A. HOW TO APPLY PHONOLOGICAL RULES

In a recent report, S. R. Anderson considered what a phonological rule does to a string which fulfills the conditions for the rule's application at more than one place. Chomsky and Halle had proposed "simultaneous application":

(1) First, locate all the points at which the conditions are fulfilled, and second, apply the rule simultaneously at each of these points.

Anderson, however, cites cases where (1) leads to an undesired result. In French, deletion of schwa (e muet) cannot be "simultaneous," since not all schwas in a string of syllables containing them can be deleted, even though each one may be in the proper environment for deletion. Anderson observes that either of two principles for applying the deletion rule would lead to the correct results:

(2) Left-to-right sequential application: Apply the rule at the leftmost possible point in the string, then move rightward to the next point at which the conditions are now fulfilled and apply it there, and so on.

(The direction left-to-right is specified by the schwa-deletion rule: other rules could require instead right-to-left sequential application.)
(X. LINGUISTICS)

(3) Revised simultaneous application: Apply as in (1), except that applications of the rule which remove the environment necessary for another application must not be made. One can then make another try at applying the rule to the resulting string.

(Anderson's Principle 2 provides a procedure for deciding which applications to leave undone in cases of non-uniqueness.)

After rejecting (1), Anderson uses an example from the Acoma language to decide between (2) and (3). A rule removes high tone from a short vowel between obstruents when the next vowel has high tone. Thus if K is any obstruent and \( \prime \) is high tone:

\[
KVKV \rightarrow KVKV
\]

Now, given a series

\[
KVKVKVKV
\]

(2) predicts the wrong result

\[
\not{KVKV}KVKV
\]

(left-to-right application; right-to-left application has been ruled out by a previous Acoma example). On the other hand, (3) predicts the correct form

\[
KVVKVKV
\]

The purpose of this report is to reopen the question by presenting examples from two languages in which algorithm (3) gives an incorrect result, but (1) and (2) give the correct one. In a previous note I described the "Rhythmic Law" in Slovak, which shortens long vowels (or diphthongs) in the syllable following another long vowel or diphthong:

\[
čitām \rightarrow čitam 'I rēad' (present)
\]

In a string of 3 longs, the second two are shortened:

\[
čitávām \rightarrow čitavam 'I rēad' (present iterative)
\]

I concluded that the Rhythmic Law applies "simultaneously" according to (1), or else right-to-left sequentially [cf. (2)]. Method (3) could also apply correctly by making a second pass:

\[
čitávām \rightarrow čitavam \rightarrow čitavam
\]

Nevertheless, new data enable us to reject (3) for Slovak. The iterative marker \( va \) can be repeated, giving a string of indefinitely many longs:
volāvāvām → volāvavam 'I call again and again'

čītāvāvā...vām → čītavava...vam

and, as we see, the Rhythmic Law applies so as to shorten all the long vowels after the first.

Method (3) also fails in Mandarin Chinese. Here there is a tonal sandhi rule changing tone 3 into tone 2 before another tone 3:

33 → 23,

and it applies in longer sequences of tone 3's:

333 → 223

and so on.\(^7\) In the most extensive study known to me of sequences of tone-3 syllables\(^8\) Chin-Chuan Cheng brings out that the change is optional at some syntactic breaks, depending on speech tempo, but otherwise applies to all but the last member of such sequences: one pronunciation of the sequence

(33)(3(33))

as in

Lau\(^3\) Li\(^3\) mai\(^3\) xau\(^3\) pi\(^3\). 'Old Li buys a good pen.'

is 22223.

Cheng notes that 33 → 23 cannot apply as part of the transformational cycle, since, for example, \((3(33))\) would be changed to \((3(23))\) on the first cycle and no further change could take place on the next one. (Nor can the application of the rule be right-to-left sequential, as the same example shows.) Cheng concludes that the rule applies simultaneously at all points where it can. Another possibility is left-to-right sequential application. But it is clear that Anderson's proposal (3) could not derive 2223 from 3333 (compare the Acoma case) or 22223 from 33333.

In summary, there are languages whose rules require type (1) or type (2) application; that is, the fact that one application of a rule destroys the environment needed for another application is not always a reason for leaving either one undone. Unless a formal difference between the Acoma rule and the Chinese and Slovak rules can be found, we must conclude that a rule can specify which application algorithm it should be used with.

E. W. Browne

Footnotes and References


5. The iterative marker is va. It lengthens the vowel of the preceding syllable: infinitive vola-ť!'to call', iterative infinitive vola+va+ť'→ vola+va+ť'. The ending m (1 sing.) also requires an a preceding it to be lengthened: vola+m 'I call'. Hence a string of 3 longs arises from the combination of a stem with long vowel (číta-), the iterative suffix, and the ending -m: číťavám.

6. I am grateful to Lj. Durović for this information (Personal communication). See also Gustav Marsall, Die Kunst die Slovakische Sprache durch Selbstunterricht schnell zu erlernen, Leipzig (1890?), p. 85.

7. I am grateful to L. Merchant for pointing this out to me (Personal communication).

8. Chin-Chuan Cheng, "Mandarin Phonology," Ph.D. Thesis, University of Illinois, Urbana, 1968, pp. 99-127. Much of the same material is also discussed in Cheng's article "Domains of Phonological Rule Application," in J. Sadock and A. Vanek (Eds.), Studies Presented to Robert B. Lees by His Students (Linguistic Research, Inc., Edmonton, 1970). (I am indebted to Mary Lou Walch for this reference.) Cheng argues that the 33→23 sandhi rule must apply both before and after a rule changing tone 3 (falling-rising) to "half-third tone" (low falling) in nonfinal position. The argument for this peculiar ordering disappears, however, when one questions the existence of a 3→half-3 rule. We agree with Nancy Woo ("Prosody and Phonology," Ph.D. Thesis, Department of Modern Languages, M. I. T., August 1969, p. 90ff.) that the underlying form of tone 3 is low, like the half-3, and the rise at the end of the 3 as pronounced before a pause is due to a rule applying only in this environment (and later than other rules of sandhi). We can then reformulate Cheng's conclusions as follows: 33→23 is obligatory at the very beginning and very end of a sequence of 3's: i.e., it must change the first tone 3 and the penultimate one into tone 2. Elsewhere in the sequence, it is optional, dependent on rate of speech at nonminimal syntactic boundaries, but is obligatory at minimal ones. Thus

```
... 3 3 ...
```  
need not be changed to 23, but

```
... 3 3 ...
```  
must be changed. At fast conversational speed, a further rule (Cheng, "Mandarin Phonology," op. cit., p. 127ff.) changes tone 2 to tone 1 when preceded by a tone 2 or 1 and followed by any tone except the unstressed "neutral tone." As expected, this rule acts on strings of tone 2's derived by 33→23:

```
33333→22223→21113.
```  
We cannot use this rule in our argument against Anderson's proposal, however, since one application of it does not spoil the environment for an adjacent application.