THE COGNITIVE REPRESENTATION OF SPEECH
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The Empirical Determination of Phonological Representations

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PHONOLOGICAL REPRESENTATION

This report concentrates on the nature of lexical representations with respect to their segmental phonology. In particular, this paper questions the empirical validity of lexical representations in terms of minimal contrastive units, or phonemes. There are several types of phonemes — autonomous phonemes, classical phonemes, systematic phonemes — and phonemes have a number of defining properties that could be examined critically. We will focus here on a single property, the central property that all types of phonemes have in common, i.e., that phonemes are discrete phonological units which contain no information which is predicted by rule. This is the essence of the phoneme as a descriptive device, and it is a very good descriptive device. There are, however, some facts about language that have been discussed in the literature in the last few years that are quite incompatible with this traditional descriptive notion. In the following, I discuss this evidence and its implications for phonological theory.

There are at least three types of phonological representations argued for in recent literature:

I Fully-specified phonemic representation of SPE phonology and natural phonology (Stanley 1967, Chomsky and Halle 1968, Stampe 1973, Donegan and Stampe 1979)

II Redundancy-free archi-segmental representation (Hooper 1975, 1976, Rudes 1976).

III Fully-specified phonetic representation (Vennemann 1974, 1978, Leben and Robinson 1977).

In Hooper 1975, I argued against a model which has a phonemic representation with different feature values from the phonetic representation, on the grounds that such a model required conflicting generalizations at the underlying and surface levels, and required an arbitrary and unparsimonious division of rules into two types that apply at two levels. On the other hand, archi-segmental representations and fully-specified phonetic representation have identical consequences for the system of rules. I decided on the archi-segmental representation because it allows a lexicon of morphemes, while the other proposal required a lexicon of words.

It was noted at the time that all the arguments were formal, and that empirical evidence concerning underlying forms was simply not available. Most issues concerning underlying representations, especially in generative phonology, are decided on the basis of the rules posited. A typical argument goes as follows: since we have an independently motivated rule of English which devoices an obstruent following a voiceless obstruent, the underlying form of the plural morpheme must be

/z/ rather than /s/, which would require a voicing rule. More extreme instances of the same type of argument lead Chomsky and Halle 1968 to the postulation of an underlying low front rounded vowel in English as the representation of the diphthong in *boy*. This relation between rules and underlying forms, however, is not a necessary one, as shown by Vennemann's (1974) model in which rules apply vacuously to underlying forms. Thus, if there is any empirical evidence concerning the nature of underlying forms, it must be independent of the rules the linguist posits. Such evidence would seem very difficult, if not impossible to obtain, since underlying forms are not directly accessible to the native speaker or linguist.

It turns out, however, that much of the evidence we need is indeed available, if we turn our attention again to the study of phonological changes in progress. In the following sections we will examine evidence that suggests that restructuring of underlying forms is gradual both phonetically and lexically. The implication for synchronic phonology is that underlying representations cannot be composed exclusively of discrete contrastive structural units.

GRADUAL RESTRUCTURING

Labov begins his 1972b article on "The internal evolution of linguistic rules" by quoting Hockett on the necessarily abrupt nature of phonemic change.

> A phonemic restructuring . . . must in a sense be absolutely sudden. No matter how gradual was the approach of EME / æ: / and /ɔ: / towards each other, we cannot imagine the actual coalescence of the two other than a sudden event: on such-and-such a day . . . the two fell together as /a:/ and the whole system of stressed nuclei . . . was restructured. Yet there is no reason to think that we would ever be able to detect this kind of event by direct observation. (1958: 456-57)

Labov approaches the problem of reconciling the gradualness of sound change with the notion of a discrete and non-variable linguistic structure. But for Labov, too, changes in underlying forms must be abrupt. His rules are variable and account for some of the gradualness of sound change, but these rules always apply to underlying forms that remain unchanged.

In any theory in which underlying representations consist only of contrastive structural units, a change in underlying representations must be abrupt. Yet the facts of sound change as observed at close range show that all instances of a given "phoneme" do not change at the same time, nor do they change at the same rate. A sound change that has progressed to a certain extent in one lexical item could be at a more advanced stage in another lexical item, and at a less advanced stage in a third. As Ferguson and Farwell (1975) point out, this phenomenon cannot be accounted for if one maintains a strict separation of phonetic and phonological levels, it can only be accounted for by assuming that lexical items have their own particular phonetic shape. Let us briefly consider some examples of lexical diffusion.

Some recent discussions of lexical diffusion have unfortunately lumped together as "sound change" three very different types of change: phoneme substitution, morpho-phonemic change and phonetically-motivated change (Chen and Wang 1975, Leben and Robinson 1977, Krishnamurti 1978). One very accessible example from Chen and Wang will illustrate: they point to the steady growth of the class of diatones (N-V pairs differentiated only by stress, e.g. *abstract*, *addict*, *accent*) as a case of lexical diffusion, which it is. It is not, however, lexical diffusion of a sound change, but rather lexical diffusion of a morphological rule.

It is the lexical diffusion of a gradual phonetic change that bears directly on the issue of the phonological representation of lexical items. Sub-phonemic distinctions consistently associated with particular lexical items are common during periods of

variability or change in progress, indeed, at all stages. Consider, for example, the gradual loss of syllabicity in post-tonic syllables in American English (Zwicky, 1972; Hooper, 1976b, 1978).[1] This process takes place when schwa is followed by a liquid or nasal and another unstressed syllable: *every, camera, memory, scenery, nursery, family,* etc. We can distinguish at least three stages in the phonetic development: (1) total loss of syllabicity, as in *every* and *camera* (where the pronunciations with schwa would be unacceptable), (2) variable pronunciation between syllabic [r̩] and loss, as in *memory* or *family*, and (3) variation between [ər] and [r̩], as in *cursory* or *mammary* (where the pronunciation without syllabicity is unacceptable).[2] Ordinarily, one does not recognize for English phonemic syllabic liquids, since in most cases these syllabics are predictable from a schwa plus a liquid. Further, one hesitates to regard pairs such as *nursery, cursory,* and *memory, mammary* as instances of contrast. Nevertheless, there are phonetic differences associated with these particular words and many others, which are not "phonemic" differences.

If we view the lexicon as the component of the grammar that contains all the information that is idiosyncratic to particular lexical items, then some phonetic information (although it is not clear how much) must be included in lexical representations.[3] This does not mean that the productive process that produces the phonetic differences in question does not also exist in the grammar. More evidence is necessary, however, to determine precisely how a given lexical item and a productive process interact in any given utterance.

Another example of a phonetic change in progress is the aspiration (weakening to [h]) and deletion of final /s/ in various dialects of Spanish (Terrell, 1975, 1977; Hooper, 1977a). Following Terrell, we use three phonetic categories, although many more are recognizable. We will refer to [s], to [h], which results from the weakening of the lingual articulation of /s/, and to ϕ, which results from the loss of the glottal articulation of /s/.[4] The original phonetic change is the loss or assimilation of lingual articulation to a following consonant. Inside a word in Cuban Spanish the appearance of [h] is almost categorical before a C.

(1) Cuban Spanish

	s	h	ϕ	Number
__C	2%	97%	1%	1567
__## C	2%	75%	23%	2949
__## V	16%	50%	34%	1145
__/ /	63%	13%	24%	1488
				5582

The following are examples of /s/ in the environments shown in (1):

a. __C: word-internally before a C

Examples:		
	feli*h*mente	'happily'
	e*h*tilo	'type'
	dentista	'dentist'

b. __ ## C: word-finally before a C

Examples:
o se traen animale*h* finos
"or fine animals are brought"
haya muchos temas
"there were many themes"
suϕ detalleh
"his details"

c. __ ## V: word-finally before a V

y mientra*h* esa sonoridad asi
"and during this voicing thus"
no vas a encontrar
"you are not going to find"

d. __/ /: before a pause

en momento*s* / / libre*h* / /
"in moments" "free"

The situation when /s/ is word-final is much more complex, for here /s/ sometimes occurs before a C, sometimes before a V and sometimes before a pause. It is in these positions that deletion becomes a possibility, and aspiration becomes variable. We will return in section 3 to a discussion of the reasons for this, but for now it is enough to note that some lexical items behave very differently with respect to aspiration and deletion across a word boundary.

We will compare four sets of figures for different lexical items to get an idea of the range of variation. We will be interested primarily in the different phonetic realizations before V's, because the proportions in the other environments tend to remain steadier. Compare (2), which shows the percentage of [s], [h] and ϕ for *pues*, a common interjection, to the overall figures for the dialect:

(2) *pues* "well" tokens: 92

	s	h	ϕ
__ ## C	0%	68%	32%
__ ## V	6%	41%	53%
__/ /	75%	11%	14%

Note that *pues* shows fewer instances of [s] before ## V than the average and more instances of ϕ.

The numerals present quite a different picture, for here the percentage of [s] before a vowel is very high and the percentage of deletion is very low.

(3) numerals, *dos, tres, seis, diez* tokens: 190

	s	h	ϕ
__ ## C	3%	86%	11%
__ ## V	42%	42%	16%
__/ /	80%	14%	6%

The third person singular present indicative of the copula shows very high aspiration before a V, but low deletion and s-retention:

(4) *es* tokens: 466

	s	h	ϕ
__ ## C	3%	94%	3%
__ ## V	9%	83%	8%
__/ /	74%	17%	9%

Finally, *entonces* 'then' shows very high deletion before a C and before a V.

(5) *entonces* 'then' tokens: 209

	s	h	ϕ
__ ## C	1%	9%	90%
__ ## V	6%	6%	88%
__ / /	55%	6%	39%

Just considering these pre-vocalic figures we find variation for *pues* ranging from [h] to ϕ, for the numerals from [s] to [h], for *es* a more consistent [h] and for *entonces* a more consistent ϕ. These could be taken as their respective lexical forms, but the following factors must be taken into consideration.

First, the occurrence of [s] before a pause might argue that [s] may still be taken as underlying. The interesting point about the realizations before pause is that realizations in this position are the most consistent across lexical items. In every case the occurrence of [s] before pause is higher than anywhere else, and the favored realization before pause is consistently [s]. This consistency should be compared to the wild variability of realization before ## V. It should also be noted that *entonces* which has 90% deletion before ## C, has 55% [s] before pause. All this consistency is indicative of rule-governed behavior, while the variability before ## V is indicative of lexicalized differences. It seems that the phonetic vestige of /s/ is allowed to reach an [s]-like articulation before pause, because here no following articulations are exerting any influence on it.

Assuming that the pre-vocalic realizations are indicative of the lexical realization (for which the strongest argument is yet to come), we will have to make a number of phonetic distinctions lexically: at least the four mentioned above, corresponding to (2) - (5), and these will have to be distinguished from words that end in vowels, for words that end etymologically in vowels never have aspiration or [s] prepausally. Thus *entonces* cannot be represented as /entonse/, but rather must have an underlying final C, a very weak version of [h]. *Pues* will have a slightly stronger [h], *es* will have an [h] which is stronger still, and the numerals could have underlying [s] or a weakened [s].

Any structuralist theory (in which I include SPE-style generative phonology) would have an underlying final /s/ for all of these words, for [s] and [h] are, after all, complementary distribution. The full [s] occurs at the beginnings of syllables, [h] occurs syllable-finally before a C, and there is variation in other environments. Only one structural unit needs to be recognized to account for the phonology. Such a theory cannot, however, account for the lexical variation.

GRADUAL CHANGE IN THE LOCUS OF CONTRAST.

There are other types of evidence that lexical restructuring is gradual and that a distributional analysis will not necessarily yield a psychologically valid lexical representation. Hyman (1977a) discusses the gradual replacement of one phonemic distinction with another. We can take as one example a change that English seems to be undergoing at present concerning the contrastive status of obstruent voicing and vowel length. As is well known, English vowels (especially in monosyllables) are longer before voiced obstruents than before voiceless ones. Such a vowel length difference is found in many languages, but in English, the difference between the short and long vowels is much greater than in other languages where this difference is predictable (Chen, 1970). In casual speech in many dialects, the final obstruent is

devoiced. Thus a phonemic distinction between *pat* /p æ t/ and *pad* /p æ d/ becomes a distinction betwen /p æ t/ and /p æ :t/. Hyman points out that such a change is gradual and necessarily involves a stage at which the phonetic representation is the same, [p æ t] and [p æ :d], but the vowel length distinction has been analyzed as the contrastive feature and the obstruent voicing has become redundant, for only then can the voicing distinction be lost without losing the contrast between the two words.

This means that there are some cases in which phonetic features which are in perfect complementary distribution must nonetheless be considered contrastive. Since the change from predictable to constrastive for vowel length is a covert change, not reflected initially by a change in the surface forms, one might conclude that such a change can never be deteted. But this isn't so. There are a number of ways to determine contrastiveness other than by examining distributional patterns. In the case at hand, a number of perceptual experiments, beginning with Denes̆ (1955), have shown vowel length to be an important cue for distinguishing words with voiced and voiceless final consonants. Other evidence that vowel length is contrastive in English is presented in Hooper (1977b).

In cases such as this one, there is no necessity for even the covert change from one contrast to another to be abrupt. There is no reason, other than consideration of structural economy, for the speakers to choose one contrast over the other. It is possible that a group of two or more features may together supply the contrast, which means, again, that lexical representations must contain considerably more phonetic information than a phonemic representation.

Another example of a change in contrast from one feature to another is discussed in Hooper (1974, 1976a). Here it is seen that the new contrast is fully established while vestiges of the old contrast still appear in phonetic representation. This case involves the aspiration and loss of final /s/ in Andalusian Spanish (the Granada dialect, Alonso et al., 1950). The vowel in a syllable closed by /s/ was slightly lower than in a free syllable. As /s/ weakens, the vowel opens more.

The loss of final /s/ in Spanish means the loss of the plural marker in nouns and adjectives. In the Granada dialect, the height of the vowel takes on the function of signalling the singular/plural distinction. This is reinforced by a vowel harmony process that makes *all* the vowels of a plural noun or adjective more open than the vowels of the corresponding singular.[5]

Orthography	Singular	Plural	Gloss
pedazo	[peðáθo]	[pęðąθǫ]	'piece'
alto	[álto]	[ą́ltǫʰ]	'tall'
cabeza	[kaβéθa]	[kąβę́θą]	'head'
selva	[sélva]	[sę́lvą]	'forest'
lobo	[lóβo]	[lǫ́βǫʰ]	'wolf'
tonto	[tónto]	[tǫ́ntǫ]	'stupid'
piso	[piso]	[pi̯sǫʰ]	'floor'
fin	[fiŋ]	[fi̯nę̨ʰ]	'end'
grupo	[grúpo]	[grúpǫʰ]	'group'

Notice that in these transcriptions the aspiration that is the vestige of the plural /s/ is still present in most cases. Note also that [h] is in complementary distribution and alternates with [s], as in [boʰ] 'voice' [boseʰ] 'voices'. Despite this, we must conclude that final /s/ has been restructured as [h], or else there would be no reason for the vowel harmony system to have developed.

BOUNDARY PHENOMENA

The interaction of phonological processes with word boundaries, whether the boundary conditions or blocks the process, is an indication of restructuring. In either case the boundaries serve to indicate that the segments inside of them are behaving as though they belong to a particular word, which is equivalent to saying that the phonetic features in question are an inherent part of the word (Hooper, 1977a; Leben and Robinson, 1977).

As an example of a process that appears to be conditioned partially by word boundaries, let us consider again the data presented above from Cuban Spanish. The table showing the percentage of occurrence of [s], [h] and ϕ in the form environments is repeated here, with a similar table for Argentinian Spanish.

(6) CUBAN

		s	h	ϕ	# of tokens
_C	A	2%	97%	1%	1567
_## C		2%	75%	23%	2949
_## V					
	B	16%	50%	34%	1145
_//		63%	13%	24%	1488

(7) ARGENTINIAN

		s	h	ϕ	# of tokens
_C	A	12%	80%	8%	4150
_## C		11%	69%	20%	5475
_## V	B	88%	7%	5%	2649
		78%	11%	11%	2407

As I mentioned above, the original phonetic environment for the aspiration of /s/ is pre-consonantal position. This is evident from the fact that the degree of aspiration pre-consonantally is quite consistent whether or not the /s/ is word-final (whether or not a word-boundary intervenes). Comparing the A boxes in (6) and (7), it can be seen that although the process is less advanced in Argentinian, the lowest percentages of [s] occur before a C.

Now consider the development of aspiration before ## V. Note that aspiration never occurs before a V inside of a word in these dialects. Therefore, when aspiration occurs before ## V, it is occurring outside of its phonetic environment. It can be seen from the tables that this is a secondary development. In Cuban, where the process is well advanced, only 16% of the occurrences before ## V are [s], but in Argentinian there is still a high occurrence of [s] before ## V. In a traditional rule format we would have to say that the rule of aspiration had "generalized" from (8a) to (8b):

(8) a. $s \rightarrow h / \_\_ (\#\#) C$

b. $s \rightarrow h / \_\_ \begin{cases} (\#\#) C \\ \#\# V \end{cases}$

The problem with this description is that what appears to be a generalization of the process to more environments must be expressed as a complication of the rule. The fact that the expression of the rule cannot be improved upon suggests that this is not a rule generalization at all.

Note that (8a) has strictly phonetic conditioning, and that the parenthesized ## merely indicates that word boundaries are *not* relevant to the application of the process. In (8b), however, the obligatory ## indicate that the environment is non-phonetic, or lexical. The weakening of the /s/ is due to that C's position in the word. This fact is expressed very awkwardly by (8b) but very naturally by registering the aspiration as a part of the lexical representation of the word. That is, the reason [h] now shows up word-finally outside of its phonetic environment is that the [h] has become an inherent part of the word.

The difference between the Cuban and the Argentinian dialects is that restructuring is well along in Cuba but only just beginning in Argentina. It is interesting to note, also, the basis of the restructured form is the pre-consonantal form of the word (as opposed to the pre-pausal form as predicted by Vennemann 1974). The reason for this could be the greater frequency of the pre-consonantal environment. Compare the number of tokens for each word-final environment: the pre-consonantal position is more frequent that the pre-vocalic and pre-pausal positions combined.

I am suggesting, then, that all phonetic variation conditioned by the presence of word boundaries must be represented lexically. This would include the famous distinction between *nitrate* and *night rate*. The difference between these two sequences is in the position of the syllable boundary (e.g. [nay t^{h}reyt] vs. [nayt $reyt]), but the syllabication is based on the syntactic constituency, i.e. the fact that *night rate* is made up of two existing words. Thus when *night* occurs in the compound *night rate* it has a lenis [t] that is syllable-final, because the word *night* always has a syllable-final lenis [t]. This particular phonetic configuration is always associated with the word *night* and should be considered an inherent part of the lexical representation for *night*.

Does this mean that the difference between *nitrate* and *night rate*, this phonetic difference between the /t/ and the /r/, is phonemic? It does, if the criterion for phonemic status is the ability to distinguish between words, because it is this phonetic difference that distinguishes the two words. But if phonemic status implies that they are structural units with an existence independent of the words they occur in, then these different [t]'s and [r]'s are not phonemes. The reason that examples such as these have troubled linguists for so long is that the phonetic building blocks of a language — the phonemes — are *not* independent of the words they occur in.

The blocking effect of syntactic boundaries on phonological processes also leads to conclusions regarding lexical restructuring. To state the case very briefly, phonetic features positioned contiguous to a word boundary are always in an alternating environment. That is, the phonetic features on the other side of the boundary can vary considerably depending on the syntactic environment. Timberlake (1978) has shown that sound change progresses more slowly in alternating environments than in non-alternating environments. This is because restructuring occurs more readily in cases where the phonetic realization is more consistent. On the view that sound change *is* lexical change, the blocking effect of syntactic boundaries is easily explained.

To summarize, a process that makes reference to word boundaries, either as conditioning or blocking the process, should be represented as a process whose output is being lexicalized. There is a particularly clear argument concerning word boundaries as conditioning in Vennemann (1978). Here it is shown that certain sandhi phenomena in Sanskrit can be understood only as a rule inversion based on a restructuring of a phonetic variant that occurs word-finally.

PERIPHERAL PHONEMES

Peripheral phonemes — phonemes with defective distribution or low functional load — serve to illustrate the point that sounds are not totally independent of the words they occur in. Consider as an example the case of the German velar and palatal spirants. Their distribution is for the most part predictable: the velar occurs after back and central vowels and glides; the palatal occurs elsewhere, which amounts to positions after front vowels and glides and after /r, n, l/. The process involved is usually described as an assimilation of the velar to a preceding palatal

environment. However, in a few cases the palatal occurs outside of its phonetic environment. The diminutive suffix *-chen* always begins with the palatal spirant, even when it occurs after a back vowel, as in *Tauchen* [ç] "small rope" and *Pfauchen* [ç] "little peacock" which contrast with *tauchen* "to dive" and *fauchen* "to spit" which have the velar spirant. Further, certain loan words contain [ç] in initial position, and after a back vowel: *China* [ç] and *Photochemie* [ç].

This case has been the subject of some controversy (Moulton 1947; Leopold, 1948). Since [ç] has such a limited distribution, the analyst is reluctant to regard it as a full-fledged phoneme of German. Its distinctive function as part of the diminutive suffix cannot be denied, however. The only way around phonemic status for [ç] is to use a boundary (open juncture in Moulton's terms) to predict the occurrence of [c]. This is tantamount to saying that [ç] belongs in the diminutive suffix, which is the same as saying that [ç] belongs in the lexical representation of *-chen.* Furthermore, for the current situation, in which [ç] occurs after back vowels and glides, to have arisen, *-chen* must have had a lexical representation with [ç] *before* it ever began to appear after back vowels and glides. That is, *-chen* had restructured while the palatal was still predictable from the phonetic environment.

In general, cases of peripheral phonemes develop because words have *phonetic* representations consistently associated with them. New marginal phonemes such as [ç] could not develop if words had only phonemic representation.

CONCLUSIONS

In the foregoing, I have assembled several different types of evidence that all converge on a single conclusion, that lexical representations must contain a significant amount of phonetic material, or that there is immediate lexical restructuring of the output of productive phonetically-conditioned processes. I have drawn primarily on evidence from change in progress, but evidence from child language, particularly that of Ferguson and Farwell (1975), should also be mentioned. It is sometimes asked whether this type of evidence is more important than distributional evidence. The answer to that question is affirmative, because it has never been shown that *speakers* use distributional evidence, we only know that linguists find it useful in description.

The evidence presented here is known to most phonologists, but I'm not sure that its full import has been appreciated. In particular I would like to emphasize that this evidence shows that for phonetically-conditioned processes the issues of what's a rule and what's an underlying form are totally distinct issues and must be decided separately. This means that questions of parsimony — economy in the lexicon or economy in the rules (an issue that could never be decided anyway) — is totally irrelevant.

This evidence argues for the dialectologists' old motto "every word has its own history." But certainly this dictum is too strong. The words of a language do not differ from one another in an infinite number of ways. The phonetic shapes of words are restricted by the phonological processes and constraints whose existence is amply demonstrated by the way speakers treat new words. So what we have is a system somewhere in between one in which every word has its own history and one in which "tout se tient." In this system the function of a lexical entry is to record what is idiosyncratic about a particular item, which, as we have seen, may include some phonetic detail. The function of a phonological rule is to specify a range of phonetic realizations for a particular configuration of features.

Vennemann's (1974, 1978) model is the one that comes closest to accounting for the facts discussed here. Vennemann proposes that a lexicon consists of a list of the

words of a language in their "systematic phonetic" representation, citing Chomsky and Halle (1968) for a definition of "systematic phonetics."

Vennemann says:

> . . . a single kind of phonological structure is specified by a single set of phonological constraints, constraints which specify what is and what is not pronounceable in the language. (Note that 'pronounceable' must here be understood in the sense of what Chomsky and Halle call a 'systematic phonetic representation'; i.e. 'fast speech' rules and other kinds of 'variable' rules are assumed to apply to 'systematic phonetic representations' and are not considered here. This is not to deny the systematicity of such rules, but rather to distinguish between 'phonological rules (proper)' and 'variable rules', and between a 'systematic phonetic representation' on the other hand and a 'phonetic realization' in a given cultural, situational, and textual context on the other.)

Unfortunately, Chomsky and Halle (1968) do not define "systematic phonetic" representation. Chomsky (1964) says that the level of systematic phonetics is "the representation in terms of phones (and, possibly, phonetic junctures) that constitutes the output of the phonological component." (p 87). This definition, which presupposes a different theory, will not do to specify lexical representations.

Ladefoged (1977) presents a very clear definition of "systematic phonetic." For Ladefoged a systematic phonetic representation must contain enough information to distinguish an utterance from all other non-homophonous utterances in other dialects, and it must show the differences between languages, but not contain any universally predictable information, or any information due to individual differences among speakers.

Ladefoged is also referring to the output of a grammar here, but this characterization could fit into Vennemann's model. The problem is, as Vennemann realizes, that there may be more than one phonetic realization of a single lexical item, and for this reason Vennemann excludes variation that is the output of "fast speech" and "variable" rules. It is reasonable to assume that rules such as these apply to a very explicit, careful speech representation (Rudes, 1976; Hooper, 1976a).

The evidence we have examined in the section concerned with Gradual Restructuring, however, suggests that a systematic phonetic representation does not contain enough information. The difficulty lies with the phonetic differences between lexical items, such as between English *nursery* and *cursory*, Spanish *pues* and *es*. The differences between these items occur in a single dialect and do not solely distinguish non-homophonous utterances. Furthermore, it doesn't seem right to choose a single, perhaps most careful, representation for each of these items when they exhibit individual differences not just in their careful forms, but also in the degree or reduction allowed in their casual forms.

It seems, rather, that if we are to adopt a model such as Vennemann's, we must modify our notions of lexical representations and our notions of rule. A lexical item may not have a discrete representation, but rather consist of a specification of ranges of variation for features that comprise it. Rules may not specify absolute constraints on pronounceability, but rather they may specify possible ranges of variation. It is important to note here that all phonetically-conditioned rules or processes create variable output, so that a division of rule into variable and non-variable is not possible anyway.

In this paper I have examined a number of ways that the determination of underlying representation can be made an empirical rather than a formal matter. Work of this type needs to be extended considerably in order to determine exactly how much phonetic information is coded in lexical representations and how much

should be considered predictable. A possible hypothesis is that intrinsic variation is not represented lexically but extrinsic variation is (Hyman, 1977a). Further, while I have argued that restructuring is both lexically and phonetically gradual, it is still possible that some abrupt lexical changes occur also, especially in the language acquisition process. More detailed studies of lexical and phonetic change in progress will reveal the interaction of gradual and abrupt changes in restructuring.

Notes

1. Other examples of this type of lexical diffusion phenomena are found in Fidelholtz, 1975, and in Gerritsen and Jensen, 1979.

2. It is probably arbitrary to distinguish only three stages along this continuum of phonetic development. I have restricted the discussion to three stages in order to simplify it.

3. Generative formalism provides two devices that make it possible to avoid including subphonemic contrasts in underlying representations. One is a rule feature analysis, in which lexical terms are marked with a diacritic which triggers a schwa deletion rule. This is just a more complex way of marking the phonetic differences in the lexical item. A second method (brought up by M. Ohala during the symposium) allows the listing, in the rule, of the particular lexical items that undergo it. This is also a complex notational variant of including phonetic information in lexical entries, and has the further undesireable consequence of destroying the concept of a rule as a generalization that is superior to a list.

4. Terrell and his associates used taped interviews made with Cubans a few months after their arrival in Miami, and with Argentinians in Buenos Aires. In transcribing the tapes, Terrell and his associates found numberous allophones of /s/ occurring pre-consonantally: some voiced, some voiceless, some velar, some palatal, and so on, depending on the particular environment. These variants were divided into three categories in order to make the data manageable. The variant was transcribed as [s] if significant sibilance was detected, as [h] if the presence of a fricative consonant was detected, but without sibilance, and as ϕ if no consonant seemed to be present. This impressionistic method is not as reliable as an instrumental one, but the large number of tokens recorded makes the general figures reliable.

5. The tail under the vowel ([e̞]) indicates an open vowel. In the case of /a/ the more open variant is slightly fronted.