FURTHER REMARKS ON NATURAL RULE INTERACTIONS

JOLANTA SZPYRA

Maria Curie-Sklodowska University, Lublin

It has been noted by Paul Kiparsky (1968) that certain orderings of phonological rules are more natural than others. This observation has evoked an on-going discussion concerning the problem of characterizing natural rule interactions. The following remarks[1] are meant as a contribution to this discussion. We demonstrate that attempts to evaluate the naturalness of rule orderings in terms of opacity/transparency and recoverability are too simplistic and, consequently, cannot determine marked/unmarked rule interactions.

Before presenting our argument, we must discuss at some length the important and often neglected problem of exactly what is meant by "natural". It seems that this term has frequently been overused in linguistic works to justify some dubious procedures. For instance very often the superiority of one description over another is claimed on the basis of its being more natural than some other description without, however, any explication of the very notion of naturalness. In consequence, this kind of approach leads to completely arbitrary judgements as to the naturalness of rules and their interactions.

Thus, quite often an appeal is made to intuition (of both a linguist and a native-speaker) as the following fragments indicate: "Yet I believe that anyone who has worked in phonology has a fairly clear, in t u i t i v e notion of what is a natural rule and what is an unnatural one" (Schane 1972:199) or: "I will frequently make in t u i t i v e judgements about the naturalness of a particular order of application of two phonological rules" (Brink 1974:49 — emphasis in both cases is mine — J. Sz.). Needless to say, intuition is not the best factor for deciding the issue since it often differs greatly from speaker to speaker

(and from linguist to linguist). It is, moreover, inexplicit, unfalsifiable and hence, unscientific.

Quite often the frequency argument is used. That is, if rules or rule interactions of certain type(s) recur over and over in languages of the world, this recurrence may be treated as evidence of their naturalness. This argument is not particularly reliable in the case of rule interactions for it is seldom that exactly the same orderings of exactly the same rules obtain in several languages.

Another common procedure of making and justifying judgements about the naturalness of a particular order consists in comparing the over-all result of applying the two rules in one order with that of applying them in the other. Brink (1974:49) explains that: "often judging (intuitively — J. Sz.) only by results, one order is so inappropriate that the other can be considered the more natural without hesitation". It is frequently the case, however, that a comparison of the results does not lead to any obvious conclusion about naturalness. Furthermore, such a procedure is used exclusively with reference to rule-pair relations and it is not clear how it would operate in the case of more than two rules.

In addition, it is usually assumed that there is a direct correlation between the naturalness of rules and their interactions, and the ease of their acquisition. Thus, unnatural rules are claimed to be hard to learn. We have also some doubts as to the validity of this argument since in the majority of cases there is no evidence available whether a given process or an ordering causes learning difficulties.

In face of these difficulties in explicating the meaning of "naturalness" as well as of describing it adequately on purely synchronic grounds, Kiparsky's attempt at defining unmarked orderings within diachronic linguistics is particularly appealing. He claims (1971, 1973a) that if rules are reordered as a result of historical change, then it may be treated as evidence for the naturalness of the innovated ordering. In other words, marked orders "could not have arisen by reordering" (Kiparsky 1973a:124). Were this hypothesis true, reordering would constitute serious and valid evidence for the points at issue. Recently, however, the status of reordering as a mechanism of linguistic change going to discuss the problem of the validity of rule reordering as a possible type of linguistic change, but stress that there are other ways in which diachrony can help to decide the naturalness issue. The reordering argument is based on the assumption (which in itself also needs justifying) that linguistic change proceeds in the direction of more natural grammars. Thus, there are other ways of reducing unnaturalness, eg. by the loss not only of the unnatural rule, but also the loss of a rule which makes some other rule marked, by the removal of some restrictions from an unnatural rule, etc. Therefore, our interest here is in the stability argument: if it is claimed that a given order is unnatural then it should be observed throughout the history of a given language that it invests

something to remove the unnaturalness of this ordering relation. To put it differently, the stability of rules and their orderings can be considered an indication of their naturalness.

To summarize the issue: there are many doubtful ways of making judgements concerning the naturalness of rule interactions. The major flaw in such judgements is that usually only one or two of these possible procedures is employed in a given analysis. Given the questionable nature of these methods in general, then it is necessary to apply several of them in support of a given conclusion. Hence, some synchronic evidence combined with arguments of a historical nature bring us results which we do hope are not arbitrary.

One more comment must be made. Linguists usually speak of marked and unmarked interactions. It seems, however, that these are not absolute, but rather relative phenomena. Therefore, important to consider is not only whether a given interaction is natural, but also what the degree of naturalness is, and how it can be compared to the naturalness of other interactions.

The first attempt to determine the principles governing natural orderings was made by Kiparsky (1968). He suggested the Maximal Utilization Principle, i.e., that feeding and counter-bleeding orders are more natural than bleeding and counter-feeding ones, since they both serve to maximize the utilization of rules. This hypothesis will not be discussed here, for its inadequacies have been pointed out in several studies (eg. in Kisseberth 1971, Kenstowicz and Kisseberth 1977). Kiparsky (1971, 1973b) modified his position and suggested the principle of Minimization of Opacity (or Maximal Transparency) to replace feeding and bleeding and their concomitant inadequacies. According to this principle, such orders of rules which reduce their opacity are more natural. Thus, transparent rules are said to be unmarked. The preference for grammars with a lower degree of opacity is based on the assumption that "opacity is a property of rules that makes them, and underlying forms to which they apply, harder to learn" (Kiparsky 1971: 623). Thus, opaque rules are undesirable and in the course of history are either lost or reordered. If we, therefore,, observe that in the history of a language a given rule or rule ordering was opaque, and it is preserved in its historical shape, then Kiparsky's claim is contradicted. At this point it is necessary to add that Kiparsky writes about tendencies only. What we shall discuss here are the consequences of adopting the strong version of the Transparency Principle (suggested eg. by Hooper 1976) according to which opacity = marked and transparency = unmarked.

Let us first recall Kiparsky's definition of rule opacity (1973b : 79):

"A rule A → B/C __ D is opaque to the extent that there are surface representations of the form:

(i) A in environment C __ D

(iia) B derived by the process P in environment other than C __ D

(iib) B not derived by the process P /i.e., underlying or derived by another process/ in environment C __ D"

We shall first analyse individual cases of the definition and predictions they make.

Generally speaking, there are two sources of rule opacity: interaction of rules, and the existence of exceptions.

Case (i) is a characterization of a rule contradicted on the surface. In other words, a rule is opaque under (i) if the structures it eliminates appear in the phonetic output. Here we have the so-called "input exceptions", i.e., forms to which a rule does not apply although its structural description is met. An example of such a rule is palatalization in Polish. This process palatalizes consonants when they are followed by front vowels, eg.

bu[t] "shoe" — bu[ć]ik "id. dim."
ko[s]a "scythe" — ko[ś]ić "to mow"
wo[z]y "carts" — wo[ź]ić "to cart"

Palatalization, however, does not apply to some foreign items, such as [t]ik "tick", Zambe[z]i, [s]inus "sine". Consequently, these words add opacity to the palatalization rule. Thus, according to case (i) rules which have fewer exceptions are more natural since they are easier to learn. We have nothing to add here except for the comment that in the case of very productive rules, such as palatalization in Polish, the existence of a few exceptions does not seem to cause any learning difficulties.

Furthermore, case (i) is "a characterization of non-feeding order" (Kiparsky 1971 : 624). Given the principle of Maximal Transparency, underlying representations and rules, it should be possible to predict the natural order of rules. Let us check the predictive power of Transparency. Velar Softening in English affects velar stops changing them into palato-alveolars before a non-low nonback vowel in words of Romance origin (Chomsky and Halle 1968 — hereafter SPE), eg.

rigour — rigid
medical — medicine

This rule interacts with Vowel Shift. Given the underlying representation /medikæt/ there are two possible orders for the application of these two rules. It is clear that, according to our principle, the order: Vowel Shift, Velar Softening is natural since it is:

a) a feeding order — i.e., desirable from the viewpoint of Maximal Utilization

b) transparent order — favoured by the Transparency Principle. Let us present a sample derivation[2]:

/medikæt/
1. Vow. Shift medikeyt
2. Vel. Soft. mediseyt
output *[mediseyt]

Clearly, this is the incorrect order. The reverse order yields the proper result although it is counter-feeding and opaque. It seems, however, that there is nothing unusual in this opaque ordering .First of all, as far as any historical evidence exists, Velar Softening was an earlier process and only later was Vowel Shift added. Thus, the synchronic order reflects the historical one. It may obviously be claimed that this interaction is unnatural due to the fact that rules are added at the end of grammars. But this is exactly the situation where the Transparency Principle expects reordering to take place, i.e., a shift in order such that Vowel Shift precedes Velar Softening. No such change has occured so far. We are aware of the fact that there can be some doubts concerning this interaction since the synchronic status of both Velar Softening and Vowel Shift is often questioned. We should like, however, to stress the fact that this is not, by any means, an isolated example where the Transparency Principle fails to predict the correct order of rules. Consider the following interaction in Polish. The j-anterior palatalization affects dental obstruents, changing them into dental affricates and palato-alveolar fricatives in the context of the following front high glide, which is subsequently deleted. This process accounts for alternations such as:

wła[d]ać "to rule" — wła[dz]a "authority"
lo[t] "flight" — le[ċ]ę "I fly"
mro[z]y "frosts" — mro[ż]ony "frozen"
cze[s]ać "to comb" — cze[š]ę "I comb"

Words such as oka[z]ja "opportunity", po[d]jechać "come up", mi[s]ja "mission", do not display such a change. In their derivation two rules interact: Palatalization, which applies first, and LOWER, which, among other things, deletes a lax vowel in front of another lax vowel (the system of rules adopted from Gussmann 1978). Let us present a sample derivation of one of such opacating words:

okazja "opportunity"
/okaz+íj+ă/
1. Palat. — — — — —
2. LOWER Ø
output [okazja]

--- --- -- --
[2] For the sake of clarity some phonological representations and rules presented in this paper are simplified.

The order of rules is counter-feeding and Palatalization is opaque by (i). The reverse order would clearly be more natural under the Transparency Principle. Thus, an "unnatural" order applies. Here, again, the striking fact is that there is no tendency to remove the opacity of words such as *misja, okazja*. Notice that the increase in transparency could be achieved not only by means of reorderding but, for instance, by the application of Palatalization sensitive to surface structure. Clearly, no such tendencies to reduce opacity can be observed.

Furthermore, there is a whole group of rules which are always opaque by case (i). These are non-automatic neutralization rules which apply only to derived forms (Kiparsky 1973b). Consequently, rules of this kind are opaque in non-derived contexts. Yet, Kiparsky argues that these are perfectly natural rules, and that there is no tendency for them to apply in contexts other than derived. Nevertheless, this is exactly what should be expected under the Transparency Principle, i.e., the removal of this restriction from rules so that they could apply to non-derived forms as well. No such change has been reported so far.

The interactions we have discussed as opaque under case (i) may cause some doubts concerning the validity of individual analyses (such as the synchronic status of rules, possibilities of establishing different underlying representations and rules). We should like, however, to demonstrate that the principle of Minimization of Opacity makes wrong predictions even for the interactions of automatic, exceptionless, low-level phonetic rules, which, to our knowledge, are not controversial under any analysis.

In Polish (as well as in some Slavic and Germanic languages) there is a rule which devoices all word-final obstruents:

$$[- \text{sonor}] \rightarrow [- \text{voic}]/\_\_\_ \#$$

This rule accounts for alternations such as:

chle[p] "bread" — chle[b]y "id. pl."
ló[t] "ice" — lo[d]y "id. pl."
ró[k] "horn" — ro[g]i "id. pl."

This rule is automatic (exceptionless). In Polish there is also a sandhi rule which voices obstruents if the following word begins with a voiced obstruent. This is a typical assimilation rule, which is in agreement with the phonetic requirement of Polish that clusters of obstruents should agree in voicing. This rule is manifest in the following alternations:

po[t] płotem   po[d] domem
po[t] strzechą   po[d] górę

Thus, the expression *pod dom* is derived from underlying /pod/ and /dom/ by applying Final Devoicing and Assimilation.

		/pod dom/
1.	Devoic.	pot ----
2.	Assim.	pod ---
	output	[pod dom]

It is clear that the form [pod] constitutes a surface contradiction to the devoicing rule since the voiced obstruent is found here in the context of the word boundary. Yet, it is obvious that these two rules can apply only in the above order. Parenthetically, this is also the historical order, and it has not changed for centuries. Nevertheless, this is exactly the kind of interaction which under the Transparency Principle is treated as unnatural. Moreover, and this is even more important here, this principle treats Final Devoicing as opaque, "hard to learn" rule, although it is completely automatic, and does not seem to cause any difficulty for the learners (for a similar example in Modern Dutch see Brink 1974).

An interesting thing is that these two processes apply not only in Polish, but also in some Slavic and Germanic languages, although the generality of the second rule differs from language to language and from dialect to dialect[3]. Thus, the frequency of these opaque interactions is quite impressive; they appear in numerous languages and no tendency to minimize the opacity they cause is observed. On the contrary, they express a natural tendency (motivated by the ease of articulation) for obstruent clusters to agree in voicing. Therefore, the Transparency Principle fails in the case of such interactions, treating them incorrectly as marked.

Let us now consider the second case of the definition. Case (iia) refers to the situations where the original environment of a rule is altered and the conditioning part of it is not present in the phonetic output. Such examples are not difficult to find. Recall the interaction between Velar Softening and Vowel Shift in English cited above. Consider the derivation of the word *criticize*:

		/kritikīz/
1.	Vel. Soft.	kritisīz
2.	Vow. Shift	kritisayz
	output	[kritisayz]

This order is opaque since the [s] derived by Velar Softening is not followed by a nonback nonlow vowel. The reverse order would be more desirable since it would yield forms transparent with respect to Velar Softening. Again,

---

[3] In Dutch, for instance, voicing takes place only before word-initial voiced stops, in Standard (Warsaw) Polish all voiced obstruents have such an effect, and in Cracow Polish voicing is evoked by all voiced sounds: obstruents, sonorants and vowels (cf. Wierzchowska 1971).

we must treat the correct order as marked. Let us mention some other examples of rule interactions opaque by (iia) (taken from SPE). Some of them involve Velar Softening. Thus, the process in question is rendered opaque not only by Vowel Shift (as in *criticize, analogize*), but also by Vowel Reduction (*medicine, criticism*), and E-elision (*purge, reduce*). Spirantization is opacated by Vowel Reduction (*accuracy, advocacy*) and by E-elision (*presence, silence*). The commonness of opaque rule interactions arising from the deletion of a segment after it has triggered a given process is noted by Kaye (1974). The well-known example of nasal assimilation and the subsequent dropping of the voiced velar stop in English can be mentioned here. Another example is provided by French, where vowel nasalization is followed by the deletion of the conditioning nasal consonant. Polish and English present an identical situation with respect to the j-palatalization rule, which is, in all cases, rendered opaque by the glide dropping rule. Consider, for example, the derivation of the word *official* (rules are taken from SPE):

$$/\text{ofis} + \text{i} + \text{æl}/$$

1.	j-insertion	j
2.	palat.	š
3.	j-delet.	Ø
	output	[oˈfišəl]

Again the Transparency Principle predicts that all these rules are hard to learn and unnatural. Notice, however, that rules opaque by (iia) have one feature in common, namely the information about their application is preserved in sue phonetic forms in spite of the lack of the original conditioning of these processes. According to the Minimization of Opacity principle, however, such phonetic traces are considered marked. Furthermore, there should be a tendency to reduce opacity in at least some of the quoted cases. Notice that reordering often would not be possible for some of these interactions since it would lead to absolute bleeding (violating in this way the principle of self-preservation). There are, however, other ways of reducing opacity of these interactions which are available, eg. sue loss of an opaque rule, or sue preservation of the conditioning segment. Nevertheless, such changes do not take place. On the contrary, Kaye (1974) notes the existence of the opposite tendency, i.e., in the process of linguistic change it often happens that a rule is added to the grammar which deletes a segment which conditioned some earlier rule. In brief, case (iia) seems to produce not the predicted result but its opposite.

Under case (iib) the existence of underlying shapes identical to those produced by a given rule is one of the sources of rule opacity. An example of such a rule is the above-mentioned Final Devoicing rule in Polish. Since voiceless consonants usually appear freely in word-final position, it is impossible to distinguish from surface forms the words to which this process

applied from those to which it did not. In Polish this often leads to the rise of homophones, eg.

$$[\text{kot}] \Big\langle \begin{array}{l} /\text{kot}/ \text{ "cat"} \\ /\text{kod}/ \text{ "code"} \end{array} \qquad [\text{grat}] \Big\langle \begin{array}{l} /\text{grat}/ \text{ "a piece of junk"} \\ /\text{grad}/ \text{ "hail"} \end{array}$$

According to the Transparency Principle, this completely automatic process is treated as marked. Similarly, the initial voicing rule is also opaque by case (iib) since it produces voiced consonants, which are found in the inventory of phonological segments.

A rule is also opaque by (iib) if some other rule(s) produce(s) identical shapes to those yielded by the process in question. Consider the interaction of three low-level assimilatory processes in Polish. In addition to the rules of final devoicing and initial voicing in colloquial speech there is a process of sandhi palatal assimilation (Wierzchowska 1971). It accounts for the following changes:

wo[z]y "carts" — wó[ž ž]eźnika "butcher's cart"
pie[s] "dog" — pie[š šč]eka "a dog barks"

The degree of opacity of all three rules is considerable. The rule of devoicing is rendered opaque by the voicing rule (by case (i)), eg. in the expression *wóz b]ez woźnicy* "a cart without a driver". Moreover, the very same rule is nontransparent also by (iib) in eg. *wó[s]* because of the presence of voiceless consonants in the phonological structure of Polish. Analogically, the voicing rule is rendered opaque in *wó[z b]ez woźnicy* because it produces segments which appear in underlying representations. The rule of palatal assimilation is opaque by (iib) because it creates palatals which are underlying segments and are produced by various palatalization processes. Thus, according to the Transparency Principle, we are dealing here with marked interactions. Yet, for any speakers of Polish it is clear that these processes do not cause any learning difficulties. Again, the principle of Minimization of Opacity fails to determine the naturalness of rules and their interactions[4]. Therefore, it seems that one of the main drawbacks of transparency as a principle for predicting the naturalness of rules lies in the fact that completely automatic processes like final devoicing, initial voicing and palatal assimilation are treated as marked, "costly", "hard to learn".

Moreover, as has been correctly observed by Kenstowicz and Kisseberth (1977 : 170): "the proposed correlation between transparency = unmarked,

---

[4] An attempt at defending the opacity theory would be to claim that not all cases of opacity are equally marked. In other words, what matters is not only whether a given rule is opaque, but also which case of opacity it is. Kenstowicz and Kisseberth (1977) present an example of reordering in Ukrainian where rules opaque by (i) become opaque by case (iib). This might suggest that opacity by (iib) is less "costly" than opacity by (i)

opacity = marked fails to explain why marked interactions occur over and over in the languages of the world. Why should this be so if marked means unfavoured and a relatively unnatural state of affairs?"

In addition to that, there are situations where both orderings are opaque. In these cases the Transparency Principle fails to tell us whether in such a situation both orders are marked, and which one applies.

It is also necessary to add that the Transparency Principle makes interesting predictions for the deletion and context-free rules. Such rules, for instance, are not opaque under those cases of the definition which refer to rule environment, i.e., (iia and (iib). Context-free rules do not have any environment in their structural descriptions at all. Deletion rules have Ø as their structural change; hence, it cannot be said whether Ø appears in contexts other than those specified by the structural description. Thus, by definition, all deletion and context-free rules are less opaque than other rules. Consequently, they should be favoured by grammars. This conclusion is inconsistent with the consequences of applying deletion rules. We have noted that they often render opaque some earlier rules and are therefore undesirable.

Finally, Minimization of Opacity fails to predict the direction of reordering. There are cases reported of rules reordering in both directions: from opaque to transparent and from transparent to opaque. Moreover, sometimes both the old and the new ordering are opaque or both are transparent (Laferriere 1975).

As a final comment on the Transparency Principle, it should be mentioned that accepting it has serious theoretical consequences. As we argue in some other place (Szpyra 1982), the degree of opacity of a given rule is closely connected with the place it occupies in the rule component. The deeper a rule is placed, the more it is exposed to the opacating application of some later rules. Thus, opacity is often the cost of abstract analyses; the more abstract phonological representations and rules, the more likely they are to be rendered opaque. Therefore, if we accept the existence of rule interactions, we are also forced to accept what is often their logical consequence, i.e., opacity. In this respect the Transparency Principle expresses the tendency to impose limitations upon abstractness of phonological analyses. No wonder its strong version is incorporated into more concrete theories such as Natural Generative Phonology (cf. Hooper 1976). However, the Transparency Principle fails even in this respect, i.e., in prohibiting opaque rules and interactions. Recall the interaction of devoicing, voicing and assimilation in Polish. These processes are all low-level and completely automatic, so they are — in natural generative terms — True Generalizations. On the other hand, they are opaque and therefore cannot be True Generalizations. It is not clear how this problem would be handled by Natural Generative Phonology.

These are some of the shortcomings of the Transparency Principle. It seems that its failure is caused mainly by the fact that it attempts to determine the naturalness issue in terms of surface structure only. In other words, it is exclusively phonetically biased.

The question that arises is why we should be concerned with transparency of rules only. Logically, the second possibility is open, i'e., examining the transparency (or opacity) of underlying forms. It is Kaye (1974, 1975) who explicates the notion of phonological transparency under the heading of recoverability. Kaye (1975 : 244) describes recoverability in the following way: "Recoverability deals with the relationship between a surface form and the number of forms from which it could be derived. In computing the possible sources of the surface form, knowledge of the phonological rules as well as various (deep) phonotactic constraints (syllable, morpheme, word) is required. In determining the recoverability of a form there is no recourse to morphologically related forms". Kaye suggests that opacity of rules can be neglected if derivations that result from their application are recoverable.

Let us now analyse some opaque interactions in terms of recoverability. Generally speaking, opacity by (i) leads to recoverable derivations. Consider, for example the phonological transparency of the word *okazja*. The voiced obstruent in this word does not undergo any serious modifications in the course of derivation, so it can be claimed to be present in the phonological representation of this item. Moreover, if we know the phonetic constraint of Polish — there are no morpheme internal clusters of dental obstruents and glides — then the deleted vowel is also recoverable: since it does not cause the palatalization, it must be [+back], since it deletes, it must be [—tense]. Similarly, we can recover the underlying shape of *medicate*. Thus, knowing that diphthongs in English are derived, the phonological representation /medikæt/ is fully recoverable. Numerous other examples can be given (see Kaye 1974, 1975; Gussmann 1976) supporting the unmarked character of counter-feeding orders, which increase opacity, but also allow for greater recoverability.

Opacity by (iia), in turn, is a result of counter-bleeding orders. Kaye[5] (1974) claims that such orders are in many cases desirable since they — like counter-feeding ones w make derivations recoverable. Consider the opaque interaction between nasal assimilation and the subsequent deletion of the voiced velar stop in English. "A speaker knows a *g* is present in the underlying representation without having recourse to paradigmatically related forms because the only possible source for [ŋ] is via a nasal assimilation rule from underlying /n/ and *g* is the only consonant which could yield such a result and still be absent from the phonetic form" (Kaye 1978).

Moreover, as Kaye (1974, 1975) and Gussmann (1976) demonstrate, there

---

[5] It should be added that Kaye does not suggest such a principle.

are cases of rule reordering in the direction of increasing opacity and, at the same time, towards greater recoverability.

It seems, therefore, that there is sufficient evidence to suggest the Maximal Recoverability Principle: natural orders allow for greater recoverability. The new principle overcomes certain difficulties which are not handled properly by Transparency. Under the Recoverability Principle the majority of interactions viewed as opaque are considered perfectly regular since they result in recoverable derivations. In other words, Recoverability favours such interactions where the information about the application of rules is preserved on the surface. Thus, the new principle often makes completely different predictions as to the naturalness of rules and their interactions. Let us illustrate this phenomenon with a well-worn example.

In some dialects of English two processes can be observed: one which changes /t/ and /d/ into a voiced flap[n] between a stressed and an unstressed vowels, and another which lengthens vowels when they appear before voiced consonants. These two processes can apply in two orders. Consider two possible derivations of the words *latter* (lætər/ and *ladder* /lædər/.

I.	/lætər/	lædər/	II.		/lætər/	/lædər/
1. flap	læfər	læfər	2. length.		———	lǣdər
2. length.	lǣfər	lǣfər	1. flap.		læfər	lǣfər
output	[lǣfər]	[lǣfər]			[læfər]	[lǣfər]

The first order is feeding and completely transparent. The derivations, however, are not recoverable since they result in homophones. In the case of the reverse order (counter-feeding) the rule of length ening is opaque in [læfər] since a short vowel appears before the voiced consonant (case (i)). Recoverability, however, is greater here because the contrast in the length of the vowels indicates the underlying opposition between voiced and voiceless consonants. Consequently, the Transparency Principle treats the first ordering as more natural, whereas Recoverability favours the second one.

It has been mentioned that one of the flaws of the Transparency Principle is that it treats automatic phonetic processes as marked. In this respect Recoverability constitutes no improvement over Transparency. To prove that let us give some examples.

In languages displaying contrasts in vowel length vowels in unstressed position are usually reduced. In Russian, for instance, in stressed position there are five vowels: *i, e, a, o, u*. In unstressed position, however, there is neutralization in the mid vowels: *e* merges with *i* (so-called "ikan'e"), while *o* merges with *a* (so-called "akan'e"). As a result of these two processes in unstressed position in Russian a three-vowel system appears (consisting of *i, u,* and *a*). It is conspicuous that ikan'e and akan'e largely decrease the recoverability of unstressed vowels. Yet, as Schane (1972) claims, these pro-

cesses belong to the category of natural rules which provide for maximum differentiation. Under the Recoverability Principle, however, they are treated as marked.

The degree of phonological ambiguity is even greater in the case of vowel reduction in English. Here schwas can be derived from all full vowels. Consequently, recoverability is very poor. Notice that often even the knowledge of related forms does not help to recover an underlying vowel, since only some schwas alternate with full vowels. Thus, various unspecified segments which often appear in phonological representations (eg. in SPE) are real cases of irrecoverability. Therefore, vowel reduction in English receives a marked designation in terms of recoverability. Yet, it is clear that the process under consideration is a low-level phonetic rule which is not "hard to learn". In addition, there are no signs which would indicate that vowel reduction as a "highly unnatural" process tends to be lost from the grammar of English.

Let us turn to the interaction of rules yielding forms which are not recoverable. Consider the process of final devoicing in Polish once again. Whenever a Polish word ends with an obstruent, it is impossible to determine the phonological shape of this segment without taking into account morphologically related forms. This is particularly conspicuous in the case of homophones. The application of sue latter rules of initial voicing and cross-word palatal assimilation does not help to recover sue underlying forms of words, either. On the contrary, they decrease the degree of recoverability. Thus, under the Recoverability Principle such interactions are considered marked although this conclusion is contrary to the observed facts: no changes in the direction of decreasing the degree of ambiguity are evident.

It must be remembered that recoverability, like opacity, is a matter of degree. Hence, the question arises what degree of ambiguity can be admitted to permit calling a given process or interaction natural[6]. In the case of nasal assimilation and velar dropping only the deleted voiced stop is recoverable, whereas the exact nature of the nasal consonant is not recoverable. Similarly, in the case of vowel nasalization in French and subsequent deletion of the conditioning nasal consonant only the vowel, but not the consonant is recoverable. For example, it is impossible to recover the quality of the nasal consonant in the word [fɛ̃] which can be either /n/ as in *fin*, or /m/ as in *faim*. In other cases recoverability is even smaller. Gussmann (1978) mentiones several instances of poor recoverability in Polish, which is, in fact, a typical feature of Polish vocalic system. Poor recoverability is frequently a result of the interaction of several rules. Consider the recoverability of the phonetic [s] in the adjectives ending in -[s]*ive* (Leben 1979). [s] comes from:

---

[7] King's analysis has been questioned by Brink (1974) and Iverson and Ringen (1973).

/sp/ as in express — expressive
/z/ as in abuse — abusive
/t/ as in permit — permissive
/d/ as in explode — explosive

The phonological ambiguity of phonetic [s] results from the interaction of Spirantization and a rule devoicing [z] in front of -ive, as well as from the presence of /s/ in the phonological structure of English. Similarly, the interaction of these rules together with the application of Palatalization affects the ambiguity of palatals. Phonetic [š] appearing before the nominal suffix -ion has the following phonological sources:

/š/ as in abolish — abolition
/s/ as in confess — confession
/t/ as in assert — assertion
/d/ as in suspend — suspension

In both cases the Recoverability Principle requires unnaturalness designation upon these interactions. Logically, we should expect this principle to evoke some changes to increase recoverability. Again, no tendency to eliminate some of the possible sources of [s] in -sive and of [š] in [š]ion can be observed.

Finally, if we treat the reordering argument as valid in deciding the naturalness issue, then we should expect phonological rules to reorder in the direction of greater recoverability. There are, however, cases of reordering which do not bring about any gain in recoverability, i.e., when reordering results in a smaller degree of recoverability, or has no effect on it. This is not surprising since counter-feeding orderings preserve recoverability while feeding ones do not and rules often reorder from counter-feeding to feeding. Let us quote one example of reordering presented in King (1969)[7]. In Early Modern German there were two rules: one devoicing obstruents in word-final position, and second lengthening vowels before voiced obstruents. The derivation of two entries: *Lob* "praise" and *Lobes* "of praise" could be presented as follows:

	/lob/	/lobəs/
1. Final Devoic.	lop	-------
2. Vowel Length.	-----	lo:bəs
output	[lop]	[lo:bəs]

The final obstruent in [lop] is not recoverable since voiceless obstruents also

* Kaye (1978) suggests that one can view recoverability as a global constraint on the degree of ambiguity permitted in phonology. He adds that "it is difficult to find phonological analyses which involve a level of surface ambiguity much beyond the order of three". Our examples demonstrate that cases of greater ambiguity are not, at all, infrequent, eg. palatals and reduced vowels in English.

appear in this position. In Modern German, according to King, these two rules reordered and the derivation of the same items is the following:

	/lob/	/lobəs/
2. Vowel Length.	lo:b	lo:bəs
1. Final Devoic.	lo:p	-------
output	[lo:p]	[lo:bəs]

Now in [lo:p] it is not only final consonant which is not recoverable but also the vowel because long and short vowels appear freely before voiceless consonants in German. Thus, the change not only did not result in greater recoverability, but on the contrary, the innovated order reduced it.

In conclusion, the Recoverability Principle suffers from exactly the same shortcomings as the Transparency Principle. Thus, contrary to our expectations, it assigns marked status to automatic phonetic rules and their interactions. Furthermore, we have noted the stability of orderings leading to derivations which are not recoverable. Finally, the reordering argument does not support the Recoverability Principle, for there are cases of rules reordering in the direction of lower recoverability. In brief, it seems that neither Transparency nor Opacity alone can decide the naturalness issue.

Logically, the third possibility is available, namely treating transparency and recoverability as complementary, and claiming that natural rule interactions are those which result either in minimization of opacity or maximization of recoverability, or both. This hypothesis is supported by some psychological factors. Opaque rules are claimed to be hard to learn since it is difficult to uncover the actual shape of a rule on the basis of the phonetic form alone (there are either surface exceptions to a rule or a rule lacks its original conditioning on the surface). Recoverability, in turn, leads to greater ease of learning underlying forms. As Kaye (1975) states, the recoverability of a form bears directly on the ease with which a speaker can carry out the operation of matching a phonetic item to its lexical representation[8]. Thus, transparent orderings result in easier acquisition of phonological rules, whereas recoverability leads to greater ease in setting up underlying representations. Since these two concepts are on a par, it seems that no preference for only one of them

* We should like to comment on the problem of the "psychological reality" of recoverability. Recoverability deals with the ease of arriving at the phonological representation of a form without taking into account any related words since, as Kaye (1975) states: "people do not speak in paradigms". Notice, however, that it is exactly the existence of paradigms that allows a native-speaker to uncover the actual shape of phonological rules. Thus, the speaker can have an access to morphologically related forms while learning rules but cannot refer to paradigms when he wants to arrive at underlying shapes. This is clearly not consistent. Moreover, it should be remembered that it is often the context (either syntactic, semantic, or extralinguistic) which disambiguates lexical items.

can be given. Consequently, most desirable are the situations with both transparent rules and recoverable derivations. In such cases underlying representations can be recovered unambiguously along with the rules which relate them to phonetic forms. Consider, for instance, the following alternations in Polish were two rules interact: i-anterior palatalization, which palatalizes consonants in the environment of a following front vowel, and palatal assimilation, which creates clusters of palatals with the same place of articulation:

mia[st]o "town" — mie[śće] "id. loc. sg."
cia[st]o "pastry" — cie[śće] "id. loc. sg."
mo[st] "bridge" — mo[śće] "id. loc. sg."

Here all forms are recoverable and rules are transparent since the vowel which conditions the palatalization, is present in the phonetic output as well as the palatal which triggers the palatal assimilation rule. Consequently, such interactions are, under any theory discussed so far, natural and unmarked.

Kenstowicz and Kisseberth (1977) put forward a hypothesis, which can be treated as an attempt at incorporating both transparency and recoverability into the principles of natural orders. They suggest the hypothesis which may be called the Modified Transparency Principle. They claim (1977:172): "phonological rules will not (normally) interact in a fashion that creates phonetic opacity unless motivated to do so". There are, according to Kenstowicz and Kisseberth, two situations where the phonetic opacity can be considered motivated:

1. when phonologically opaque interactions help to maintain underlying semantic contrasts

2. when such interactions arise from the inherent nature of the phonological processes themselves (i.e., when two rules are mutually contradictory and in whatever order they apply, one opacates the other).

What is conspicuous in the above formulation of this hypothesis is that the notion of recoverability does not appear in it. It seems, however, that "preservation of underlying semantic contrasts" practically means recoverability. Let us recall an example given by Kenstowicz and Kisseberth (1977:157, 170-1) to illustratewhat they mean by "preservation of semantic contrasts". In the Bantu language Mwera, a voiced stop is optionally deleted after a homorganic nasal, while a voiceless stop is voiced after a nasal:

lu-gomo, ŋ-gomo/ŋ-omo "lip"
lu-kuya, ŋ-guya "cape bean"

Thus, the derivation of ŋ-omo and ŋ-guya can be presented as follows:

	/ŋ-gomo/	/ŋ-kuya/
1. Voiced stop del. n-omo	ŋ-omo	---------
2. Voic. after nas.	--------	ŋ-guya
output	[ŋ-omo]	[ŋ-guya]

This order makes the first rule opaque in ŋ-guya since it contains a voiced stop after a homorganic nasal, in spite of the rule deleting voiced stops in this position (opacity by case (i)). The underlying shape of ŋ-guya, however, is recoverable because the voiced stop after a nasal signals that this form comes from an underlying stem with the initial voiceless stop. Therefore, the underlying contrast between stem-initial voiced and voiceless stops is presented in a phonetic contrast between Ø and a voiced stop. In other words, "the phonetically opaque interaction of these rules preserves the underlying opposition between voiced and voiceless initial stems, which presumably aids in the recovery of the underlying form (emphasis mine — J. Sz.) and ultimately of the meaning of the sentence" (Kenstowicz and Kisseberth 1977:171). It is quite clear from the quoted example that "preservation of semantic contrasts" results in recoverability. Another example of the similar kind is the interaction of two rules which appear in some dialects of American English, i.e., the rule of vowel nasalization before nasal consonants and the process of nasal elision which deletes nasal consonants before homorganic obstruents. Thus, there are two possible orderings of these two processes, as can be demonstrated on the sample derivation of the word *lamp*:

I.		/læmp/	II.		/læmp/
	1. Vow .nas.	lãmp		2. Nas. del.	læp
	2. Nas. del.	lãp		1. Vow. nas	--- ---
	output	[lãp]		output	*[læp]

In the case of the first ordering the rule of vowel nasalization is rendered opaque by the nasal elision rule (by case (iia) since a nasal vowel occurs here in non-nasalizing context. The derivation, however, is fully recoverable: since there are no underlying nasal vowels, it is clear that an oral one is found phonologically. Furthermore, since nasals are deleted only before homorganic consonants, this points to the presence of a bilabial nasal in the phonological structure of this word. The second derivation is not recoverable, although both rules are transparent here. Moreover, the phonetic form which arises as a result of the application of the transparent ordering is phonologically and semantically ambiguous since the surface form alone does not indicate whether we are dealing with the phonetic realization of the word *lamp* or *lap*. Consequently, it is the opaque ordering which helps to preserve the semantic contrast. Therefore, the Kenstowicz and Kisseberth hypothesis can be reformulated in the following way:

Phonological rules will not interact in a fashion that creates phonetic opacity unless derivations that result from the application of these rules are recoverable.

In order to check the validity of this hypothesis, let us discuss the rela-

tionship between opacity and recoverability in greater detail. There are four possible types of rules and interactions with regard to these two notions:

1. transparent rules and recoverable derivations — to this group belong "true generalizations" — as the proponents of Natural Generative Phonology would call such rules — these are rules and interactions which are not problematic under any theory
2. opaque rules and recoverable derivations — in this case our Modified Transparency Principle allows us to treat opacity as negligible since the resulting derivations are recoverable (cf. Kaye 1974, 1975, Gussmann 1976). These are cases — how Kaisse (1978) calls them — of "natural opacity". Here the lack of the conditioning environment is redundant, since it happens "without an appreciable loss of information", i.e., "a crucial distinctive feature of the conditioning segment which has been deleted (or altered — J. Sz.), is "trapped" on the surface (point of articulation, nasality, and syllabicity)" (Kaye 1974:147). We can therefore conclude that such cases are unmarked.
3. transparent rules and derivations which are not recoverable — such cases are infrequent since the third case of the definition of rule opacity makes costly the rules which create phonetic shapes identical to underlying forms or derived by some other rule(s). In other words, a given rule is opaque by (iib) if the structures it creates are phonologically ambiguous, i.e., not recoverable. Thus, transparent rules which result in derivations which are not recoverable are only those which neutralize some phonological contrast and at the same time produce novel segments, i.e., ones not found in the phonological inventory nor produced by some other rule(s). Vowel Reduction in English is an example of a transparent rule which results in the derivations that are not recoverable. The interaction between the rules of flapping and vowel lengthening which leads to the rise of homophones is also of this kind. These cases would be problematic under the Recoverability Principle, but, according to the Modified Transparency Principle, they are perfectly regular, for no marked status can be assigned to a given interaction if the rules are transparent, regardless of recoverability.

A problem which appears here is what interaction can be considered unmarked in the case of one transparent order with derivations which are not recoverable, and another where the order is opaque but derivations are recoverable. We envisage such a situation in some dialects of English which contain the flapping and vowel lengthening rules. The Modified Transparency Principle predicts that both orders are natural (as a matter of fact both appear in various dialects). Therefore, it may be claimed that there would be one universal principle of naturalness of rule interactions, and in the case of two possible natural orders (i.e., one leading to transparency, another to recoverability) there would have to be language-speci-

fic statements stating which principle takes precedence (either Maximal Transparency or Maximum Recoverability). Thus, the only situation undesirable for both principles would be the one with opaque rules and derivations which are not recoverable.

4. opaque rules and derivations which are not recoverable — these cases are doubly marked: both by the Transparency and Recoverability Principles as well as by the Modified Transparency Principle. In what follows we shall demonstrate that opaque and irrecoverable derivations should not be treated as unnatural and, consequently, that none of these principles is able to determine the naturalness of rule interactions. Let us first recall some examples of such rules and interactions.

First of all there are some automatic phonetic rules which fall into this category. Final devoicing (in Polish and numerous other languages) as well as all rules which are opaque by (iib) lead to the derivations which are not recoverable. Thus, word-final position in Polish is one where the phonological opposition between voiced and voiceless consonants is neutralized. Similarly, the processes of ikan'e and akan'e in Russian neutralize the underlying opposition between unstressed high and mid front vowels as well as mid and low back vowels. Again, the Modified Transparency Principle forces us to treat these purely phonetic processes as marked. Recall the interaction between final devoicing, voicing and assimilation in Polish. This interaction has been discussed both as opaque and not recoverable and, hence, undesirable under our hypothesis. Yet, as we have argued, all these rules are of purely assimilatory character, and treating them as marked is contrary to Jakobsonian and SPE markedness theories. Consider also the cases of interaction of more than two rules in English such as Velar Softening, Spirantization, E-elision, Palatalization, Glide dropping, and Vowel Reduction (cf. SPE). The result of these interactions are phonetic shapes whose underlying representations are not recoverable and which result from opaque rules. Thus, cases of opaque rules and derivations which are not revocerable are not infrequent. Moreover, it seems that quite often their existence is simply a cost of abstract analyses.

In addition, it is very striking that there are certain changes which would be desirable both for transparency and recoverability purposes, but which do not occur. A typical example is deletion rules, which add opacity to rules and, at the same time, decrease the degree of recoverability. Let us recall once again some interactions which have been discussed throughout this paper.

The deletion of nasal consonants after they trigger the process of vowel nasalization in French makes the deleted segment nonrecoverable. Furthermore, the very same deletion rule renders nasalization opaque. Thus, preservation of nasal consonants in this position would be doubly desirable. Clearly, there is no tendency for French to get rid of the deletion rule. Similarly, the deletion of front glides both in Polish and English renders palatalization

rules nontransparent and at the same time decreases largely the degree of recoverability. Here, as in the previous case, no changes are observed which would modify this presumably unnatural state of affairs.

So far we have not examined interactions of mutually opacating rules. It is clear that in the case of such interactions recoverability should be the decisive factor in determining which order is unmarked. The Nootka example of contradictory rules quoted by Kenstowicz and Kisseberth (1977:171—2) shows that transparency fails to predict the correct order of mutually opacating rules. (in this particular example both orders yield opaque rules and derivations which are not recoverable).

Finally, the Modified Transparency Principle fails to predict the direction of linguistic change which, according to the principle, should proceed towards lower opacity or greater recoverability.

Recall the reordering of vowel lengthening and final devoicing in German. It has been shown that this change brought about a decrease of recoverability. It also increased opacity. That is, in Early Modern German only final devoicing was opaque. However, in Modern German both processes, i.e., vowel lengthening and final devoicing are nontransparent. Thus, the reordering did not result in any gain in transparency or recoverability. Another example of reordering given in King[9] (1969) also demonstrates the insufficiency of the existing principles.

The grammars of all the early Germanic dialects contained two rules:

1. changing the voiced nonstrident fricatives into the corresponding voiced stops word-initially, after nasals, and in gemination.

2. devoicing of word final fricatives

According to King, these two rules applied in the above order in Gothic, Old Norse, and Old German. Thus ,a sample derivation of the third person plural of the Gothic verb "to bind" follows:

	/ƀinðanð/
Rule. 1.	bindand
Rule 2.	——— —
output	[bidand]

Here the order is bleeding, the rules are transparent, and the derivation is recoverable. In a group of Germanic languages comprised by Old English, Old Saxon, and Old Frisian, however, a reordering is presumed to have taken place, and the order of these two rules is claimed to be the opposite.

---

[*] Hogg (1976) throws doubt upon this analysis.

	/ƀinðanð/
Rule 2.	ƀinðanþ
Rule 1.	ƀindanþ
output	[bindanþ]

Here, again, the order is bleeding, rules are transparent, and the derivation is recoverable. Thus, the reordering did not influence transparency or recoverability. This indicates that there are other factors which motivate reordering.

In the present paper an attempt has been made to describe (natural rule interactions in terms of opacity/transparency and recoverability. Three hypotheses: Minimization of Opacity, Maximization of Recoverability, and a combination of both have been analysed as possible principles which determine natural rule interactions. It appears that we find the same sorts of difficulties with all of them: they make wrong predictions both for synchronic phenomena and for the direction of linguistic change. Thus, our conclusion is that none of these principles can decide the naturalness of rule interactions issue. In fact, the present author is skeptical about the possibility of finding such a principle. It seems more probable that a set of such principles is at work (perhaps something similar to Anderson's (1974) hierarchy of principles used to decide the natural orders within his local ordering theory, or a set of principles like those suggested by Brink (1974)). All suggested principles have a high degree of generality, but fail in specific instances. They help, however, to achieve a level of "exegetic adequacy" in Anderson's terms. Thus, "if we distinguish the ex post facto understanding of a linguistic fact which a given principle can provide from the ability of that principle to predict beforehand what the facts will be, we can...find a proper value to set on principles..." (Anderson 1979:18).

REFERENCES

Anderson, S. R. 1974. *The organization of phonology*. New York: Academic Press.

Anderson, S. R. 1979. "On the subsequent development of the 'standard theory' in phonology". In Dinnsen, D. A. (ed.). 1979. 2—30.

Bach, E. and R. Harms. (eds). 1968. *Universals in linguistic theory*. New York: Holt, Rinehart and Winston.

Brink, D. 1974. "Characterizing the natural order of application of phonological rules". *Lingua* 34. 47—72.

Chomsky, N. and M. Halle. 1968. *The sound pattern of English*. New York: Harper and Row.

Dinnsen, D. (ed.). 1979. *Current approaches to phonological theory*. Bloomington: Indiana University Press.

Dingwall, W. (ed.). 1971. *A survey of linguistic science*. College Park: University of Maryland.

Fujimura, O. (ed.). 1973. *Three dimensions of linguistic theory*. Tokyo: TEC.

Goyvaerts, D. In press. *Phonology of the 70's*.

Gussmann, E. 1976. "Recoverable derivations and phonological change". *Lingua 40*. 281—303.

Gussmann, E. 1978. *Explorations in abstract phonology*. Lublin: Maria Curie-Sklodowska University.

Hogg, R. M. 1971. "Gemination, breaking and reordering in the synchronic phonology of Old English". *Lingua 28*. 48—69.

Hogg, R. M. 1976. "The status of reordering". *Journal of linguistics 12*. 103—23.

Hooper, J. B. 1976. *An introduction to natural generative phonology*. New York: Academic Press.

Iverson, G. and C. Ringen. 1973. "Rule reordering and the history of High German vowel length" *CLS 9*. 223—32.

Kaisse, E. 1978. "On the stability of opaque rule orderings". *CLS 14*. 103—204.

Kaye, J. 1974. "Opacity and recoverability in phonology". *Canadian journal of linguistics 19*. 134—49.

Kaye, J. 1975. "A functional explanation for rule ordering in phonology". *Papers from the parasession on functionalism*. Chicago Linguistic Society. 244—52.

Kaye, J. 1978. "Recoverability, abstractness and phonotactic constraints". In Goyvaerts, D. (ed.). In press.

Kenstowicz, M. and Ch. Kisseberth. 1971 ."Unmarked bleeding orders". In Kisseberth, Ch. (ed.). 1971.

Kenstowicz, M. and Ch. Kisseberth. 1977. *Topics in phonological theory*. New York: Academic Press.

King, R. D. 1969. *Historical linguistics and generative grammar*. Englewood Cliffs, New Jersey: Prentice-Hall.

Kiparsky, P. 1968. "Linguistic universals and linguistic change". In Bach, E. and R. Harms (eds). 1968. 171—205.

Kiparsky, P. 1971. "Historical linguistics". In Dingwall, W. (ed.). 1971. 576—649.

Kiparsky, P. 1973a. "On comparative linguistics: the case of Grassmann's Law". In Sebeok. T. A. (ed.). 1973. 115—35.

Kiparsky, P. 1973b. "Abstractness, opacity and global rules". In Fujimura, O. (ed.). 1973. 57—86.

Kisseberth, Ch. (ed.). 1971. *Studies in generative phonology*. Edmonton, Alberta: Linguistic Research.

Laferriere, M. 1975. "Rule exceptions, functionalism, and language change". *Canadian journal of linguistics 20*. 161—82.

Leben, W. 1979. "The phonological component as a parsing device". In Dinnsen, D. (ed.). 1979. 174—201.

Schane, A. S. 1972. "Natural rules in phonology". In Stockwell, R. P. and R. K. S. Macaulay (eds). 1972. 199—230.

Sebeok, T. A. (ed.). 1973. *Current trends in linguistics*. Vol. 11. The Hague: Mouton.

Stockwell, R. P. and R. K. S. Macaulay (eds.) 1972. *Linguistic change and phonological theory*. Bloomington: Indiana University Press.

Szpyra, J. 1982. "The concept of rule opacity and its usefulness for phonological analysis". *SAP 14*.

Wierzchowska, B. 1971. *Wymowa polska*. Warszawa: Państwowe Zakłady Wydawnicw Szkolnych.