19. Rule Ordering

GREGORY K. IVERSON

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The role of phonological rules is to express generalizations about phonological structure. Rules are also ordinarily taken to represent specific derivational instructions, or steps along the path relating deep to surface representations. In this capacity, certain of the rules may affect the application of others, either increasing or decreasing the number of forms to which the others may apply.

Under the assumptions of conventional generative phonology as laid out in Chomsky and Halle (1968), the individual rules are all applied sequentially, arrayed in an extrinsically ordered, or language-specifically determined linear list. With respect to a rule A ordered before another rule B in such a list, A will bear one of three possible relations to B (terms adapted from Kiparsky 1968):

1 A *feeds* B just in case the application of A increases the number of forms to which B applies.

2 A *bleeds* B just in case the application of A decreases the number of forms to which B applies.

3 A *does not affect* B just in case A neither feeds nor bleeds B.

For example, contraction of the copula in English (e.g., *Bill is here* → *Bill's* [z] *here*) creates a syllabically stranded fricative, /z/, which cliticizes onto the preceding noun; if this noun happens to end in a voiceless segment, then the /z/ further devoices to /s/ because of the application of progressive devoicing among obstruents clustered in the syllable coda (*Jack is here* → *Jack's* [s] *here*). Contraction thus *feeds* devoicing in derivations where both rules are applicable because it is only through operation of the former that the /z/ of *is* comes to be syllabically affiliated with a voiceless segment in the preceding word, i.e., contraction precedes devoicing. Applied in the reverse sequence, devoicing before contraction, the ordering relation would be one in which contraction *counterfeeds* devoicing (assuming that once a rule is scanned for application it may not be applied again in the same derivation); in this case, the structural description of devoicing would not be met at the point it is considered for application because the vowel in *is* would not yet have been contracted, i.e., the /z/ in this word would then still be postvocalic, not part of an obstruent cluster.

Counterfeeding rule interaction is actually a kind of nonaffecting relation, since the counterfeeding rule neither increases nor decreases the number of forms to which the counterfed rule applies (contraction will take place irrespective of whether devoicing precedes or follows it in the applicational sequence). Its status is singled out from other nonaffecting rule interaction types, however, because counterfeeding represents the potential – albeit unrealized – for a dynamic, additive effect: while application of contraction after devoicing would not increase the number of forms to which devoicing applies, the reverse applicational sequence does have this (feeding) result. The effect of devoicing on contraction, by contrast, is neither additive nor subtractive no matter what order the rules are applied in, hence devoicing simply *does not affect* contraction. Strictly speaking, then, the ordering relation between any pair of sequentially applied rules A and B is compound, such that A bears one relation

(possibly nonaffecting) to B, bears another to A.

The most common analysis of English inflections characterizes the regular noun plural affix also as /z/, phonologically identical with the contracted form of *is*. Progressive devoicing in coda clusters then distinguishes voiceless plurals such as in *shacks* [s] from voiced ones as in *pills* [z], but clusters of sibilants, as arise in the derivation of plurals like *raises* [əz](< /rez + z/) and *races* [əz](< /res + z/), are instead subject to a rule of epenthesis. Even when the cluster which epenthesis interrupts is heterogeneous with respect to voicing, as intermediate /s + z/ is in the derivation of *races*, devoicing of the suffix /z/ does not occur. The explanation from rule ordering for this nonapplication of devoicing, despite the fact that its structural description is satisfied by morpheme sequences like /res + z/, is that epenthesis is applied prior to devoicing, and hence *bleeds* it. The number of forms to which devoicing applies is accordingly decreased because of the applicational priority of epentesis, for were epenthesis not in the grammar to begin with, all things being otherwise equal, devoicing would be able to apply even in sibilant clusters. Devoicing could also apply in these environments, however, if the order of application of the rules were reversed (to devoicing before epenthesis), or indeed if the rules were applied simultaneously. Under either of these possibilities (/res + z/ → *[resəs]), the ordering relation would be one in which epenthesis *counterbleeds* devoicing, resulting in the special kind of nonaffecting interaction in which a rule fails to realize its potential to reduce the number of forms to which another rule applies. Irrespective of whether epenthesis bleeds or counterbleeds devoicing, though, there is no (real or potential) effect on epenthesis, because devoicing is capable neither of increasing nor decreasing the number of forms which are subject to epenthesis.

Another kind of technically nonaffecting interaction between rules arises in cases in which the sets of inputs remain constant irrespective of applicational sequence, but where ordering nonetheless makes a difference in the phonetic results. For example, if there exist both a rule to stress the penultimate vowel of a word and a rule to apocopate word-final vowels in trisyllabic or longer words, neither would be capable of feeding or bleeding the other, but the order in which they are applied is still crucial. For a representation like /pine + ta/, which satisfies the structural requirements of both of these rules, the applicational precedence of stress assignment over apocope yields [pinét]; but applied in the reverse sequence, apocope before stress assignment, the rules produce [pínet]. Since both rules do apply in either of the sequences, it is not the case that the application of one is facilitated (fed) or blocked (bled) by that of the other. Following Kiparsky (1971), the form [pínet] in this example is said to be *transparent* with respect to the rules involved in its derivation, because the conditions for their application are neither violated (there is no word-final vowel present to contravene apocope) nor concealed (the vowel which is stressed appears superficially in penultimate position). The form [pinét], on the other hand, is *opaque* with respect to stress assignment since that rule calls for stress to fall on the penult, not the ultima.

Feeding and bleeding (as well as nonaffecting) rule interaction result in transparency, as just illustrated, but counterfeeding and counterbleeding interaction cause opacity in surface forms. Early work in rule applicational relationships (Kiparsky 1968; Koutsoudas, Sanders, and Noll 1974; Anderson 1974) suggested that the *natural* mode of rule interaction, presumably the one easiest learned and to which phonological change would gravitate, was that which resulted in *maximal application* of the rules, i.e., feeding and counterbleeding interaction. Under the terms of *local ordering* (Anderson 1974), in fact, the same pair of rules might interact in one way in some derivations, but in the reverse in others, particularly if the variation coincides with differences attributable to presumed naturalness in the ordering relation. For example, in its inflectional morphology, Modern Icelandic gives evidence of feeding interaction between rules of syncope and *u*-umlaut, the latter of which modifies the vowel *a* to ö before a *u* in the next syllable: *katil* + *um* (syncope) → *katl* + *um* (*u*-umlaut) → *kötlum* "kettle" dat. pl.; cf. *katli* dat. sg., *ketill* nom. sg. But it appears the same rules interact in a counterbleeding fashion, i.e., in the reverse applicational sequence, when that is possible in the derivational morphology: *bagg* + *ul* + *i* (*u*-umlaut) → *bögg* + *ul* + *i* (syncope) → *böggli* "package" dat. sg.; cf. *baggi* "pack".

Other work (Kenstowicz and Kisseberth 1971; Kiparsky 1971; Iverson 1974; Goldsmith 1991) leads to the conclusion that natural interaction favors the feeding and bleeding relations of transparency, with rules applying only minimally (but persistently) to remove representations which satisfy their structural descriptions. The predominently self-feeding and self-bleeding mode of application among *iterative* rules, which are capable of applying to their own outputs (Howard 1972; Kenstowicz and

Kisseberth 1977), would seem to support this view, particularly if it is assumed that the principles which govern the application of individual rules are also at play in their interaction with one another. In the 1970s, considerations such as these led to the hypothesis of *universally determined rule application*, i.e., to the idea that the ordering relation between rules (and rule applications) is predictable from other aspects of the grammar, and from principles with the universal force of the "Elsewhere Condition" (Kiparsky 1973), "Proper Inclusion Precedence" (Sanders 1974), or the "Survival Constraint" (Anderson 1974). By the end of the decade, however, attention had turned more toward the increasing richness of phonological representation than to the specifics of rules and their interaction; in fact, the entire class of stress rules had been supplanted by the configurations and parameters of metrical theory, and the rise of autosegmental and metrical representation cast an entirely different light onto the conventional rules of linear phonology (cf. Goldsmith 1990 for summary elaboration and chapters 5–8 of this volume).

Today, some researchers assume that the question of rule order in phonology has essentially been answered, and that rule interactions are governed by general, though obviously still developing principles (within the context of radical underspecification theory, cf. especially Archangeli 1988, p. 185). Others maintain that at least some language-specific rule ordering stipulations may be necessary. Bromberger and Halle (1989), in particular, consider that phonology differs from the rest of grammar primarily in its requirement for *extrinsic* ordering (Chomsky 1967; but cf. Klausenburger 1990), a point which they consider to be demonstrated by instances of language change or dialect variation where differences in rule order alone might be at play. Certainly if rule applicational interactions are specific to individual grammars, then it should be expected that rule order will vary from stage to stage of a language, or from dialect to dialect, presumably in about the same magnitude as do other linguistic constructs, including the lexicon and the phoneme inventory. Such variation is in fact very difficult to establish, however; in the cases that have been suggested, alternative explanations of equal or greater generality, with order determined by principle, are easily available, and are often also necessary (Iverson 1974; Koutsoudas, Sanders, and Noll 1974). The familiar case of Canadian vowel raising, for example, which Bromberger and Halle review in this connection, has often been cited as justification for extrinsic rule ordering; but many alternatives have been offered, including one by Kiparsky and Menn (1977) involving different phonemicization, and it is not clear to begin with, following Chambers (1973), that exactly the same rules are involved in both of the dialects.

As first reported by Joos (1942), Canadian raising affects the diphthongs /ay/ and /aw/, centralizing them to [ə̆y] and [ə̆w] before voiceless consonants, as in *write* [rə̆yt] versus *ride* [rayd]. Voicing (and tapping) of /t/ also takes place intervocalically, so that /t/ merges with /d/ in *writer* and *rider*. But whether these words are homophonous depends on the applicational interaction of the voicing and raising rules. If raising takes place before (counterbleeds) voicing, then, as characterizes one variety of Canadian English, the diphthong in *writer* [rə̆ydə̆^{r}] will be centralized in comparison to that in *rider* [raydə̆^{r}]. But if voicing is applied before raising, and so bleeds it by eliminating the voicelessness which raising requires, then the two words will be pronounced the same, i.e., both as [raydə̆^{r}], which represents the pronunciation of the other dialect. As Kiparsky and Menn (1977, p. 48) observe, however, this variation can also be accounted for with the assumption of /ay/ and /ə̆y/ as separate phonemes, with in the second dialect an additional rule (which the first one has lost) lowering /ə̆y/ to [ay] before voiced segments. Under this interpretation, of course, the rules are not the same, and the variation between the dialects is due to a commonplace difference in the rules themselves rather than to stipulations on their mode of interaction.

The model of lexical phonology (Kiparsky 1985) offers another account of how what appear to be the same rules may apply in different orders under different conditions. On this view of the lexicon and its relation to phonology, "deeper", less productive morphological operations involved in derivation and irregular inflection affiliate with certain phonological rules at Level 1, while the "shallower," more general aspects of word formation typical of regular inflection are governed by another class of rules at Level 2. Some phonological rules apply throughout the lexicon, however, essentially whenever their structural descriptions are met. The Icelandic rules of syncope and *u*-umlaut discussed above would appear to be of this type, for they interact in the counterbleeding sequence of *u*-umlaut before syncope in the derivational morphology, which produces *böggli* from /bagg + ul + i/, but in an order

reverse of this in the inflectional morphology, a feeding which produces *kötlum* from /katil + um/. Construed as cyclic, lexical rules available throughout the derivation, syncope and *u*-umlaut will apply until their structural descriptions are no longer satisfied, which yields the observed counterbleeding interaction in some derivations, feeding in others.

Even if the same phonemic inventory is assumed for the two Canadian dialects under discussion, similarly, lexical phonology provides a natural basis for distinguishing the "bleeding" dialect (*writer* = [rəydə]) from the "counterbleeding" one(*writer* = [raydə]). As Chambers (1973) points out, there are exceptions in the former to the raising rule (e.g., *cyclops* with [ay], not [əy]), which would imply it is lexically restricted, whereas voicing has to be a postlexical rule in order to be able to apply in multiword phrases like *fight it*. Since it is a general property of the theory that lexical rules precede postlexical rules, the bleeding of voicing by raising is predicted; in the counterbleeding dialect, by contrast, which Chambers maintains no longer exists and for which there is no evidence of exceptionality with respect to raising, both rules were presumably postlexical, free to apply, in counterbleeding fashion, whenever their structural descriptions were met.

The idea that at least some rules are *persistent*, applying throughout the grammar whenever their structural descriptions are satisfied, was first suggested by Chafe (1968), and has found new vitality in the proposals of Myers (1991), who seeks to identify such rules on the basis of their form alone, without reference to language-specific function. In other recent work, particularly Hyman (1993), it is argued that conventional ordering of rules confounds rather than facilitates the description of certain tonological phenomena, i.e., that the rules involved cannot be ordered in any sequence without significant loss of generalization. In the geometric representations of current phonological description, (see chap. 7, this volume), feature and node delinking operations, or neutralizations, are found always to feed into feature spreading rules, or assimilations, not to counterfeed them. In the theory of "harmonic phonology" (Goldsmith 1991), similarly, or in the connectionist modeling of Wheeler and Touretzky (1991), rule interactions are all determined by the nature of the grammar itself, too: these approaches exploit the "natural" sequencing provided by, on the one hand, the precedence of rules relating morphological representations to the word level, and the word level to phonetic representations (cf. also Anderson 1975), and, on the other hand, the predicted precedence of rules which determine syllabic and other prosodic structure over those which impose traditionally segmental changes (cf. also Kenstowicz and Kisseberth 1971). Details vary from model to model still, but the machinery available in present phonological theory appears to provide sufficient descriptive capacity without the stipulation of special constraints on rule ordering.

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