ANGLED BRACKETING AND ASYMMETRICAL DISJUNCTIVITY

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The present paper is an attempt at investigating what is an overtly formal aspect of current generative phonological theory — the status of angled bracketing as a notational device for collapsing rules into rule schemata. It is claimed that in a rather considerable number of cases where angles have been used in the formulation of rules since SPE, they are inadequate in that they fail to capture correctly the generalizations which the rules are designed to express. Quite often the use of angles stands in conflict with the principles that are generally recognized as forming a basis for their application, such as disjunctivity of the subrules abbreviated.

While various ways have been devised in the literature to remedy this situation (which has been more or less openly recognized), they all deal with particular cases and introduce unnecessary complications into the formalism of the theory. A notational device that is independently needed in GP — indexed parentheses — is suggested here as applying universally and systematically in place of angles, and especially in the well-defined number of cases where angled bracketing is clearly inadequate.

As the argument pivots on logical considerations, the examples given are few (though representative) and are not supposed to provide a basis for empirical verification, for which a much more extensive body of data would be needed.

Since SPE, angled bracketing has usually been treated by phonologists in the way outlined by Chomsky and Halle, that is as "a generalization of the use of parentheses to the case of discontinuous dependencies" (SPE:77). Therefore, the principle of disjunctive ordering has generally been held to apply whenever two (or more) adjacently ordered subrules that express 'the same' or 'similar' phonological process are collapsible by angled bracketing into a schema. By this principle, a schema with two single brackets (and no other abbreviatory devices) expands into two subrules which apply in a specific order: first the subrule with the material in brackets (single features, complexes of features or boundary markers), second — without it. If the structural description (SD) of the first subrule is met, this rule applies and the second is regarded as inapplicable even if its SD is also met. But if the first subrule is inapplicable, then the second applies (its SD being met). Thus it has been claimed that in a schema with angles either one or the other subrule will apply. Under this interpretation the logical association between the single brackets in the schema is particularly strong: one bracket appears *if and only if* the other also does. Thus a rather restrictive sort of symmetry is imposed on the rule. It was soon noticed that in many cases it was in fact too restrictive.

It is necessary in this place to summarize briefly the possible arrangements of (two) angled brackets in the structure of a rule. While the cases where the whole segment is angled are quite interesting in themselves, they will be ignored here for expository reasons. With some simplification, we can distinguish four logical possibilites:

1. $\begin{bmatrix} Q \\ \langle A \rangle \end{bmatrix} \longrightarrow \begin{bmatrix} N \\ \langle B \rangle \end{bmatrix} / \_\_\_ \; [P]$

2. $\begin{bmatrix} Q \\ \langle A \rangle \end{bmatrix} \longrightarrow [N] \; / \_\_\_ \begin{bmatrix} P \\ \langle B \rangle \end{bmatrix}$

3. $[Q] \longrightarrow \begin{bmatrix} N \\ \langle A \rangle \end{bmatrix} / \_\_\_ \begin{bmatrix} P \\ \langle B \rangle \end{bmatrix}$

4. $[Q] \longrightarrow [N] \, / \begin{bmatrix} R \\ \langle A \rangle \end{bmatrix} \_\_\_ \begin{bmatrix} P \\ \langle B \rangle \end{bmatrix},$

where A, B, Q, N, R, P are (complexes of) fully specified features. As can be seen, angled brackets can appear in input, output and in the environment of the rule. Yet, the principle of disjunctive ordering, as stated above, will be applicable without any auxiliary conditions, only to two out of the four cases outlined, namely 1 and 3. What these two have in common is, of course, that one of the brackets is in the output segment in both cases. Schemata 2 and 4, on the other hand, have both their brackets in the SD (input or environment). It is, of course, an empirical question to see if this is in fact the crucial difference. As cases 1 and 3 are the ones where the logical 'if and only if' dependency between brackets holds (that is necessary for the statement of disjunctive ordering of the form given above), they will be called *symmetrical*, as opposed to cases 2 and 4, which will be shown to be *asymmetrical* in an important sense.

Cases 1 and 3 may be shown to be necessarily symmetrical under the conditions generally acepted in GP. If schema No 1 were to have its 'if and only if' restriction violated, the two possibilities would be as follows:

1. if $_{\text{first}}\langle\;\rangle$, then $_{\text{second}}\langle\;\rangle$ but not vice versa[1]

Under general interpretation in GP this would mean that the process expressed by the rule goes on whether or *not* the angled material on input is present:

1st expansion: $\begin{bmatrix} Q \\ A \end{bmatrix} \longrightarrow \begin{bmatrix} N \\ B \end{bmatrix} / \_\_\_ [P]$

2nd expansion: $[Q] \longrightarrow \begin{bmatrix} N \\ B \end{bmatrix} / \_\_\_ [P]$

But then, of course, there is no need for brackets at all, because we simply have a rule equivalent to the 2nd expansion above, where A is irrelevant.

2. if $_{\text{second}}\langle\;\rangle$, then $_{\text{first}}\langle\;\rangle$ but not vice versa.

1st expansion: $\begin{bmatrix} Q \\ A \end{bmatrix} \longrightarrow \begin{bmatrix} N \\ B \end{bmatrix} / \_\_\_ [P]$

2nd expansion: $\begin{bmatrix} Q \\ A \end{bmatrix} \longrightarrow [N] / \_\_\_ \; [P]$

In this case, the same segment is changed into two different segments in the same environment (phono- or morphological), which obviously does not make phonological sense, at least in GP. And so, either we have a non-rule or, if the first P is not equal to the second P, we have a case for two different rules (possibly collapsible into schema No 3).

Now, if the symmetrical 'if and only if' condition in schema No 3 is violated, the following possibilities will appear:

1. if $_{\text{first}}\langle\;\rangle$, then $_{\text{second}}\langle\;\rangle$ but not vice versa.

1st expansion: $[Q] \longrightarrow \begin{bmatrix} N \\ A \end{bmatrix} / \_\_\_ \begin{bmatrix} P \\ B \end{bmatrix}$

2nd expansion; $[Q] \longrightarrow [N] / \_\_\_ \begin{bmatrix} P \\ B \end{bmatrix}$

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[1] Integral subscripts are not used intentionally.

Here we have a similar case to that numbered 2 above: a segment is transformed into two different segments under the same circumstances. The same reasoning applies here.

2. if $_{\text{second}}\langle\ \rangle$, then $_{\text{first}}\langle\ \rangle$ but not vice versa.

1st expansion: $$[Q] \longrightarrow \begin{bmatrix}N\\ A\end{bmatrix} / \_\_\_ \begin{bmatrix}P\\ B\end{bmatrix}$$

2nd expansion: $$[Q] \longrightarrow \begin{bmatrix}N\\ A\end{bmatrix} / \_\_\_ [P]$$

In different environments the same segmental change appears, which means that either it is not this portion of the environment that motivates the process, or else that the environment in the two subrules is in fact not different, in which case the appropriate choice of distinctive features for the environmental segment will reveal the unity of the two processes. As a result, then, there is only one rule and the need for angled bracketing disappears, much like in the first asymmetrical arrangement for schema No 1.

It seems, then, that whenever one of the brackets in the given schema falls in the output of the rule, the schema is necessarily symmetrical in the sense explained above. It is in such symmetrical schemata that the principle of disjunctive ordering in its restricted all-or-none form does not encounter any difficulty. To illustrate the above discussion two examples are given, one for schema No 1, one for No 3.

Second velar palatalization in Polish is formulated in the following way by Gussmann (1978:73):

$$\begin{bmatrix}+\text{back}\\ \langle -\text{cont}\rangle\end{bmatrix} \longrightarrow \begin{bmatrix}-\text{back}\\ +\text{strid}\\ +\text{del rel}\\ \langle +\text{ant}\rangle\end{bmatrix} / \_\_\_ \begin{bmatrix}+\text{syll}\\ -\text{back}\end{bmatrix}$$

The asymmetrical cases would arise if the noncontinuant /k, g/ became anterior and nonanterior in the same environment or if both the noncontinuants and the continuant /x/ became anterior. Neither of these ever happens in educated Polish. (If the 'mazurzenie' phenomenon is taken into account, there is no need for angled brackets). Consequently, the schema is expanded regularly and tested for application in the accepted way.

As an example of schema No 3, a slightly simplified rule from modern Greek is given, formulated by Sommerstein (1977:140) in the following way:

$$[+\text{nas}] \longrightarrow \begin{bmatrix}\alpha\text{lab}\\ \beta\text{cor}\\ \gamma\text{back}\\ \left\langle\begin{matrix}+\text{cont}\\ \delta\text{features}\end{matrix}\right\rangle\end{bmatrix} / \_\_\_ \begin{bmatrix}+\text{cons}\\ \alpha\text{lab}\\ \beta\text{cor}\\ \gamma\text{back}\\ \left\langle\begin{matrix}+\text{cont}\\ \delta\text{features}\end{matrix}\right\rangle\end{bmatrix}$$

that is, "a nasal is assimilated completely to a following continuant and in point of articulation to a following occlusive" (ibid.). The possible asymmetry here would be: (a) a nasal assimilates completely before both continuants and noncontinuants (then — one rule, not two), or (b) before a continuant, a nasal at one time assimilates completely, and at another only the place of articulation is assimilated (an ill-formed rule).

Schemata exemplified under 2 and 4 are much more problematic for the all-or-none type of application, commonly abbreviated by angled brackets. A typical example of the difficulty encountered in expanding a schema like 2 is discussed in Sommerstein (1977: 139—140). A hypothetical rule is presented whereby all vowels shorten before clusters of two (or more) consonants, but the most open vowel, /a:/, shortens only before three consonants or two word-final consonants. With immaterial changes (writing Sommerstein's 1 height as [+low]), the schema runs as follows:

$$\begin{bmatrix}V\\ \langle +\text{low}\rangle\end{bmatrix} \longrightarrow [-\text{long}] / \_\_\_ CC\left\langle\begin{Bmatrix}C\\ \#\end{Bmatrix}\right\rangle.$$

The expansions of the schema are:

1. $$\begin{bmatrix}V\\ +\text{low}\end{bmatrix} \longrightarrow [-\text{long}] / \_\_\_ CC\begin{Bmatrix}C\\ \#\end{Bmatrix},$$ [2]

2. $$[V] \longrightarrow [-\text{long}] / \_\_\_ CC.$$

It will immediately be seen that this is in fact an asymmetrical case, as the 'if and only if' condition is not satisfied. While it is true that 'if$_{\text{first}}\langle\ \rangle$, then$_{\text{second}}\langle\ \rangle$', it is not necessarily true that 'if$_{\text{second}}\langle\ \rangle$, then$_{\text{first}}\langle\ \rangle$', because nonlow vowels will also shorten before three consonants or a word-final two-

[2] Unexpanded for brevity.

consonant cluster. As it stands, the schema will correctly apply to strings such as:

1. $\begin{bmatrix} V \\ +low \end{bmatrix} CC \begin{Bmatrix} C \\ \# \end{Bmatrix}$

2. $V\ C\ C \begin{Bmatrix} C \\ \# \end{Bmatrix}$

3. V C C

But once a string like $\begin{bmatrix} V \\ +low \end{bmatrix}$ CC is encountered, the application of the schema runs into problems. The first subrule of the expansion will be inapplicable because the environmental description is not met. In this situation the second subrule applies incorrectly shortening the low vowel before a two-consonant cluster. Sommerstein's remedy to this is an 'interpretative convention' (ibid.): "... if P is any expression composed of specified features, then a schema $X\langle Y\rangle Z \begin{bmatrix} W \\ \langle P\rangle \end{bmatrix} V$, where $\begin{bmatrix} W \\ \langle P\rangle \end{bmatrix}$ is an input segment and not an environment segment,[3] is interpreted as the disjunctively ordered sequence $XYZ \begin{bmatrix} W \\ P \end{bmatrix} V$, $XZ \begin{bmatrix} W \\ \text{not-P} \end{bmatrix} V$".

Under this convention, the second expansion of the schema discussed would be:

$$\begin{bmatrix} V \\ -low \end{bmatrix} \longrightarrow [-long]/\_\_\ CC,$$

and, therefore, it (properly) could not apply to $\begin{bmatrix} V \\ +low \end{bmatrix}$CC.

Sommerstein's move, while saving the standard mode of disjunctive application, is a complication in the grammar in two ways: one, in adding the interpretative convention, two, in the necessity of keeping a 'not' specified feature in the input segment in the second expansion. Moreover, there is an interesting class of cases, corresponding to what is termed here a type 2 schema, which, although seemingly equivalent to Sommerstein's example, is not saved by his convention.

One such case is found in Lass (1976:178), where a rule is given raising (to mid) short nonback low vowels before a cluster liquid+velar, and long

[3] Sommerstein consciously makes this requirement more restrictive than SPE, where the 'input segment' condition was not mentioned. As will be shown later, this may have been ill-advised.

nonback low vowels "whether or not a liquid intervened" between the vowel and the velar:

$$\begin{bmatrix} -cons \\ -back \\ +low \\ \langle -long\rangle \end{bmatrix} \longrightarrow [-low]/\_\_ \left\langle \begin{bmatrix} -obstr \\ +cor \end{bmatrix} \right\rangle \begin{bmatrix} +obstr \\ +back \\ +high \end{bmatrix}$$

Now, under Sommerstein's convention, the expansion will look like the following:

1. $\begin{bmatrix} -cons \\ -back \\ +low \\ -long \end{bmatrix} \longrightarrow [-low]/\_\_ \begin{bmatrix} -obstr \\ +cor \end{bmatrix} \begin{bmatrix} +obstr \\ +back \\ +high \end{bmatrix}$

2. $\begin{bmatrix} -cons \\ -back \\ +low \\ +long \end{bmatrix} \longrightarrow [-low]/\_\_ \begin{bmatrix} +obstr \\ +back \\ +high \end{bmatrix}$

This will work for (where V is a front low vowel, L — a liquid, K — a velar):

1. $\begin{bmatrix} V \\ -long \end{bmatrix}$ LK,

2. $\begin{bmatrix} V \\ -long \end{bmatrix}$ K, (where the rule will be correctly stopped from applying),

3. $\begin{bmatrix} V \\ +long \end{bmatrix}$ K.

But how about $\begin{bmatrix} V \\ +long \end{bmatrix}$LK? Neither expansion of the schema will apply to this string simply because in neither is the SD met. Specifically, expansion No 2 will *not* apply because, while for purposes of the SD of a rule what comes on both sides of the string meeting the SD is ignored, it is not the case with the material that may come inside the string matched.[4] This, if it appears, must block the rule from applying on the basis that its SD is not met. This is

[4] Possible problems with this approach are indicated by Stanley (1973:190 and 199).

exactly the point where Lass's example differs from that of Sommerstein's. While Sommerstein's rule: $\begin{bmatrix} V \\ -\text{low} \end{bmatrix} \longrightarrow [-\text{long}]/\_\_\_\,\text{CC}$ will apply whether or not there is anything following CC, Lass's second expansion will not apply in similar circumstances (contrary to what he says in the informal statement of the rule). A reformulation of the schema, like the following:

$$\begin{bmatrix} -\text{cons} \\ -\text{back} \\ +\text{low} \\ \langle -\text{long} \rangle \end{bmatrix} \longrightarrow [-\text{low}]/\_\_\_ \begin{bmatrix} +\text{cons} \\ \left\langle \begin{matrix} -\text{obstr} \\ +\text{cor} \end{matrix} \right\rangle \end{bmatrix} \begin{bmatrix} +\text{obstr} \\ +\text{back} \\ +\text{high} \end{bmatrix}$$

will not save the case either. It will only reverse the situation, as now the rule will not apply to $\begin{bmatrix} V \\ +\text{long} \end{bmatrix}$K, because this string will not meet the SD of the rule. This is, however, incorrect, as the rule has to apply to long vowels immediately followed by a velar.

It seems, on the whole, that Sommerstein's convention is not the best way to remedy the asymmetrical type 2 schema expansion. It fails completely for type 4 schemata, which are also asymmetrical. A typical example is found in Anderson (74:153). Anderson presents a rule of Kasem phonology which creates the glide /w/ from an underlying /u/ before nonround vowels, but before /a/ only if this /a/ is followed by another consonant:

$$\begin{bmatrix} +\text{high} \\ +\text{back} \end{bmatrix} \longrightarrow [-\text{syll}]/\_\_\_ \begin{bmatrix} +\text{syll} \\ -\text{round} \\ \langle +\text{low} \rangle \end{bmatrix} \langle [-\text{syll}] \rangle.$$

The expansions here are the following:

1. $$\begin{bmatrix} +\text{high} \\ +\text{back} \end{bmatrix} \longrightarrow [-\text{syll}]/\_\_\_ \begin{bmatrix} +\text{syll} \\ -\text{round} \\ +\text{low} \end{bmatrix} [-\text{syll}]$$

2. $$\begin{bmatrix} +\text{high} \\ +\text{back} \end{bmatrix} \longrightarrow [-\text{syll}]/\_\_\_ \begin{bmatrix} +\text{syll} \\ -\text{round} \end{bmatrix}$$

These will work correctly for (where C is a consonant):

1. /ua/C
2. /u/ $\left\{ \begin{matrix} /e/ \\ /i/ \end{matrix} \right\}$
3. /u/ $\left\{ \begin{matrix} /e/ \\ /i/ \end{matrix} \right\}$ C, (by virtue of the fact that the material on either side of a string does not count in matching the SD).

But the second subrule will also incorrectly apply to /ua/not-C, which had to be ignored when the first expansion was tried. Sommerstein's convention will not solve the case as, by definition, it applies only to input segments. If his statement were not so restrictive (that is, if he followed SPE more closely on this point) it could be claimed that the not-feature convention applies generally when the second expansion of angled brackets is reached. We would then have:

2nd expansion: $$\begin{bmatrix} +\text{high} \\ +\text{back} \end{bmatrix} \longrightarrow [-\text{syll}]/\_\_\_ \begin{bmatrix} +\text{syll} \\ -\text{round} \\ -\text{low} \end{bmatrix},$$

and the rules would work correctly for all strings mentioned. If, however, we had a rule like the one discussed but with bracketed segments transposed: $\langle [-\text{syll}] \rangle \begin{bmatrix} +\text{syll} \\ -\text{round} \\ \langle +\text{low} \rangle \end{bmatrix}$, we would come back to Lass's problem mentioned above, and neither the SPE nor Sommerstein's 'not' conventions will be of help, as both work only for $\begin{bmatrix} F \\ \langle A \rangle \end{bmatrix}$ segments, and not for $\langle [A] \rangle$ segments, where A may be a complex of features as in Lass.

Anderson, however, chose a different solution to the problem — he indexed the angles and added a convention, so that the schema in his formulation actually looks like the following:

$$\begin{bmatrix} +\text{high} \\ +\text{back} \end{bmatrix} \longrightarrow [-\text{syll}]/\_\_\_ \begin{bmatrix} +\text{syll} \\ -\text{round} \\ {}_{a}\langle +\text{low} \rangle \end{bmatrix} {}_{b}\langle [-\text{syll}] \rangle$$

condition: if a, then b.

Thus, the condition will correctly block the rule from applying to a string like /ua/, while allowing its application in the other relevant cases.

While both the SPE/Sommerstein's convention and Anderson's condition will produce correct results, yet they are considerably different in status. The former is in fact only a patch-up on the otherwise unaltered all-or-none symmetrical arrangement in the expansion of angled brackets, and the number of expansions is exactly two. The if-and-only-if requirement is untouched. The latter presupposes the reading of indexed brackets independently of each other, since otherwise the condition 'if a, then b' would be unnecessary, as the situation 'a but not b' would never arise. It would be excluded automatically by the all-or-none way of expansion. The fact that Anderson included this condition must mean that he thought of the schema as allowing a four-way expansion:

1\. ... $\begin{bmatrix}+\text{syll}\\-\text{round}\\+\text{low}\end{bmatrix}$ $[-\text{syll}]$,

2\. ... $\begin{bmatrix}+\text{syll}\\-\text{round}\end{bmatrix}$ $[-\text{syll}]$,

3\. ... $\begin{bmatrix}+\text{syll}\\-\text{round}\end{bmatrix}$,

4\. ... $\begin{bmatrix}+\text{syll}\\-\text{round}\\+\text{low}\end{bmatrix}$.

The first three cases would work correctly, and the condition is designed to block the rule with 4 as environment from applying, as mentioned above.

It is worth noting here that indexed bracketing as used by Anderson will solve Lass's problem mentioned above. It is enough to reformulate Lass's schema as:

$$\begin{bmatrix}-\text{cons}\\-\text{back}\\+\text{low}\\{}_{a}\langle-\text{long}\rangle\end{bmatrix} \longrightarrow [-\text{low}]/\ \_\_\_{}_{b}\left\langle\begin{bmatrix}-\text{obstr}\\+\text{cor}\end{bmatrix}\right\rangle \begin{bmatrix}+\text{obstr}\\+\text{back}\\+\text{high}\end{bmatrix}$$

condition: if a, then b.

The rules will now work similarly as in Anderson's Kasem example. Indexed brackets will also be applicable instead of Sommerstein's convention in the example on page 111.

To sum up to this point: two ways of dealing with asymmetrical angled bracket expansion have been presented (there may be more possible): (1) SPE/Sommerstein's not-feature convention, which tries to retain the symmetrical all-or-none bracket expansion, but fails in certain cases (vide Lass), (2) indexed brackets, which were used quite early in GP (see Harms 68:74) and seem to be a rather powerful device, but stand in overt conflict with the commonly accepted principles of (a) all-or-none bracket application, (b) a 'general vs specific case' mode of application, with the first expansion covering an idiosyncratic restriction on the rule and the second dealing with the general case. The latter is, of course, a functional requirement imposed on

disjunctivity by Kiparsky in his 1973 article (Kiparsky 1973: 93—106). It seems fair to point out here that Kiparsky's 'elsewhere condition' would make correct predictions in all the cases so far mentioned (but it fails for the last troublesome example on page 118 in this paper). This functional approach has not been considered here in any detail as the purpose of the article is to investigate the strictly formal properties of angled bracketing.

It seems, then, that neither (1) nor (2) are without faults, and, moreover, that they are both necessary only to cover up the cases where the standard (symmetrical) mode of bracket application falls into problems, encountering asymmetrical arrangement of dependencies. Furthermore, it would seem logical that all these three notational devices (one symmetrical and two asymmetrical), different formally but so closely related functionally: covering discontinuous elements by which two disjunctively related rules differ, are just variants of one universal notational mechanism. Once this is accepted, a possible candidate is not far to seek — parentheses. This is of course no novelty. It was explicitly stated in SPE that angled bracketing is just "... a generalization of the use of parentheses to the case of discontinuous dependencies" (SPE:77). It may only seem odd why indexed parentheses have not been used from the beginning.

The advantages of introducing indexed parentheses are the following: (1) a unified notational device is used in all those functionally related cases where similar rules are disjunctively ordered (this would also include cases of a single parenthesis, as generally accepted in the literature),[5] (2) no special SPE or Sommerstein's type conventions would be necessary, (3) there would be no conflict between asymmetrical parentheses arrangements and the all-or-none requirement, as in the asymmetrical cases the indices would not be equal, thus suggesting a four-way expansion.

In the symmetrical cases the indices would be equal, i.e.: $X_a(Y)Z_a(Q)V$, and so the standard all-or-none mode of application would be retained with two expansions.

In the examples of asymmetrical schemata discussed so far in this paper indexed parentheses would work similarly to Anderson's indexed brackets, that is, they would generate a series of four disjunctively ordered subrules

[5] In SPE (p. 212), as a result of schema expansion, we get:

$$\begin{bmatrix}\text{V}\\-\text{tense}\\+\text{back}\end{bmatrix} \longrightarrow \begin{bmatrix}\langle+\text{tense}\rangle\\-\text{round}\end{bmatrix} \Big/\ \overline{[+\text{high}]}\ C_0^1\ [-\text{cons}],$$

that is another schema (to be disjunctively expanded) with *one* pair of angled brackets. This needs another convention which would be unnecessary if indexed parentheses were used. Then the above schema would expand in the same way as (independently needed) single parentheses normally do, e.g.: $X(Y)Z \rightarrow$ I XYZ, II XZ.

(the order of expansion, if significant at all, is a matter for empirical studies) one of which would be correctly prevented from applying by a condition of the form 'if a, then b'. Incidentally, it is of course quite possible that some language specific restrictions could make this condition redundant as the sequences that would require the condition might not appear at all, being disallowed by the morpheme structure component (this would happen if, e.g. $\begin{bmatrix} \text{V} \\ +\text{low} \end{bmatrix}$CC, $\begin{bmatrix} \text{V} \\ +\text{long} \end{bmatrix}$LK, or the /ua/ strings never appeared in the language from which the respective examples in this paper were taken). How many such cases may be found is presumably a matter for empirical study. Whatever the results, however, the formalism proposed here seems valid as a universal (though, perhaps, not exceptionless) principle.

In the symmetrical cases discussed in this paper, the parentheses, being subscribed with the same letter, would apply in a way equivalent to (unindexed) angled brackets.

By way of final exemplification, here is a typically asymmetrical example from Kenstowicz and Kisseberth (1979: 358–359). In ChiMwi:ni, prefixes of the shape C$\begin{bmatrix} \text{V} \\ +\text{high} \end{bmatrix}$ delete the vowel when the preceding consonant is a sonorant. In case it is not, however, the deletion appears only when the next morpheme starts with a voiceless consonant. Kenstowicz and Kisseberth come up with the following rule (ibid.: 358):

$$\begin{bmatrix} \text{V} \\ +\text{high} \end{bmatrix} \longrightarrow \emptyset / + \underset{\langle[-\text{son}]\rangle}{\text{C}} \_\_\_ + \underset{\langle[-\text{voiced}]\rangle}{\text{C}} \text{VC}_0\text{V}.$$

They also notice that while disjunctive ordering should regularly be applicable in this example, yet the angled bracketing device will not produce correct results. Of course, the problematic string is: $+\begin{bmatrix} \text{C} \\ -\text{son} \end{bmatrix}\begin{bmatrix} \text{V} \\ +\text{high} \end{bmatrix} + \begin{bmatrix} \text{C} \\ +\text{voice} \end{bmatrix}$, to which the second expansion of the schema will (incorrectly) apply after the first has failed to. This is not a problem for indexed parentheses. A schema:

$$\begin{bmatrix} \text{V} \\ +\text{high} \end{bmatrix} \longrightarrow \emptyset / + \underset{\text{a}([-\text{son}])}{\text{C}} \_\_\_ + \underset{\text{b}([-\text{voice}])}{\text{C}} \quad \text{VC}_0\text{V}$$

condition: if, a then b.

will correctly apply in all four possible cases. While Kenstowicz and Kisseberth do not settle the problem by providing a notational variant of the Anderson type, they emphasize the systematic difference between what

was called here symmetrical and asymmetrical disjunctivity. Whether this dichotomy — in terms of this paper: $X_a(Y)Z_a(V)Q$ versus $X_a(Y)Z_b(V)Q$ — has some significance in terms of the general conventions for rule application in GP remains an important empirical question.

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