Head-Dependent Asymmetries in Phonology

B. Elan Dresher
University of Toronto

Harry van der Hulst
Leiden University/HIL

0. Introduction

In his paper on degree-0 learnability, Lightfoot (1989) explores the possibility that the syntax of a language is learnable only from main clauses, without recourse to data from embedded clauses. He notes that the proposal is attractive on several grounds. From the point of view of acquisition, the hypothesis, building on work of Wexler, and Culicover (1980), claims that grammars should be learnable on the basis of simple and ubiquitous data which every child has access to. He then goes on to observe that an acquisition strategy of this kind could also account for a generalization noted by Ross (1973) and Emonds (1976), to the effect that many transformations can be found which are limited to root clauses, whereas there are arguably no transformations which are limited to embedded clauses. Lightfoot points out that this result follows if learning is based primarily on main clauses.

Lightfoot is not able to confine learning to degree-0, however, and concludes that a certain amount of embedded clause information is required also, notably data involving complementizer properties. He concludes that what is needed is degree-0 and a bit. In his commentary on this article, Rizzi (1989) points out the rather arbitrary nature of degree-0 and a bit, and proposes that the extra bit appears to be limited to information about heads. He proposes that children pay attention to heads, and that the grammar is to a large extent learnable from the properties of heads.

In this paper we will propose that much the same is true in phonology. Our proposal will include the following claims:

First, there is a meaningful notion of phonological head that cuts across segmental and supersegmental levels, indeed perhaps across phonology and syntax; cf. Halle and Vergnaud (1987), who assume that constituency and heads are fundamental linguistic concepts, as do Anderson and Ewen (1987).

Second, like root sentences in syntax, phonological heads show the maximum complexity allowed by a grammar. Thus, heads and dependents may be equally complex; but if there is an asymmetry, it will always be the head that is more complex than the dependent. We will discuss a number of these head-dependent asymmetries (HDAs) at various levels of the phonology. At levels above the segment, our observations will be couched in terms of theories of metrical and prosodic structure that are widely accepted. We will argue that at the segmental level, too,there are HDAs of a similar nature, and that these can be perspicaciously captured in terms of a theory that enables us to talk about the relative complexity of segments, so that, say, *o* is more complex than *u*, and *y* is more complex than *i*.

Third, as in the Lightfoot-Rizzi hypothesis for syntax, we locate the origin of HDAs in the acquisition process. We assume that learners begin with relatively impoverished representations, and move to more richly articulated representations under the pressure of data. Moreover, the strategy of 'pay attention to heads' implies that heads will be expanded before dependents. In many cases, the dependents catch up; but when they don't, the result is an HDA.

Fourth, we will make some proposals as to what we mean by complexity. Let us note at the outset that complexity is a relative notion, so when we say that a constituent is complex, we always mean relative to one that is less complex. With that understanding, we will focus on two types of complexity, which we will call local and nonlocal complexity.

We will say that a node C has local complexity if it branches, whereas other nodes of the same type do not branch, as in (1a); or a node can be locally complex relative to other nodes if it has an immediate dependent when others do not (1b):

(1) Local complexity

a. complex simple b. complex simple

There is a second type of complexity which is relevant to our discussion, and this we will call nonlocal (or Vergnaud) complexity. A node C is nonlocally complex when it has access to the internal structure of its dependents. In (2), C is complex if it has access to nodes of type E, and simple if it cannot 'see' below the level of D:

(2) Nonlocal complexity

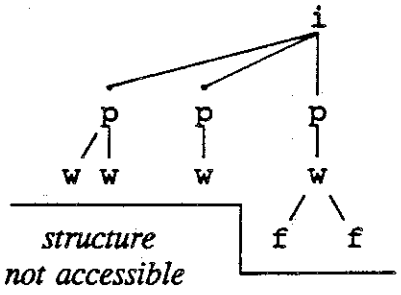
complex simple

We will proceed as follows. First, we will consider the nature of HDAs in prosodic structure, at the level of the phonological phrase, word, and foot. Then we will pursue the investigation at the syllable and segmental levels.

1. The head-dependent asymmetry at the phrase level

We will begin with a relatively simple example at the phrase level. In Tiberian Hebrew, the basic phonological phrase consists of two words or one word. These are the p-phrases in (3). The rightmost phrase in an intonational phrase i is the most prominent one, a fact attested to by various phonological strengthening phenomena (vowel lengthening, heightened stress) which characteristically occur here. Thus, we can say that the rightmost phonological phrase is the head of its i-phrase, and the other phrases are dependents. Now we observe the following HDA: in the head phrase only, a long word counts as if it is two words. It can be shown (Dresher 1981a, 1981b, 1982) that the relevant notion of long word is a word which consists of at least two feet (in (3), the head of i is the p directly under it, a convention we will use throughout):

(3) HDA at the phonological phrase (Tiberian Hebrew)



The line represents the bottom level of structure that must be analyzed in the formation of each phrase. Dependent phrases look as far as the word level; the head phrase looks further, to the foot level. In terms suggested by Jean-Roger Vergnaud, it is as if in the head position the foot level is incorporated into the prosodic tree: thus, a word with two feet counts as branching in terms of the prosodic tree.

This example illustrates one type of complexity that is involved in HDAs, namely nonlocal complexity: head phrases are sensitive to further levels of structure. In dependent positions, all words look the same: they are equally w, one unit; in head positions, words are not equal. Our claim is that we will not find the reverse cases, where a richer analysis is required in dependent positions than in head positions.

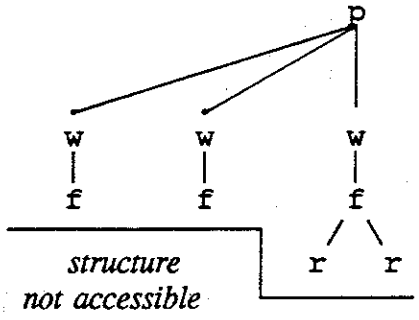
The above example illustrates how distinctions may be brought into heightened focus in head positions. Tiberian Hebrew also provides examples of the converse of this phenomenon: in the most deeply embedded phrases in a prosodic structure, it is possible, under various conditions, to include more than two words into a p-phrase, by combining two or more p-phrases into one. Though such dependent p-phrases contain more words than head phrases are allowed to have, this is not a manifestation of greater complexity, but rather of the opposite: a kind of blurring wherein phonological words lose their full value as units. Evidence for this loss of value is that such dependent phrases are never required to have a designated number of words, nor do they have any richer internal structure than other phrases: the rightmost word is still the unique head, and all the other words are dependents. This loss of value is akin to cliticization, though not as extreme. Indeed, cliticization is another way to include extra words into a p-phrase, but in this case the cliticized words lose their status as independent words.

2. The head-dependent asymmetry at the word level

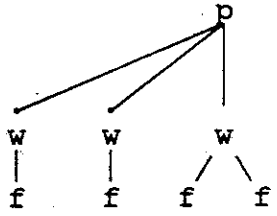
Let us move down one level in the prosodic hierarchy, to the level of the phonological word. Following what we observed at the phrase level, we might expect to find HDAs at the word level that look like (4). The type of situation schematically illustrated in (4) would be as follows: imagine a language where the word that occupies the head of a phrase, say the rightmost word in a phrase, must meet certain conditions that phrase-internal words do not. For example, the head word, but not the dependent words, might be required, as in (4a), to consist of a branching foot; or, in the local version of this HDA in (4b), the head word might be required to have at least two feet, a degree of structural complexity not required of dependents.

(4) HDA at the word level (hypothetical)

a. Nonlocal HDA



b. Local HDA



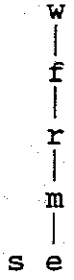
We are not sure if there are any languages which demonstrate exactly this kind of HDA; but there is a good reason why such cases might be rare. Since most words can appear either as heads or nonheads of phrases, it follows that to manifest the HDAs in (4) a language would have to have pervasive allomorphy, whereby words would come in two forms, a longer form for head position, and a shorter form for other positions. Moreover, the allomorphy would have to be productive, to apply to new words if the system is to maintain itself.

Nevertheless, we do find such HDAs in a slightly different form. Many languages have minimal word requirements, whereby a word must have a certain complexity. Such requirements are typically imposed on content words, i.e. words that can be the heads of maximal projections; other words, such as function words and clitics, i.e. words belonging to certain closed classes, are often excluded from these requirements. For example, a minimal word in Old English must have at least 2 moras, a requirement that is imposed on major class words such as nouns, verbs, and adjectives (5a); however, minor class words may escape it, so that the words in (5b) are permissible:

(5) Lexicalized HDA at the word level (Old English)

a. Major class words
scip 'ship', sæ: 'sea', *sæ

b. Minor class words
we 'we', se 'that', hwa 'who?'



We propose that this type of case represents the lexicalization of an HDA: major class words, which are all potential heads, must be complex all the time, not just when they actually are in head position. Minor class words, which are never heads, may be exempt from minimality.

In fact, there also exist traces of the sort of head-dependent allomorphy we mentioned above. We noted that this allomorphy would be very costly if it were applied to major class items. The same, however, is not true of closed classes, and we do find examples where minor class words come in two forms, strong and weak, whose distribution has a prosodic basis. An example is Modern English, where modals, possessives, determiners, and so on, come in strong and weak varieties. The weak varieties occur in phrase-medial or even cliticized positions, and often fall below the minimal weight requirement for regular English words: e.g. *n't* for *not*, *him* reduced to syllabic *m*, etc. These alternations have been discussed by Selkirk (1972).

To conclude this part, then, we consider the existence of asymmetric minimality requirements to be the lexicalized version of HDAs. We will encounter this kind of lexicalization at other levels of structure as well.

3. The head-dependent asymmetry at the foot level

Moving one level down to the foot level, we will now consider a similar type of situation that recurs in the metrical structure of words. There is a phenomenon found in a number of languages whereby main stress appears to be sensitive to quantity, but secondary stress is not. Some examples are Seneca (Stowell 1979, Halle and Vergnaud 1987), Maung (Capell and Hinch 1970, Ghomeshi 1990) and to some extent English (Halle and Vergnaud 1987):

Seneca: Main stress falls on the last nonfinal even-numbered syllable that is either closed itself or immediately followed by a closed nonfinal syllable; secondary stress alternates in an iambic pattern preceding the main stress.

Maung: Main stress falls on the first two syllables of words of up to three syllables (equally stressed), and on the penultimate of longer words, except that a preceding closed syllable tends to take primary stress; secondary stresses fall on alternate syllables preceding main stress.

English: Main stress falls on a closed penult, otherwise on the antepenult; secondary stresses fall on alternate syllables preceding main stress.

In these languages, main stress depends on syllable weight and extrametricality; secondary stress then alternates back from the main stress. Halle and Vergnaud (1987) find this situation to be so common that they give it a special name, the Alternator. The contrary situation, where main stress falls on a fixed syllable regardless of weight, while secondary stress is sensitive to quantity, appears to be rare, perhaps nonexistent.

Of course, we do not exclude cases of quantity sensitive systems where it happens that main stress always falls on the same syllable. For example, stress in Germanic is sensitive to quantity (Dresher and Lahiri 1991), but because feet are trochaic, main stress always falls on the initial syllable. In this type of case, main stress facts alone are not sufficient to diagnose quantity sensitivity, but they are compatible with it. These types of cases count against the very strong claim that metrical structure should be learnable from the facts of main stress alone; this claim is demonstrably false on a number of grounds.

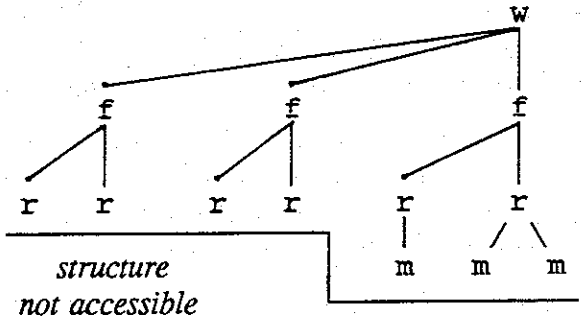
A variant of this asymmetry in quantity sensitivity is found in languages like Spanish (Roca 1986, Halle, Harris and Vergnaud 1991), Italian (Vogel and Scalise 1982), and

Chamorro (Chung 1983, Halle and Vergnaud 1987). In these languages, main stress falls on one of the last three syllables of the word in an unpredictable fashion, and secondary stress alternates evenly on preceding syllables. To account for main stress in such languages we may suppose that certain syllables may be exceptionally marked for accent. Such cases are like quantity sensitivity in that construction of metrical structure depends on some further property of syllables beyond just their linear sequence. In languages with systematic lexical accent, such as Russian and Sanskrit, any syllable may have a lexical accent; but in asymmetric languages, lexical accent exists only on syllables that may bear a main stress, and is not reported for other syllables.

These facts can be readily represented in terms of current versions of metrical theory, but they remain to be accounted for. Thus, it would be just as easy to model the opposite situation, i.e. to make the Alternator quantity sensitive, or sensitive to lexical accent, and main stress insensitive to quantity or accent.

By now the explanation for this tendency should be evident: it is a nonlocal HDA at the level of the foot, as shown in (6). The foot bearing main stress in a word is a head, whereas feet controlling secondary stress are subordinate to it. Only the head foot is built on lower-level projections from syllable structure in which the distinction between light and heavy syllables is maintained. The nonhead feet have no access to this distinction, and are rather built on undifferentiated lower-level structures:

(6) Nonlocal HDA at the foot level (main stress QS, alternator QI)



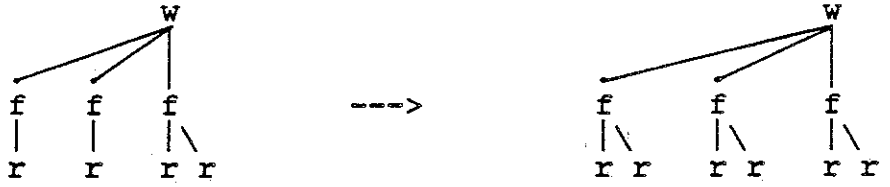
The contrary situation, where secondary stress is sensitive to quantity while main stress is not, would require nonheads to attend to a distinction that is not available to the head.

If we think of the observations concerning head/dependent asymmetries within the foot in terms of an acquisition sequence, we might propose the following possibilities. First, with regard to the structure of the foot itself, we might expect that there could be a stage where there exists a local HDA, i.e. the head foot (the main stress foot) branches, but the dependent feet do not, as in (7a). Perhaps languages without secondary stresses are of this type. Assuming that stress patterns exist which do not include a statement about secondary patterns and assuming that we adopt something like the Strict Layer Hypothesis (Selkirk 1984, Nespor & Vogel 1986), we would be forced to the representation in (7a). In languages where full vowels occur in head positions of feet and reduced vowels occur in nonhead positions, this sequence would predict that unstressed vowels would be unreduced in earlier phases: since all dependent feet are unary, and the only positions in unary feet are head positions, the only

vowels which could occur in such positions are unreduced:

(7) Possible acquisition sequence: local HDA ---> symmetrical feet

a. first phase b. second phase



A following stage would then involve the adoption of branching feet throughout, as in (7b), producing a rhythmical alternating pattern.

With regard to nonlocal complexity, the logic of our argument would lead us to expect that the structure of the rime is at first not accessible to foot construction, leading of necessity to QI feet in the first phase, as in (8a); when rime structure does become available, the HDA principle predicts that the dependent branch of the foot may not be more complex than the head; this leads either to balanced feet, or to feet as in (8b):

(8) Possible acquisition sequence: symmetrical feet ---> nonlocal HDA

a. first phase b. second phase

We assume that the development of branching rimes need not interfere at first with the development of branching feet.

This view of the phases corresponds to the learning path suggested in Dresher & Kaye (1990) for discovering whether a system is QI or QS. We assume that learners suppose that structures are only as articulated as they need to be. It follows that the initial state should be QI, where there is no differentiation of syllable types into heavy and light; a learner would then be driven to assume QS by finding that the metrical system is sensitive to quantity distinctions. If we find QS, we now have a further decision: whether or not to suppress it for nonheads. We now have a two-way distinction as to the type of feet languages employ:

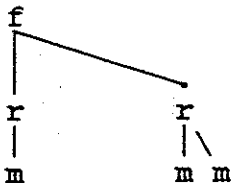
(9) QI and QS feet

a. QI feet b. QS feet

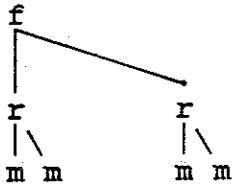
The logic of our claim predicts that the head/dependent asymmetry results in having QS-feet as in (9b), and not those in (10a):

(10) Other logically possible feet

a. reverse QS



b. both branches heavy



Feet of the type in (10b) do not go against this logic, so perhaps some languages (e.g. Aklan, or right-headed Capanahua) are correctly analyzed as having precisely this foot type (cf. van der Hulst 1991b), but we will not go into this here.

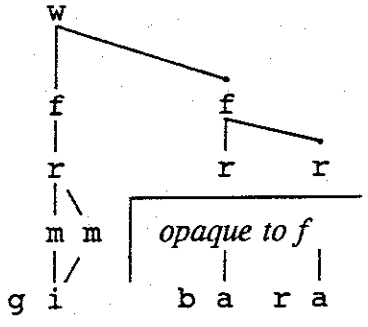
A further possible stage is one in which all feet are QS. Here we might still find an asymmetry in that the head foot is 'more sensitive' to weight distinctions than the nonhead feet. In Chugach, for example, both long vowels and closed syllables count as heavy for the head foot, whereas only long vowels count as heavy for nonhead feet.

So far we have discussed cases where a quantity distinction potentially exists throughout the metrical domain but is only exploited in the head. There is another type of situation which leads to the same general result, in which certain syllable quantity types exist only in head metrical position.

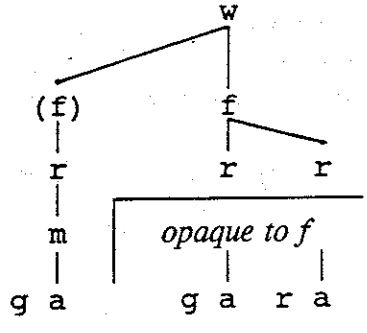
A typical example occurs in many Australian languages, as exemplified by Wargamay (Dixon 1981, Hayes 1991): in simplex words, long vowels occur only in initial syllables, which in such cases bear main stress. Since only syllables with long vowels are heavy, the heavy/light distinction is available only there. Stress alternates trochaically from the end of the word: S s, s S s, S s S s, etc. where s is unstressed, S is a stressed syllable. But compare (11b) *gaGAra* (s S s), where the initial foot is degenerate, causing stress to fall on the second foot, with (11a) *GI:bara*, where the initial long syllable preserves the foot, which becomes the head of the word:

(11) Lexicalized QS/QI HDA (Wargamay): hypothetical first stage

a.



b.

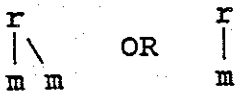


According to Dixon (1980, p. 212), there is evidence that Proto-Australian had a contrast between long and short vowels in initial syllables, but there is no evidence for long

vowels in other syllables. We might nevertheless speculate that at some earlier stage Proto-Australian may have allowed long vowels in noninitial positions also, but had metrical feet which exhibited a nonlocal HDA: dependent feet could look only as far as r, whereas head feet could look to m. Such a situation could lead diachronically to a loss of the quantity contrast everywhere but in the head foot, leading to a local HDA at the syllable level: now, head syllables of words can have 2 moras, others only 1 mora:

(12) Lexicalized QS/QI HDA (Wargamay): final stage

a. word-head syllables



b. word-dependent syllables

It is instructive to observe what happens in Australian languages where the stress shifts away from the initial syllable. Such a shift has the potential to create a situation where the initial syllable, now a nonhead syllable, retains a contrast between long and short vowels which does not hold of the new head syllable, thus creating a violation of our principle that a dependent syllable may not be more complex than a head. It is noteworthy, then, that such situations do not appear to occur; if they do occur, they are not permitted to persist.

A striking example of this occurs in the Cape York 'initial-dropping' languages, whose history was reconstructed by Hale (Hale 1964, Dixon 1980). In these languages, stress shifted from the first to the second syllable, and changes occurred to the initial syllable: the word-initial consonant may be dropped, and the vowel deleted if short, and shortened or dropped if long. (In some cases traces of the initial CV are transferred to the second syllable by metathesis, but we will not discuss that process here.) The historical sequence of these changes is not known. If the reduction of initial syllables preceded the stress shift, then there would be no long vowels anywhere in the language, and no violation of an HDA. If stress shift preceded, then there would have existed a stage immediately following stress shift where long vowels existed only in initial unstressed position, and never stressed (in second position). This follows from the assumption that the earlier stage had long vowels only in the initial syllable.

Such a stage, if it ever existed, would be a counterexample to our claim, since the head syllable of a word, now the second syllable, would be systematically lacking a type of complexity, represented by long vowels, which occurs in a dependent syllable (the initial one). It is significant, therefore, that this kind of asymmetry is not observed in the Cape York dialects. On the strong interpretation of our theory of HDAs, in which such asymmetries are never allowed, a hypothetical stage of the type just sketched would be impossible: in that case, the development of peninitial stress could not occur prior to one of two ocurrences: either the reduction of long vowels in the initial syllable, or the development of new long vowels in the second syllable. Lacking new long vowels, the historical sequence would have had to be reduction of initial syllables followed by stress shift.

On the weaker interpretation of HDAs, it could be that violations may arise through particular historical circumstances, but that the highly marked state so produced would be historically unstable and subject to change. Barring evidence to the contrary, we will continue with the strong intepretation.

Putting this in terms of a typology, we find (a)-(c) below, but not (d):

a. languages with long vowels in stressed and unstressed syllables
b. languages with no length contrast at all
c. languages with long vowels only in stressed syllables
d. languages with long vowels only in unstressed syllables

These languages are different from ones where long vowels occur throughout but do not count as heavy. In Australian languages, we could make metrical structure QS throughout, and let morpheme structure conditions confine heavy syllables to certain positions, which turn out to be associated always with main stress. But this is to miss the fact that the two types of cases are connected in confining certain quantity distinctions to the metrical head.

Another type of case is Chimwiini (Kisseberth and Abasheikh 1974, Selkirk 1986, Hayes 1989), which has underlying long vowels throughout, which are permitted to surface only in one position in a phrase, corresponding to the head metrical position (an abstract main stress). Here, shortening rules are called in to reduce all long vowels in nonhead positions.

A similar situation occurs in some Australian languages, where long vowels, though confined to morpheme-initial position, may nevertheless potentially occur in word-medial position due to morphological concatenation of morphemes. In Dhuwal and Ritharngu of the Yuulngu group (Heath 1980a, 1980b), such vowels are systematically shortened.

We thus have a range of cases in which quantity distinctions are suppressed in nonhead positions: In the first type, syllable quantity distinctions exist throughout, but are not counted by metrical structure in nonhead positions, as in the Alternator cases. In the second type, syllable quantity distinctions exist in lexical (underlying) structure, but are suppressed by the phonology in the course of the derivation, as in Chimwiini. In the third type, syllable quantity distinctions are restricted by the grammar (morpheme structure conditions) to head positions, as in Wargamay. What is simply stipulated in the first type is achieved by 'conspiracy' in types (2) and (3). Though the formal mechanisms are different, they lead to similar results.

4. The head-dependent asymmetry at the syllable level

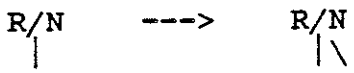
We have been assuming the prosodic hierarchy in (13):

(13) Prosodic Hierarchy

i	intonational phrase
p	phonological phrase
w	phonological word
f	foot
r	rime (and/or the mora, m, and nucleus, N)
x	skeletal position

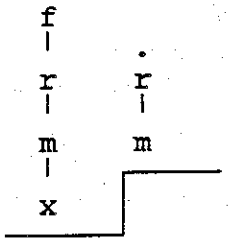
We have discussed complexity differences between heads and dependents at the higher levels and now arrive at the level of the syllable or rhyme. At the syllable/rhyme level, growth in terms of local complexity involves the addition of branching rhymes or nuclei:

(14) Local growth at the syllable level



We have already seen this type of asymmetry in (12a), where long vowels, i.e. vowels with a branching nucleus containing two moras, are limited to stressed syllables. A nonlocal correspondent to (14) would involve a case, for example, where there is a complexity requirement within a foot on the head of the head rime, i.e. on the vowel):

(15) Nonlocal complexity requirement (foot - segmental levels)



We will consider such cases in terms of local complexity at the segmental level.

5. The head-dependent asymmetry at the segmental level

What we expect to find are cases in which head syllables allow segments of greater complexity then dependent syllables. In order to find such examples, we need to specify which syllables are heads, and we need a theory of segmental structure which recognizes complexity differences between segments. With regard to the first point, we will continue to assume that stressed syllables are heads of metrical domains, and the syllable with main stress is the head of its word. We will leave open for now whether there can be other types of heads at the syllable level, e.g. harmony heads which are different from metrical heads. With respect to segmental complexity, a number of current theories are currently available which allow us to express relative complexity in terms of branching even at the level of segmental representation. In the following discussion we will limit ourselves to vowel systems.

Consider first the often-cited case of Russian, where a strong syllable may contain either of the five vowels in (16a), whereas weak syllables can only contain those in (16b):

(16) Russian vowels

a. in strong syllables

i u
e o
a

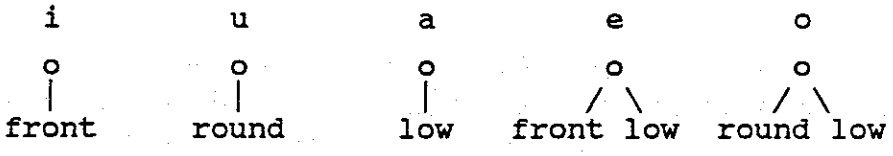
b. in weak syllables

i u

a

In order to be able to classify this as a case of nonlocal complexity, we need a theory of segmental representation which classifies the three peripheral vowels as less complex then the two mid vowels. Most theories which view vowels as being composed of combinations of basic particles or elements (versions of particle phonology, dependency phonology, and government phonology) have this property, as shown in the minimal representations in (17):

(17) Vowel structure



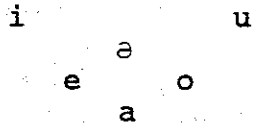
In such theories, the basic units are unary features which can occur seperately or in combination. As shown, mid vowels are branching under this view, and more complex than the other vowels. In the above example, then, the generalization is that vowels with branching structures are permitted only in stressed syllables.

Asymmetries between sets of stressed vowels and sets of unstressed vowels having roughly this character are quite common. A number of such cases were collected by Trubetzkoy (1969). Trubetzkoy's interest was in developing a theory of neutralization, which has obvious points of contact with our enterprise. Thus, in Trubetzkoy's terms, privative and gradual oppositions involve a contrast between an unmarked segment and a segment or segments which are marked for the property in question. Since the neutralization product of such oppositions (the archiphoneme) 'can only contain that which is common to both opposition members' (1969: 82), it follows that they will neutralize to the unmarked member. We expect that segmental complexity will reflect markedness: if asymmetries between stressed and unstressed vowel sets reflect complexity restrictions on the latter, we expect that the more complex vowels will be the ones that are missing.

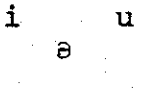
An interesting case is that of Bulgarian, which has stressed and unstressed vowel sets as in (18):

(18) Bulgarian vowels (Trubetzkoy 1969)

a. in stressed syllables



b. in unstressed syllables



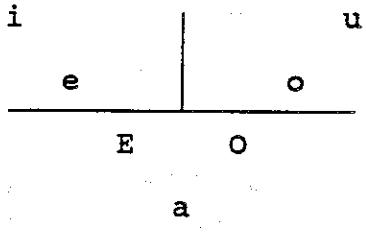
We may assume that the structure of Bulgarian vowels is as in Russian. We will represent schwa as an indeterminate vowel with no expansion, i.e. as simply a node dominating no structure. We can derive the vowels of unstressed syllables by ruling out any vowels with the element [low].

In the above cases, we have been comparing vowel sets, and neutralization here refers to the difference between contrasts found in one set and the other. More specific evidence bearing on vowel structure and vowel complexity can be found by looking at actual alternations in which the same underlying vowel can be observed in both stressed and

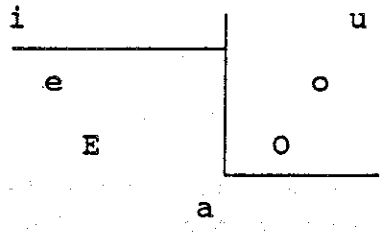
unstressed positions. Kamprath (1991) compares neutralization patterns in Catalan and Romansh. According to her, both languages have a seven-vowel stressed system and a three-vowel unstressed system, as shown in (19):

(19) Romansh and Catalan neutralization patterns (Kamprath 1991)

a. Raeto-Romansh



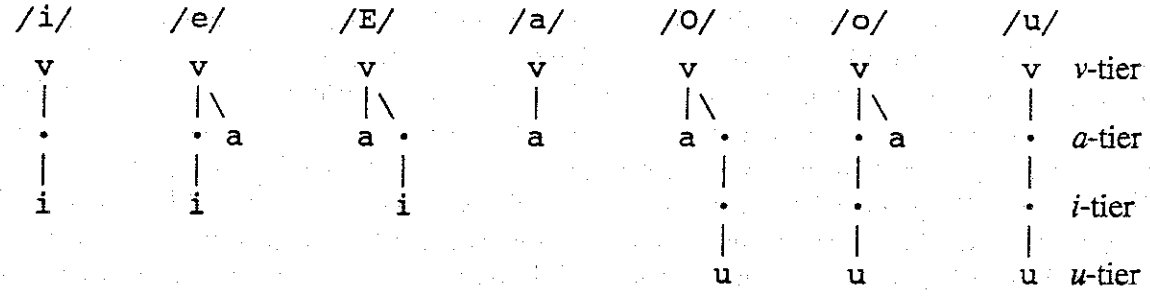
b. Catalan of Barcelona



Though these systems look the same, they differ in the neutralization patterns. in Catalan, all round vowels neutralize to [u], and all other vowels except /i/ become schwa. In Romansh, the higher mid vowels /e/ and /o/ neutralize to their high counterparts.

Kamprath suggests that these different neutralization patterns can be accounted for if we suppose that mid vowels are differently represented in the two languages. For representations, she adopts the model proposed by van der Hulst (1989), which elaborates considerably on the simple structures we have been using to here (see further van der Hulst 1991b). In this model, the basic elements |i|, |u|, and |a|, each on their own tier, roughly stand for front, round, and low respectively (though the interpretation is somewhat more complex than this), and head-dependent relations hold of the elements. Kamprath proposes that in Romansh /i/ and /e/ are headed by the |i| element, /u/ and /o/ by the |u| element, and the other vowels by |a|; thus, all segments neutralize to their heads in unstressed syllables:

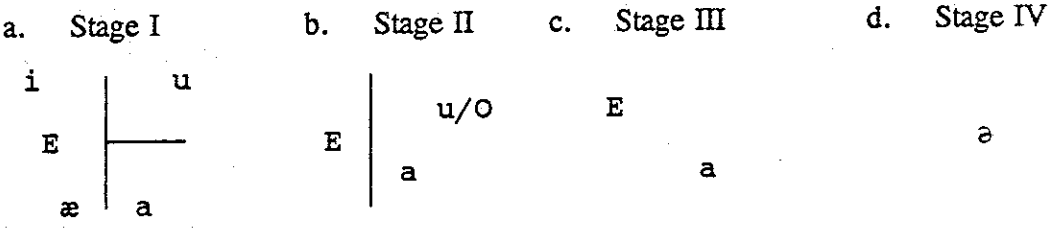
(20) Romansh vowel structure (based on van der Hulst 1989)



By contrast, she proposes that in Catalan, all the round vowels are headed by the |u| element, and all the other vowels except /i/ are headed by |a|. While this is one possible approach, the required structures are rather complex and asymmetrical. Another possibility is that the vowel structures of Catalan are basically the same as for Romansh, but the neutralization process is different. Whereas in Romansh reduction is always to the structural head, in Catalan it may be element-driven: thus, all vowels with a |u| element, whether as head or dependent, reduce to it, and all vowels with an |a| element reduce to schwa.

Another type of evidence bearing on this issue comes from diachronic mergers of vowels. For example, Early Old English (Campbell 1959) had the unstressed vowels shown in (21a):

(21) Old English unstressed vowels: diachronic mergers (Campbell 1959)



In a subsequent stage, the three front vowels merged to *e* and /u/ developed a prominent allophone *o*, creating the system in (21b). Still later, the two back vowels merged, creating an opposition between /a/ and /e/, which is perhaps schwa (21c). The end of the process was the final reduction of all unstressed vowels to schwa (21d). We can interpret this sequence as involving increasing restrictions on what may be a head in unstressed position. In stage (a), vowels may be headed by all three elements, though there are restrictions on complexity, since front rounded vowels and /o/, which appear in stressed syllables, are excluded. In the next stage, interpreting the derived vowel as schwa, no vowels with branching structures or with an |i| head are permitted. In the third stage, the |u| element is excluded, and the fourth stage represents the state of minimum complexity.

Reduction to schwa raises another issue which is relevant to our discussion. In old English, unstressed vowels may have started out as a subset of the stressed vowels, but by the time schwa arises, this can no longer be the case, since schwa is excluded from stressed syllables. In many other languages, too, we find that the vowels in dependent positions are not just a subset of those in head positions. In unstressed position we often find reduced vowels of various kinds which may be excluded from stressed syllables. In such cases it is evident that head positions impose conditions of minimum complexity which reduced vowels do not meet.

To conclude this discussion, it should be noted that complexity may not be the sole determiner of the shape of vowel systems. Thus, it has been noted that {a i u} is the favoured three-vowel system, as opposed to, say, {a E O}. While suggestive, this fact by itself does not necessarily demonstrate that /i/ and /u/ are structurally simpler vowels than /E/ and /O/; rather, the vowel system may be favoured because it achieves maximum dispersion over the vowel space (Crothers 1978, Disner 1984, Maddieson 1984). Apart from observations of commonly occurring vowel systems, study of how segments participate in head-dependent asymmetries and patterns of neutralization provoked by these provide a fruitful source of evidence bearing on segmental complexity.

6. Conclusion

To conclude, we have tried to show that head-dependent asymmetries occur at all levels of the phonology. In particular, these asymmetries systematically correspond to differences in complexity, in the sense that heads can be more complex than dependents in two ways, which

we have referred to as local and nonlocal complexity.

We have also discussed some of the implications these facts might have for the developmental course of acquisition. If this investigation is on the right track, we expect that the empirical study of stages of acquisition will shed a great deal of light on head-dependency relations.

Among his strategies of acquisition, Slobin (1973) proposed maxims such as 'pay attention to stressed syllables', 'pay attention to the beginnings (or ends) of words', and so on. The question arises, what is it about these things that makes them part of a class to which learners should pay special attention? Our proposal is that they are all heads at some level of the grammar, and that many of these maxims can be subsumed under a more general one: 'pay attention to heads!'

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