Discussions of linguistic structure generally accept a distinction between rules of sentence structure and rules of sound structure, but there is very little agreement on further subcategorization beyond this general dichotomy. Indeed, recent discussion in the area of syntax and semantics has been dominated, at least superficially, by the question of whether it is possible and/or desirable to distinguish within the rules of sentence structure between syntactic rules and semantic rules, and perhaps to impose further subcategorizations on each of these; see, for example, the contributions by Chomsky and Postal to Peters (1972). Within syntax and semantics, however, there is probably much less disagreement than meets the eye: most would agree that a desirable goal for linguistics is to isolate and distinguish as many types of rule as possible, and to associate each type with a set of maximally restrictive formal and substantive constraints.\(^1\)

Although much less attention has been concentrated on this issue in phonology in recent years, the tradition of structuralist or autonomous phonemics took fairly explicit positions on a number of issues concerning the possibility of subdividing the study of sound structure. Figure [1] is a composite representation of the internal organization of that part of a structuralist grammar which deals with phenomena below the level of word structure:

Thus, on this view, the conversion of a morphemic representation into sound involves two distinct intermediate levels: a level of morphophonemic representation (for those who believed in the utility of morphophonemics), and a (taxonomic or autonomous) phonemic representation. Each is defined by the set of rules which relate it to those on either side.

Since Halle’s celebrated argument against the phoneme was first presented in the late 1950s, generative phonologists have generally felt that they had freed themselves from the strictures imposed by the positing of such intermediate levels. Halle demonstrated, that is, that a representation with the characteristics of the autonomous phonemic level could not be maintained as a condition of adequacy for grammars, since this would lead to a loss of generalization in the description of sound structure. The same rule would sometimes have to be

\[1\] A preliminary version of portions of this paper was read at the Natural Phonology parasession accompanying the tenth annual meeting of the Chicago Linguistic Society on 18 April 1974, and will appear in the proceedings of that meeting.
stated separately at two distinct places in the grammar, a complication entailed only by the particular requirements of the posited intermediate representation. Most right-thinking phonologists since that time, then, have taken the position that there is no reason to expect that any specific intermediate level of representation between that of the surface structure given by the syntax and the most concrete phonetic form will satisfy any particular set of constraints universally.

In fact, however, generative phonologists have gradually re-established most of the important features of the structuralist model in [1]. In The sound pattern of English, for example, the ‘syntactically motivated’ surface structure is assumed to be converted first into a ‘phonologically motivated’ surface structure by the operation of a set of ‘readjustment rules’. This phonologically motivated structure is given in terms of systematic phonemes, and is operated on by the phonological rules proper. Of these, it is generally assumed that the ones whose environments include essential reference to purely morphological categories, or to the identity of specific morphemes in the string, apply first; they are followed by the rules which are statable purely in terms of the phonological constituency of the string. The result of this operation is a representation (still specified in terms of strictly binary features) in which most variation of potentially distinctive parameters is completely determined. These binary values are then converted into more specific numeric values, perhaps along a quasi-continuous scale, yielding the maximally specific level of systematic phonetics, whose elements are directly relatable to articulations.

Such a rigid internal organization, beyond the division between re-adjustment rules and phonological rules proper, is not explicitly argued for (or accepted) by Chomsky and Halle. In innumerable places in the literature of the field, however, it has been taken for granted, and at least in the theory of ‘Natural
INTERACTION OF PHONOLOGICAL RULES OF VARIOUS TYPES

In generative grammar (discussed in a number of works by Vennemann) it has been elevated to the status of a fundamental theoretical postulate. Vennemann hopes to be able to eliminate all explicit ordering statements from the grammars of particular languages, and to replace them with a set of principles which would predict rule interactions in all cases where this is significant.\(^2\) One of the principles by which Vennemann intends to predict orderings is the claim that any morphological rule must precede any phonological rule (actually, Vennemann distinguishes two types within the domain of what we will call phonological rules); and any phonological rule must precede any phonetic (i.e., 'subphonemic' or 'detail') rule.

The view that the rules of the phonology can be divided into such types has a certain amount of support. It can be shown that the various principles and constraints that have been proposed to govern the form, application, and interaction of phonological rules are often sensitive to just these differences, so that they may be limited to rules of one or two types to the exclusion of others. A great deal of discussion in Chomsky and Halle (1968), for instance, is devoted to a principle of disjunctive ordering which governs rule interactions. This principle was later modified (along lines originally due to Pāṇini) by Anderson (1969, 1974b), and the modified version further argued for by Kiparsky (1973); an essentially similar constraint is proposed by Koutsoudas, Sanders and Noll (1974) under the name of 'proper inclusion precedence'. In fact, as shown by Anderson (1969, 1974b), there is reason to believe that this principle is limited in its applicability to phonological rules proper, and that phonetic detail rules which formally would fall under it are not in fact subject to it.

A further example is the problem of 'exchange' rules. There has been a certain amount of debate in the literature on the question of whether rules of this type should be permitted by phonological theory. In fact, it appears that a number of rules of this type can be attested from natural languages, but that they all have the property that they apply in morphologically, rather than phonologically defined environments. This suggests that the principle of simultaneous application of rules abbreviated by Greek-letter variables, suggested in Chomsky and Halle (1968), should be restricted to the domain of morphological rules. This would have the desirable effect of predicting that exchange rules could never take a purely phonological form. Since no well-supported examples of phonological exchange rules appear to exist, such a prediction would seem to be reasonable. For some discussion of these issues, and of specific examples, see Anderson & Browne (1973).

There are other constraints that may be related to these same divisions,\(^[2]\) This is of course also the aim of several other phonologists, such as Koutsoudas, Sanders & Noll (1974), who present a somewhat different approach. For arguments suggesting that such elimination of 'extrinsic' ordering is impossible within the general sort of programme suggested by Koutsoudas, Sanders & Noll, see Anderson (1974b).
though they are not as well established at present. An example is the possibility that rules may be blocked from applying entirely within the domain of a single morphological or lexical element if (a) the conditions for the rule's application are satisfied in the underlying form; and (b) such application does not lead (potentially at least) to an alternation. This condition on rule application can in fact be seen as analogous to Kiparsky's constraint (1968) on absolute neutralization. The original condition prohibits context free rules which have the effect of preventing an underlying distinction from ever showing up in surface forms; the proposed addition would prohibit context-sensitive rules from applying so as to merge absolutely two possible lexical representations. This possibility, or something like it, is discussed by Kiparsky (1974), though the exact form of such a constraint is not yet clear. Further discussion of this principle will be found below; for our purposes it is important to note that it must be limited in application so that it does not prevent the imposition of phonetic detail on non-alternating morphemes. It thus appears that its relevance is limited to the domain of phonological rules, excluding phonetic (and perhaps morphological) rules.

Further possibilities include various proposals for constraining the effects of rules which operate at a distance. There is no doubt that morphologically conditioned rules can affect segments much 'farther' from a conditioning environment than phonological rules can; it is probably possible to impose some sort of constraint, therefore, to the effect that PHONOLOGICAL rules can only affect the 'nearest relevant segment'. Such a constraint is obviously related to the extent to which phonological rules can be taken to have phonetic motivation. It presumably extends with even greater rigidity to the domain of phonetic rules, though there is no obvious reason to expect morphological rules, for which phonetic motivation is generally lacking, to be subject to it. Efforts to define such a constraint include Palacas (1971), Howard (1972), and Jensen & Stong-Jensen (1973). Yet another possible constraint lies in the domain of syllable counting rules, discussed by Hankamer (1973). Such rules affect forms in different ways depending on the number of syllables they contain; from present evidence, it appears that only morphological rules can have this property, and that other rules which appear to be sensitive to length in this way are actually dependent on some other parameter, such as the presence of stress.

All of these constraints seem to be sensitive to roughly the same division of rules into types. While there are obviously many issues of detail to be clarified before the dividing lines can be firmly established, we take the following as provisional designations of the classes involved: MORPHOLEXICAL rules are those whose environments involve essential reference to the identity of specific morphemes, lexical items, or classes of morphemes (e.g., 'in plurals', 'before lsg pres. indic.', 'after {OX}', 'before an Aspect Marker', etc.); PHONOLOGICAL rules are those whose environments involve reference only to the phonological
composition of elements of the string, to boundary elements, and perhaps to major lexical class (e.g., ‘before coronals,’ ‘at morpheme boundary’, ‘in Nouns’, etc.), and which furthermore operate so as to alter the categorical (+/-) value of some feature which is distinctively specified in underlying forms of the language; while phonetic rules are those whose environments involve reference only to the phonological/phonetic makeup of segments in the string, together with the location of major (i.e., word or phonetic phrase) boundaries; and which specify non-categorial (numeric) values or non-distinctive features.

From the fact that rules can be divided into such classes, with each class subject to a distinct set of constraints on formal properties and operation, one might well conclude that the rules of the phonology ought to be arranged into a set of components, with the components themselves arranged in a sequence. It is certainly the case that, ceteris paribus, a morpholexical rule will generally precede a phonological one, and a phonological rule will precede a phonetic one. Separating the rules into components in the fashion just suggested, then, elevates this observation to the status of a formal claim about the structure of grammars. Notice now that the points of interface between components on such a view define intermediate representations between the most abstract and the most concrete in much the same way the intermediate levels described above in the theory of autonomous phonemics were defined. From the fact that such a relative ordering of rules obtains generally, however, it does not by any means follow that an organization of the grammar along the above lines will always be possible. This is, in fact, a rather strong empirical claim about the interaction of phonological rules. It is the intention of this paper to present a set of examples which appear to falsify this claim, explicit in a view like that of Vennemann and implicit in the work of many others. Despite the fact that it would obviously be a result of considerable interest if such a claim could be upheld, it appears that in fact the rules of the phonology which fall into the three types just described, with their distinct formal properties, are inextricably intertwined in the operation of actual grammars of natural languages.

The area of reduplication provides a number of examples in a variety of languages of the interaction of a morpholexical rule with the remainder of the phonology. Reduplication itself, though it appears in a variety of forms in different

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[3] The interaction of reduplication with other phonological rules is studied for a number of cases in a variety of languages (including Tagalog and Luiseño, discussed below) by Wilbur (1973), though this work was not available to me until after the bulk of the present paper had been completed. Wilbur concludes that global rules are required to handle these cases, and that rule ordering is not adequate. This conclusion is based on the fact that (a) for rule ordering to provide an account of these cases, it is necessary to allow phonological rules to precede a morphological rule (reduplication); and (b) the rules required for Luiseño cannot be linearly ordered. The first of these objections is of course the object of the present paper; the second is dealt with explicitly below. We conclude, therefore, that the examples adduced by Wilbur can in general be dealt
ent languages, has a particularly clear status with respect to the typological division among rules proposed above. So far as is known, there is no language in which reduplication applies in an exclusively phonologically defined environment: no language, that is, has a rule of the form ‘reduplicate the initial CV of monosyllables,’ ‘reduplicate the first two syllables of any form beginning with a velar,’ etc. Rather, reduplication serves to form new morphological categories, either by itself or in the company of other affixes, vowel changes, etc. In many languages, reduplication is employed to form plurals, distributives, iteratives, intensives, etc., where it has a vaguely iconic function. In other cases (e.g., in Sanskrit) the function of reduplication is more purely formal, yielding perfects or other stem categories. In every instance, however, the environment for reduplication is exclusively (or primarily) a set of morphological categories and/or specific lexical items, and hence the rule is unambiguously a morpholexical one in terms of the distinctions made above.

An example of the interaction of reduplication with other processes is provided by a number of the languages of the Indonesian group. Most of these languages have a rule which incorporates a morpheme-final velar nasal into a following root, merging it with an initial consonant into a nasal homorganic with the original consonant. This process is often subject to further conditions: for example, in Javanese, the nasal is not incorporated into vowel-initial roots; in Sundanese it only applies to a morpheme which consists exactly of a velar nasal and nothing else; in many languages it is only applicable before voiceless initial consonants; in Malay and other languages the result of velar nasal plus /s/ is a palatal, rather than a dental nasal, reflecting the origin of Malay /s/ as proto-Austronesian *ty, etc. Nonetheless, in a large number of languages, the process is quite general and applies in all environments that satisfy a purely phonological condition.

Bloomfield (1933) was one of the first to note the interest of the interaction of this process with reduplication. In his study of Tagalog, he had observed that several prefixes show a final velar nasal before roots beginning with a vowel or liquid; these prefixes, however, show coalescence of the nasal with a following root-initial voiceless (or sometimes voiced) obstruent. Thus, there is a prefix /pang/ which (among other things) forms nominals; when combined with /atip/ this yields pangatip ‘roofing material’, but if combined with /putul/, the result is not *pangputul, but pamutul ‘that used for cutting’. Tagalog also has a rule of reduplication, used to form intensives among other categories. Thus, from the same root /putul/, reduplication of the initial CV of the root yields with in terms of ordering relations. Two possible exceptions to this claim are examples from Serrano and from Chukchee; both of these are based on inadequate descriptive material (one form in each case), and their status is far from clear. In general, the area of reduplication appears to furnish evidence for our thesis rather than for the (otherwise unnecessary) existence of global rules.
**puputul** 'to cut repeatedly'. Now it is possible to form a nominal with the prefix /pang/ from this intensive, but the result is not *pamuputul*, as might be expected, but *pamumutul* 'a cutting in quantity'. Note that this is just what we would expect if the reduplication of the root-initial CV does not take place until after the prefix-final nasal has coalesced with the root initial. This implies, therefore, that the phonological rule of nasal cluster coalescence must precede the morpholexical rule of reduplication. The same fact can also be attested from Cebuano, a related language (cf. Bunye & Yap, 1971). In Cebuano, among the nasal final prefixes is /mang/ which, together with reduplication, yields occupation nouns. From roots such as /dagat/ 'fish', /sulat/ 'write', etc., we can form *mananagat* 'fisherman', *manunulat* 'writer', etc. In Cebuano, therefore, it is also necessary for nasal-cluster-coalescence to precede reduplication, and again this is an instance of a phonological process preceding a morpholexical one. It is interesting to note, by the way, that in other Indonesian languages the same rules interact in the opposite way, so that the form corresponding to Tagalog *pamumutul* would be *pamuputul*.

A somewhat more complex example of the interaction of reduplication processes with the rest of the phonology is furnished by Luiseno (cf. Munro & Benson, 1973). Luiseno has a general rule by which the affricate /č/ is replaced by the spirant /ʃ/ in final position or before a stop:

\[2\]  \(\text{č} \rightarrow \text{ʃ} / -\text{cont}\) 

This rule is responsible for such alternations as [qe:niš] [qe:ničum] 'squirrel/squirrels', [ki:ča]/[kiš] 'house (nom)/house (acc)', [čapomkat]/[čašpunkatum] 'liar/liars', [ne:ču]/[ne:šmal] 'become an old woman/old woman', and many others. With the single exception of the forms to be discussed below, this rule is completely mechanical, and applies wherever its phonologically stated environment is satisfied.

In the last two pairs of forms just cited, we see (in addition to rule 2) the operation of a rule of vowel syncope. This rule deletes a vowel which is followed by a single consonant plus vowel, and preceded by a single consonant which is itself preceded by a stressed vowel (which must itself be short if the form is a verb, though we will ignore that restriction below). Such a rule can be given as [3]:

\[3\]  \(V \rightarrow \text{Ø/\text{Ʉ} C} \rightarrow \text{CV}\) 

It is apparent from the forms just cited that the spirantization rule (2) follows the syncope rule (3): thus, from /čikwi (:la)-/ 'to be sad', it is possible to form an intensive by reduplication. This is underlyingly /čikwi + čikwi—/ 'to suffer'; stress is assigned to the second vowel of this form (by rules not detailed here, but discussed by Munro and Benson). This renders the third vowel subject to

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syncope by rule 3, which yields /čikwí + čkwi/; this in turn undergoes rule 2 to give the surface form [čikwísčkwi-].

In addition to intensive reduplication, there is another reduplication process in Luiseño, which derives (adjectival) nominals from verbs. The semantics of these forms are apparently not completely predictable, but often include a component of deintensification, the exact opposite of the usual effect of reduplication. Thus, we have pairs like [maha-] ‘to stop’, [mahamhaS] ‘slow’; [ʔava-] ‘to be red’, [ʔavaʔvaš] ‘pink’, etc. As these forms show, the reduplicated adjectives undergo the syncope rule, which requires that the reduplication process in question must precede the application of rule 3.

The interesting point concerns the application of this reduplication process to forms beginning with /č/. In pairs like [čara-] ‘to tear’, [čaračraš] ‘torn’; [čoka-] ‘to limp, be crippled’, [čukačkaš] ‘limping’, etc., we find reduplication, followed by syncope, but without the subsequent application of rule 2. If rule 2 had applied, of course, we would expect *[čaračraš], *[čukačkaš], etc., instead of the attested forms. As Munro and Benson point out, it cannot be that these stems are lexically marked as exceptions to the spirantization rule, for they in fact undergo it in other formations: thus, from [čoka-] ‘to limp, etc.’ there is a derived noun [čukaylaš] ‘cane’, which can undergo syncope if preceded by a prefix; when this happens, the initial /č/ does spirantize to [š], giving [nuškayla] ‘my cane’. It is thus necessary to find some other device for preventing the application of spirantization to the reduplicated adjectives.

The obvious way of doing this would be to order spirantization before reduplication, as Munro and Benson point out. They are not able to do this, however, since the two other ordering relationships discussed above (reduplication precedes syncope, and syncope precedes spirantization) imply the opposite ordering, namely that reduplication precedes spirantization. They are thus forced to employ some other device: either they must recapitulate the syncope rule (as well as other processes of stress-movement, not discussed here) in the statement of the reduplication rule, in order to have it apply after spirantization; or they must allow the reduplication rule to introduce a feature of exceptionality with respect to spirantization. Both of these procedures are unpleasantly ad hoc, as they note: the one requires needless duplication and loss of generalization, while the other allows exception features to be introduced in the course of a derivation by rules. Allowing rules to introduce such features is equivalent to allowing arbitrary pairs of rules to be disjunctively ordered, which all investigators have agreed would be undesirable. Some way of salvaging the simple ordering restriction ‘spirantization precedes reduplication’ would thus be a much better alternative.

The ordering problem noted by Munro and Benson arises from their assumption that ordering relations must be transitive: that is, that if A precedes B, and B precedes C, then A necessarily precedes C as well. Considerable evidence
exists, however (cf. Anderson, 1974b, and literature cited there), that this assumption is invalid. An alternative to the theory of linear ordering, the theory of **LOCAL ORDERING**, allows a natural statement of the fact summarized above. In this theory, the grammar of Luiseño would contain only one (relevant) ordering statement: ‘spirantization precedes reduplication’. Other pairs of rule would be related by general principles of natural ordering, involving maximizing rule applicability, transparency, paradigmatic regularity, and other properties. Thus, in a form like [mahamhaś] ‘slow’, from /maha-/ ‘to stop’, reduplication can ‘feed’ syncope, since it creates new forms that meet the conditions for syncope. This ordering is thus natural, since the opposite ordering would be non-feeding (or counter-feeding, in another terminology), and the grammar contains no ordering restriction contradicting it. Similarly, in forms like [nešmal] ‘old woman’, from /neču + mal/ (cf. [ne:ču-] ‘to become an old woman’), syncope feeds spirantization, while the opposite order is non-feeding; since the grammar contains no explicit ordering contradicting this natural ordering, the rules apply in the order syncope-spirantization. The important point here is that the explicit ordering ‘spirantization precedes reduplication’ does not come into play in either class of forms, since only one of these rules is applicable to each class of forms. The rules that are applicable in each case, then, apply in their natural order.

Now consider a reduplicated adjectival form derived from e.g. /čara/ ‘to tear’. To the base form, only reduplication can apply, giving /čara + čara/. At this point, syncope can apply, and as there is no overt restriction in the grammar to prevent this, it does, giving /čara + čra/. At this point spirantization could apply, which would yield *[čarašra(ś)]*; such incorrect application is prevented, however, by the ordering restriction that requires spirantization to precede, not follow, adjectival reduplication. Thus, the correct form [čaračra(ś)] is obtained. This is because the ordering restriction relates only these two rules; other forms, to which only one of the rules of reduplication and spirantization could apply, are unaffected.

The theory of local ordering, then, allows us to state the processes involved in Luiseño in a natural way without invoking *ad hoc* devices of the sort (reluctantly) proposed by Munro and Benson. It is thus supported over a theory of strictly linear ordering by this example. More important for our purpose here, however, is the content of the explicit ordering statement which is involved: spirantization is a purely phonological rule, while the formation of adjectivals from verbs by reduplication is a (derivational) morpholexical process. Observe, incidentally, that this reduplication process is distinct from other reduplications which are otherwise similar in phonological form: contrast the behaviour of the reduplicated intensives, such as [čikwiški-] ‘to suffer’, from the same root as [čikwi: la-] ‘to be sad’. The two reduplication processes differ semantically (de-intensive vs. intensive modification), syntactically (adjectivals from verbs, vs. verbs from verbs), and phonologically (spirantization precedes adjectival reduplication,
while it is allowed to follow intensive reduplication. These differences thus re-inforce one another. The ordering restriction which is involved, then, is of the type we have been considering: a morpholexical process which follows a purely phonological one. The fact that the ordering involved is an unnatural (or extrinsic) one makes this example doubly interesting: it illustrates the general proposition that, while much of what goes on in natural languages can be seen to follow from general principles, every language has a certain residue of unnatural, idiosyncratic, and therefore unpredictable aspects to its grammar. It is particularly plausible that such idiosyncrasy should appear in connection with derivational (rather than inflectional) morphology.

Reduplication is by no means the only area in which morpholexical and phonological rules interact, with phonological rules preceding. Another interesting case is furnished by the rule for the formation of imperatives in Danish, most completely described by Basbøll (1969). Other rules relevant to the problems mentioned below are dealt with by Basbøll (1971, 1972) and by Rischel (1969). The imperative in Danish is generally described as identical with the stem of the verb: e.g., from *sparke* 'to kick', is formed an imperative *spark* 'kick!' The stem, in turn, is found by subtracting a final schwa from the infinitive. In verbs whose infinitive ends in a vowel other than schwa (e.g. *gaa* 'to walk' or 'walk!'), the infinitive and the imperative are the same.

This description of the imperative is correct as a description of the orthography, and also as a description of the segmental phonology with the exception of one important area. The Danish orthography does not in general indicate vowel length in those positions where it is distinctive, nor does it indicate the position of the important accentual feature of Danish known as the *stød* (a glottal stop which may be realized as laryngealized voicing, and which will be transcribed here as [?] following the segment affected). In both of these areas, the imperative may diverge from the simple stem, though this is not revealed in the orthography. Consider, for example, the verbs *bade* 'to bathe' and *spille* 'to play'. These are phonetically [bae:ʊ] and [spella], with long vowel and long consonant, respectively. The stems of both, however, contain only a short vowel followed by a short consonant: cf. the related nouns *bad* 'bath', and *spil* 'game', phonetically [bað] and [spel]. It is not the case that the nouns involve shortening of the stem vowel, as shown by the fact that stems with basic long vowels show those vowels unchanged in related forms. Thus, e.g., *mase* 'to toil', phonetically [mae:sə], has an underlying long vowel as shown by the related noun *mas* 'bother', phonetically [mæ:s], where the presence of *stød* confirms the vowel length. Similarly, contrasting with *spille* is the verb *spilde* 'to waste', phonetically [spilla], where the underlying long consonant is shown by the related noun *spild* 'waste', phonetically [spil?]. Again, the presence of length is shown by the *stød*. The imperatives of *bade* and *spille* are *bad* 'bathe!', phonetically [bae?̊], and *spil* 'play!', phonetically [spel?], with long vowel and long consonant,
respectively. Furthermore, the nouns also show length in the plural, which, like the infinitive, is formed by the addition of schwa to the stem. The plural forms of ‘bath’ and ‘game’, therefore, are bade, phonetically [baːɻdi], and spille, phonetically [spilə]. Thus, stems in short vowels show length in the following places: in the infinitive, in the plural, and in the imperative.

Lengthening in the infinitive and in the plural can be shown to follow from a relatively straightforward phonological rule. As discussed by Rischel (1969) and Basbøll (1969), there is a general phonological rule of Danish by which a stem ending in short vowel plus single consonant, followed by a vocalic ending, lengthens the vowel if the consonant is a labial or velar approximant. If the consonant is a ‘dental’ approximant (/r/ or /ð/), lengthening depends on the quality of the vowel; thus, low rounded vowels are lengthened before /r/, while all other vowels are lengthened before [ʊ]. It should be noted that my description of /r/ as a dental is completely inaccurate phonetically; Danish /r/ is phonetically a uvular spirant or a pharyngealized low back vowel. Other stems ending in /l,j,m,n/ or in /ð,r/ which do not show vowel lengthening lengthen the consonant in the same environment. The lengthening is extremely important, for it determines the possibility of inserting stød; as Basbøll (1972) shows, stød can be predicted by a rule which inserts it in a definable class of stressed syllables at an appropriate point in the derivation in case either (1) the vowel of the syllable is long; or (2) the vowel is short, and followed by a phonetically voiced consonant which is itself followed by another consonant. Long consonants count as sequences for the purposes of this rule. In case (1), the stød falls on the vowel, while in case (2) the stød falls on the post-vocalic consonant; these facts probably indicate that the proper generalization is that the stød falls at a position which comes after a fixed time interval from the onset of the vowel.

We note here parenthetically that if the stød-insertion rule is taken to be morpholexical in character, as is traditionally assumed, it might furnish another example of our general thesis. This is because /r/ generally counts as a voiced consonant for determining whether the rule can apply, except in one particular case: when followed by an underlyingly voiceless obstruent. Standard Danish (or at least its conservative varieties) have a rule by which /r/ in exactly this position is phonetically devoiced, which could account for stød exceptionality. This involves, however, the application of the (possibly) phonetic rule of /r/-devoicing before the application of the (possibly) morpholexical (or at least phonological) rule of stød-insertion.

The importance of these observations for our purposes here is the following: if we take a view similar to the traditional one that the imperative in Danish is derived from a form similar to the infinitive by loss of a final schwa, we can regularize the appearance of length without resorting to an ad hoc morphological feature which lengthens vowels (or consonants) in imperatives, as well as under exactly the same conditions when short stems are followed by vocalic endings.
That is, if we assume that the imperative is not simply the stem, but rather the infinitive minus a final schwa, we need only state lengthening before vocalic endings. This phonological rule of lengthening, then, will precede the (obviously) morpholexical rule by which imperatives are formed by deleting a final schwa from the infinitive.

A final instance in which a phonological rule appears to precede a morpholexical rule is found in the grammar of Abkhaz (and other related dialects of the Northwest Caucasian group such as Abaza), and primarily concerns the structure of the verb. This example is discussed further, and motivation is given for the rules involved, in Anderson (1974a). The relevant facts are to be found in Allen (1956) and Dumézil (1967). As detailed by Paris (1969), the verb in Abkhaz (as in the other NWC languages) consists of a stem preceded by a large number of prefix positions. These prefixes include markers of the person and/or noun class of the principal NPs in the clause: subject, object, indirect object. There are also markers for negative, incorporated nouns, some elements that appear to be a sort of incorporated postpositional phrase, and other material. We are primarily concerned with the person/gender markers, most of which are composed of a single consonant in underlying representation. The concatenation of several of these elements, as well as the concatenation of multiple root elements (each of which is, again, underlyingly composed of a single consonant in the majority of cases), can give rise to long sequences of consonants. While Abkhaz does allow consonant clusters which, from the perspective of familiar European languages, are quite complex, the clusters that are formed are broken up by the operation of a very general rule of epenthesis. Some reservations have to be made in this rule, according to Dumézil and Allen, for the exact behaviour of clusters of liquids; while this fact complicates the statement of the rule, it does not alter its phonological basis, which is essentially as stated in [4]:

\[
\begin{align*}
0 \rightarrow & \varepsilon \langle C \rangle \{ V \} \\
\end{align*}
\]

This rule results in alternations of the position of syllabicity in sequences of prefixes and other elements; thus, we have contrasts such as [yartot'] ‘they give it to him’ vs. [yrartot'] ‘they give it to them’ vs. [yraśwa:yt'] ‘they hit them’, etc. The rule is perfectly regular, and is the primary determinant of the surface shape of words in Abkhaz.

In addition to the epenthesis rule just discussed, Abkhaz contains another rule which has excited a certain amount of interest in the literature on Northwest Caucasian linguistics, and which appears to be an instance of a phonological (or more accurately, morpholexical) rule which involves the relation of coreference. Among the person/gender prefixes are several which can appear in absolute initial position in the verb with the same underlying shape, /y/. In particular, initial /y/ marks 3sg. irrational NPs, or any 3pl NP (masculine, feminine, or...
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irrational). These prefixes agree with the NP which is subject if the verb is intransitive (including a class of verbs which, while transitive in most European languages, are treated structurally as intransitives plus postpositional phrase in Abkhaz), or with the object if the verb is (structurally) transitive. The rule which concerns us is limited in its application to this prefix /y/, in any of its functions: when verb-initial /y/ is immediately preceded by the NP with which it agrees, the /y/ is lost. Since Abkhaz allows scrambling of subject and object, the operation of this process is often the only way to determine which of two NPs is subject and which is object:

\[5\]

a. \[\text{a-c°g°a-la y-a-ba-yt'}\]
\[\text{def-cat def-dog 3i-3i-see-past}\]
\[\text{`The dog saw the cat.'}\]

b. \[\text{a-c°g°a-la a-ba-yt'}\]
\[\text{def-cat def-dog 3i-3i-see-past}\]
\[\text{`The cat saw the dog.'}\]

In 5b, the facts that the verb contains only one prefix rather than two, and that the one which appears (a-) normally occurs only in second position, indicate that the preceding NP is the one that would agree with an initial /y/, and hence that ‘the dog’ is object; the fact that 5a has two prefixes indicates that the preceding NP is not one that would agree with initial /y/. Since the preceding NP is a 3i NP, it must be that it is subject; hence, the object must be ‘the cat’. If the verb-initial prefix is other than /y/ (e.g., /d/ for 3sg rational NPs, /s/ for lsg, etc.) it is never lost, regardless of the presence of an immediately preceding NP with which it agrees. The prefix loss rule, then, applies only to verb initial prefixal /y/.

The facts which are of interest to us here are found in the interaction of these rules with stress assignment. Stress is assigned on a basis which is at least partly morphological, and which is not completely formulated by any of the authors who have dealt with Abkhaz; there are some verbal forms, however, where we can be fairly sure that stress should be assigned to the initial vowel of the word. The point at which this rule applies must be after the application of the epenthesis rule, for the vowel which receives stress may itself be epenthetic. What is important is the fact that the /y/-loss rule must also follow epenthesis: in categories where initial stress is present, if the environment for /y/-loss is satisfied, the initial stressed schwa remains. Thus, if [y3rtot’] ‘they give it to him’ receives initial stress, and is directly preceded by the direct object NP (thus conditioning /y/-loss), the result is not *[r3tot’], but [3rtot’]. In order for this result to be obtained, the rules must apply with (phonological) epenthesis first, then (at least partially morpholexical) stress assignment, and then (morpholexical or even syntactic) /y/-loss next. Aside from the intrinsic interest of the /y/-loss rule, then, it is of further interest in providing an instance of a morpholexical
rule which is preceded by a phonological rule. Notice that even if, contrary to all other evidence, one treats the alternation of schwa and zero in prefixes as deletion, rather than epenthesis (i.e., represents the prefixes as syllabic and subject to a schwa loss rule in the complement of the environment for the (independently necessary) rule 5), it is still necessary to apply the phonological rule which determines whether schwa is or is not present after the first prefixal element before stress is assigned; the thrust of the example remains, therefore, even under this alternative analysis.

The above examples, then, serve to demonstrate the general proposition that morpholexical and phonological rules may be intermixed in a grammar. They thus serve to disconfirm any claim that a principle of ordering should require morpholexical rules to precede phonological ones. It may well be, of course, that such orderings are natural, even though they are not required; this would be the typical case, given that languages contain some unnatural rules and orderings as well as natural ones. It is not hard to envision what a demonstration of this claim would consist of: one would want to show that if two rules R1 and R2 apply in that order in a language at one point in time, and R2 is later reanalyzed so as to become morpholexical, while R1 remains phonological, then R2 also tends to shift its position in the ordering so that it comes to precede R1, but that the opposite change cannot take place (i.e., if R1 becomes morpholexical, the phonological R2 cannot be reordered so as to precede it). Such a demonstration would undoubtedly be possible, along the general lines of Kiparsky’s (1968) demonstration of the naturalness of feeding orders and the unnaturalness of bleeding orders, but is beyond the scope of this discussion. Some suggestions will be made below, however, about the basis for the naturalness of orderings in which morpholexical rules precede (and phonetic rules follow) phonological rules.

Instances in which morpholexical rules follow phonological rules are not the only examples in which violations of the schema given in [1] occur. There are also cases in which subphonemic, or phonetic rules must precede the operation of phonological (or in traditional terms, morphophonemic) rules. Some cases in which phonetic detail can be argued to be necessary for the formulation of phonological rules are discussed by Vennemann (1972); some further cases will be discussed below.

One of the best-known processes in American English, which has become almost a cliché of the generative phonological literature, is the lengthening of vowels before voiced consonants. This process is related to another process, t/d-flapping, in a way that produces a major problem for an autonomous phonemic analysis of English as shown by Chomsky (1964). Chomsky notes that an intuitively satisfying analysis of the contrast between writer and rider in American English would locate the contrast in the intervocalic consonant: the first has /t/ where the second has /d/. For many speakers, however, the intervocalic con-
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sonant in both is the same segment, phonetically: a voiced alveolar flap [D]. The phonetic difference between them is located in the vowel of the first syllable, and they can be represented phonetically as [rajDår] vs. [ra:jDår]. In phonemic terms, then, the difference between the two words would have to be taken not as a contrast between /t/ and /d/, but as evidence for the contrastive function of vowel length in English. Such a conclusion, however, can be avoided by positing the two rules in 6, ignoring the fact that it is the nucleus of a diphthong, rather than its final element, which should be lengthened by 6a:

\[6\]

a. \( V \rightarrow [+\text{long}]/[+\text{voice}] \)

b. \( \{t,d\} \rightarrow [D]/V[\text{V,-stress}] \)

If the two apply in this sequence, they will convert underlying /rajt+år/ into [rajDår], but underlying /rajd+år/ into [ra:jDår]. The fact that rules can apply in a sequence, then, allows us to maintain intuitively correct underlying representations without distorting the surface facts.

It is usual to present the vowel lengthening rule in the simple form \(6a\), implying that it is a categorial feature of length which is affected by following voiced consonants. When the full range of facts is considered, however, it is clear that this is insufficient. The classic discussion of the influence of consonantal environment on vowel length in American English is House & Fairbanks (1953); other studies of this problem in English and other languages are reported by Lehiste (1970). From House and Fairbanks’ data, it is clear that, while voicing is the feature of the following consonant which plays the greatest rôle in determining vowel length, it is by no means the only one. In their material, averaged over all vowel qualities, the shortest duration observed is ca. 160 msec., for vowels preceding [p] or [k]. A set of other factors can be isolated, such that if this length (ca. 160 msec.) is taken as ‘basic’, the effects due to the following consonant are approximately additive: if this is [+coronal], add ca. 20 msec.; if it is [+cont], add ca. 35 msec.; if it is voiced, add ca. 80 msec.; while if it is nasal, subtract ca. 10 msec. Obviously, more than one such effect can be present at the same time; thus, before [n], vowels were found to be approximately 160 (basic) + 20 (coronal) + 80 (voiced) – 10 (nasal) = 250 msec. long, while before [z] they were 160 + 20 + 35 (continuant) + 80 = 295 msec., etc. All of the effects observed are not purely linear, but this description provides a reasonable degree of accuracy, and brings out the fact that voicing is by no means the only relevant factor. These influences cannot simply be ignored, and ascribed to a description of universal ‘co-articulation effects,’ but must be treated as specific facts about specific dialects of English. Lehiste’s (1969) discussion makes it clear that these effects differ in type and in degree from language to language, and thus must be taken as part of the language-specific knowledge of individual speakers.

Not only is it clear that rule 6a is oversimplified; from the facts just adduced, it is clear that the rule for vowel length in English cannot be considered to
manipulate a binary feature. Rather, it must be written so as to alter a numerically specified, detail value of a feature, and thus it must be a phonetic rather than a phonological rule. While it is of course possible to isolate the effects of voicing from those of other features of the following consonant, there is no reason whatsoever to do so other than a desire to preserve the form of rule 6a; voicing differs only in degree, not in kind, from other features in its effect on length. Having observed that the vowel length rule is phonetic, rather than phonological, however, we can return to the original observation, that determination of vowel length must precede flapping (6b). The flapping rule itself is still phonological in character: it manipulates a feature which is distinctive in underlying forms ([voice], as well as [obstruent]); it also produces a neutralization of a phonological opposition (between /t/ and /d/). It cannot, thus, be treated as a subphonemic, phonetic, or ‘detail’ rule. The fact that it must nevertheless follow the phonetic length rule provides an instance of the intermixture of phonological and phonetic rules.

Danish provides another example of this sort in the interaction of a vowel quality rule with a rule of nasal assimilation. As described by Basbøll (1972), short /a/ in Danish varies considerably in its fronting, depending on the following consonant. In particular, when followed by tautosyllabic non-coronals, /a/ is retracted to a vowel we can transcribe as [ʊ]. In fact, the allophones of /a/ are more complex than this, and at least in conservative standard Danish, four or even more degrees of backness are distinguishable. The furthest back type occurs before (tautosyllabic) /r/; the next most back variety appears before velars; a slightly more front variant appears before labials; while the most front variant appears before coronals and in open syllables. For our purposes it is sufficient to distinguish the variant which appears before coronals from those which appear before non-coronals. The rule which specifies the various allophones of /a/ does not alter the fact that all of these segments are categorically [+back]; it simply specifies numeric or detail value for backness and is thus a phonetic rule. Another rule of Danish can convert coronals into non-coronals under certain conditions: in compounds, a process of nasal assimilation applies. Consider the pair of words sand ‘sand’, phonetically [sanʔ], with the front variant of /a/ as expected before a coronal, and sang ‘song’, phonetically [sanŋʔ], with the back variant as expected before a velar. It is possible to combine either of these with krabbe ‘crab’ to make a compound, in which case the final nasal of the first element may assimilate to the position of the /k/. These compounds are thus phonetically [sanŋkrabba] ‘sand crab’ and [sanŋkraba] ‘singing(?) crab’. (This latter form is not, according to Basbøll, an actual compound in Danish, but is nonetheless perfectly constructable, and it is clear what its pronunciation would be.) The two are thus distinguished solely by the quality of the first vowel. This situation is exactly analogous to the English case; the (phonetic) vowel quality rule must precede the (phonological) nasal assimilation rule if we are to avoid the
counter-intuitive claim that front and back quality in /a/ is distinctive in Danish. The phonological character of the nasal assimilation rule is due, of course, to the fact that it neutralizes a distinction which is otherwise contrastive in the language: the distinction between dentals and velars.

Another example of an interesting interaction between phonological and phonetic rules is provided by Breton. For a description of the main phonological characteristics of a variety of Breton dialects, cf. Jackson (1967). A general characteristic of virtually all of the (numerous) distinct dialects of Breton is the distribution of variants of the mid vowels /e, o, œ/. Each of these appears in three forms: a lengthened, raised form, occurring when the vowel is followed either by no consonant or by one of a class of ‘weak’ voiced consonants; a lowered form, occurring before velar continuants and before clusters of r plus consonant; and a ‘neutral’ form occurring elsewhere (i.e., before ‘strong’ consonants that do not lower). We are concerned with the distinction between lowered and non-lowered variants: we will denote the raised and lengthened type as [e:, ò:, œ:]; the lowered type as [E, O, Æ], and the neutral type simply as [e, o, œ]. The rule which specifies the distribution of the lowered variant affects the numeric value of the feature [-low] in mid vowels, and does not alter categorial values of any feature. It is therefore a phonetic rule, in the terms of this discussion. Morris Halle has suggested to us that the distinction between, e.g., [e] and [E], may be in terms of a categorial value for a feature of tongue root position, rather than in terms of a numeric value for a feature of tongue height. Even if this position is accepted, however (and it is not easy to see how the five phonetic front unrounded vowels of Breton, [i, e:, e, E, a], are to be kept distinct on this analysis), our conclusion that the process involved is one of phonetic ‘detail’ is unaffected, for the tongue root position feature involved is not distinctive in Breton. The phonetic character of the lowering rule, and of the distinction between lowered and non-lowered mid vowels, is confirmed by the character of a mirror-image rule which operates on the vowels in question; it is conjunctively applied, rather than disjunctive. For further discussion, cf. Anderson (1974b).

It is important to note that the quality of vowels before /r/ can be either lowered or not, depending on whether the /r/ is itself followed by a vowel or a consonant. Thus, in bered, ‘cemetery’, phonetically [bé:red] the vowel is not lowered because the vowel is followed by intervocalic /r/; while in kerschet ‘to walk’, phonetically [kErzEt] the vowel is lowered, because the /r/ is part of a cluster. The lowering rule, however, interacts with another rule of epenthesis in some dialects, so that the generalization just stated is obscured. In most (non-Vannetais) dialects of Breton, there is a process which inserts a vowel to break up word-final clusters of /r/ plus consonant; thus erc’h ‘snow’, underlyingly /erx/ (Breton orthographic c’h is phonetic [x], a velar spirant), is phonetic [Erx] in some areas, but [Erɔx] in most others. The quality of /e/ as [é] or [E] in the environment [. . . rV . . .] is thus apparently contrastive: it is [E] if the following
vowel is epenthetic, but [ɛ] otherwise. Since [E] is normally found only before /r/ plus consonant, it is clear that there is a ready explanation for this fact: we need simply order the vowel quality rule before the epenthesis rule, and the correct result will be obtained. The epenthesis rule, however, is clearly phonological in character, since it creates a segment and thus obviously alters categorical values. This is even more obvious in those dialect areas where the epenthetic vowel is not [ə] but [a], a vowel whose position is elsewhere distinctive. In such areas, the presence of this vowel can even result in the opening of the first syllable, producing lengthening of the lowered mid vowel: thus erc’h becomes phonetic [E:rax]. The rules must thus apply in the order lowering, epenthesis, lengthening. It is clear, therefore, that Breton presents us with another instance of a phonological rule which must follow the application of a subphonemic or phonetic rule.

A final example comes from Rotuman, as discussed by Anttila (1972) on the basis of data from Churchward and Biggs. In Rotuman, there is a set of low-level rules which affect the phonetic quality of vowels. Although the underlying inventory of vowels is a small and perfectly natural one (basically /i,e,a,o,u/), these elements are altered under the influence of the vowel in the following syllable, with the result that a large number of phonetically distinct vowels appear in surface forms. These vowels differ from one another on the basis of numeric or detail values, and in general the variation is completely ‘allophonic’ or ‘subphonemic’; the rules which specify it are phonetic, in our terms. The interesting point of the example comes from the process of forming the so-called incomplete phase of stems (a sort of indefinite form): this is produced by deleting the final vowel of the stem, but the preceding vowel retains the quality it would have if that vowel were still present. The ‘incomplete phase’ rule is surely morpholexical, since it operates on the basis of a morphological category only; the example therefore presents us with a case in which a phonetic rule (vowel quality determination) precedes a morpholexical one. This is surely the ultimate in intermixture of different rule types.

Above we have discussed examples from a variety of languages which establish the general position that the rules of the grammar must be, at least in principle, freely intermixed. This does not, however, conflict with the general observation that morpholexical rules typically precede phonological ones, and phonological rules typically precede phonetic ones. In fact, this conclusion can probably be shown to follow at least in part from the independently motivated principle of TRANSPARENCY, discussed by Kiparsky (1972). Kiparsky’s argument is based on data from historical change, but in Anderson (1974b) it is argued that much the same principle is operative in the organization of synchronic grammars as well. Basically, the principle of transparency claims that where phonological processes interact, they will apply in such a way as to maximize the extent to which their operation can be recovered from surface forms: that is, the extent to which, if
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A rule converts \( a \rightarrow b / \_ \_ \_ c \), the only instances of \( b \) in surface forms will be followed by \( c \) and will be derived from /a/. Further, the occurrence of \( a \) in \( \_ \_ \_ c \) in surface forms will be minimized. This notion corresponds closely to that of a rule’s being ‘surface-true’: that is, to its not being contradicted in surface forms by the appearance of segments which either appear to meet the conditions for the rule but not to have undergone it, or which appear to have undergone it without meeting its structural description.

It is apparent that where a phonological rule and a phonetic rule interact, the phonological rule will in general be equally transparent regardless of their order of application. This is because the phonological rule operates in terms of categorial values for distinctive features, and these are not affected by the phonetic rule. Where there is a difference, however, is in the relative transparency of the phonetic rule: if it applies before the phonological rule, and the phonological rule alters some parameter which is specified in its environment, this may reduce its transparency. It will be seen readily that this is the case in each of the examples discussed above: English t/d-flapping, Danish nasal assimilation, Breton epenthesis, and Rotuman vowel loss all eliminate the conditioning environment of the related phonetic rule from the surface form, so that the phonetic rules are no longer transparent in their effect. This is presumably something like the first stage on the way to a complete ‘phonologization’ of these originally phonetic processes, but such a shift is still only a potential one in each of these cases. In any event, it is apparent that the character of phonetic and phonological rules in general is such that having the phonological one precede will maximize transparency.

The same conclusion follows for the interaction of morpholexical and phonological processes. Since the environment for the application of a morpholexical process is at least partly non-phonological, phonological rules cannot have much of an effect in reducing the transparency of morpholexical processes. Morpholexical rules, on the other hand, have phonological effects, and thus can reduce the transparency of phonological rules. This can be seen to be the case in the examples discussed above: Tagalog and Cebuano nasal cluster reduction, Luiseño \( c \rightarrow f \), Danish vowel and consonant lengthening, and Abkhaz epenthesis are all less transparent because of their particular interactions with morpholexical processes than they would be otherwise. Thus both of the general observations about the interactions of these rule types, that morpholexical rules typically come ‘early’, while phonetic rules come ‘late’, are simply special cases of the general principle of transparency. The possibility that rules can violate this natural organization, applying in the fashion of the examples discussed above, is then an aspect of the general fact that, while rules tend to apply in a natural (and therefore transparent) order, it is not always possible to determine unequivocally on this basis which order will in fact obtain in a particular case.
In fact, in each of these cases, we can see that, while the phonological rule becomes less transparent, the morpholexical rule becomes more transparent: Luiseno reduplication, Danish imperative formation, Rotuman incomplete phase formation, and even Abkhaz /y/-loss become marginally more transparent, in that the reduplicated syllable in Luiseno looks more like the base from which it is reduplicated, the Danish imperatives now share more features with the infinitives from which they are derived, the Rotuman incomplete phase forms are now exactly the complete phase forms minus the final vowel, and the Abkhaz verbs in /y/-loss position are now lacking exactly /y/. Thus, the forms which have undergone these rules now display that fact in a maximally 'literal' way on the surface. Loss of transparency for one rule, then, may be compensated for by a gain in transparency for another; and when this happens, it may lead to a reversal of otherwise-natural precedence relations. It should not, therefore, be concluded that these examples illustrate some higher or more general principle of rule interaction than that of transparency; they are simply instances of the capacity of natural languages to display alternative resolutions of the conflict between incompatible forms of naturalness.

In the cases cited above of the interaction of phonological and phonetic rules, it is not possible to appeal to the same justification for the observed orderings. In each case, the application of the phonological rule after the phonetic rule reduces the transparency of the latter, but without any gain in transparency for the phonological rule itself. It is also unclear that any appeal to other well-established principles of natural ordering, such as maximizing rule applicability or paradigmatic regularity, will suffice in all cases. There is a factor which is common to all of these cases, however, and we suggest that there is indeed another principle of natural ordering which they reveal. The principle involved is somewhat similar to that of the alternation condition, elaborated by Kiparsky in various places. The original form of the alternation condition, the prohibition of absolute neutralization rules, was intended to prevent grammars from establishing underlying segmental distinctions which a context-free rule prevents from ever appearing directly in surface forms. As suggested above, Kiparsky's recent suggestion that rules should be prevented from applying entirely within the domain of a single lexical item under certain conditions can be regarded as an analogous condition, preventing grammars from applying context-sensitive rules in such a way as to neutralize unconditionally a potential contrast between underlying representations for lexical items. We suggest that these are all aspects of a condition that was a basic part of the theory of autonomous phonology: the requirement of biuniqueness (as characterized by Chomsky, 1964). If a linguistic description is to conform to this requirement, it must be the case that any distinction which is present in underlying forms should correspond to a possible contrast in surface forms: that is, phonemic forms of utterances should be distinct if and only if the utterances (in their surface forms) contrast. The ques-
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tion of whether the surface contrast is located 'in the same place' as the phonemic contrast is in principle completely separate from this; this question is the domain of the principles of linearity, local determinacy, etc.

From the point of view of biuniqueness, the original alternation condition is entirely reasonable. It is simply the requirement, at the level of the segment, that phonological contrasts always correspond to phonetic contrasts. Similarly, the extended alternation condition corresponds to the requirement that grammars do not permit rules to apply in such a way as to permit underlying representations for lexical items to differ in ways that do not correspond to surface contrasts in their shape. Now seen from this point of view, the orderings we have observed above in some cases of phonetic/phonological rule interactions have similar motivation: in each instance, the observed ordering has the effect of allowing phonemically distinct underlying forms to be represented by phonetically distinct surface forms. English t/d-flapping, for example, would have the effect of merging the surface forms corresponding to underlying /rajd+ər/ and /rajt+ər/ if no other rule intervened. By allowing vowel length determination to precede this neutralization, however, the grammar preserves the two forms as distinct (though the distinction does not appear in the same place in the form on the surface as in underlying representations). Similar observations apply to the other cases discussed: Danish /a/-quality determination, Breton mid-vowel lowering and Rotuman vowel-quality each have the effect of preserving as distinct forms that would otherwise be merged with others (at least potentially) by nasal assimilation, epenthesis, and final-vowel truncation, respectively. Thus, in each case, the loss of transparency of the phonetic rule is compensated for by an increase in the extent to which the grammar conforms to the biuniqueness principle.

While we believe it is correct to see the observed orderings in these cases as due to a desire to preserve biuniqueness, it is evident that this principle is by no means mechanically applicable in all instances. In particular, there are undeniably cases in which non-biunique analyses are indicated, motivated by the principles of maximizing rule applicability, transparency, etc. In fact, the extent to which grammars conform to this principle varies with the form in which it is applicable: apparently the segment-alternation condition is the most effective form of the principle, since it constitutes a nearly absolute prohibition on possible analyses. The lexical item alternation condition, constituting a constraint on rule applicability, is less absolute, since it is apparently applicable only to phonological rules, and not to phonetic rules. The instantiation of the principle in the cases of rule interaction just discussed is even less absolute, since it constitutes here only a tendency, a form of preferred ordering which is only absolute in the absence of conflicting demands due to other factors. Nonetheless, we believe that it is correct to see all of these conditions on natural grammars as instances of the same principle, which is in fact the basic principle enunciated by Saussure and other early phonologists as the essence of a phonemic
representation: the requirement that utterances be phonemically distinct if and only if they are also phonetically contrastive.

If the morpholexical, phonological, and phonetic rules of a grammar are freely intermixed (at least in principle), does this mean that there is no formal distinction among them? After all, if distinct formal principles are seen to govern these rule-types, the most natural interpretation of that fact would be that each type belongs to a separate 'component' of the grammar. This is by no means the only possible interpretation of the observation that, e.g., the principle of disjunctive ordering does not apply to phonetic rules, however. It has generally been recognized that certain types of rules are subject to unique conventions: thus, Chomsky and Halle (1968) propose a convention of stress lowering, by which the assignment of primary stress to a vowel results in the lowering of stress on all other vowels of the same form by one degree. This is clearly a convention restricted to 'stress rules', if it is valid at all. Similarly, all linguists would agree that other suprasegmental phenomena, such as tone and length, are subject to unique conventions. Yet these observations have not generally led to the conclusion that a distinct component of stress rules, or of pitch rules, should be established; these rules are intermixed with the rest of the phonology, and simply belong to a different type. Indeed, Leben (1973) for example has proposed that the general problem of providing a typology for tone languages can be reduced to that of specifying the relative ordering (i.e., the interaction) of the types of tone rules in a language with respect to the rest of its phonology.

There is every reason to believe, therefore, that instead of being divided into components, the set of phonological rules should be divided into types, with formal conventions governing rules of a specific type regardless of their position in the grammar. The distinctions among morpholexical, phonological, and phonetic rules, then, are to be treated as exactly on a par with the distinctions among stress rules, pitch rules, and segmental phonology. The content of this claim is that there are no special ordering relations which are entailed by these typological distinctions except where these follow from independently motivated general principles; thus, a theory like that of Vennemann in which ordering relations are supposed to follow from typological distinctions, is disconfirmed. One important result of this move is to make it possible to distinguish much finer rule types than simply morpholexical, phonological, phonetic, stress, pitch, etc.; once there is no reason to expect that a formally significant typological distinction will always be associated with an invariant ordering relation, the way is clear to investigate the specific formal properties of, e.g., assimilation rules, epenthesis rules, etc., in a much more substantive way. If it is required that any typological distinction among rules correspond to an ordering property, however (thus leading to an elaborated form of the model [1]) such investigation can only be impeded: it is entirely plausible that special constraints, etc., apply uniquely to metathesis rules, e.g., but much less likely that metathesis
rules will always be found at the same position in the ordering of an entire grammar.

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