On keeping exchange rules in Czech

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The claim that phonological rules apply in a sequence is by now uncontroversial. Chomsky (1967) has noted, however, that the fact that some rules must apply sequentially does not imply that all rules can be applied in this way; and that there are situations that can be imagined that would pose problems for sequential application. One such problem, he suggested, would be the following: suppose that, in some phonological environment, underlying A is replaced by B, while underlying B is replaced by A. Assuming no further complications, such as intervening rules, it is easy to see that these two processes (A \rightarrow B / X \_ Y and B \rightarrow A / X \_ Y) cannot be applied sequentially, for either sequence would result in a neutralization of the distinction between A and B in X \_ Y.

Chomsky claimed that in fact examples of this formal structure do exist in natural languages, and cited as an example the rules which describe the synchronic reflex of the great vowel (discussed in Chomsky and Halle 1968). The question apply to tense vowels at a point in the derivation, and have the effect of high and mid vowels, and then of intersecting low vowels. The result is that, depending on independently needed rules of tensing, a form may show major differences in resulting in well-known alternations divine/divinity, etc.

Chomsky further noted however, that vowel shift have appropriate formal that they fall under the definition - convention of abbreviation by variables values, first proposed by Halle (1963). The significance of this is following: in order to resolve the specifying the two parts of an exchange necessary not to apply the rules directly could, instead, be applied simultaneously, so that neither would be apply output of the other. Now there are rules abbreviable by variables which sequence, and it would therefore be that (universally) any set of rules abbreviable is to be applied simultaneously.
synchronic reflex of the great vowel shift in English (discussed in Chomsky and Halle 1968). The rules in question apply to tense vowels at a particular stage of the derivation, and have the effect of interchanging high and mid vowels, and then of interchanging mid and low vowels. The result is that, depending on whether independently needed rules of tensing and laxing apply, a form may show major differences in vowel quality, resulting in well-known alternations of the type divine/divinity, etc.

Chomsky further noted however, that the rules of vowel shift have appropriate formal properties, such that they fall under the definition of the notational convention of abbreviation by variables over feature values, first proposed by Halle (1963) for treating assimilation. The significance of this observation is the following: in order to resolve the difficulty in applying the two parts of an exchange process, it is necessary not to apply the rules directly in sequence. They could, instead, be applied simultaneously (or disjunctively), so that neither would be able to affect the output of the other. Now there are no cases known of rules abbreviable by variables which must be applied in sequence, and it would therefore be possible to propose that (universally) any set of rules abbreviable by variables is to be applied simultaneously rather than
sequentially. In this case, the ordering problem would be resolved by giving a precise formal definition of the circumstances in which a non-sequential ordering principle obtains.

Unfortunately, the need for such a move has not been demonstrated with many other examples. The English vowel shift rule has remained virtually the only example of a true exchange rule which has received extensive discussion. Other authors, however (e.g. McCawley, 1971; Stockwell, to appear) have questioned Chomsky and Halle's account of the vowel shift. The surface alternation patterns are clear (at least for the front vowels) but alternative accounts can be imagined that deal with these same alternations without positing a direct exchange of two elements in the same environment. In particular, if the high vowels become centralized vowels before lowering, and the mid and low vowels are simply raised one step, no exchange is involved, and the ordering problem does not arise. In the discussion of these alternatives, an important point has been the question of whether exchange rules can exist in natural languages. Some authors have felt that their effect would be to impair intelligibility radically, and thus that they could not develop in grammars. If this is so, of course, it would provide motivation for an alternative to Chomsky and Halle's account of the vowel shift.

A priori objections based on the phonemic notion of exchange rules as historically independent cannot be taken too seriously. When we look at histories of languages such as Armenian, it is clear that languages can survive changes much more extreme than a simple exchange. In this case, it has been pointed out that exchanges may arise from other, non-exchange rules at a level of grammar by restructuring. The question of whether exchange rules exist (and hence of whether the vowel shift in English which posits such a change is plausible or not) remains an empirical question, and it is necessary to bring forward examples from the history of English in order to resolve it.

In a previous issue of this journal, it has attempted to provide such evidence. In this paper, it has examined some other examples in which exchange rules have been indicated, and concludes that they do not exist in natural languages. Of the examples examined, three bear directly on the question of whether there can exist in natural languages. Of the examples, two are such that they can be said to carry much weight. One example is a drum-signalling system, in which it is the exchange of high tone for low and vice
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A priori objections based on the potentially dramatic effect of exchange rules as historical changes cannot be taken too seriously. When we consider the histories of languages such as Armenian and Arapaho, it is clear that languages can survive changes that are much more extreme than a simple exchange; and in any case, it has been pointed out that exchange rules could arise from other, non-exchange rules already in the grammar by restructuring. The question of whether exchange rules exist (and hence whether an account of vowel shift in English which posits such a rule is plausible or not) remains an empirical one, and it is necessary to bring forward examples from other languages in order to resolve it.

In a previous issue of this journal, Wolfe (1970) has attempted to provide such evidence. She discusses some other examples in which exchange rules are apparently indicated, and concludes from them that such rules can exist in natural languages. Of these examples, three bear directly on the question of exchange rules; but two of these are such that they cannot really be said to carry much weight. One example concerns a drum-signal system, in which it is claimed that an exchange of high tone for low and vice versa was not
even noticed. Further exact 'phonetic' data on the tones involved would be necessary to decide if a real exchange was involved, but in any case there is no obvious reason to expect that the formal properties of such auxiliary modes of communication will accurately reflect those of natural language in every detail.

Another example concerns an alleged vowel shift in Old Prussian, based on somewhat ambiguous evidence from orthographic confusion. Again, precise phonetic data that would support an exchange rule are lacking, and in any case our knowledge of Old Prussian is so fragmentary that it would not be wise to base matters of formal detail on evidence from this source alone. Neither of these examples, then, can be taken to provide convincing proof of the existence of phonological exchange rules.

Wolfe's main example, however, is taken from Modern Czech, about which the facts are reasonably clear. Her discussion is based on Kučera's (1958, 1961) account of the relation between two forms of modern Czech. One of these, the Czech literary language (LL) was originally based on Central Bohemian dialects, and has a long and reasonably continuous tradition reaching back at least to the fourteenth century. The literary language has evolved in ways that are to some extent independent of the evolution of 'popular' or conversational Czech, and the modern Bohemian dialect of Prague and its surroundings differs from the literary in ways. This dialect is the basis of the standard variety of spoken Czech, called the Czech Language (CC). There are in addition both of these dialects available to us, extent internmix features from both conversational utterances, dependent on other non-linguistic factors.

Among the systematic differences Wolfe claims that the following does not appear in underlying form. LL [i:] corresponds to the diphthong CC [iː]; and LL LL [ɛ] corresponds to CC [ow]. In addition, Wolfe claims that in fact the phonology of CC and LL and works at least for the non-low front vowel and by means of optional phonological rules of the same underlying forms as are used by optional rules are applied through then CC results; when (...) the rules applied and sometimes not, we get
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ways. This dialect is the basis of a more or less stan-
dard variety of spoken Czech, called the Czech Common
Language (CC). There are in addition numerous regional
and local peculiarities identifying non-standard dia-
lects, but it is the relation between CC and LL that is
of interest here. In fact, most Czech speakers have
both of these dialects available to them, and to some
extent intermix features from both in ordinary conversa-
tional utterances, dependent on social context and
other non-linguistic factors.

Among the systematic differences between LL and CC,
Wolfe claims that the following are of significance:
LL [i:] corresponds to the diphthong [ej] in CC; LL [e:] corresponds to CC [i:]; and LL [u:] corresponds to
CC [ow]. In addition, Wolfe claims that the vowel /o/ does not appear in underlying forms in either dialect.
We will return below to the discussion of the back
vowels, and for the present will concentrate our atten-
tion on the long non-low front vowels. Wolfe suggests
that in fact the phonology of CC can "be described by
means of optional phonological rules applied to the
same underlying forms as are used for LL; if these
optional rules are applied throughout wherever possible
then CC results; when (...) the rules are sometimes
applied and sometimes not, we get the normal type of
conversational utterance" (1970, p. 223). In fact, the relation between the two is not so simple, as remarked by Havránek (1929):

Le système phonologique du tchèque littéraire ni ne concorde avec le système actuel du tchèque courant et populaire, ni n'est simplement l'image d'un stade antérieur de la langue populaire de Prague ou du centre de la Bohême; la langue littéraire a échappé à certains changements qui ont atteint le parler courant à partir de la fin du XVIIème siècle tandis qu'elle a subi d'autres changements parfois plus récents.

Havránek 1929, p. 110

As a result, it is not accurate to characterize CC as simply LL with the addition of some late, optional rules. For the purposes of discussion, however, we will accept this idealization of Wolfe's, and assume (confining our attention to front vowels) that CC contains rules converting /e:/ to [i:] and /i:/ to [ej].

On that basis, Wolfe could be justified in assuming that the diphthongization in CC [ej] is secondary, and that the rule in question first interchanges /i:/ and /e:/ before diphthongizing the derived /e:/ (from /i:/) to [ej]. This interchange of /i:/ and /e:/ would be an exchange of the type that is to be demonstrated, and would therefore (granting the necessary assumptions about the relation between CC and LL) provide evidence for the existence of exchange rules.

There is an important problem with this example, however. As pointed out by Kučera (e.g. Kučera 1961

fn 1, p. 88), not all of the [i:]'s in CC. While all LL [e:]'s are in CC,² only those [i:]’s that arise from earlier [i:] are lowered to [ej]; those that arise from earlier [i:] remain as [i:].

The fact that Czech is not sufficient reason to posit synchronically. The fact that LL [pi:xe] 'writes', [ni:sto] 'pours', 'spoil' correspond to CC [pi:xe], [ni:sto], but LL [zi:pra] 'tomorrow', [hluxi:na] 'dead' correspond to CC [pejxal], [zejtra], CC. Taken by itself, of course, this has only historical validity. The fact that (LL) [i:] is the reflex of both [i:] and [e:] under the vowel shift rule in CC. The distinction between original and not just a historical one, however. It makes a synchronic distinction in modern Czech (CC and LL) between palatalizing and /i:, /i/, /e:/, /e/. The case of /e/
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fn 1, p. 88), not all of the [i:]'s of LL correspond to [e] in CC. While all LL [e:]'s are raised to [i:] in CC, only those [i:]'s that arise historically from earlier [i:] are lowered to [e]; those [i:]'s that arise from earlier [i:] remain as [i:] in both LL and CC. Taken by itself, of course, this observation has only historical validity. The fact that modern Czech (LL) [i:] is the reflex of both [i:] and [i:] in Old Czech is not sufficient reason to posit a distinction between two morphophonemic sources for surface [i:] synchronically. The fact that LL [pi:xa] 'pride', [zi:tra] 'tomorrow', [hluxi:ma] 'deaf (instr. pl)', correspond to CC [pejxal], [zejtra], and [hluxema], but LL [pi:se] 'writes', [mi:sto] 'place' and [kazi:] 'spoils' correspond to CC [pi:se], [mi:sto], and [kazi:] might not be related to any aspect of their phonological structure. One could simply mark the vowels of the second set of words as exceptional, in that they do not undergo the vowel shift rule in CC. The fact that the rule has exceptions would not, of course, impugn its status as a rule.

The distinction between original [i:] and [i:] is not just a historical one, however. It is necessary to make a synchronic distinction in modern Czech (in both CC and LL) between palatalizing and non-palatalizing /i:/, /i/, and /e/. The case of /e/ is cleaner, since
palatalizing /e/ appears with preceding [j] after consonants that do not participate in palatalized/non-palatalized pairs. With the palatalizing /-e/ of the prepositional case singular, for example, we have alternations such as [koška]/[košce] 'cat/(about) the cat'; [praža]/[praž] 'Prague/(in) Prague'; [okno]/[okně] 'window/(in) the window'; [kra:jv]/[kra:jve] 'cow/(about) the cow'.

The non-palatalizing /e/ of the prepositional plural ending /-ex/, however, leaves the root final unchanged: [okně]/[oknex] 'windows/(in) the windows'; [mravě]/[mravex] 'morals/(about) morals', etc. A natural account of this fact would follow if we simply represent palatalizing /e/ as /je/; the /j/ is then absorbed into a preceding palatalized consonant, preserved initially and after labials, and deleted elsewhere. The distinction between palatalizing and non-palatalizing /i/, /i/ is not so clear, however, since palatalizing /i/, /i/ are not typically preceded by /j/. In the declension of /bratru:v/ 'brother's' and /srestři:n/ 'sister's', for instance, we find palatalization in the prepositional singular (before /-je/)

nominate and possessive plurals (non-palatalizing /-i:x/): [bratrovi], [srestři], [bratři:v], [srestři:x].

The distinction between palatalizing palatalizing /i:/, /i/, and /e/ is a parameter in Czech morphology (cf. for example Newman's statement that /i:/ in LL preceded by /t,d,k,x,h,r,n/ corresponds uniformly to /i:/ in LL preceded by /p,b,s,z,m,l,v,c|.| not (unpredictably, depending on the word) correspond to CC [ej]. After consonants from palatalization, however, such as /i/ [i:] always corresponds to CC [i:]. The use of these consonants can never be followed palatalizing /i:/, since that would convert /t/ into /t',d',c,s,z,r'n/. The second group could be followed by either palatalizing /i:/ with no resultant difference group (/t', etc.) could only be followed /i:/, since they arise only through pal
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/-i:x/): [bratrovi], [sestři], [bratrovi:x],
[sestři:x].

The distinction between palatalizing and non-
palatalizing /i:/, /i/, and /e/ is a pervasive one in
Czech morphology (cf. for example Newman, 1971) and
must be represented in any adequate description of the
language. The relevance of this distinction to the rel-
tion between LL and CC is that it is precisely the
non-palatalizing /i:/'s which lower to [e] in CC;
palatalizing /i:/ is preserved. This fact is reflected
in Křeč's statement that /i:/ in LL preceded by
/t,d,k,x,h,r,n/ corresponds uniformly to CC [ej], while
/i:/ in LL preceded by /p,b,s,z,m,l,v,c,i:/ may or may
not (unpredictably, depending on the word involved)
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from palatalization, however, such as /ť,č,d,r,x,ř/ CC
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ing /i:/ with no resultant difference, and the third
/t'/, etc.) could only be followed by palatalizing
/i:/, since they arise only through palatalization.
This distribution confirms the fact that it is exactly non-palatalizing /i:/ (synchronously) which undergoes the change of /i:/ to [e] in CC.

The difference between palatalizing and non-palatalizing /i:/, /i/ is most naturally represented in terms of a feature which is involved anyway in palatalization. This is produced by /j/ and by /je/ (if this is the correct representation of palatalizing /e/); it is of course well known that high front vowels and glides produce palatalization in many languages. Non-palatalizing /i:/ and /i/, then, should differ from palatalizing /i:/ and /i/ in one of the features high and back, and since high is already necessary to distinguish /i:/, /i/ from /e:/, /e/, back seems most appropriate. We will represent non-palatalizing /i:/, /i/, then, as /i:/, /i/, and assume a rule which follows palatalization which merges /i:/, /i/ with /i:/, /i/. In that case, however, the CC vowel shift takes on a completely different character. Instead of the exchange process /e:/ \rightarrow /i:/, /i:/ \rightarrow /e:/, the vowel shift is now composed of the rules /e:/ \rightarrow /i:/, /i:/ \rightarrow /e:/ In CC, the rule /i:/ \rightarrow /i:/ is thus no longer needed, though the corresponding rule for short vowels is still necessary.

The analysis that we have just proposed posits an abstract segment /ɪ:/ (as well as its short counterpart, /ɪ/) which never appears as such on the surface. It is of course an example of absolute neutralization which would be prohibited by a constraint such as suggested by Kiparsky (1960). Numerous other papers have shown, however, that Kiparsky’s position can be maintained (cf., for example, Brame 1972, Vago 1970) and that absolute neutralization processes and abstract segments are sometimes necessary in phonological description. The alternative proposed by Kiparsky assumes the use of exception features, rather than phonological composition; but that alternative would be inappropriate here. Notice that we would have to mark all of palatalizing /i:/’s as exceptions to palatalization exactly the same set of /i:/’s as exceptions to the vowel shift. The fact that the same segments are involved in both cases would be unexpressed, and it seems better to attribute both facts (non-palatalization and failure to undergo vowel shift) to the same feature of the phonological composition. It is exactly in such cases where two or more kinds of exceptionality are different related that the mechanism of exception features is inappropriate and an abstract segment is indicated.

This re-analysis results in the elimination of the Czech vowel shift as support for the existence of exchange rules, since the two segments affected are not interchanged. /e:/ is raised to /i:/, but the
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phonological composition. It is exactly in such a case,
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This re-analysis results in the elimination of
Czech vowel shift as support for the existence of
exchange rules, since the two segments affected are
not interchanged. /e:/ is raised to /ɪ:/, but the
segment which is lowered to /e:/ is not /i:/ but /i:/.

We are, thus, left in approximately the same position as before with respect to the existence of exchange rules: the English vowel shift is the only substantial example known. If exchange rules are possible processes in natural languages, it is peculiar that more examples are not forthcoming. Since an alternative view of vowel shift is possible (indeed, several have been argued for in the literature), we might want to strengthen the claims made by phonological theory by prohibiting such rules altogether. Such a prohibition would be extremely easy to introduce, of course; all we have to do is remove the special exception to sequential ordering proposed by Chomsky for rules involving variables over feature values. If such rules apply sequentially, it will be impossible to formulate an exchange process, as we saw above. The prohibition against exchange rules, then, would follow not from any putative disruption that such a rule would produce in the linguistic system, but rather from the formal property of grammars that the rules of the phonology generally apply in a sequence.

When we look at a wider range of languages, however, we see that examples do appear in which a grammatical process interchanges two elements. One such is discussed in Chomsky and Halle (1968): in some forms of Arabic, there is an imperfect form of verbs which is formed from verbs whose stem vowel is /a/ by replacing this with /o/, but the stem vowel in the perfect is underlyingly /a/. Thus, /a/ and /o/ in the verbal category in question. It is doubt that this is, indeed, an exchange process we have considered prohibited.

Other exchange processes can be found in Nilotic languages of Africa. According to (1972), Luo has a process which exchanges voiceless stops in two categories: a marker /-t/ (realized as [e] or [E]) harmony which is disregarded here; and a particular affixative. Thus, according to the synonym 'mountain', we get gode 'mountains' and gede 'mountain', while corresponding to lwede 'hand', lwet 'hand-of'. The correspondences established are between /, g, t, k/ respectively, and include not only singular but also Swahili loanwords such as pl. kitope, and debe 'gallon tin'; related language Shilluk also displays a process in plural formation: cf. pair pl. lab; twye 'rifle', pl. twaj; re-
formed from verbs whose stem vowel in the perfect is /a/ by replacing this with /o/, but from verbs whose stem vowel in the perfect is underlying /o/ by replacing this with /a/. Thus, /a/ and /o/ are exchanged in the verbal category in question. There seems no doubt that this is, indeed, an exchange rule, and it is necessary to inquire about whether it has any other properties that might distinguish it from the sort of process we have considered prohibiting above.

Other exchange processes can be attested from the Nilotic languages of Africa. According to Gregersen (1977), Luo has a process which exchanges voiced and voiceless stops in two categories: before the plural marker /-E/ (realized as [e] or [ɛ], depending on harmony which is disregarded here); and in the "singular appertentive". Thus, corresponding to got 'mountain', we get gode 'mountains' and god 'mountain-of'; while corresponding to lwedo 'hand', we have lwete 'hands' and lwet 'hand-of'. The correspondences thus established are between p, t, c, k and s, ʃ, ɗ, y, ɬ, respectively, and include not only the native vocabulary but also Swahili loanwords such as kitābu 'book', pl. kitepe, and debe 'u-gallon tin can', pl. debe. The related language Shilluk also displays an exchange process in plural formation: cf. pairs such as lep 'tongue', pl. leb; tuye 'rifle', pl. tua; rejo 'fish', pl. rişi;
bak 'fence', pl. bag; jago 'chief', pl. jak. In several languages (including Luo, Alur, Adhola, and Anuak) this exchange of voicing is also paralleled in stems ending in a nasal. All of these languages show plural and appertentive forms with nasal plus homorganic stop (or perhaps prenasalized stops): thus, buoc 'wing', pl. bucombe, app. sg. buorh; toq 'spear', pl. togeb, app. sg. tosag, etc. In general, corresponding forms with final nasal-stop clusters remain unchanged: thus, Luo rombo 'sheep', pl. rombe. In the Pari dialect of Anuak, however, the process is apparently extended to roots in final nasal-stop, as well, so that in addition to the above, we have awendo 'guinea fowl', pl. aweiene; trembo 'blacksmith', pl. rembe. Thus, in addition to the exchange between voiced and voiceless obstruents, this dialect also shows an exchange between simple nasals and clusters (or between nasals and prenasalized stops).

A related Nilotic language, Dinka (described by Nobel, 1948) also displays an exchange rule, though of a completely different sort. Dinka uses a large number of processes to form noun plurals, including suffixation and suppletion, but most plurals are formed by alternations of the stem vowel. There is a substantial class of nouns with long stem vowels in the singular, which form their plurals by shortening this vowel. Thus,

we have pepi 'moon', pl. pe; nin 'hand', pl. nga; agok 'monkey', pl. agok. On the other hand, another class of nouns with short stem vowels have their plurals by lengthening the vowel: pl. paal; nin 'sleep', pl. niin; atuel 'atuel. In this language, then, there is involvement in plural formation which exists for both short and long vowels. The same rule is also in plural formation in the Yuman language (see Walker, 1970 for details).

A similar process can be attested in fact. Diminutives are formed from nouns by -ek, -ka, or -ko (perhaps preceded by -e- expressing endearment). Many masculines and with long vowels in the stem shorten this diminutive: thus, [du:m] 'house', din. [dom; e]; gate', dim. [brajka]; [mama] 'Mamma', -k, -ka. Other nouns with short stem vowels, however, these vowels in forming diminutives: [da:rek]; [list] 'leaf', dim. [lis:teki]; dim. [kni:ška]. While not all nouns behave there may be at least a semi-productive which interchanges long vowels and their parts in the formation of diminutives in

Given the set of exchange rules just would seem that the existence of such pro
we have pêi 'moon', pl. pêi; ñin 'hand', pl. ñin; agak 'monkey', pl. agak. On the other hand, there is another class of nouns with short stem vowel which form their plurals by lengthening the vowel: cf. pal 'knife', pl. paal; ñin 'sleep', pl. niin; atuel 'club', pl. atuel. In this language, then, there is a rule which is involved in plural formation which exchanges long and short vowels. The same rule is also attested for plural formation in the Yuman language Diegueno (cf. Walker, 1970 for details).

A similar process can be attested in Czech, in fact. Diminutives are formed from noun stems by adding -ek, -ka, or -ko (perhaps preceded by -ec or -in to express endearment). Many masculines and feminines with long vowels in the stem shorten this in the diminutive: thus, [dum] 'house', dim. [domek]; [brana] 'gate', dim. [branka]; [matma] 'Mamma', dim. [maminka]. Other nouns with short stem vowels, however, lengthen these vowels in forming diminutives: [dar] 'gift', dis. [da:rek]; [list] 'leaf', dis. [li:ste:k]; [kniha] 'book', dis. [kni:ška]. While not all nouns behave in this way, there may be at least a semi-productive exchange rule which interchanges long vowels and their short counterparts in the formation of diminutives in Czech.

Given the set of exchange rules just cited, it would seem that the existence of such processes is not
seriously in doubt. The fact that the LL-CC vowel shift in Czech did not turn out to have that form would appear to make it simply irrelevant: after all, most (if not all) rules are not exchange rules, so this result is unsurprising for any given rule. But if we consider the rules that have just been presented, we see that they have a common feature which is not shared by rules of the LL-CC vowel shift type (in Wolfe's formulation). All of these rules have the property that they apply in an environment whose specification is given in morphological terms, rather than in terms of the phonological properties of the string. In West Semitic verb ablaut, Luo and Pari Anuak plural and appertentive formation, Dinka and Diegueno plural formation, and Czech dinitive formation, the phonological properties of the environment of the affected segment are essentially irrelevant. In each case, the change is one which is associated with some specific grammatical category (or categories) for which no phonological characterization can be given. Such morphological rules (to use Bloomfield's term) specify the phonological realization of a grammatical category (which may, of course, involve other processes such as affixation, in addition), and do not specify modifications based on the phonological composition of the string. They have the form of ablaut processes, such as that of English ring/rang/rung, rather than of (e.g.) an allomorph-phonetic explanation, and typically relate to segments that are otherwise unnatural.

An ideal phonological theory, like an ideal syntactic theory, would be as highly structured as possible. An important aspect of structuring is the isolation of distinct types and the imposing on each such class of as many as possible a set of restrictions. Thus, for instance, the environment of a phonological process can extend over considerable parts of a form, it has been proposed (cf. Palacas, 1971) that a class of deletion rules can be isolated and constrained to which an element is assimilated (or adjacent to it (or at least is the closest to the relevant type). Another example concerning the principle of disjunctive ordering, discussed in (1967). Consideration of rules of types of those Chomsky originally discussed leads to an exclusion (cf. Anderson, 1973) that the don't principle is limited to the class of phonological rules specifying categorial (+/−) values of features that it does not extend to rules specifying
in doubt. The fact that the LL-CC vowel Czech did not turn out to have that form would make it simply irrelevant: after all, most 11) rules are not exchange rules, so this re- surprising for any given rule. But if we the rules that have just been presented, we they have a common feature which is not shared of the LL-CC vowel shift type (in Wolfe's n). All of these rules have the property apply in an environment whose specification in morphological terms, rather than in terms bological properties of the string. In West ablaut, Luo and Pari Anuak plural and formation, Dinka and Diegueno plural forma- zech diminutive formation, the phonological of the environment of the affected segment ally irrelevant. In each case, the change h is associated with some specific grammati- (or categories) for which no phonological tion can be given. Such morphological (E Bloomfield's term) specify the phonologi- of a grammatical category (which may, involve other processes such as affixation, and do not specify modifications based logical composition of the string. They have the form of ablaut processes, such as the relation of English ring/rang/rung, rather than of (e.g.) assimilations. Since they are not determined by phonological conditions, they are hardly (if at all) amenable to phonetic explanation, and typically relate classes of segments that are otherwise unnatural.

An ideal phonological theory, like an ideal syntactic theory, would be as highly structured and restricted as possible. An important aspect of such structuring is the isolation of distinct types of rules, and the imposing on each such class of as narrow as possible a set of restrictions. Thus, for instance, while the environment of a phonological process can in general extend over considerable parts of a form, it has been proposed (cf. Palacas, 1971) that a class of assimilation rules can be isolated and constrained so that the segment to which an element is assimilated is always adjacent to it (or at least is the closest segment of the relevant type). Another example concerns the principle of disjunctive ordering, discussed in Chomsky (1967). Consideration of rules of types other than those Chomsky originally discussed leads to the conclusion (cf. Anderson, 1973) that the domain of this principle is limited to the class of phonological rules specifying categorial (+/-) values of features, and that it does not extend to rules specifying numeric
(phonetic detail) values for features.

A number of recent writers have argued that more attention needs to be paid to the properties of morphological processes in language. It is probably fair to say that current practice is to relegate all of the processes traditionally treated as part of morphology either to phonology or to syntax (or perhaps to an as yet unformulated theory of 'lexical structure'). Yet there is no reason not to expect that a class of processes can be isolated, with structural changes similar to those of phonological rules (and thereby distinguished from the quasi-syntactic processes of prefixation, infixation, and suffixation) but with structural descriptions specified (primarily) in terms of morphological categories rather than phonological features. If such a class of processes is to be interestingly definable, it should be possible to discover formal properties and restrictions which are peculiar to it, and the above discussion of exchange rules suggests that this is indeed the case. We suggest, that is, that the class of segmental exchange rules is limited to the domain of morpholexical processes. Such a limitation can be achieved, as we noted above, simply by limiting the principle of simultaneous application of the subparts of a rule schema involving variables over feature coefficients to the class of morpholexical rules. In that case it will be impossible to account for the facts, since the lowering of [ow] in CC can clearly be treated as parallel to lowering of [i:] to [ej]. If there are no instances of 'expressive lengthening' of this case, her proposed rule of vowel shift can show such a correspondence. Thus, LL [u:] corresponds to CC [ouřat] 'office', and LL [e] corresponds to CC [ne-ouroda] 'bad harvest'. [muže] 'can (3sg.)' corresponds only to CC not to [nouže]. The reason for this is not to seek. LL, as well as CC, has the vowel segment [e] in LL, however, this is limited to non-initial positions.
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abled, as we noted above, simply ciple of simultaneous application rule schema involving variables ents to the class of morpho-logical rules. In that case it will be impossible to formulate a purely phonological exchange process.

With this proposal in mind, we can now return to the discussion of Czech, to take up the problem of the back vowels. WHO claims, as we noted, that the LL vowel [u:] corresponds to [ow] in CC, and that there are no instances of basic /o:/ in LL (apart from a small group of clearly exceptional loan words and a few instances of 'expressive lengthening' of [o]). In this case, her proposed rule of vowel shift would account for the facts, since the lowering of LL [u:] to [ow] in CC can clearly be treated as parallel to the lowering of [i:] to [e:]. If there are no /o:/'s, then the prediction that they would be raised to [u:] parallel to the raising of /e:/ to [i:] does no harm.

The first difficulty that we must note with this formulation is that not all LL [u:]'s correspond to '/ow' in CC: in fact, only those in absolute word initial position, or preceded immediately by a prefix, can show such a correspondence. Thus, LL [u:kat] corresponds to CC [ou:kat] 'office', and LL [ne=u:roda] corresponds to CC [ne=souroda] 'bad harvest', but LL [mu:ze] 'can (3sg.)' corresponds only to CC [mu:ze], not to [nou:ze]. The reason for this is not hard to seek. LL, as well as CC, has the vowel sequence [ou]. In LL, however, this is limited to non-initial position.
On morphological grounds, initial [u:] can be identified with non-initial [ou] in LL. We must now ask, however, what the underlying forms are for a) non-initial [u:], and b) initial [u:], identified with the element which appears as [ou] elsewhere.

An indication is given by the effect of various morpholexical rules in Czech which affect the length of vowels. We have already noted that diminutives of nouns with basic long vowel often show a short vowel, and vice versa. Other relations between corresponding long and short vowels include the following: a) a number of masculine nouns show long vowels in the nominative singular and short vowels elsewhere (e.g. [dum] 'house', [domu]); b) a number of feminines with long vowel show a short vowel in the genitive plural (e.g. [rouba] 'mushroom', g.pl. [hup]); c) many verbs show long vowels in the infinitive and short vowels in other forms (e.g. [ru:st] 'to grow', present [rostu]; d) derived verb forms often show shortening of the vowel in the stem from which they are derived (e.g. [vi-rostat] 'to grow up' from the stem of [rostu]); e) some collectives show shortening of the stem vowel (e.g. [dubi:] 'young oak grove' from [dup] 'oak'); f) adjectives with irregular comparative forms often have short vowels in the comparative when this is used adjectivally, and long vowels in the comparative when this is used adverbially (e.g. [dra:hi:] 'dear', [dra:zi:] 'dearest', [dra:je] 'more dearly'; [bli:ski:] 'near', [bli:je] 'neater', [bli:zi] 'more nearly'). These processes can be seen, involve both lengthening and shortening, and the vowels which are paired by them are ([u:] 'short' vowel given first): [a] with [a:]; [i:] with [i:]; (palatalizing) [e] with [i:]; (non-palatalizing) [e] with [e:]; [o] with [u:]; and [u] with [ou] initial or [u:] (initial). This suggests that the initial phonetic [u:] is in fact the long correspondent of [o] at some stage, and that the vowel which appears initially as [u:] and elsewhere as [ou] is the long correspondent of [u] at the same stage.

If this analysis is correct, it would seem we are right back where we started from. Though we have eliminated one proposed exchange rule in Czech (CC vowel shift proposed by Wolfe), we have arrived at a situation which seems to suggest another one; it comes from /u:/, and [u:] comes from /o:/, is the same as the rule that the necessary rules come:

a) interchanging /o:/ and /u:/; b) adding /w/ and then reducing /o:/ to /o/ and /w/ as a process of LL which is simply generalized
ounds, initial [u:] can be identified [ou] in LL. We must now ask, underlying forms are for a) non-initial [u:], identified with the as [ou] elsewhere.

given by the effect of various in Czech which affect the length already noted that diminutives of vowel often show a short vowel, relations between corresponding include the following: a) a
nes show long vowels in the non-short vowels elsewhere (e.g. [du:n]; b) many verbs show active and short vowels in other grow', present [rostu]; d) de-
show lengthening of the vowel in are derived (e.g. [vi=r-stat]
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the stem vowel (e.g. [ducubi:] dup] 'oak'); f) adjectives with forms often have short vowels in
is used adjectively, and active when this is used
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[e] with [e:]; [o] with [u:]; and [u] with [ou] (non-initial) or [u:] (initial). This suggests that (non-initial) phonetic [u:] is in fact the long correspondent of [o] at some stage, and that the vowel which appears initially as [u:] and elsewhere as [ou] is the long correspondent of [u] at the same stage.

If this analysis is correct, it would seem that we are right back where we started from. Though we eliminated one proposed exchange rule in Czech (the LL-CC vowel shift proposed by Wolfe), we have arrived at a situation which seems to suggest another one; if [ou] comes from /u:/, and [u:] comes from /o:/, is this not exactly like the vowel shifts Wolfe discusses? It might be proposed that the necessary rules consist of a) interchanging /o:/ and /u:/; b) adding /w/ after derived /o:/, and then c) shortening /o:/ to /o/ before /w/. These latter steps would be parallel to the derivation of [ej] from /i:/ in CC, and could be regarded as a process of LL which is simply generalized in CC.
Since the proposed exchange process is not a morpho-
lexical rule, we would be left with a counterexample to
our proposed constraint on exchange rules.

It has been suggested to us by M. Halle that addi-
tional support could be found for this proposed rule
exchanging back vowels. Let us reconsider the distinc-
tion between palatalizing and non-palatalizing front
vowels. Recall that we proposed above that non-pala-
talizing [i, i:] be represented as /i, i:/ . In the case
of the mid vowels, however, it was the palatalizing
vowel which was to be assigned a remote representa-
tion distinct (in some cases) from its surface shape; pala-
talizing [ɛ] was to be represented as /e/. Suppose,
however, that we treat the mid vowels in the same way
as the high vowels: palatalizing [ɛ] as front (written
/e/), and non-palatalizing [ɛ] as back (thus, assume
that /ɛ/ is a back vowel). There is good reason to
believe that this solution accords with the historical
facts (cf. Jakobson, 1979), and it need entail no com-
pliation of the grammar since the rule required to
derive the phonetic value of /ɛ/ is exactly the same as
that required to yield [i, i:] from /ɛ, ɛ:/ . The under-
lying vowel system of Czech (both CC and LL) would then
consist of the following, with each vowel appearing
both short and long:

Let us consider the consequences of this
first for CC. In this dialect, as we have seen,
the basic /o:/ is raised to [u:] and basic /ɛ:/ is
raised to /ɛ:/ (which is then fronted to [i:]). But
/i:/, rather than /i:/, that /ɛ:/ is raised to the
resultant vowel is still non-palatalizing
[di:1ka] 'length', not *[di:1ka], correspondingly
[de:1ka]). On the other hand, we could also say
that /u:/ and /ɛ:/ are lowered to /o:/ and
/ɛ:/, respectively, before being diphthongized to
/ɛo/ and /ɛe/. Thus we would have parallel rules of raising
applying to non-low long back vowels, and an exchange process even more extensive than
that at first.

The first difficulty of this analysis is
the CC vowel shift as simply an extension of back rounded vowels present also in LL;
there is no motivation for the use of [+back] vs.
-distinguish non-palatalizing and palatalizing
etically, both are clearly [-back], and the velar palatalization (distinct from the pal
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Let us consider the consequences of this analysis,
first for CC. In this dialect, as we have argued above,
basic /o:/ is raised to [u:] and basic /e:/ is raised
to /i:/ (which is then fronted to [i:]). It must be
/e:/, rather than /i:/, that /e:/ is raised to, because
the resultant vowel is still non-palatalizing (cf. CC
[di:1ka] 'length', not *[d'i:1ka], corresponding to LL
[de:1ka]). On the other hand, we could also propose
that /u:/ and /a:/ are lowered to /o:/ and /e:/, re-
spectively, before being diphthongized to [ou] and [ej].
Thus we would have parallel rules of raising and lower-
ing applying to non-low long back vowels, constituting
an exchange process even more extensive than appeared
at first.

The first difficulty of this analysis, which treats
the CC vowel shift as simply an extension of the switch
of back rounded vowels present also in LL, is that there
is no motivation for the use of [+back] vs. [-back] to
distinguish non-palatalizing and palatalizing [a]. Pho-
ettically, both are clearly [-back], and the rule of
velar palatalization (distinct from the palatalization
process discussed thus far) applies before some non-
palatalizing [e]'s (as well as before some [i]'s), as in [bo:e] 'Oh god!', vocative of [bu:h] 'god' from the
stem /boh/. This suggests that even non-palatalizing
[e] has been in some sense a front vowel for some time.
The feature distinguishing palatalizing from non-pala-
talizing [e] for Jakobson was not frontness but diph-
thongization, with palatalizing [e] long and short
represented as long and short /ie/. A representation
of palatalizing [e] as /je/ has the virtue that this
[j] actually appears on the surface (after labials and
initially), and would thus have to be inserted if it
were not present underlyingly. These arguments do not
apply to the distinction between palatalizing and non-
palatalizing [i], however, since [j] does not appear
before palatalizing [i]. Thus, independent of the
question of exchange rules, /e/ vs. /je/ and /i/ vs. /i/
seem the most natural representations for the non-pala-
talizing/palatalizing contrast in the two vowels. In
this case, however, the raising and lowering rules are
no longer parallel: raising applies to the front vowel
/e:/ and the back vowel /o:/, while lowering applies to
the back vowels /i:/ and /u:/, but must not be allowed
to affect the front vowel /i:/.

Thus, the raising and lowering processes have different conditions, and could
not be collapsed into a single schedule letter variables convention.

In fact, the same conclusion follows because lengthened palatalizing
on either analysis, is also raised to /e:/, as well as the back vowels /o:/
by the convention of variables over
analysis of CC. Lowering, however, affects long /o:/, raising it to /u:/.

Now consider the facts of LL.

rule still affects long palatalizing /e:/, and also
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long /o:/, raising it to /u:/.

The lowering rule in LL
front vowel /i:/ nor the back vowel
back rounded vowel /u:/, and then on
non-initial position. Here too, the
processes on raising and lowering are quite different and cannot be combined into a single set of variables over feature values.
not be collapsed into a single schema by the Greek-letter variables convention.

In fact, the same conclusion follows even if it is assumed that non-palatalizing [e] is [+back]. This is because lengthened palatalizing [e], which is [-back] on either analysis, is also raised to [i]: cf. [vi:ra] 'faith', gen.pl. [vjer]; [pospi:bit'1] 'hurry', imper. [pospje3]. Raising thus applies to the front vowel /e:/, as well as the back vowels /o:/ and /e:/ on this analysis of CC. Lowering, however, applies only to the back vowels /u:/ and /i:/, and not to the front vowel /i:/.

The conditions on the two rules are thus different, and they cannot be combined into a single schema by the convention of variables over feature values.

Now consider the facts of LL. Here the raising rule still affects long palatalizing /e:/ (based on the same forms as cited above for CC), and it also affects long /o:/, raising it to [u]. It does not, however, affect long non-palatalizing /e:/, and this becomes simply [e:]. The lowering rule in LL affects neither the front vowel /i:/ nor the back vowel /u:/, but only the back rounded vowel /u:/, and then only when /u:/ is in non-initial position. Here too, then, the conditions on raising and lowering are quite distinct, and they cannot be combined into a single schema by the convention of variables over feature values.
Both LL and CC, then, have rules of raising and of lowering, but in neither case can the rules be combined by the convention which Chomsky suggested defined the class of rules which are applied simultaneously. The problem he originally noted, however, seems to arise on either analysis. Both LL and CC have a rule which, among other things, raises /o/ to [u:]. If they also have a rule which lowers /u:/ to /o:/, then whichever order the two are applied in, the distinction between underlying /u:/ and /o:/ will be neutralized. We would have a set of processes which properly include an exchange, but which are not abbreviable by the appropriate convention even if simultaneous ordering is allowed for the class of cases described by Chomsky.

The key to this dilemma lies in the phonetic value of the diphthong ou. Wolfe transcribes this as [cw]; that is, as a sequence of vowel plus glide consonant, and it is this representation that makes the derivation /u:/ > /o:/ > /o:w/ > [cw] plausible. In fact, however, the diphthong ou is unlike the sequences of vowel plus (tauto-syllabic) glide that appear elsewhere in the language ([uj, ej, oj, aj, i:j, a:j, u:j]). Phonetically, the element [i] in these sequences is definitely short and non-syllabic, and the sequence is phonetically and distributionally parallel to other vowel plus consonant sequences. The diphthong ou, however, "is pronounced like ow in English row, probably. This diphthong is much prolonged, the longest Czech vowel sound. It begins with Czech a sound which gradually blends with, and ends with a clear Czech u sound;" (Harkin.) This is not a sequence [ow] of vowel plus glide, but rather a sequence [ou] of two vowel sounds, definitely a unit, however: Czech does not sequences, and generally breaks up those over boundaries by the insertion of glottal. The ou sequence is structurally a single unit, with the phonetic long vowels, as has been by Mathesius (1929) and Jakobson (1968). As suggested above, its underlying source is

As is well known, long vowels in many languages are best treated as (tautosyllabic) sequences of short vowel elements (called moras). There do not appear to be any other properties that are consistently associated with this bimoraic element, it is probably the case that long vowels are always at least potentially ambiguous between units and sequences. In these terms, the elements /o:/ and /u:/ in Czech are also cylindrical as /oo/ and /uu/; and it is clear from the facts that the rule applying to non-initial ou give ou simply alters the quality of the f
pronounced like /u/ in English now, prolonged considerably. This diphthong is much prolonged, and is the longest Czech vowel sound. It begins with a clear Czech a sound which gradually blends with Czech u, and ends with a clear Czech u sound;" (Karksins, 1953:9).

This is not a sequence [ow] of vowel plus consonant, but rather a sequence [ou] of two vowel sounds. It is definitely a unit, however: Czech does not allow vowel sequences, and generally breaks up those that arise over boundaries by the insertion of glottal stop. The ou sequence is structurally a single unit, on a par with the phonetic long vowels, as has been emphasized by Mathesius (1929) and Jakobson (1968). As we have suggested above, its underlying source is /u/.

As is well known, long vowels in many languages are best treated as (tautosyllabic) sequences of identical short vowel elements (called moras). Since there do not appear to be any other properties that are consistently associated with this bimoric treatment, it is probably the case that long vowels are always at least potentially ambiguous between single units and sequences.12 In these terms, the underlying elements /o:/ and /u:/ in Czech are also analyzable as /oo/ and /uu/; and it is clear from the phonetic facts that the rule applying to non-initial /uu/ to give ou simply alters the quality of the first element.

But, however, seems to arise when LL and CC have a rule which raises /o/ to [u:]. If they also raise /u/ to /o:/, then whenever this lies in, the distinction between /o:/ will be neutralized. We would be not abbreviable by the approach if simultaneous ordering is available, as described by Chomsky. The dilemma lies in the phonetic value tables, as transcribed by Wolfe as [ow]; of vowel plus glide consonant, notation that makes the derivation [ow] plausible. In fact, how-
of the sequence. The sequence /oo/, on the other hand, is converted to [uu], a change which can be described in terms of either the single-segment or the sequence analysis of long vowels. Given the fact that any non-initial vowel in Czech will be preceded by a non-syllabic element, these changes could be formulated as (1):

(1) a. [+syll] \[+\text{round}\] \rightarrow [+\text{high}]/[+\text{syll}] \[+\text{round}\] [+\text{high}]

b. [+syll] \[+\text{round}\] \rightarrow [+\text{high}] /[-\text{syll}]\[+\text{high}\]

c. [+\text{syll}] \[+\text{round}\] [+\text{high}] /[-\text{syll}]\[+\text{high}\]

Rule (1a) converts non-initial /uu/ to /ou/, as required; rule (1b) converts /oo/ to /uo/, which is then converted to /uu/ by (1c). The splitting of the raising of /oo/ into the two rules (1b) and (1c) may appear peculiar, but it is in accord with the historical facts, since Modern Czech [u:] from /o:/ was phonetically [ue] until about the 16th century. Evidence for the separation of (1b) and (1c) synchronically comes from the fact that (1c) can be generalized naturally to account for the raising of long palatalizing [e] to [i:]. If we assume that the lengthening and shortening rules give representations in which long palatalizing [e] is represented as /ie/, while short palatalizing [e] is represented as /je/, then (1c) need only be replaced by (2) to raise /ie/ to /ii/ as well as /uo/ to /uu/.

(2) [+syll] \[+\text{high}\]/

The raising and lowering processes are represented by the rules (1a), (1b), and (1c) above.

According to Jakobson, the LL ones in part in that non-joined palatalizing long [e:] is diphthongized to /ie/, and the rule (2). This diphthongization of /oo/ to /uo/ by rule (2) should replace (1b) by (3):

(3) [+syll] \[-\text{low}\]/ [+\text{high}]/

The other difference between CC (domain) is that in CC /i:/ becomes front, accomplished in the following way: rule to front /i/, /i/ to /i/, i.e., as (4) below:

(4) [+\text{round}] \[-\text{low}\]/ [+\text{back}] /

Rule (4) applies in both LL and LL, where to diphthongize /i:/ by lowering this sequence would then be considered /ei/. The required diphthongization is a generalization of (1a), which
The raising and lowering processes in LL, then, can be represented by the rules (1a), (1b), and (2).

According to Jakobson, the CC dialects differ from the LL ones in part in that non-palatalizing long \( [e] \) joined palatalizing long \( [e] \) in undergoing raising. This would result if underlying /ee/ were to undergo diphthongization to /ie/, and then subsequently undergo rule (2). This diphthongization of /ee/ to /ie/ is, of course, an extension of the already necessary diphthongization of /oo/ to /ou/ by (1b). In CC, then, we should replace (1b) by (3):

\[
(3) \left[ +\text{syl} \right] \rightarrow \left[ +\text{high} \right] \left[ +\text{syl} \right] \left[ -\text{high} \right]
\]

The other difference between CC and LL (in the relevant domain) is that in CC /ii/ becomes \([e]\). This could be accomplished in the following way: we already need a rule to front /i, ii/ to /i, ii/, which we could write as (4) below:

\[
(4) \left[ +\text{round} \right] \rightarrow \left[ +\text{back} \right]
\]

Rule (4) applies in both LL and CC. Accordingly, if we were to diphthongize /ii/ by lowering its first element, this sequence would then be converted by rule (4) to /ei/. The required diphthongization of /ii/ is simply a generalization of (1a), which diphthongized /uu/ to
[ou], and we should accordingly replace (1a) by rule (5) below for CC:

\[(5) \begin{array}{c}
+\text{syl}\ll \to [-\text{high}] / \\
+\text{back} \to [\text{high}]
\end{array}\]

The sequence /ei/ will then be converted to [ej] by an independently necessary rule which desyllabifies /i/ after an unlike vowel. Thus, the vowel quality rules for CC are (5), (3), and (2), and the differences between LL and CC consist in the generalization of two LL rules ((1a) and (1b)) in CC.

The important aspect of the above analysis for our purposes is that there is no longer an exchange process in either dialect. Though (1a) and (1b), or (5) and (3), perform a lowering of high vowel moras and a raising of mid vowel moras, the rules involved are dissimilation processes, and the environment in which raising takes place is distinct from that for lowering. The problem raised by Chomsky does not therefore arise in this case, and a sequential ordering of the rules is perfectly possible.

The essential basis of the analysis given here is that we assume diphthongization and raising/lowering to be inextricably connected. The long vowel /oː/, for example, does not change directly to [uː], but is rather raised first in its first mora. A precedent for such a diphthongization process is not hard to find; consider, for example, the well known rule underlying /ee/, /oo/, and /ü/, /ü/, respectively. That diphthong shift are connected in this way following fact: there are words like [boːr] 'boron' which do not undergo diphthongization in CC, however, any form like LL [sis:əd] is [seːsa], with vowel shift or diphthongization in CC. If the raising process is regarded as applying to long vowels, there is no reason why it should be followed by a diphthongization of the diphthong. Thus, there is no reason why the exception to just one of these analyses given here, however, there is no way for /æː/ to become /eːsə/ with 'vowel shift or diphthongization'), since the only way to this form is the diphthongization from /uː/, not from LL. The analysis given here explains the pattern therefore. A form in LL can be exchange
ld accordingly replace (la) by rule (5)

\[ \text{[high]} \]

\[ \text{[back]} \]

will then be converted to [ej] by an auxiliary rule which desyllabifies /i/.

Thus, the vowel quality rules (1) and (2), and the differences between the generalization of two (1b) in CC.

aspect of the above analysis for our discussion is no longer an exchange process. Though (la) and (1b), or (5) and (6), do not differ in the number or order of high vowel moras and a low vowel mora, the rules involved are distinct from one another. Chomsky does not therefore arise sequential ordering of the rules is a basis of the analysis given here is diphthongization and raising/lowering processes. The long vowel /oi/, for example, is diphthongized directly to [u:], but is rather a two-mora unit. A precedent for such a rule is not hard to find; consider,

for example, the well-known rule in Finnish by which underlying /ee/, /oo/, and /uu/ become /ie/, /uo/, and /uu/, respectively. That diphthongization and vowel shift are connected in this way is supported by the following fact: there are words like [se:sa] 'scene', and [bo:ro] 'boron' which do not undergo either vowel shift or diphthongization in CC (or LL). There is no exception to this rule, however, any form like LL [si:sa] whose CC correspondent is [se:sa] with vowel shift but not diphthongization, or a form /so:sa/ which (in either dialect) could fail to change to [su:sa] but could undergo diphthongization to [sou:sa]. If the raising and lowering rules are regarded as applying to long vowels as units, followed by a diphthongization of the remaining long mid vowels, there is no reason why a form could not be an exception to just one of these processes. On the analysis given here, however, there is no way for /si:sa/ to become /se:sa/ (with 'vowel shift' but not 'diphthongization'), since the only rule which could apply to this form is the diphthongization rule (5). Similarly, there is no way for /so:sa/ to diphthongize to /sou:sa/: the only possible source for [ou] is by diphthongization from /uu/, not from /oo/. The analysis given here explains the pattern of exceptions, therefore. A form in LL can be exceptional with respect to
(1b), and thus not undergo vowel shift (these are the foreign loans with long \[o:]\), universally considered exceptional, but there are apparently no exceptions to (1a) or to (2). In CC, a form can be exceptional with respect to (3), and thus preserve \[e:]\) or \[o:]\). There may also be some exceptions to (5), which would preserve long \[i:]\) from /\[i]/ rather than giving \[ej\) (though here it is difficult to tell whether we are dealing with exceptions to a CC rule, or rather with LL forms in a sentence which also contains CC forms, a sort of mixture mentioned above). Again, there are no exceptions to (2). The important point is that a form is exceptional, if at all, with respect to exactly one rule, and there are no exception features linked in a 'both or none' relationship, as would be required by the alternative analysis.

Apparently, therefore, the facts concerning the long back vowels in Czech do not provide motivation for an exchange rule after all. In fact, all putative examples of segmental exchange rules (leaving the English vowel shift out of account) turn out either to involve morpholexical processes or to be based on faulty or incomplete analyses. This fact suggests that we should impose the restriction on such processes that was suggested above: namely, limiting them to the domain of morpholexical rules.

Footnotes

1. The relation between the language and the modern spoken dialect is a topic of much discussion in the (1953) provides an account of which is in some respects more discussion with considerably more matters, cf. Havránek (1979).

2. Not quite all LL \[e:]\)'s are CC. For example, [vn:no] (hypo-

3. Variant of usual form with

4. The unpalatalized/palatized/ to are \(t'/t\), \(d'/d\), \(n/f\), \(k/c\), \(h/\)

5. There are a few instances which must not be reduced allo-

6. For the vowel quality and see the discussion below.
undergo vowel shift (these are the long [oː], universally considered exceptions to (5), which would m /iː/ rather than giving [eː].

The important point is that at all, with respect to there are no exception features relationship, as would be live analysis.

e, the facts concerning the do not provide motivation for all. In fact, all putative change rules (leaving the Eng- count) turn out either to be based on cases or to be based on uses. This fact suggests that fiction on such processes that y, limiting them to the

domain of morpholexical rules. This in turn suggests that we should prefer an account of the English vowel shift which does not violate this restriction by containing a phonological exchange rule.

Footnotes

1. This work was supported in part (Anderson) by a postdoctoral fellowship from the American Council of Learned Societies, and in part (Browne) not. We are grateful to Morris Halle, who does not agree with us, for his comments on an earlier version.

2. Not quite all LL [eː]'s are raised to [iː] in CC. For example, [ve:nol] (hypocorist of [vaːclav] 'Wenceslaus') has [eː] in both LL and CC.

3. Variant of usual form with [-l:mi] used when modifying certain words (e.g., [hluxi:ma ušíma] 'with deaf ears.'

4. The unpalatalized/palatalized pairs referred to are t/t', d/d', n/n, k/c, h/z, x/s, r/ř. The glide j appears before palatalizing e after the labials p, b, f, and v.

5. There are a few instances of the sequence [je] which must not be reduced although they follow a non-labial consonant. It is not clear whether these forms show that the representation /je/ is untenable for palatalizing e, or whether the j-deletion rule must be restricted.

6. For the vowel quality alternation in this pair, see the discussion below.
7. The productivity of this process is sufficiently limited to raise questions about its operation in the form suggested here. In a sample of dictionaries and native speaker interviews, no masculine or neuter forms were found which shorten the vowel in forming. In these forms, long vowels stay long, while short vowels lengthen in the great majority of cases. The feminines are more interesting from our point of view. Of these, the results were as follows:

- Long stem, short diminutive: 19 (+3 questionable or doubles)
- Long stem, long diminutive: 39 (+7)
- Short stem, short diminutive: 42 (+11)
- Short stem, long diminutive: 8 (+3)

Thus, of the long stems less than a third alternate, while about one sixth of the short stems do. It should also be noted that, while the old Slavic vocabulary is distributed among all four classes, recently acquired words like škola, scena are exclusively in the non-alternating class. The status of this regularity is thus problematic.

8. Wang (1967) has claimed that exchange rules are extremely common in tone sandhi rules in Chinese languages. He does not present much of the data on which his conclusion is based, and his sources are not generally accessible to us. Accepting his analyses, however, we restrict our claim here to the domain of processes affecting segmental features (however these are to be delimited). Since it is clear that tone sandhi rules have formal properties that are in many ways distinct from those of other phonological processes, this limitation does not affect the substance of our claim.

9. It is interesting to note that, in the case of the one other example which has been argued to support an exchange rule in the literature (Bever's (1967) descent), a recent paper by Goddard (1972) shows that the phenomenon in question is in fact morpho-lexical rather than phonological. Goddard's conclusion is entirely independent of ours, but supports the proposal made here.

10. We refer here to the diphthong written ou in Czech orthography, and ow by Wolfe (1970). The phonetic character of this diphthong will be discussed immediately below.

11. Initial cu in CC is being lost in language word by word. Ouruoda for LL (u:ra) is current, but ourat for LL (u:rat) is still marked, and ne-ouruoda is impossible for all speakers.

12. Within generative phonology, see the discussion of Kenstowicz (1970). In Bave's (1973) it is argued that the "schizophrenia" of long vowels may be so extensive that the rules may refer to them in one part of its SD and not in another part as sequences.

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MIT RLE.

11. Initial cu in CC is being lost in the modern language word by word. Guroda for LL [u'uroda] is still current, but curat for LL [u'urat] is stylistically marked, and ne-curora is impossible for at least some speakers.

12. Within generative phonology, see for example the discussion of Kenstowicz (1970). In Anderson (1973) it is argued that the "schizophrenic" character of long vowels may be so extensive that the same rule may refer to them in one part of its SD as units, and in another part as sequences.

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