

On What to Teach the Undergraduates: Some Changing Orthodoxies in Phonological Theory

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Preprint version (1992).
Published 1995 in Ik-Hwan Lee, ed.,
Linguistics in the Morning Calm 3,
Hanshin, Seoul, pp. 59-77.

1 Introduction

Like many phonologists, I teach for a living, and a certain amount of what I teach is beginning generative phonology, for an undergraduate audience. Aside from its own inherent rewards, teaching at an elementary level can be useful in forcing one to give thought to matters that are important but not necessarily active topics in one's own research. In principle, a beginning course should teach the ideas that are truly fundamental, that are least controversial, and that prepare students to go on to more advanced work. Deciding what these ideas are is hardly a trivial matter.

In recent years I have grown slightly uneasy while teaching introductory phonology, since recent research has served to throw some of its basic ideas of "intro" into doubt. By this I refer to two areas: the theory of phonetic rules, and lexicalist approaches to phonology. Between them, they squeeze the old concepts in interesting ways.

The goal of this paper is to summarize recent developments in these areas, and assess their possible future effects on phonology in general. I do this not as a hand-wringing expression of angst for the future of the field; to the contrary, I will argue that for various reasons, phonological theory is likely to continue as a thriving research enterprise even if a radical shift should occur in our conception of its foundations.

The Seoul conference on which this volume is based had a theme: "New Directions in Linguistics for the 21st Century," a topic which might be taken by speakers as an invitation to predict the future. This is of course an impossible task; one risks saying things that will prove quite embarrassing if people in the future should actually read them. Let it be noted, then, that what follows is definitely speculative. I present it not as a prediction of how phonology will evolve, but rather as a way of pointing out areas where future investigation may be profitable.

2 Introductory Phonology

It is of course a matter of opinion which ideas in phonology are “foundational”. Here, I will only outline in brief what I have felt comfortable teaching as “basic phonology” in the past, in the hope that at least some readers will find it familiar. Then, I will describe some of the ways in which views concerning these ideas are changing in light of developments in phonetic rule theory and lexicalism. I conclude with some conjectures about the course of future research. In the following presentation of introductory phonology, expressions such as “it can be argued that...” or “it is believed that” have been dispensed with for the sake of brevity and vividness.

2.1 Phonemic Representation

All spoken languages are phonemic in character, i.e. their segmental representations can be reduced to sequences of symbols taken from a limited inventory, namely their set of phonemes.

2.2 Phonological Rules

Phonemes characteristically do not have an invariant phonetic realization, but vary both according to their phonological context and according to the style and rate of speech. Such variation is systematic, and can be encoded by phonological rules, which apply to the underlying representations of phonemes, to derive their variants or allophones. Such rules characteristically refer to natural classes of sounds, defined as complete sets of sounds within a given language sharing a set of phonetic properties. Where the realization of phonemes varies according to the rate or style of speech, this can often be attributed to optional phonological rules.

2.3 Neutralization

Besides deriving the allophones of phonemes, phonological rules can convert one phoneme to another. For example, the optional rule of Nasal Assimilation in English can convert underlying /n/ to surface [m], thus merging it with underlying /m/:

(1) *Nasal Assimilation*

$$n \rightarrow [\alpha \text{ place}] / \text{---} \left[\begin{array}{c} \text{C} \\ \alpha \text{ place} \end{array} \right]$$

<i>phone book</i>	/fo:n buk/	→	[fo:mbuk]
<i>foam book</i>	/fo:m buk/	→	[fo:mbuk]
(“directory of manufacturers of foam”)			

There are also phonological rules that convert two underlyingly distinct phonemes to a third surface value, as in the Flapping rule of (2).

(2) Flapping

$$\begin{bmatrix} -\text{continuant} \\ +\text{coronal} \\ +\text{anterior} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{sonorant} \\ +\text{continuant} \\ +\text{voice} \end{bmatrix} / [\text{consonantal}] \text{ ____ } \begin{bmatrix} +\text{syllabic} \\ -\text{stress} \end{bmatrix}$$

- a. *kitty* (hypocoristic of 'kitten'): /kítɪ/ → [kírɪ]
 b. *kiddy* (hypocoristic of 'kid'): /kídi/ → [kírɪ]

Together with cases of deletion, such examples fall under the heading of *neutralization*.

Neutralization rules can sometimes be ordered after allophonic rules. In certain cases, this produces a striking effect: we find minimal pairs that fail to prove a phonemic distinction, as in the following example from Upper Midwestern English (modeled on Chomsky 1964, 69):

- (3) /pæt+ɪŋ/ 'patting' /pæd+ɪŋ/ 'padding' underlying forms
 pǣtɪŋ — Vowel Shortening: V → V / ____ $\begin{bmatrix} C \\ -\text{voice} \end{bmatrix}$
 pǣɾɪŋ pæɾɪŋ (2) Flapping
 [pǣɾɪŋ] [pæɾɪŋ] output

Thus although there are surface minimal pairs in this dialect for [ǣ] vs. [æ], these sounds are not distinct phonemes, since the distinction is derivable by rule.

2.4 Phonology, Grammatical Organization, and Alternation

The phonology typically acts as an interpretive component with respect to the rest of the grammar. The morphemes and words that are concatenated by syntactic and morphological rules are represented as sequences of underlying phonemes. After they have been concatenated, the result is submitted to the sequence of phonological rules in order. Since the rules will apply according to environments arranged by the morphology and syntax, morphemes are observed on the surface (following phonology) to take on different forms, or *alternate*. Thus the underlying morpheme /pæt/ is realized as [pæɾ] when the morphology or syntax has provided a following vowel to trigger the Flapping rule (e.g. in *patting* or *pat it*), and as [pæt] when the morphology or syntax place it before a consonant or pause (*pat the dog*, *They will pat*).

2.5 Deduced Underlying Forms

In many instances, the information needed to establish the underlying form of a morpheme is not present in the surface form of the morpheme as it is pronounced in isolation. Thus the isolation surface form [ra:t] in German can be either underlying /ra:d/ 'wheel' or /ra:t/ 'advice', due to a rule that devoices all obstruents in final position. The underlying form can be determined when the morphology adds a vowel-initial suffix, protecting the final obstruent from devoicing:

(4) ‘wheel’	‘wheel-gen.’	‘advice’	‘advice-gen.’	
/ra:d /	/ra:d-əs/	/ra:t/	/ra:t-əs/	
t	—	—	—	Final Devoicing: [-sonorant] → [-voice] / ___ #
[ra:t]	[ra:dəs]	[ra:t]	[ra:təs]	output

Language learners (and analysts) must consult the contextual forms in order to learn the underlying forms.

3 Phonetic Rules

An important aspect of the account of “introductory phonology” above is its reliance on neutralization. If phonological rules never merged together distinct underlying representations, then the computations they carry out would be quite different in character.

In this respect it is interesting to examine carefully the examples of neutralization given above, since they have been used by numerous phonologists over the years to teach the concept. Recent work suggests that few if any of these examples actually involve neutralization.

For example: it appears from the work of Barry (1985) and Nolan (1992) that the underlying forms /fo:n buk/ (*phone book*) and /fo:m buk/ (*foam book*) do not merge completely, but only partially. In particular, *phone book* contains a nasal segment that is both alveolar (as a result of its underlying form) and bilabial (as a result of its assimilation to the following /b/. This articulatorily complex segment could be transcribed in ad hoc fashion as follows:

(5) [fo: $\left\{ \begin{matrix} m \\ n \end{matrix} \right\}$ buk]

More precisely, the “n” component of the assimilated segment is articulated to a variable degree, ranging from full closure to only a slight tongue-blade raising gesture.

To be sure, the listener usually cannot detect the difference between [fo: $\left\{ \begin{matrix} m \\ n \end{matrix} \right\}$ buk] and [fo:m buk]. Clear evidence for this is the common misspelling *imput* for *input*, which apparently reflects a relexicalization based on assimilated forms heard from other speakers. But in principle, nonperceptibility is irrelevant: assuming that we seek to characterize the internalized rule system of the speaker, then our analysis of that system should characterize distinctions in its output precisely, even where such distinctions are perceptually almost useless.

The sobering character of this example for phonologists should be apparent: by relying on traditional phonetic observation instead of instrumental measurements, phonologists have for decades mistaken a case of allophonic variation for a case of neutralization.

Consider another example, the case of final devoicing in German. This has been used not only as an instance of neutralization, but also to justify the idea of deduced underlying forms (§2.5). Here again, careful phonetic work suggests that subtle phonetic differences exist between

underlyingly voiced and underlyingly voiceless final obstruents in German. In fact, an expanding literature, discussed in Dinnsen (1985) and Port and Crawford (1989), has taken on many of the final devoicing rules found in European languages and shown them to be phonetically non-neutralizing.

The third example of neutralization cited above, that of Flapping, may also be non-neutralizing. Most studies that have examined Flapping phonetically (cf. the reviews in the references just cited) have found subtle differences between words like *latter* and *ladder*, often involving the length of the preceding vowel.¹

The spirit of recent work in phonetic rules (cf. Pierrehumbert 1980, Liberman and Pierrehumbert 1984, Pierrehumbert and Beckman 1989) is that the commonly accepted model of phonology, in which one symbolic, categorial representation is derived by a sequence of rules from another, is inappropriate for many rules. The model these authors propose instead is one not of translation but of *implementation*: the phonological representation is given a physical, quantitative interpretation in space (position of articulators) and time. In such a model, the output of the rules is expressed in continuous phonetic rather than categorial phonological representations. A phonetic representation forms a realization of the phonological structure, but does not replace it (Pierrehumbert 1980).

All of the cases of neutralization noted above plausibly involve phonetic implementation, rather than categorial substitution of one phonological representation for another. In particular, they all appear to involve the gradient phonetic properties (e.g. duration, or degree of closure) characteristic of phonetic rules.

Given the enormous (i.e. infinite) number of possible outcomes when continuous values are allowed, it should not be surprising if distinct phonological representations normally are implemented as distinct phonetic representations.

4 Lexicalism

In the outline of introductory phonology given above, phonological rules have a purely interpretive function, that of providing a phonological realization for the outputs of the syntax and morphology. The rise of lexicalism and theories of lexical organization has offered an interesting alternative.

In a lexicalist approach it is possible to think of the lexicon as an “organized database.” In this view, rules may apply “within the lexicon” to relate listed entries rather than to derive one entry from another. This idea extends the view of Aronoff (1976), who suggests that the rules of derivational morphology serve to relate existing items as well as deriving new ones.

Such a view of lexicalism is based on the common-sense notion that items are more easily memorized if they fall into patterns. As a simple example, consider that metered verse is easier

¹ Port (1981) and Keating (1985) report neutralizing Flapping in Eastern American dialects, though there is always the possibility that more intensive investigation would uncover a phonetic difference.

to memorize than prose; the metrical pattern does not allow *prediction* of the words of the line, but the redundancy it embodies makes the line easier to remember. An analogous claim for the lexicon would be that *serenity*, though memorized, is easier to remember due to the morphological and phonological rules that relate it to *serene*.² This conception is illustrated below:

(6) /səri:n/ /səri:niti/ lexical entries

Adjective + /iti/ → Noun }
 i: → ε / ___ C₀VC₀V } lexical rules relating the entries

As Aronoff made clear, lexical rules often are used productively as well, in generating new forms. For instance, Liberman and Prince (1977, 294) apparently created the word *extrametricality*, deriving it from *extrametrical* by affixation of *-ity* and application of the lexical stress rules. Similarly, when as a speech error I once said [diró:v] as the past tense of *derive* (cf. Jaeger 1983, 76 for a similar case), it seems probable that the source of the error was the lexical rule that derives past tenses like *wrote*, *rode*, *rose*, *drove*, *shone*, etc.

Psycholinguistic evidence provides some support for the view that lexical rules mostly serve to characterize existing items in the lexicon, rather than applying “on-line” as in §2.4 above. For example, stress in English, which is derived by lexical rules, appears to serve as a crucial organizing principle for lexical access; see evidence cited by Selkirk (1980, 597). Experiments testing the “psychological reality” of lexical rules seem to give more positive results when they involve memory tasks rather than on-line rule application (Cena 1978, Jaeger 1983, Wang and Derwing 1983); again, this suggests that lexical rules normally serve as organizing principles that aid in memorizing the lexicon, rather than as on-line rules for production. Further interesting support for the claim that lexical rules may relate listed items may be found in the experimental work of Stemberger and MacWhinney (1988).

The dominant theory taking the lexicalist approach within phonology is of course the theory of Lexical Phonology (see Kiparsky 1982a and much other work). Of researchers in this area, it has been K. P. Mohanan (1982, 1986) who has argued most seriously for the psycholinguistic interpretation of lexical phonological rules described above, as serving to relate existing items rather than deriving output forms on line. Thus, for Mohanan a form like *divinity* is phonemically /divínti/, with a short rather than a long stressed vowel. To be sure, a lexical rule of Trisyllabic Shortening serves to relate /divínti/ to *divine* /diváyn/, but both constitute independent lexical entries. For this reason, it is possible to argue that native speakers do not store any kind of representation like /diváyn+iti/ or /diví:n+iti/, a claim that Mohanan supports with a number of arguments.

² These ideas are of course not original with the lexicalist movement; see in particular discussions of the same notions in the Natural Generative Phonology literature of the 1970's, for example Vennemann (1974, 154).

4.1 Indeterminate Lexical Rules

The idea of rules that relate listed lexical entries is compatible with a further possibility: lexical rules that are indeterminate in their outcome. Consider, for instance, the alternations found in English when a stressless syllable, containing schwa, is assigned stress following addition of a suffix:

- (7) [ə] ~ [æ]: métal ~ metálic
 [ə] ~ [ɛ]: élement ~ eleméntal
 [ə] ~ [ɪ]: áctive ~ actíivity
 [ə] ~ [a]:³ psychólogy ~ psycholólogical
 [ə] ~ [ʌ]: illustrate ~ illústrative

Traditionally (e.g. in Chomsky and Halle 1968), these alternations are analyzed by setting up base forms like /metəl/, and applying a rule of Vowel Reduction that converts to schwa all vowels that have not been assigned stress by the stress rules.

Here is an alternative: we set up the underlying form of *metal* as /metəl/, similar to the isolation form. In the derived form /metəl+ɪk/, stress is assigned to the penult by the lexical stress rules, then a rule of Full Vowel Restoration converts a stressed schwa into a short full vowel in the derived form.

(8) *Full Vowel Restoration*

$$\left[\begin{array}{c} \text{ə} \\ +\text{stress} \end{array} \right] \rightarrow \left[\begin{array}{c} \text{V} \\ -\text{long} \end{array} \right]$$

The quality of the vowel created by Full Vowel Restoration (here [æ]) need not be specified in the rule, since the output form is itself a lexical entry. Since Full Vowel Restoration serves only to relate listed lexical items, it can be expressed indeterminately (this idea corresponds to the “via rules” of Natural Generative Phonology; cf. the work of Vennemann 1972, 1974). Note that the Vowel Reduction would also be retained in the grammar, to derive the initial reduced vowel in *metallic* [mətæɪɪk] and similar forms.

A bit of evidence supporting Full Vowel Restoration is the widespread pronunciation by linguists of the feature name *consonantal* as [kənsənɛntəl], in spite of its spelling. It is extremely unusual for orthographic *a* in English to have the phonemic value /ɛ/. The pronunciation nonetheless seems to follow a clear pattern of English phonology: when [ə] occurring in the environment / ___ nt is assigned stress upon suffixation, the vowel that emerges is [ɛ]; cf. *environmental*, *accidental*, *momentous*, *residential*, *penitentiary*, etc. We hypothesize that alongside the generally indeterminate rule of Full Vowel Restoration, we also have a determinate subcase:

³ [ɒ] for many dialects.

(9) /ε/ Restoration

$$\left[\begin{array}{c} \text{ə} \\ +\text{stress} \end{array} \right] \rightarrow \varepsilon / \text{ ____ } \text{nt}$$

The generalization embodied in this rule is extended to *consonantal*, even in the face of orthographic evidence.⁴

An alternative to /ε/ Restoration would be to seek an explanation at the underlying level of representation: perhaps speakers internalize the principle that the only vowel allowed *underlyingly* before final /nt/ is /ε/. But this cannot be right, because in cases where the underlying vowel surfaces with stress in the isolation form, it can have other qualities: cf. *implant*, *ant*, *stunt*, *gallivant*, *affront*, *haunt*, etc. All that the language really constrains is what may alternate with [ə] when [ə] appears before /nt/ in the isolation form. This is what (9) accounts for.

English stress, as treated in Hayes (1982, 236-7), appears to be a similar case of indeterminate lexical rules. The stress rules specify a range of possible patterns, to which lexical entries must conform. However, for most words it is not possible to predict stress from the segments of the lexical entry: compare for example *Pámela* with *vanílla*. As noted above, there is evidence that stress in English is lexically listed.

Summing up, it appears that there is something to be gained from the view that phonological rules are not strictly interpretive, applying to the output of syntax and morphology. Rather, a subset of rules is lexical, serving as an organizing principle for the lexical database. Aside from the ordinary rules of lexical phonology, we have considered in addition the possibility of indeterminate lexical rules.

5 Consequences

Let us now consider some possible consequences of the theories of phonetic rules and lexicalism.

⁴ A computer dictionary search revealed three exceptions to /ε/ Restoration: *elephantine* (with [æ], but for some speakers initial stress and [ə]), *infanticide*, and perhaps *Constantinople*, if the latter is derived from *Constantine*. With the suffixes *-al* and *-ial*, /ε/ Restoration is exceptionless, other than for those linguists who follow the orthography in their pronunciation of *consonantal*.

Donca Steriade (p.c.) notes that we expect Full Vowel Restoration to restore the same vowel in different derived forms, e.g. in *solid* [sáləd], *solidity* [səlídəti], *solidify* [səlídəfay]. These may perhaps be attributed to etymology (i.e. the form these words had before English acquired full Vowel Reduction), or else to speakers' ability to employ orthography in devising a stressed vowel to derive from schwa. If such explanations turn out not to suffice, clearly our account of Full Vowel Restoration would need amplifying, e.g. by splitting Full Vowel Restoration into different rules for different vowels, and associating particular rules with particular stems.

5.1 The Attack on Neutralization

First, Dinnsen (1985) suggests the possibility that there is no neutralization at all. If we are to take this at all seriously, I think we must take it in a particular sense. Consider for instance the rule of Trisyllabic Shortening in English, which has the following central effects:

(10) *Trisyllabic Shortening*

$$\left. \begin{array}{l} \text{ai} \rightarrow \text{i} \\ \text{i:} \rightarrow \text{ɛ} \\ \text{e:} \rightarrow \text{æ} \\ \text{o:} \rightarrow \text{a}^3 \end{array} \right\} / \text{--- } C_0 \left[\begin{array}{c} V \\ \text{-stress} \end{array} \right] C_0 V$$

Now, if Trisyllabic Shortening were non-neutralizing, then we would predict that there should be subtle phonetic differences between the [ɪ] of *divinity* (derived from a long vowel; cf. *divine*) and the [ɪ] of *virginity* (underlyingly short; cf. *virgin*); similarly with [ɛ] in *serenity* and *rennet*, [æ] in *opacity* and *pacify*, and [a] in *conical* and *Conable*. This strikes me as quite unlikely, though obviously studies should be carried out to be sure.

Assuming for purposes of argument that there is no difference, we could plausibly attribute this to the fact that Trisyllabic Shortening is unproductive. It suffers from a numerous and expanding set of exceptions (e.g. the neologism *national* [né:ʃənəl]), and does not do too well in psychological tests that require it to be extended productively (see Jaeger 1983, Wang and Derwing 1983, and references cited there). If, as seems plausible, Trisyllabic Shortening has an attenuated status as a phonological process (i.e. represents a lexical regularity rather than applying on-line), then we might be able to retain Dinnsen's claim that true, productive rules of sound structure do not neutralize.

This brings up the possibility raised by Liberman and Pierrehumbert (1984): that (possibly with certain exceptions) *all* phonology might ultimately be redistributed between the theory of phonetic rules and the theory of lexical organization. Under such a view, essentially all of the content of "undergraduate" phonology disappears: insofar as rules apply postlexically, they are phonetic and gradient, and insofar as they treat discrete categories, they are part of the lexicon rather than applying to the output of syntax.

I have sometimes had this impression myself when doing descriptive work in collaboration with a native speaker consultant. Of the Ilokano rules studied in Hayes (1989) and Hayes and Abad (1989), all struck me at the time of research as falling into one of the two categories discussed here: either they seemed phonetic in character, so that my conventional phonetic transcription represented an overidealized categorization of continuous data, or they struck me as not fully productive, lexicalized rules.⁵ At the time I occasionally wondered, "Where is the normal phonology that I was trained to study?"

⁵ For the interested reader, the rules which seem phonetic are Glide Formation (with compensatory lengthening), Palatalization, and Glottal Deletion.

The sensible descriptive worker must of course present the facts in an organized and intelligible way, and the discrete symbols of phonetic transcription are a useful tool for doing this. Still, I am led to wonder to what extent the phonological data in descriptive grammars might be over-idealized for purposes of clarity.

The position that all rules are either phonetic or lexical must be taken at present as a radical one, given the massive descriptive literature that recognizes neither type of rule. Still, it seems worthwhile reexamining earlier cases in light of the proposal.

5.2 Deduced Underlying Forms and Kuryłowicz's Second Law

As defined in §2.5, a deduced underlying form is one that cannot be determined from the isolation form of a morpheme. Perhaps the clearest evidence that has been taken to support the existence of deduced underlying forms has been cases of final devoicing, such as German /ra:d/, /ra:t/ → [ra:t]. Given the evidence that the two [ra:t]'s are not actually the same, it would seem that the underlying forms here are not necessarily deduced.

Children at the age of language acquisition have been shown to have phonetic sensitivity surpassing that of adults in many respects; see for example Werker and Tees (1984). Thus it is hard to exclude the possibility that German children can learn that the words for 'wheel' and 'advice' have different underlying representations simply by listening to the surface forms. Even for adults, it has been shown (e.g. by Port and Crawford 1989) that the surface forms can be discriminated at a better-than-chance level.

Final Devoicing is probably the most commonly cited example in which phonological base forms are claimed not to be deducible from isolation forms. If the final devoicing examples are in doubt, what might be the general status of deduced isolation forms?

For the sake of argument, let us suppose that the following is a general strategy of phonological acquisition:

(11) "**K2L**"

In establishing the base form for a phonological alternation, assign priority to the phonetic evidence of isolation forms.

The terminology "K2L" is intended to evoke "Kuryłowicz's Second Law", as (11) is inspired by the Second Law of Analogy of Jerzy Kuryłowicz (1945-9). Kuryłowicz proposed that "Analogy proceeds from a base to a derived form." Since Kuryłowicz had quite different notions of what a "base form" is, the parallel is only a loose one, and the use of the abbreviation is intended to remind the reader of this. In essence, K2L claims that deduced underlying forms are disfavored, since to arrive at them the language learner must consult evidence from derived forms. A proposal akin to K2L has been made earlier by Vennemann (1972).

Do language learners use K2L as part of their acquisition strategy? There seems to be some evidence that they do:

(a) Eastern Ojibwa is a classic example of the kind of data that require deduced underlying forms. At least historically, the language had a pattern of left-to-right alternating stress, followed by deletion of stressless vowels, as in (12).

(12) a. ‘he teaches him’	b. ‘I teach him’	(Kaye 1974, 246-247)
/gigino:ʔamaw-a:d/	/ni-gigino:ʔamaw-a:/	underlying forms
gígínó:ʔamáwá:d	nígígínó:ʔamáwá:	Alternating Stress
gØgino:ʔØmawa:d	nØgigØno:ʔØmawa:	Syncope
kino:ʔmawa:d	—	gg → k
kino:ʔmawa:t	—	Final Devoicing
—	ŋgigno:ʔmawa:	Nasal Assimilation
[kino:ʔmawa:t]	[ŋgigno:ʔmawa:]	output

To infer the underlying representation /gigino:ʔamaw/, the language learner would have had to patch it together using information from both the prefixed and unprefixed allomorphs: the prefixed form for /gig/, and the isolation form for the second vowel. Kaye (1974) and Rhodes (1985) observe that this system was unstable, and highly vulnerable to restructuring. For example, the alternating forms above arguably are in the process of being restructured, on something like the following lines (cf. Kaye 247, Rhodes 467):

(13) a. /kino:ʔmaw-a:d/	b. /nda-kino:ʔmaw-a:/	underlying forms
—	nda-kØno:ʔmawa:	Syncope
kino:ʔmaw-a:t	—	Final Devoicing
[kino:ʔmawa:t]	[ndakno:ʔmawa:]	output

Observationally, what happens is that the old isolation form remains the same, but a new prefixed form replaces the old. As a synchronic account of the reanalysis, I conjecture that the new underlying form is as indicated, and that Syncope has been restructured so as to delete short vowels only in derived environments, perhaps: /V + C₀___]_{syl}; the data do not suffice to determine this fully. Although it remains unclear what the correct synchronic analysis for restructured Eastern Ojibwa is, it does seem fairly clear (from these and other data) that in the new system, the isolation form of a stem largely suffices to determine its underlying form.

(b) In my experience in teaching beginning linguistics students how to transcribe English phonetically, I find that they readily mistranscribe a full vowel instead of [ə] when the full vowel occurs in the base form, as in *metallic* [mætɛlɪk], mistranscribed *[mɛtɛlɪk]. They do not mistranscribe [ə] in the base form on the basis of its appearance in a derived form, e.g. *[mɛtɛl]. My suggestion is that the students “hear” their underlying forms (Sapir 1949), which following K2L would be /mɛtəl/, /mɛtɛlɪk/. If these underlying forms are correct, then at least some alternations of full vowels with schwa in English must be due to indeterminate lexical rules of Full Vowel Restoration, as in §4.1.

(c) It is important not to confuse K2L with a different principle of analogy, namely that alternation within a paradigm tends to be reduced (see for example Kiparsky 1982b, 101). In fact, sometimes the effect of K2L is to *increase* the degree of alternation, as in the following case. In Turkish, we find the basic pattern of data that has been taken to motivate a Final Devoicing rule:

- (14) a. dib-i ‘bottom-accusative’
 dip nom.
 b. hep-i ‘all, the whole-accusative’
 hep nom.

But in polysyllables, there is a striking pattern: *all* forms that have a voiceless obstruent when final have a voiced one when suffixed (Lewis 1967, 11):

- (15) a. prensip ‘principle-nom.’
 prins**i**b-i ‘principle-acc.’
 b. şerit ‘tape’
 şer**i**d-i ‘tape-acc.’

The forms of these words in the languages from which they are borrowed is significant: French *principe* and Arabic *şarīṭ*.

What is going on? One fact to note is that unlike other European Final Devoicing rules, the Turkish rule has exceptions, such as *Ad* ‘proper name’, *serhad* ‘frontier’ (Kaisse 1986). Thus it is less likely to be a rule of phonetic implementation, as in the other cases. If this is the case, then the data pattern in (14) is one that cannot be handled in ordinary terms without violating K2L.

I conjecture that Turkish speakers internalize the following analysis: underlying forms correspond to isolation forms, and there is a voicing rule, rather than a devoicing rule:

(16) *Turkish Presuffix Voicing*

$$\left[\begin{array}{l} \text{-sonorant} \\ \text{-continuant} \end{array} \right] \rightarrow [+voice] / \text{ ___ } + V$$

This rule would apply regularly within polysyllables, and also to certain lexically-marked monosyllables, with underlying representations: /dip/, /hep/, /prensip/, /şerit/. Such an analysis (inspired by Lewis 1967 and Zimmer 1974) respects K2L.

(d) The nature of the phonological cycle seems to reflect K2L. The cycle is a formal means within the grammar to make derived forms resemble base forms: because e.g. *assimilation* is cyclically derived from *assimilate* (Chomsky and Halle 1968), its stress pattern resembles that of *assimilate*. The same point could be made from almost any other proposed instance of cyclical

rule application in phonology. To my knowledge, no one has ever proposed a reverse cycle, in which base forms inherit the phonological properties of derived forms.

(e) Kiparsky (1973, 1982b) has noted a strong tendency for obligatory neutralizing rules to become “derived-environment” rules. Such rules do not apply within roots, but only when affixes are added to a root. Kiparsky’s observation is compatible with the language-acquisition strategy implicit in K2L: memorize the roots, and posit phonological rules to account for what happens when affixes are added to roots. What is not done is to posit phonological rules to account for the shape of the root in isolation.

For further examples supporting K2L, see Hale (1973) on Maori suffixal allomorphy, Vennemann (1972) and Wells (1982, 222-227) on /r/ Insertion in English dialects, Schuh (1972) on Klingenberg’s Law in Hausa, and the example of /ε/ Restoration above.

It is crucial that the examples discussed here include reanalyses in which the phonological alternation actually survives, rather than being leveled out. Consider in contrast a well-known case from Latin: *honor* analogically replaced the isolation form *honos* as the nominative singular of ‘honor’, based on the widespread appearance of *honor* in inflected forms (e.g. gen. *honor-is*), as formerly derived by a rule of Rhotacism ($s \rightarrow r / V _ V$). Here, in the restructured system the alternation is wiped out, the new underlying form is /honor/, and the $s \rightarrow r$ rule has no role to play.

K2L should thus be taken as governing how language learners “do phonology”, and not necessarily how they do morphology. It is possible for language learners to employ their internalized morphological parsers and deduce the “incorrect” /honor/ as a base. What they do not do, it is conjectured, is set up phonological analyses that make use of such bases as underlying forms. That is, phonology is something which “happens to a stem when an affix is added.”

It may clarify this point to consider a hypothetical analogical change that violates K2L: suppose Latin speakers had misinterpreted the *honos* ~ *honoris* alternation as the result of a rule $r \rightarrow s / _ \#$, applied to the deduced underlying form /honor/. This would have resulted in a shift elsewhere in the language: forms that had previously had stem-final /r/ across the board would have acquired /s/-final allomorphs in isolation. I conjecture that such cases of analogical change do not occur, and that K2L is the reason.

The possibility of a phonological theory that respects K2L seems worth exploring for theoretical as well as empirical reasons. In particular, the theory of lexical phonology might be tightened considerably, in particular by eliminating the class of lexical post-cyclic rules, which crept into the theory during the mid-1980’s (Halle and Mohanan 1985, Booij and Rubach 1987) as an accretion—unwanted a priori, but thought at the time to be empirically necessary. Such a move would also make it possible to restore Mohanan’s (1982) very constrained view of the phonological cycle: the output of each cycle is a lexical entry, and consists of a phonemic string which is “spelled” in a lexical alphabet and which serves as the locus of the native speaker’s maximal conscious phonological awareness. Thus, proposed jer-strewn representations of Slavic languages, or putative /mn/-final words of English, neither of which pass Mohanan’s tests for

native speaker awareness, would be discarded under a K2L-obeying theory, and the cyclic phonologies of Slavic and English would again satisfy Mohanan's stringent criteria.

I conclude this section with a caveat. Despite the appeal of K2L, it strikes me as quite premature to propose it as an iron-clad law of phonology. One potential obstacle to a general statement K2L is the phonology of Korean, where we find the same general pattern as in German Final Devoicing. The difference is that in Korean, the final consonant of the isolation form can alternate with not just two, but with up to eight different contextual forms. This is illustrated by the chart below, which follows work of N.-K. Kim (1987), Hong (1991), and S.-H. Kim (1992):

(17) *Word-Final* *Alternates with Prevocalic*

[pʷ]	[p, p ^h , p', ps, lp]
[tʷ]	[t, t ^h , t', č, č ^h , č', s, s']
[kʷ]	[k, k ^h , k', ks, lk]

If K2L is correct, either these alternations are phonetic (with subtle, as yet undetected distinctions in the isolation forms), or else they reflect a massive system of indeterminate lexical rules.

The work of Hong (1991) bears interestingly on the question of K2L in Korean. Hong documents an analogical change in progress whereby forms like *kaps-i* 'price-nom.' are gradually being replaced by forms like *kap-i*. This is just the sort of change we would expect under K2L, given that /s/ would not appear in the isolation form. Under this assumption, we might expect that the conservative variant *kaps-i* would be derived from /kap/ by an indeterminate lexical rule. Clearly, further work, including phonetic studies, could yield additional insight into the status of K2L in Korean.

5.3 Phonological Theorizing in General

Current phonological research pursues many different directions. Among those not named above are research in syllable structure, in metrical theory, in multiple tiers and the structure of the segment, in prosodic morphology, and in underspecification. Let us suppose for the moment that the (quite speculative!) suggestions made above are all correct, and hence that "undergraduate phonology" must be submitted to massive revisions. To what extent would such radical restructuring affect phonological research in general? Current work often indicates in various ways that it presupposes some of the ideas of conventional "undergraduate phonology". But the extent to which research results depend on the validity of those ideas must be evaluated on a case by case basis.

One example can be given suggesting that at least some current research might be propelled in different directions by more attention to the developments outlined above. It is argued in a number of works (e.g. in many of the papers in Paradis and Prunet 1991a) that coronal consonants are characteristically underspecified for place of articulation; i.e. that phonologies treat the coronals essentially as placeless consonants, with their phonetic place of articulation determined by late rules. One argument that has been presented in favor of this view (e.g. by

Paradis and Prunet 1991b, 9) is that coronals characteristically are the segments that most often undergo assimilation; the general premise being that assimilation tends to affect unspecified segments.

The observations by Barry and Nolan noted above concerning coronal assimilation in English throw this argument into doubt. English is in fact one of the languages in which coronals (specifically, alveolar non-continuants) undergo assimilation, and non-coronals do not. Now, if the relevant coronals in English were underspecified, there would be no way to ensure that the phonetic outcome for *phone book* would be eligible for coronal fill-in, since the assimilation rule would already have assigned labial place to the final segment of *phone*. Thus the underspecification account wrongly predicts neutralization here. This suggests that the explanation for the special vulnerability of coronals to assimilation must be sought elsewhere.

However, despite the existence of such cases, I think in general that a great deal of current phonological research would not be greatly affected by a radical restructuring of “undergraduate phonology”. The reason is pointed out by McCarthy (1989): in recent years, phonological research has tended to focus increasingly on the structure of phonological *representations*, rather than on phonological *rules*. Such representations include syllable structure, phonological phrasing, metrical structure, and feature trees. As McCarthy notes, when we get the phonological structures right, it is often the case that the problems raised by the phonological rules are greatly simplified.

Now, even rules of phonetic implementation refer crucially to phonological structure, in fact, often the very kinds of phonological structure that form the central focus of current work. For example, Pierrehumbert and Beckman (1989), in their ground-breaking work on the phonetic rules of Japanese, insist quite strongly that the phonetic rule system cannot be understood outside of a well-articulated theory of phonological structure, in particular of syllables, moras, and hierarchical phrasing. Kahn’s (1976) work on Flapping shows that a full understanding of this rule is impossible without a sophisticated account of English syllabification. German Final Devoicing likewise has a subtle and interesting syllabic structural description, described by Rubach (1990).

The point is that irrespective of whether we treat rules as phonological or phonetic, the phonological structures that guide their application are crucial to an adequate understanding.

On the opposite, lexical side of the system, recent work in Prosodic Morphology (e.g. McCarthy and Prince 1986 and other work) has shown a fascinating connection between non-concatenative morphological processes (e.g. reduplication and Semitic-type morphology) and the theories of syllable weight and metrical structure. That is, the basic categories of prosody appear to form the system of “measurement” employed by lexical rules that copy or rearrange phonological material. Just as with phonetic rules, it appears that when we get the phonological structures right, the rule systems we study are simplified and illuminated.

To conclude: I have raised the possibility that much of the content of “undergraduate phonology” could disappear, replaced by newer and better-supported assumptions about the organization of the grammar and the division between phonetics and phonology. Should this

happen, however, it would hardly result in the disappearance of phonology as a field, since the current main focus of phonological investigation, namely on phonological structure, would continue to be crucial to our understanding even in a conceptually very different theory. Phonology at the frontiers of research would not be undermined by changes in the basic assumptions of “undergraduate phonology”; rather, it would be seen to have outgrown those assumptions.

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