perspective, changing a tone is perceived as the equivalent of losing it,

20 Not to mention—from a more general perspective—that Head Identity, which is intended to avoid derivations, is not totally deprived of 'derivational residue'. As shown by Booj (Chapter 8 above), Head Identity entails that 'when a language has co-phonologies, complex words must be evaluated cyclically'.

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whereas changing a segment is viewed as a more or less minor modification within the segment, as long as its root node is not deleted.21

Assuming that this explanation is valid, however, it is not clear how it can be dealt with or even implemented in OT. Splitting Parse into Parse tone and Parse segment, in order to rank them differently, leaves the explanation provided above completely aside, since constraint-splitting as it currently functions in OT is, as already mentioned, essentially descriptive—for instance, it does not explain why tone preservation is more important than segment preservation—despite the efforts of some authors to restrain or prohibit some constraint rankings within families of constraints such as Parse (see Itô and Mester, 1995; Smolensky, 1995). In contrast, the non-insertion/insertion of a timing slot in (19) and (20) is predicted by TCRS without any extra tool, i.e. from the general principles of the framework. To this effect, I will first present a brief overview of its most basic mechanisms.

As already mentioned, constraints in TCNS are preserved by repair strategies which apply minimally, according to the Minimality Principle in (23).

(23) Minimality Principle: Repairs
(a) apply at the lowest phonological level to which the violated constraint refers and
(b) involve as few strategies (steps) as possible.

The lowest phonological level is determined by the Phonological Level Hierarchy in (24). Note that this scale simply reflects the phonological organization required independently of TCNS, where the metrical level is the most important or ‘organizational’ level, and the terminal feature level the least.

(24) Phonological Level Hierarchy: Metrical level > syllabic level > skeletal level > root node > non-terminal feature > terminal feature.

Repairs are also governed by the Preservation Principle in (25).

Now let us reconsider (14a), where the pronoun vowel is unlicensed underlyingly. There are three ways of solving the problem: by inserting a timing unit and attaching it to the pronoun vowel; by anchoring the pronoun vowel in the stem vowel’s timing slot; or by deleting the pronoun vowel. The first solution could be the one selected if Gere did not allow diphthongs. However, since it does, the second appears as the most minimal one in the view of the Minimality Principle. According to the Phonological Level Hierarchy in (24), a

change at the feature level is less dramatic than one at the skeletal (timing slot or mora) level. As for the third solution (deletion of the pronoun vowel), it is rejected by the Minimality Principle since it would needlessly violate the Preservation Principle—more or less the equivalent of general Parse in OT—at a higher level, i.e. the segment level, than the second solution, which violates the Preservation Principle only at the feature level (with [−high] delinking).

In contrast, the rescue of the unlicensed MH intransitive tone in (14d) faces fewer options. Since tones are indivisible entities, only two repairs can be considered: deletion of the MH tone, or insertion of a timing slot to anchor the floating tone. Both solutions are equally minimal, but since the latter is more ‘preservative’ in the view of the Preservation Principle, it is the one which is selected. One could object, though, that the behaviour of the MH tone in (14) differs from that of the MH tone in (15), where the first option (deletion of the tone) is selected. The answer to this objection lies in the fact that the MH tone of the intransitive does not violate the same constraint in the two cases: in (14) it violates the Tone Constraint (2c), while in (15) it infringes upon the OCP. While the former constraint can be satisfied with the addition of a new syllable—the Tone Constraint refers to syllability (see (2c)), the latter cannot; the lowest level it refers to, according to the Minimality Principle, is the tone level. In other words, deletion of the tone in (15) is the only option. This is predicted by TCNS on the basis of universal principles. In OT, however, it would have to be treated as an idiosyncrasy of Gere in terms of language-specific constraint-splitting and ranking.

6. Conclusion

I have endeavoured to show that the non-transparent effects of the unviolated Sonority Constraint in Gere provide evidence of the need for a cyclic application of constraints. OT’s usual alternatives to cyclicity, Identity constraints and Alignment, have proved inadequate to handle the Gere facts. We have also seen that the level-ordered option, although the most attractive alternative at first sight in OT’s view, can hardly be invoked, since the Intransitive suffix and the clitic object pronouns are most likely appended at the same level.

However, a cyclic application of constraints is not the panacea, since it is not easily compatible with OT’s thesis. First, conceptually, it seriously undermines the claimed aserialism of OT. If we accept that constraints may refer to a serial device such as the morphological cycle, can we establish a non-arbitrary limit to serialism? Unless this question is directly and seriously addressed, OT risks being stripped of its essential claims. Second, constraint evaluation on a cyclic basis, no more than one on a level basis, cannot deal with the fact that the (intermediate) output in (19) is not surface-true. This is a
serious problem for OT since Eval, by definition, can only select candidates which are surface-true; indeed, the constraints of Eval are not supposed to be able to make reference to phonological information that never comes to the surface. Finally, a constraint evaluation on a cyclic basis as well as on a level one entails, in the case examined, drawbacks such as (so far) unprincipled constraint-splitting or extrinsic constraint-ranking, both of which are easily replaceable by more explanatory devices in a derivational constraint-based framework such as TCRS.

The chapter's specific goal has been to demonstrate the need for constraint cyclicity, a tool that is antithetical to a non-derivational constraint-based theory. Its broader goal has been to show the superiority of a derivational constraint-based approach over a non-derivational one. I have not sought to improve on non-derivational theories in general, or OT in particular—the task is left to advocates of a non-derivational view. From a more general perspective, it is important to remember that, although theory-internal criticism is both necessary and fruitful, phonological theory benefits most when particular theories are criticized from outside as well. What is offered here, then, is an external alternative to a non-derivational constraint-based view.

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