REMARKS ON VOICING PHENOMENA: WITH SPECIAL REFERENCE TO ENGLISH AND POLISH

PIOTR RUSZKIEWICZ

Pedagogical University of Opole

The present paper concerns itself with selected aspects of voicing phenomena in English and Polish viewed as:

(1) changes of voiced segments to voiceless segments, and

(2) changes of voiceless segments to voiced ones.

Of the two kinds of changes, more attention will be paid to the processes in (1). Also, since different classes of segments can undergo the processes in (1) or (2) to a different degree, my attention will be focussed primarily on the class of obstruents, though other classes of segments will also be occasionally referred to.

In the literature of the subject one can come across discussions of various aspects of the voicing phenomena. The following is a partial list:

(3) The degree to which segments are voiced, i.e. fully voiced, partially voiced versus completely voiceless segments (many references, both structuralist and generative, for instance, Jones 1956 (and earlier editions), 1975 (and earlier editions), Gimson 1962 and Rubach 1975).

(4) Identification of the individual segments and classes of segments which undergo the processes of voicing and devoicing as well as the description of the environments in which these processes operate (numerous sources, but see especially Dinnsen and Eckman 1978 and the works cited therein).

(5) Connected with (4) is the issue of how general a given voicing or devoicing process is and how it is to be placed in the grammar of a language. This question was raised in Chomsky and Halle (1968) and has reappeared ever since (cf., for instance, Selkirk 1972, Rubach

1975, Hooper 1975, Aronoff 1976, Ruszkiewicz 1983, Halle and Mohanan 1985).

(6) The question of choosing the most plausible feature(s) by which to describe the processes under discussion. It is noteworthy that in the period following the publication of Kim (1965) the overwhelming majority of linguists decided on the feature [voice], rather than [tense], to adequately describe voicing phenomena in various languages.

(7) The direction in which the feature [voice] spreads. Since the majority of voicing phenomena have been viewed as processes of assimilation, it is not surprising that many authors talk of progressive and regressive assimilation of voice (cf., for instance, Abercrombie 1967, chapters 5 and 8, and Rubach 1975).

(8) The interaction of the processes of voicing and devoicing with other processes, and

(9) the formulation of the rules of voicing and devoicing as either rewrite rules or *if-then* constraints (see the interesting discussion in Rubach 1977).

In the present paper I wish to concentrate on two of the above-mentioned problem areas, i.e. the role of the features [voice] and [tense], and the place of the rules of voicing and devoicing (or whatever they are called) in the grammars of Eglish and Polish.

Structural phoneticians like Jones (1956, 1975) and Abercrombie (1967), but not Gimson (1962), described voicing phenomena in terms of similitude and assimilation. The two terms are defined in Jones (1975:217, § 836, and 219, § 841a) in the following way:

(10) *Similitude*: the subsidiary sound B belonging to the phoneme whose principal member is the sound A is used when the sound C is adjacent to it or near to it.

(11) a. *Ordinary assimilation*: the sound A is replaced by the sound B under the influence of the sound C.

b. *Coalescent assimilation*: the sounds A and C influence each other and coalesce into the single sound B.

Jones emphasized the need for keeping similitude and assimilation apart. In Jones (1975:219, § 842) he claimed that "it would not be accurate to say that the use of a partially breathed *l* in *please* is a case of 'assimilation'. Such a statement would imply that the *l* of *please* had at one time been fully voiced and had subsequently lost part of its voice owing to the presence of the *p*; there is, on the contrary, every reason to believe that the *l* in this word has had its present value ever since the word first appeared in the language".

Abercrombie (1967:87, *passim*) follows Jones' distinction between similitude and assimilation. He refers to (juxtapositional) assimilation as *changes* in pronunciation (133) and observes that the use of the word 'change' "seems to attribute priority to one of the forms concerned" (Abercrombie 1967: 175, note 2). He fails to explain clearly the distinction between what he calls complete versus partial regressive assimilation of voicelessness. For instance, on p. 137 he calls the devoicing of [v] in the phrases *of course* and *have to* complete, but the devoicing of [z] in the phrase *his son* partial. It is only by reference to Abercrombie's transcriptions of the sounds that the reader arrives at the exact nature of a completely voiceless [v] and a partially voiceless [z].

Abercrombie (1967:138) considers the devoicing of segments in utterance-final position to be a case of assimilation, with silence being the assimilating factor. Within the Jones-Abercrombie approach this statement is as problematic as Jones' above-mentioned statement concerning the nature of *l* in *please*. That is, claiming that the two final consonants in *fields*, *sands* and *graves* (Abercrombie's 1967:138 examples) get assimilated to silence involves the assumption that the consonants in question are basically voiced. But if this is a plausible solution to the problem, then one can also assume that the *l* in *please* is voiced at some level of abstraction and gets devoiced by assimilation to the preceding tautosyllabic [p].

It is obvious that the latter question does not arise in generative phonology. The generative phonologist has at his disposal an abstract level of underlying representation at which all segments are specifies as [+voice] or [—voice]. By applying rules of the appropriate kind to underlying representations derived representations are formed which contain all the necessary phonetic details, including information as to the degree of voicedness or voicelessness.

The problem of priority of linguistic forms mentioned by Abercrombie does not arise, either. The underlying representation of a string has priority, in Abercrombie's sense, over all other representations, whether intermediate or derived.

Some other questions remain unresolved. Take, for instance, Abercrombie's description of the devoicing of [v] and [z] referred to above. The description is extremely vague because it has been carried out in terms of the feature [voice] alone. Working within the generative framework, Rubach (1975) considers the choice of features to account for low phonetic voice assimilation with Polish and English obstruents and makes the following claims (pp. 125 and 131, respectively):

(12) a. The mere fact that voicing or unvoicing of obstruents must be determinate suggests the importance of the feature [voice] for distinctions among obstruents. In some contexts, however, these distinctions may be obliterated completely (as in Polish) or partially (as in English).

b. It seems best to accept the view that at least for English and Polish [voice] and [tense] are concomitant features. For phonological and the majority of phonetic analyses [voice] provides sufficient distinction. It is only very rarely that these two features are separated (cf. rule (8)[9] [=rule (13) below, P. R.] and some Polish examples below, then [—tense] appears in the left side specification). In other cases in this paper whenever we state that an obstruent has been unvoiced (the whole segment, i.e. solid line in our notation) we always understand that the change from [+tense] to [—tense] (*sic*) has also taken place.

Rubach's (1975:131) rule (8) referred to in (12b) is reproduced for the reader's convenience as (13) below:

$$(13)\ \begin{bmatrix}+\text{obstr}\\-\text{tense}\end{bmatrix} \rightarrow [-\text{voice}] / \begin{bmatrix}+\text{obstr}\\+\text{voice}\end{bmatrix} \_\_ \begin{Bmatrix}\#\ \#\\ \#\ [-\text{voice}]\end{Bmatrix}$$

A few remarks szggest themselves in connection with Rubach's statements in (12a, b) and the rule in (13). Although his decision to describe the voicing phenomena in Polish and English obstruents in terms of the feature [voice] runs counter to Gimson's attempts to apply two independent features, *fortis* and *lenis*, his approach is in perfect agreement with the practice of formulating obstruént voicing and devoicing rules current among the generative phonologists, see, for instance, Chomsky and Halle (1968:95, 228, *passim*), Selkirk (1972:187, *passim*), Shibatani (1973:88-89, 93), Siegel (1974:126), Rubach (1975; 1977:38, 141-142, *passim*; 1984:38, 45, *passim*), Gussmann (1978: 115-118, 139; 1980a:31, 66, 83, *passim*), Ruszkiewicz (1983:87, *passim*), Halle and Mohanan (1985: 98), and many others.

Rubach's claim voiced in (12b) that "for English and Polish [voice] and [tense] are concomitant features" will be discussed in connection with rule (13) and other rules to be presented later in the paper.

Rubach (1975:131) formulates the rule in (13) to account for the complete voicelessness of the final segments in (14):

(14) *robs, beds, bags*

when the obstruents in question occur before a pause or a voiceless segment. Also, as indicated in (12b), his intension is to illustrate the relatively rare case when the features [voice] and [tense] must be separated. This is necessary because, as Rubach (1975:131) observes, "This fully unvoiced obstruent [i.e. the last obstruent in (14), P. R.] is not, ..., phonetically identical with [s] as in *see*."

It is to be observed that if English (and Polish) obstruents are assumed to differ in terms of the feature [tense], then the feature [voice] is redundant.

This relation is expressed by the rules in (15):

$$(15)\ \text{a.}\ \begin{bmatrix}-\text{son}\\+\text{tense}\end{bmatrix} \downarrow [-\text{voice}] \qquad \text{b.}\ \begin{bmatrix}-\text{son}\\-\text{tense}\end{bmatrix} \downarrow [+\text{voice}]$$

If, on the other hand, the obstruents in question are taken to differ in terms of the feature [voice], then [tense] becomes redundant.

Rubach appears to rely on the feature [voice] in his formulation of obstruent voicing and unvoicing rules. Therefore it seems plausible to assume that it rather than the feature [tense] is distinctive among English (and Polish) obstruents. If my assumption is correct, then by (16):

$$(16)\ \begin{bmatrix}-\text{son}\\+\text{voice}\end{bmatrix} \downarrow [-\text{tense}]$$

the specification [—tense] in the left-hand part of the rule in (13) becomes redundant.

The same remarks apply to Rubach's (1975:134) formulation of rule (10), reproduced here as (17):

$$(17)\ \begin{bmatrix}+\text{obstr}\\-\text{tense}\end{bmatrix} \rightarrow [-\text{voice}] / \_\_ \begin{bmatrix}+\text{son}\\-\text{voice}\end{bmatrix}$$

which is supposed to devoice the obstruents spelled *dz*, *b* and *d* in the Polish words:

(18) *pieniędzy* ('money' gen. pl.), *srebra* ('silver' gen. sg./nom. pl.), *wyjadę* ('I shall leave')

provided that the following sonorants have already been devoiced. Moreover, the use of the feature [—tense] in (17) leads to a loss of generalization: the rule can not apply vacuously to such Polish strings as:

(19) *tatę* ('father' acc. sg.), *brata* ('brother' gen. /acc. sg.) etc.

although, with the final sonorants devoiced, they are perfectly well-formed strings at the low phonetic level.

As was indicated above, it has been a common practice among the generativists to describe voicing phenomena in terms of the feature [voice]. To illustrate this observation, let us quote a few other rules:

(20) (=Chomsky and Halle's 1968:238, rule (2))

$$t \rightarrow [+\text{voice}] / = \begin{Bmatrix}\text{mi}\_\_+\text{ive}\\ \text{ver}\_\_+\text{ion}\end{Bmatrix}$$

(21) (=Rubach's 1984:38, rule (32))

$$s \rightarrow [+\text{voiced}] / \begin{bmatrix} +\text{syll} \\ +\text{tense} \end{bmatrix} - [-\text{cons}]$$

(22) (=Rubach's 1984: 45, rule (48))

$$z \rightarrow [-\text{voiced}] / - \begin{Bmatrix} \text{is} \\ \text{ive} \end{Bmatrix}$$

(Remark: rules (21) and (22) are modified versions of Chomsky and Halle's 1968: 228, rule (119b) and 232, rule (124), respectively.)

(23) (=Ruszkiewicz's 1983:87, rule (19))

$$[-\text{son}] \rightarrow [_b\langle - \rangle - \text{voice}] / \left[\begin{matrix} -\text{voice} \\ \left\langle \begin{matrix} +\text{cor} \\ -\text{son} \\ +\text{dist} \end{matrix} \right\rangle \\ {}_a\langle \alpha\text{strid} \rangle \end{matrix} \right] \# \left[\overline{\quad} \atop {}_a\langle \alpha\text{strid} \rangle \right] \#$$

Condition: if a, then b.

(24) (=Gussmann's 1978:115, rule (146) unvoicing final obstruents in Polish)

$$[+\text{obstr}] \rightarrow [-\text{voice}] / - \# \#$$

(Remark: details aside, rule (24) is identical with Rubach's 1977:38, rule (6) unvoicing word-final obstruents in German.)

(25) (=Selkirk's 1972:187 rule of full voicing assimilation in English)

$$\begin{Bmatrix} \text{d} \\ \text{v} \\ \text{z} \\ \text{ð} \end{Bmatrix} \rightarrow [-\text{voice}] / -] [\# \begin{bmatrix} \text{C} \\ -\text{voice} \end{bmatrix} \ldots$$

(Remark: the rule in (25) has been reconstructed on the basis of Selkirk's (1972:187) statement of the environment together with the accompanying examples and her commentary).

This partial list should be enlarged by adding the rules that have already been discussed.

Let us now take a closer look at, for instance, rule (21). Suppose that /s/ has the distinctive feature specification in (26):

(26)
$$\begin{bmatrix} +\text{tense} \\ +\text{ant} \\ +\text{cor} \\ +\text{strid} \end{bmatrix}$$

That is, I assume that the feature [tense], rather than [voice], is distinctive in the English obstruents. Consequently, /s/ is redundantly [−voice].

Suppose further that all phonological rewrite rules like (21) are interpreted in such a way that the class of segments designated by (26) incorporates the feature [+voice] in the given environment. This interpretation is more cogent than the one which says that the specification in (26) is rewritten as [+voice]. To get the last-mentioned interpretation, the rule would have to take on the following shape:

(27)
$$[-\text{voiced}] \rightarrow [+\text{voiced}] / \begin{bmatrix} +\text{syll} \\ +\text{tense} \end{bmatrix} \begin{bmatrix} \overline{\quad} \\ +\text{tense} \\ +\text{ant} \\ +\text{cor} \\ +\text{strid} \end{bmatrix} [-\text{cons}]$$

This convention of writing phonological rules is adopted in, for instance, Laskowski (1975:68, *passim*).

After the rule in (21) (or its equivalent in (27)) has applied, the specification in (28):

(28)
$$\begin{bmatrix} +\text{tense} \\ +\text{ant} \\ +\text{cor} \\ +\text{strid} \\ +\text{voice} \end{bmatrix}$$

is formed. This is an ill-formed segment because outside the class of [+syll] segments the features [+tense] and [+voice] cannot cooccur.[1]

To remedy the specification in (28) in a principled way, one might resort to the morpheme structure conditions of English, especially to the segment redundancy statements. In particular, of interest are the redundancy statements in (15a) and (16) or modifications thereof presented in (29):

(29) a. $\begin{bmatrix} -\text{syll} \\ +\text{tense} \end{bmatrix} \rightarrow [-\text{voice}]$ b. $\begin{bmatrix} -\text{syll} \\ +\text{voice} \end{bmatrix} \rightarrow [-\text{tense}]$

[1] Halle's proposal quoted in Postal (1968:78) to specify half-voiced segments as $\begin{bmatrix} +\text{tense} \\ +\text{voice} \end{bmatrix}$ was not particularly felicitous. Rubach (1975:128) is right when he claims that "the devoicing of obstruents is not due to the introduction of articulatory tension but rather to the assimilation to [−voice] segments." See, however, the discussion below.

Applying (29a) to (28) produces (30):

(30) $\begin{bmatrix} +\text{tense} \\ +\text{ant} \\ +\text{cor} \\ +\text{strid} \\ -\text{voice} \end{bmatrix}$

which means that the effect of the *s*-Voicing rule in (21) has been undone. If, on the other hand, (29b) is applied, the resulting segment is:

(31) $\begin{bmatrix} -\text{tense} \\ +\text{ant} \\ +\text{cor} \\ +\text{strid} \\ +\text{voice} \end{bmatrix}$

which is as required.

It should be noted that applying morpheme structure conditions in the above fashion is not free from diffiulties. First of all, since the specification in (28) is the product of applying a phonological rule, it is not an underlying segment. Thus the procedure described above requires that morpheme structure conditions apply not only at the underlying level but also at the level of intermediate representation. Secondly, and more importantly, contrary to the classical view of morpheme structure conditions as implicational rules, they must be given the power of changing the values on features, i.e., they must have the status of feature-changing rules.

Let us now entertain the idea that (21) is an *s*-Laxing rather than an *s*-Voicing rule. As such it must be based on the feature [tense] and can assume the form in (32):

(32) *s*-Laxing

$$[+\text{tense}] \rightarrow [-\text{tense}] / \begin{bmatrix} +\text{syll} \\ +\text{tense} \end{bmatrix} \begin{bmatrix} \text{———} \\ +\text{ant} \\ +\text{cor} \\ +\text{strid} \end{bmatrix} [-\text{cons}]$$

The only difficulty resulting from the application of this rule consists in that it produces a $\begin{bmatrix} -\text{tense} \\ -\text{voice} \end{bmatrix}$ segment in the wrong environment, i.e. in the position between a tense vowel and a non-consonant, which is a bilaterally voiced

environment. Observe, however, that otherwise $\begin{bmatrix} -\text{tense} \\ -\text{voice} \end{bmatrix}$ segments are perfectly well-formed.[2]

The latter problem can be eliminated by postulating a surface phonetic constraint or a convention which would have the power of a feature-changnig rule. This is tantamount to saying that ruling out a sequence like (33):

(33) $\begin{bmatrix} +\text{syll} \\ +\text{tense} \end{bmatrix} \begin{bmatrix} -\text{tense} \\ -\text{voice} \end{bmatrix} -\text{cons}$

is no satisfactory solution since a grammar which did that could not achieve the level of observational adequacy in the sense of Chomsky (1964:63).

In the light of the foregoing discussion it becomes clear that Rubach's (1975:131) claim (adduced in (12b) above) concerning the automatic conversion of the value on the feature [tense] which is triggered by changing the value on the feature [voice] is something that is easier said than done. In order to get things come out right, a number of assumptions accepted in generative phonology without much debate must be revised.

To pour some more oil on the flame, let us take a quick look at rule (22). If it applies in the form given above, sequences like that in (34):

(34) $[+\text{syll}] \begin{bmatrix} -\text{tense} \\ -\text{voice} \end{bmatrix} [+\text{syll}]$

are created. Now, whatever rule or convention is set up to take care of (33) it will also affect the string in (34) converting [—voice] into [+voice], which is contrary to what is required.

Suppose that (22) is reinterpreted as a *z*-Tensing rule. It will assume the form in (35):

(35) *z*-Tensing

$$[-\text{tense}] \rightarrow [+\text{tense}] / \begin{bmatrix} \text{———} \\ +\text{ant} \\ +\text{cor} \\ +\text{strid} \end{bmatrix} \begin{Bmatrix} is \\ ive \end{Bmatrix}$$

and produce segments like (28) above. It is clear that this rule repeats all the difficulties generated by rule (21).

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[2] $\begin{bmatrix} -\text{tense} \\ -\text{voice} \end{bmatrix}$ is a possible configuration not only in the obstruents but also in the sonorants. See Biedrzycki (1975) on the phenomenon of voiceless vocoids in Polish (and English).

To solve the issue, I suggest that the following assumptions be made:

(36) a. Morpheme structure conditions[3] are allowed to operate, in an extended form, at the level of intermediate representation, after the application of the individual rules.
b. Morpheme structure conditions have the power of feature-changing rules, and, most importantly,
c. Should two conflicting morpheme structure conditions be applicable, like (29a, b) in the case of rule (21), the ambiguity is resolved by the following principle:
Given that phonological rules are of the form A→B/—C, where B is the output of the rule,[4] and morpheme structure conditions are of the general form If: D

↓

Then: E

a given morpheme structure condition can apply to the output of a phonological rule if the latter is a member of the *If* part of the former. Formally, if B ∈ D.

In the ambiguous cases discussed above, principle (36c) will secure the correct choice of a morpheme structure condition. For instance, the specification in (28), repeated here as (37):

(37) $\begin{bmatrix} +\text{tense} \\ +\text{ant} \\ +\text{cor} \\ +\text{strid} \\ +\text{voice} \end{bmatrix}$

which results from applying rule (21) (or its equivalent in (27)), can be affected only by the segment redundancy statement in (16) because the rule's factor B (i.e. [+voice]) is included in the *If* part of the latter (i.e. $\begin{bmatrix} -\text{son} \\ +\text{voice} \end{bmatrix}$ or $\begin{bmatrix} -\text{syll} \\ +\text{voice} \end{bmatrix}$ as in (29b)).

The net effect of the principle in (36c) is that the value on the feature introduced by a phonological rule just prior to the application of the segment redundancy statement is preserved. It is largely on open question, however, how far down the derivation of a string morpheme structure conditions (or

[3] Morpheme structure conditions or any other mechanism that would be capable of readjusting phonological specifications. See the discussion below.

[4] In the narrow sense of the term. I am following Rubach's (1982:107) terminological use here.

whatever else the relevant devices are called, cf. note 3 above) should be allowed to intervence.

A cursory inspection of the rules presented above reveals that quite diverse processes are involved here. They differ with respect to their place in the grammar, degree of generality, type of conditioning and the question of whether or not the feature [tense] is affected given the assumption that the processes are based on the feature [voice].

Let us consider the last-named issue first. Since it appears that enough English examples have been discussed so far, I suggest we concentrate on the relevant Polish data.

The linguistic literature contains accounts of the voicing phenomena in Polish obstruents which resemble those occurring in English (discussed above), i.e. processes which affect the features [tense] and [voice] simultaneously. At the same time, the literature is largely silent on the processes which affect only the feature [voice], leaving the specification for [tense] intact.

Various authors have observed that in Polish sequences of obstruents need not be uniform with respect to voicing. This lack of congruence can be due either to differences of accent (Educated Warsaw Polish versus the Cracow-Poznań type of pronounciation, cf., for instance, *The dictionary of Polish pronunciation*, p. XXVII), to phonostylistic factors (e.g. Rubach 1975) or to some unidentified conditions (Łobacz and Jassem 1971, Jassem and Łobacz 1972). For instance, in the pronounciation of the Wielkopolska region, the following obstruent clusters:

(38) a. /kv/ — *kwadrat* ('square'), *kwas* ('acid')
b. /sv/ — *swada* ('fluency of speech'), *swastyka* ('swastika')
c. /tv/ — *twór* ('product'), *twardy* ('hard')
d. /xv/ — *chwała* ('glory'), *chwila* ('a while')

occur within morphemes. Łobacz and Jassem (1971:173) note the occurrence of the clusters /zt/, /fz/, /tb/, and a few others, but they do not state their distribution. It is deplorable that the relevant literature contains no information concerning the degree of voicing found in the 'voiced' obstruents in question. In my idiolect they appear to be devoiced in that part of the segment which is adjacent to a voiceless obstruent.

There is a type of context in which Polish obstruents get completely devoiced, with the value on the feature [tense] remaining intact. This phenomenon forms a part of the process which produces voiceless vocoids in the intonational tail following the nuclear tune of the falling type (i.e. high or low fall). This process is described informally in Biedrzycki (1975). Rubach (1975) presents an attempt to account for it in generative terms though in spirit his approach does not differ from Biedrzycki's. In particular, Rubach (1975:134) assumes the existence of a sonorant unvoicing rule (which he does not formu-

late) which feeds his stylistic rule (10) reproduced above as (17). Given the data in (18) as well as those in (39):[5]

(39) a. (from Biedrzycki 1975:17)
nogi (legs''), bardzo ('very (much)'), dzień dobry ('good day')
b. prędzej tam ('hurry up'), był na bani ('he was drunk'), nędzny ('miserable'), co tam masz ('what have you got')

it is difficult to imagine how one can plausibly formulate a rule which would take care of the voiceless sonorants. In other words, on the Biedrzycki-Rubach approach there is no natural way to explain why, for instance, the last vowel in *co tam masz* gets devoiced and why the process of devoicing spreads to the left, affecting the segment /m/ and other sonorants. The forms in (40):

(40) *zamsz* ('suede'), *msza* ('mass'), *Omsk* etc.

show that it is not natural for /m/ (or any other nasal or liquid) to get devoiced in the position before a voiceless segment.

I would like to suggest that what is at work is a devoicing process of a different format. First of all, the process affects whole syllables, not just individual segments. Second, it is not directional, i.e., it is not statable as a case of regressive or progressive assimilation of voicelessness. The following formulation:

(41) $\sigma \rightarrow [-\text{voice}] / \overset{\text{H/D}}{\underset{\sigma}{\diagdown\!\diagup}} \; \ldots - \ldots]_s$

where: σ = syllable
H = High tone
D = Mid tone (*D* for Goldsmith's 1979:208 *Drop*)
L = Low tone

is a first approximation.[6] The rule devoices all syllables that happen to occur

[5] The small circles placed above or below ordinary letters are supposed to indicate that the corresponding phonetic segments are completely devoiced.

[6] Two things should be noted in connection with rule (41). First, it presupposes a division into syllables of the string to be affected. Second, the high/low fall need not be realized on a single syllable but can involve two neighbouring syllables, as in (i):

(i) H/D L
| |
σ σ

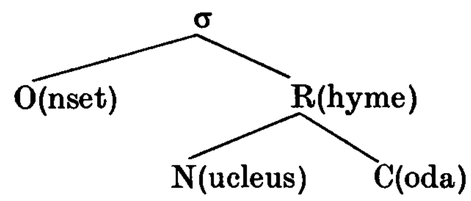
Then the syllable dominated by H/D is pronounced on a level tone.

The difference between (i) and the relevant portion of (41) entails interesting consequences. Namely, the coda of the syllable dominated by H/D alone tends to preserve its voiced nature regardless of whether it is occupied by a sonorant or an obstruent. On the other hand, the coda of the syllable dominated by H/D L loses its voicing.

in the section bounded by a high or low fall on the left and sentence boundary on the right.[7]

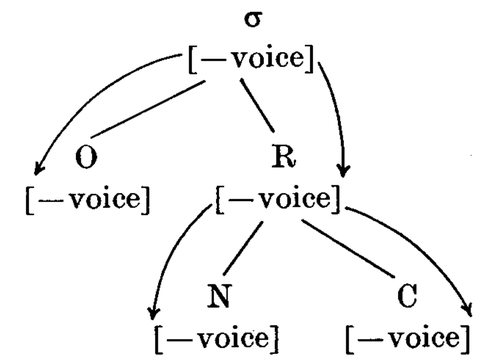
Given that the structure of the syllable is like that in (42) (cf. Selkirk 1980:569, and the references mentioned in note 5 on the same page):

(42)



and assuming some sort of feature inheritance/percolation mechanism (for details see Chomsky 1980:30, note 34; Lieber 1981:49-50 and 54; Williams 1982:279; and Ruszkiewicz 1986), all the constituents of a syllable get devoiced, as exemplified in (43):

(43)



If the positions designated as O and C happen to be occupied by obstruents, they too get devoiced in the usual fashion.

As indicated above, the interesting thing about this process is that it affects only the feature [voice], leaving the value on the feature [tense] intact.

It now becomes obvious that three types of voicing phenomena exist in both English and Polish obstruents:

(44) a. voicing/devoicing processes which also involve the feature [tense]
b. devoicing processes which produce partially voiced obstruents, without affecting the feature [tense]
c. devoicing processes which produce completely voiceless obstruents, at the same time leaving the feature [tense] intact.

The last two of these can be considered variants of the same process, see (45) below.

[7] I am ignoring here the sporadic cases observed by Biedrzycki (1975:21) when the syllables which normally carry the nuclear tune are also devoiced.

In generative phonology (44a, b, c) have all been described in terms of the feature [voice]. This practice may be due to Chomsky and Halle's (1968) inconsistency in dealing with the features [voice] and [tense]. Thus, on pp. 176-177 (see *Table 1*) the feature [tense] is only used to characterize the vowels and semivowels (i.e. the nonconsonantal segments). The feature [voice] appears only in the specification of the consonantal segments. However, in the descriptive statements found on pp. 324-326, Chomsky and Halle (1968) relate the feature [tense] to both nonconsonantal and consonantal sounds.

This state of affairs is highly implausible. The consistent use by many writers of the feature [voice] in stating the voicing/devoicing rules implies that we have to do here with a more or less uniform phenomenon. At the same time it becomes obvious that now the voicing/devoicing processes affect the feature [tense], now they do not. The latter property of the [voice]-based processes remains unexplained.

In view of the foregoing discussion it seems plausible to suggest that voicing phenomena in English and Polish fall into two categories:

(45) a. [tense]-based processes (type (44a))
b. [voice]-based processes (type (44b, c))

It will be shown in the remainder of the paper that these two types can be related to separate components of the respective grammars.

Consider the question of generality of the processes discussed and their placement in the grammars of English and Polish. A cursory glance at rule (20) reveals that it applies only to two English roots, *mit* and *vert*, when they occur in the position before specified suffixes (+*ive* and +*ion*, respectively).[8] In the case of rule (21), the range of application is significantly wider though, obviously, its input strings by no means run into hundreds. Rules (22) and (23) appear to do similar things but the input strings taken care of by rule (23) far outnumber those associated with rule (22). This situation is due to two factors. Firstly, the /z/ affected by (22) is only one of two segments affected by rule (23) (i.e. /z/ and /d/). Secondly, since the /z/ and /d/ of rule (23) function as exponents of the regular plural, Saxon Genitive and the regular past, it is not surprising that the regular nouns and verbs as well as the irregular nouns which receive the Saxon Genitive morpheme should *en masse* make the application of the latter rule so general. Rules (24) and (25) come from two different languages and will not be compared here. Suffice it to note at this point that since rule (25) has been designed to operate on (phonological) surface structure, one might be tempted to accord it relatively great generality. The fact, however, is that the rule devoices (or rather tenses) the final obstruents in a very limited

[8] Strictly speaking, this is only true of American English. In British English the root *vert* does not undergo rule (20).

class of what are known as nonlexical items (e.g. auxiliaries, prepositions, conjunctions).

The question that must now be posed is: In which segments of the grammar should the individual rules be located? The answer to this question is by no means straightforward. In the standard theory of phonology rules which affect phonological segments can be placed in one of the three possible components: (a) the readjustment rules, (b) the phonological component, and (c) the late phonetic rules.

It is noteworthy that Chomsky (1964:88ff.) speaks of "phonological regularities" in connection with rules which produce a similar effect as rule (20) does. In Chomsky and Halle (1968:223) rule (20) appears as one of the readjustment rules, i.e. outside the phonological component.

Linguistic research carried out in the period after the publication of Chomsky's (1970) "Remarks on nominalization" has not only redefined, following the emergence of a morphological component, the domain of syntax but also thrown some new light on the nature of phonological rules. For instance, in connection with the rules like (20) above Aronoff (1976:6) asks "whether some of these alternations which are not phonologically determined are in fact not part of the phonology at all" and argues that "a class of rules which a more tightly constrained theory rejects as not optimal phonological rules can be fruitfully included in a theory of morphology."

The linguistic literature, both structuralist and generative, contains intuitive statements pertaining to the relation between the lexicon and syntax (or *grammar* in pre-generative terms). The formulation of explicit criteria demarcating one province from the other is due to Wasow (1977). In particular, he proposes the following criteria (331):

	Lexical Rules	Transformations
Criterion 1	do not affect structure	need not be structure preserving
Criterion 2	may relate items of different grammatical categories	do not change node labels
Criterion 3	"local"; ivolve only NPs bearing grammatical relations to items in question	need not be "local"; formulated in terms of structural properties of phrase markers
Criterion 4	apply before any transformations	may be fed by tranformations
Criterion 5	have idiosyncratic exceptions	have few or no true exceptions

Various authors referred to these criteria separately, both before Wasow (1977) and afterwards. For instance, Chomsky (1970) made use of Criterion 2. Roeper and Siegel (1978) found their paper on Criterion 3. The proponents of lexical functional grammar (see the Bresnan-edited 1982 volume) draw heavily on Criterion 5.

It was research within lexical functional grammar which gave Mohanan (1982) an impetus to revise the established view of the phonological component.[9] He makes the following confession (viii): "An initial impetus came from the course of computational linguistics given by Joan Bresnan and Ron Kaplan in 1978, where I was exposed to the idea that syntactic rules which have lexical exceptions are lexical rules. What would happen if the same principle applied in phonology as well, I asked myself: the traditional 'morphophonemic' rules would become lexical rules, and 'allophonic' rules would become post-lexical rules. The idea that phonological rules could apply in the lexicon took seed in my mind."

Another way of saying that a rule has lexical exceptions is to state that it applies to a lexically defined class of items. Of the rules discussed so far, rule (20) clearly has this sort of status. Thus, it is not surprising that Chomsky and Halle (1968) never included it among the rules of the phonology.

But what about the remaining rules? Consider, for instance, rule (21). Although it has the appearance of a purely phonological rule, it is morphologically governed. Rubach (1984:38) himself states that, "This rule captures the well known behavior of //s// in prefix-stem structures[7]", such as the following (=Rubach's 1984:38 examples in (33)):

(47) *resign, design* vs. *consign*
resume, presume vs. *consume*
resist vs. *consist*

As exceptions to rule (21) Rubach (1984:39, note 18) quotes *spacious, racial usage* etc., which exemplify a different sort of structure, i.e. the base-suffix structure.

Unlike (22), which is a morphologically conditioned rule, rule (23) again has the appearance of being purely phonological. The fact, however, is that it is as heavily constrained by morphological factors as rule (21). That is, it tenses //d// or //z// whenever they occur to the right of the base within a word but not

[9] Recall that the first revision of the phonological component in the post-1968 period was due to Siegel (1974). She established two classes of affixes in English, class I affixes and class II affixes, and made the claim that, since some of the class II affixes are stress-sensitive, it was plausible to remove the cyclic stress assignment rules from the phonological component and place them between class I and class I affixation processes. This move also enabled Siegel to dispense with global constraints on class II affixation.

inside the base, cf.:

(48) a. plās#d → plās#t (*placed*)
b. mis#dēl ↛ *mis#tēl (*misdeal*)

Gussmann's (1978) rule adduced in (24), which unvoices word-final obstruents in Polish, applies only to major lexical categories (N, V, A), not to minor categories like preposition. This follows from the application of Chomsky and Halle's (1968:366) convention (115), called SPE-I in Selkirk (1972:12), and Selkirk's (1972:12) SPE-II convention, which makes it impossible for nonmajor categories to occur before # #. Gussmann's formulation of the rule implies that it applies to phonological surface structures and that consequently it is a rule of the phonological component. Observe, however, that being a noun versus a preposition is a lexical property of the given item. This means that in a sense rule (24) is also lexically governed.

In certain respects, rule (25) is similar to (24). Since it mentions a single occurrence of # in its environment, the segments undergoing it must occur in the final position of nonmajor categories. Thus, like rule (24), it too is lexically governed.

Among the sequences to be affected by rule (25) Selkirk (1972:187) mentions *of course* and *as for*. But these as well as *have to, used to* etc. are now lexicalized constructions. Rule (25) is thus supposed to account for both lexicalized constructions and syntactic structures. This is a spurious move.

Observe that, as it now stands, rule (25) produces ill-formed strings. The problem is that the rule should be allowed to tense the /d/ of *could* and *should* in (49) (from Selkirk 1972:187):

(49) a. You could pawn it.
b. I should think so.

only after the preceding vowel is deleted. Consequently, the respective representations in (50) (based on Selkirk's 1972 representations for American English):

(50) a. [juw kət pón ɪt]
b. [aj šət θíŋk sow]

are ill-formed.

Given though that vowel deletion precedes obstruent tensing in (49) and other similar examples, it may well be the case that syllable-based principles of some sort set in. Observe that in the onset part of the English syllable sequences of obstruents must be uniform in the phonetic representation with respect to the feature [tense]; in the coda part, they need not, though certain restrictions apply here as well. Consider the following examples (from Jones

1975:221, § 847):

(51) *width* [widθ], *breadth* [bredθ], *amidst* [əˈmidst]

which contain sequences of obstruents in their coda part that are not uniform with respect to the feature [tense]. Note, however, that the codas in (51) follow the pattern in (52):

(52) $\begin{bmatrix}-\text{son}\\-\text{tense}\end{bmatrix}\left(\begin{bmatrix}-\text{son}\\+\text{tense}\end{bmatrix}\right)_{\circ}$

and not one like (53):

(53) $\begin{bmatrix}-\text{son}\\+\text{tense}\end{bmatrix}\left(\begin{bmatrix}-\text{son}\\-\text{tense}\end{bmatrix}\right)_{\circ}$

This restriction explains why the realizations in (51) are well-formed, but those like (54):

(54) *[plejsd] (*placed*)

are not and must obligatorily undergo a rule of the appropriate kind. On the other hand, the examples in (51) are only optionally converted into those in (55):

(55) [witθ], [bretθ], [əˈmitst]

The observations made above suggest that rule (25) is a spurious rule of English phonology. Its function should be taken over by two different kinds of rules, lexically governed rules and late phonetic rules (or syllable-based principles of some sort).

Taking into account the properties of the rules in (21)—(25) and Wasow's (1977) criteria in (46) it would not be completely implausible to class the rules in question as lexical.[10] This move runs parallel to the syntactician's attempt to free the syntactic component from all processes which are notoriously bound with (lexical) exceptions.

[10] It should be obvious that classing rules (21)—(25) as lexical must be matched with far-reaching changes in their structure. For instance, all boundary symbols must be removed. This should come as no surprise since in lexical phonology a number of separate strata are set up which encode the information formerly carried by the boundary symbols. It must be noted at this point that in the earlier frameworks the boundary symbols + and # were burdened with too many functions and in consequence they were not attached to the individual affixes consistently. For instance, Chomsky and Halle (1968:85—86) argue that, since the suffix *-ing* is neutral with respect to stress and both /r/ and /l/ in e.g. *hindering* and *twinkling* (the participle) remain syllabic in the position before it, it should carry the boundary #. On the other hand, Gussmann (1980a:38), talking about the phenomenon of *linking r* in British English, appears to class *-ing* as a +boundary suffix.

It is obvious that classing, for instance, rules (25) (or a version thereof) and (23) as lexical is not tantamount to putting them into one bag. Selkirk (1972:82) observes that the overwhelming tendency among English obstruents is towards the regressive voicing (i.e. tensing) assimilation and that "the *only* segments affected by the progressive voicing assimilation are the single-segment morphemes *-z-* (and *-d-* in the preterite)".

Taking Halle and Mohanan's (1985) approach as a first approximation to the lexical model of English phonology, Selkirk's observation can be accommodated by assigning forms like (51) to Stratum I and those like (54) to Stratum IV. These strata are then allotted as domains to the rule of regressive tensing assimilation and the rule of progressive tensing assimilation, respectively.

Returning now to the question of relating [tense]-based and [voice]-based processes to the structure of the grammar, I would like to suggest that the former are basically lexical in both English and Polish while the latter postlexical.

Nykiel (1986) has recently argued against Polish morphology being viewed as level-ordered. Her conclusions do not bear directly on the structure of Polish phonology. I assume Halle and Mohanan's (1985:58) claim that:

(56) Languages may differ in the number of strata they recognize, but there appear always to be at least two strata, one lexical and the other postlexical, unless the language has no morphology whatever.

to be true and wish to emphasize that certain rules like the one of syllable devoicing mentioned above are definitely postlexical and that at least some of the [tense]-based rules should be treated as lexical. I realize though that my proposals expressed here constitute hypotheses which are subject to empirical verification.[11]

To sum up, we have dealt in the present paper with processes which are traditionally called the voicing and devoicing/unvoicing of obstruents. It has been shown that basing the processes upon the feature [voice] and treating it and the feature [tense] as concomitant lead to serious difficulties. It has been argued that voicing phenomena in English and Polish obstruents fall into two classes of processes: [tense-]based and [voice]-based, and that the features in

[11] Our knowledge of the voicing phenomena in Polish is still far from satisfactory. In his pioneering work on Polish morphonology, Laskowski (1975) does not discuss voicing phenomena. Gussmann (1975) discusses a host of Polish examples which involve voice assimilation of one sort or another but chooses to disregard the issue (116). In Gussmann (1980b) the need for rules that would take care of voicing phenomena in Polish is duly appreciated but the *Summary of Rules* found on pp. 133-135 does not contain a single rule of voicing or devoicing. Rubach's (1975) approach is only a first approximation. It follows that voicing phenomena in Polish present a problem area which still awaits investigation.

question need not be concomitant. The two categories of processes have further been related to two different components of the grammars of English and Polish.

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