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(Continued on p. 3 of Cover)

A non-linear analysis of vowel-zero alternations in Polish¹

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INTRODUCTION

Gussmann (1980) has presented an analysis of Polish morphophonemics within the framework of *SPE* (Chomsky & Halle, 1968). His treatment appeals extensively to underlying representations containing segments which never appear in surface representations. He justifies this use of absolute neutralization with the claim that other rules of Polish phonology appeal to such underlying forms. Rubach (1984) has reanalysed much of Gussmann's description within the framework of Kiparsky's (1982) Lexical Phonology, retaining the analysis of the neutralized segments and even adding to the inventory of abstract elements. The arguments presented by both scholars are a paradigm of elegance and ingenuity, representing generative phonological analysis at its best. However, the considerable reliance they put on abstract underlying representations, morphologically conditioned rules, extrinsic rule ordering and other devices which give rise to a high degree of opacity arouses suspicion. For this reason I have sought to re-examine some of their material within a more 'concrete' interpretation of Lexical Phonology, making use of recent ideas from theories of non-linear phonology and theories of allomorphy.

Many phenomena which require a highly abstract treatment in linear phonological frameworks can be given a much more concrete analysis if use is made of the rich representational resources of non-linear theories. Thus, relatively concrete analyses of vowel harmony ('concrete' in the sense of relying on phonological primes and not on arbitrary diacritics) have been proposed within the theories of Autosegmental and Metrical Phonology (Clements, 1981; Clements & Sezer, 1982; Halle & Vergnaud, 1981). A

[1] A version of this paper was presented at the London Phonology Seminars at the School of Oriental and African Studies, and to the Autumn 1985 meeting of the LAGB, University of Liverpool. I am grateful to members of both audiences for helpful discussion, especially Richard Coates and Grev Corbett. For useful criticism and encouragement I am indebted to Grzegorz Dogil and especially to Jerzy Rubach. None of these colleagues bear responsibility for remaining errors of fact or interpretation.

representational theory of morphophonemic alternations in Finnish involving what, in a linear theory, would be a consonant subject to absolute neutralization has been proposed by Keyser and Kiparsky (1984), and the *h-aspiré* phenomena of French have been given a similar treatment by Clements and Keyser (1983) (and see now Stemberger, 1985 and Klausenburger (this vol.)). The trend has even extended to the theory of child language acquisition. The massive absolute neutralization effected by the realization rules of Smith's (1973) *SPE* model of the acquisition of phonology is largely dispensed with in an autosegmental analysis of developmental data presented in Spencer (1984a).

At the same time, doubts have been expressed about the role of morphological conditioning in phonological rule systems. Lieber (1980, 1982) and following her Marantz (1982) and Spencer (1984b, 1985) have suggested that 'minor rules' be replaced by morpholexical relationships, which, formally speaking, are interpreted either as lexical redundancy rules (Lieber, Marantz) or as a highly specific kind of phonological rule triggered by alphabetic diacritic features and relating root allomorphs to each other in the lexicon (Spencer). Some of these suggestions are somewhat reminiscent of earlier proposals within the framework of Natural Generative Phonology (cf. Hooper, 1976), but differ significantly in a number of respects, the most important of which is probably the overall grammatical framework presupposed by the later authors, which lays much greater emphasis on the organization of the lexicon in morphological and phonological theory.

Given these developments it is worthwhile re-examining the work of Gussmann and Rubach to determine the extent to which the devices of abstract phonology are required to do justice to the facts of Polish. In this paper I propose that the insights of non-linear phonology and the use of morpholexical relations will provide a much less abstract theory, and that this theory is motivated by other considerations. Section 1 is a presentation of the basic facts of vowel-zero alternations and palatalization as described by Gussmann and Rubach. Section 2 is a non-linear account of the vowel-zero alternations which are the cornerstone of their analysis. This section appeals to Archangeli's (1984) theory of underspecification. In Section 3 I reanalyse the palatalization facts in terms of morpholexical rules. Section 4 concludes the paper with speculations relating to learnability considerations and the nature of linguistic theory construction.

1. ABSOLUTE NEUTRALIZATION IN POLISH

1.1. The Polish sound system

A convenient introduction to the facts to be addressed is presented in Rubach (1984: Ch. 2). His work is the most exhaustive and compelling account of Slav phonology to be found in the recent literature and I take it as my starting

point. Discussion of his theoretical proposals will also serve as a useful introduction to the descriptive facts.

The surface phoneme inventory of Polish is given in Tables 1 and 2. I use

i	i	u
e, ē	o, ō	
	a	

Table 1
Polish surface vowels

bilabials	p	b	m		
labiodentals	f	v			
dentals	t	d	n		
alveolars	s	z	c	ʒ	r l
postalveolars	ʃ	ʒ	č	ž	
prepalatals	ś	ź	ć	ź	ń
palatals	j				
velars	k	g	x	w	

Table 2
Polish surface consonants

/c, ʒ, č, ž, ć, ź/ to represent the affricates [ts, dz, tʃ, dʒ, tɕ, dʑ] and /š, ž, ś, ź/ to represent the fricatives [ʃ, ʒ, s, z] in accordance with the practice of Slavists. Palatalization of consonants is represented by a superscript (^h). I give the Polish examples in Polish orthography except where it is important to draw attention to a particular phonetic fact, when the relevant segment(s) will be placed in square brackets. For the convenience of the reader the most important peculiarities of Polish orthography are noted in Table 3.

Orthography	Pronunciation	Orthography	Pronunciation
ś, si	ś	cz	č
ż, zi	ż	dż	ž
ć, ci	ć	ch, h	x
dź, dzi	ź	c	c
ń, ni	ń	dz	ʒ
sz	š	l	w
rz, ź	ž	w	v

Table 3

1.2. *Vowel-zero alternations* (Havlik's Law)

A pervasive phenomenon in Slavic phonology is the alternation between vowel and zero in morphologically defined environments, and Polish phonology is no exception. The alternating vowel in Polish is /e/. The facts are explained very clearly by Gussmann (1980: 26ff). He points out that there are two types of alternating /e/, one of which induces palatalization, the other of which doesn't. At the same time, two types of non-alternating /e/ are observed, one palatalizing, the other non-palatalizing. He cites the examples of (1).

- (1) (a) [v'e]ś [f]si 'village'
 (b) [se]n [s]nu 'dream'
 (c) [će]ń [će]nia 'shadow'
 (d) sz[me]r sz[me]ru 'rustle'

Gussmann ultimately collapses his analysis of the palatalizing properties of the alternating /e/ with that of the non-palatalizing /e/. However, the non-alternating /e/'s in the examples he cites occur in root morphemes. As Rubach points out, in a Cyclic or Lexical framework such phonemes cannot condition cyclic palatalizations in roots, for that would constitute an underived environment. I shall therefore follow Rubach (cf. 1984: 103) in assuming that the non-alternating /e/'s in roots, along with the palatalized consonants preceding them, are present underlyingly in those morphemes.

Gussmann further shows that the vowel-zero alternations cannot be accounted for by a phonological rule of epenthesis, and therefore proposes to represent the distinction between alternating and non-alternating vowels by setting up two new lax high vowels, one front, the other back, represented as /i, i/ respectively. These correspond to the 'jers' of Slavic philological reconstructions which have been commonplace in generative analyses of Slavic sound systems since Halle (1959). The jers never surface. They are either lowered to /e/ or deleted by a rule, which Gussmann refers to as Lower, given informally in (2).

$$(2) \quad i, i \rightarrow \left\{ \begin{array}{l} e, \text{ } \text{ } / \text{--- } C_0 i, i \\ \emptyset \end{array} \right\}$$

Rubach's account splits this rule into its component subrules (3a, b), the first of which lowers /i/ to /e/ and /i/ to /ɤ/, the second of which, a postcyclic rule, deletes any jers surviving the battery of cyclic rules.

- (3) (a) $i, i \rightarrow e, \text{ } \text{ } / \text{--- } C_0 i, i$
 (b) $i, i \rightarrow \emptyset$

Notice that rules (2), (3) must lower jers in a string from left to right.

We can treat the lowering part of each formulation as essentially equivalent. Its effect is to lower all but the rightmost of a consecutive string of jers. The remaining jer is then deleted. Sample derivations are provided in (4) and (5).

VO ELL-ZERO ALTERNATIONS

(4)	cukier 'sugar'	cukru 'id. gen. sg.'	cukiereczek 'sweet (dim.)'	cukiereczka 'id. gen. sg.'
	(a) cukīrī	(b) cukīru	(c) cukīrīkī	(d) cukīrīkīka
Lower	e		e ɤ ɤ	e ɤ
Other rules	je		je eč	je eč
Jer-deletion	∅	∅	∅	∅
	[cukjer]	[cukru]	[cukjereček]	[cukjerečka]

(5)	kupiec 'merchant'	kupczyk 'id. (dim.)'
	(a) kupīčī	(b) kupīčīkī
Lower	e	
Other rules	je	či
Jer-deletion	∅	∅ ∅
	[kupjec]	[kupčik]

Gussmann assumes a rule of Derived Imperfective Tensing to account for a common alternation in Polish verb roots in which the allomorph of the perfective aspect has no vowel while the imperfective allomorph has /i/ or /i/. This rule is given in (6) (this formulation being an informal version of Rubach's (44), p. 241).

$$(6) \quad i i \rightarrow i, i / \text{--- } C_0 a]_{DI}$$

A sample set of derivations is given in (7).

(7)	odpycha 'push off (imperf.)'	odepchnie 'id. (perf.)'	odpchlīc 'de-flea'
	(a) odīpīxa	(b) odīpīxnje	(c) odīpīxīc
DI Tensing	i		
Lower		e	
Other rules		ń ∅	
Jer-deletion	∅	∅	∅
	[odpīxa]	[odepīxīe]	[odpīxīc]

The operation of Lower corresponds approximately to the historical process referred to traditionally as Havlik's Law. Such an analysis presupposes two absolutely neutralized underlying segments, the jers. This would immediately be suspect were it not for the fact that the two jers, being marked distinctively for the feature [back], behave differently with respect to the other pervasive phonological phenomenon of the Slav languages, palatalization; the palatalizing alternating /e/ being derived from the front jer /i/ while the non-palatalizing alternating /e/ is derived from the back jer /i/. At the same time, the underlying representations containing jers allow a general statement of a rule of /o/ Raising, and of nasalization phenomena, both characteristic of the sound pattern of Polish. Thus, there is considerable phonological

support for the Gussmann/Rubach 'abstract' analysis and for absolute neutralization in Polish.

1.3. Palatalizations

There are several distinct palatalization processes in Polish. The first, which Rubach refers to as Surface Palatalization, is a late (postcyclic) process which applies across word boundaries (in the domain of phrases) to palatalize stop consonants before /i, j/. Thus, it transforms /k/ into /k'/, /t/ into /t'/, /p/ into /p'/ and so forth. This process is to be distinguished from the cyclic rule of Coronal Palatalization which replaces coronal segments with prepalatals. Velar consonants are affected by two separate palatalizations, traditionally known as 1st Velar Palatalization and 2nd Velar Palatalization. As a result of 1st Velar we observe the alternations /k ~ č/, /g ~ ž/ (→ /ž/ by another rule, Spirantization), and /x ~ š/. This is an all-pervasive phenomenon and it occurs before a wide variety of morphemes (see the list in Rubach 1984: 110–111). 2nd Velar is much more restricted in its operations. Indeed, it is conditioned entirely by morphology. The only time it is observed is when a velar root is affixed by the dative/locative desinence, the masculine nominative plural ending or a de-adjectival adverb ending. Rubach argues that a process of Affricate Palatalization also applies to underlying /c, ʒ/ stems with essentially the same effect as 1st Velar (i.e. the sounds become /č, ž/). Finally, there is a phenomenon observed most frequently in verb paradigms by which /s, z, t, d, st, zd/ alternate with /š, ž, ć, ź, śč, źź/. This is a process known as Iotation (traditionally: *Jotowanie*). Rubach also discusses a couple of other morphologically conditioned palatalizations affecting only a small number of segments (his Nominal Strident Palatalization and Adjectival Strident Palatalization). These can readily be handled by the same mechanisms I develop for the other palatalizations in Section 3 of this paper, and I shall not discuss them here.

2. A NON-LINEAR ANALYSIS OF VOWEL-ZERO ALTERNATIONS

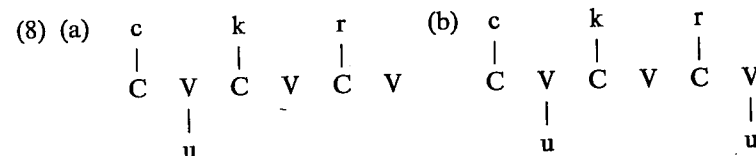
2.1. Havlík's Law

It has been suggested in many places that phonological representations distinguish between different levels corresponding to different phonological units. Thus, representations are viewed as multidimensional objects, not linear strings of distinctive feature matrices. In particular, many analyses assume a level or 'tier' at which consonant and vowel features only are represented, the CV tier, or prosodic template (cf. Halle & Vergnaud, 1981; McCarthy, 1981; Prince, 1984). Clements and Keyser (1983) and Keyser and Kiparsky (1984) make very interesting use of the notion 'CV tier' to explain the apparently exceptional behaviour of Finnish vowel-final morphemes.

Some phonological processes in Finnish, such as consonant gradation, are sensitive to the rhyme structure of syllables, only applying, for example, in

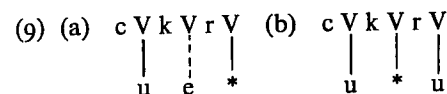
closed syllables. Many roots apparently ending in a vowel behave as though they ended in a consonant with respect to such rules. Clements, Keyser and Kiparsky claim that the underlying forms of such morphemes contain a C slot on the CV tier which is not associated to a segment matrix. The C slot, though empty, can condition syllable-sensitive rules, but if left unassociated at the end of a derivation it is deleted.

A similar analysis of Polish alternating vowels and Havlík's Law suggests itself. Suppose we assume (8) as underlying representation for *cukier*, *cukru*.

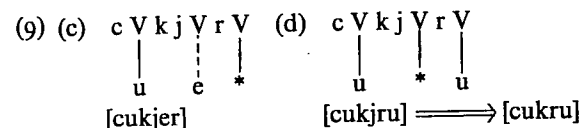


The separation of V and C slots apparent in (8) is motivated independently. Polish stress is defined solely in terms of rhyme projections (i.e. V slots) and never makes any reference to consonants. Thus, unless we can refer independently to vowels and consonants the stress rules will be filled with totally unnecessary occurrences of C_0 .

Let us now assume a rule of e-association attaching /e/ to a string of consecutive unassociated V slots, ignoring the rightmost slot. This can be achieved formally by marking the rightmost such V slot 'extrametrical' and interpreting extrametricality in this case as a bar on association. This may be worth considering as a reflex of the historically earlier 'metrical' behaviour of the jers. The 'extrametrical' V slot will be marked with a star *. This will give us the derivations of (9) (representing consonants inside the CV tier itself for perspicacity). The derivation of *sen/snu* from /sVnV, sVnu/ will be parallel to (9).



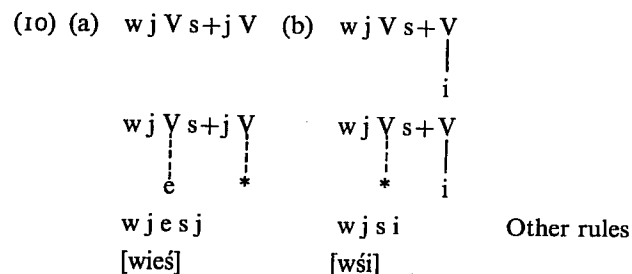
Let us further assume that e-association is cyclic and that by convention a postcyclic rule deletes unassociated V slots. We can account for the presence of the glide /j/ before the inserted /e/ of some forms by assuming that it is present in the underlying representation and that a further postcyclic rule (fed by the V slot deletion rule) deletes the glide interconsonantly. Thus, we revise (9a, b) to (9c, d).



This formalization of Havlík's Law accounts for all the alternations

discussed by Gussmann and Rubach without assuming anything more abstract underlyingly than an unassociated V slot.

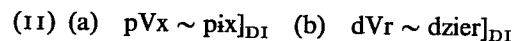
Similarly, in (10) we see derivations of *wieś*/*wsī*:



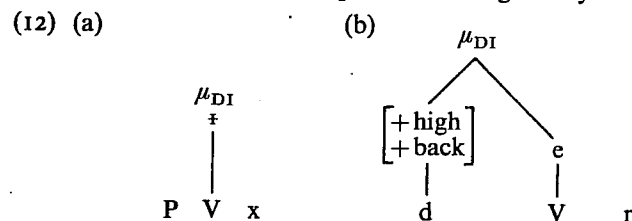
Words such as *cień/cienia* and *szmer/szmeru* must be represented as such underlyingly (as Rubach points out).

It will be recalled that Gussmann also appealed to underlying jers in his analysis of alternations of the type *odpycha ~ odepchnie*, *oddziera ~ odedrze*, which depended crucially on the ordering of his rule of Derived Imperfective Tensing before the rule of Lower. A curious fact about the rule of DI Tensing is that the whole of its phonological environment is redundant. The rule applies solely to Imperfective allomorphs of verb roots, and thus the application of the rule is conditioned entirely by the morphological diacritic, 'DI'. This strongly suggests that DI Tensing is not a proper phonological rule but rather that it is the kind of 'minor rule' which Lieber (1982) has argued should be analysed as a 'morpholexical rule', that is as a lexical redundancy rule relating listed allomorphs in the lexicon (see Section 3 for more detailed discussion).

Given this reasoning the DI Tensing rule will take the form of a redundancy rule relating items listed in the lexicon in the form of (11).



A rather more sophisticated analysis of such forms is possible within the framework of Spencer (1984b). The /i/ vowel can be associated with the imperfective morpheme in lexical forms on a separate tier from the rest of the morpheme if we extend the ideas of McCarthy (1981) to the theory of allomorphy. We will then obtain a representation such as (12), in which the identity of the imperfective morpheme can be given by a lexical rule.



The interpretation given to (12) will be that the internal root vowel is /i/ or /je/ in the imperfective but unspecified in other forms. In the case of (12b) the Derived Imperfective morpheme includes a component which palatalizes the preceding consonant. As the reader can verify, we can now easily reconstruct the Gussmann/Rubach treatment of alternations such as *odpycha ~ odepchnie* and *oddziera ~ odedrze* by adopting their assumption that the underlying form of the prefix *od-* is *odV-* with unassociated V.

All that remains is to explain where the inserted /e/ comes from. At worst we could stipulate that this is the default vowel for the vowel-zero alternations. However, a more insightful approach is open to us. I shall argue that the Polish alternations are in essential respects exactly like Spanish e-epenthesis. Harris (1980) has argued persuasively that there is a very general rule of e-epenthesis in Spanish which accounts for at least four distinct phenomena. Archangeli (1984) has provided a principled explanation of why Spanish should chose /e/ as its all-purpose epenthetic vowel, an explanation which hinges on her theory of underspecification, which I shall present in the next subsection as it applies to underlying vowel inventories. I shall then show that an explanation of Polish vowel-zero alternations parallel to that of Spanish epenthesis is available.

2.2. Underspecification and e/∅ alternations

2.2.1. *Archangeli's theory of underspecification.* Archangeli (1984) has presented a theory of underspecification which generalizes the notion 'archiphoneme' in an extremely interesting way. She proposes that underlying segment inventories are given the minimum possible specification in distinctive features and that all redundancies are captured by redundancy rules. Some of these take the form of default rules (DR) provided by Universal Grammar (UG), some take the form of complement rules (CR) provided by UG in conjunction with language particular rules and representations, while others are learned as language-particular rules. The redundancy rules apply late in the derivation (postcyclically in the framework of Lexical Phonology). Archangeli shows how this permits a theory in which phonological rules can apply to change feature specifications without the need for a battery of phonetic readjustment rules late in the derivation. In effect, the device of underspecification and late redundancy rules acts as a filter on derivations by allowing segments to surface only if they belong to the canonical phoneme inventory.

Archangeli suggests that this view of underlying representation has interesting repercussions when we look at underlying vowel inventories and choice of epenthetic vowels. She points out that Spanish, Japanese and Telugu all have an underlying five-vowel system (i, e, o, u, a) and that each makes use of a particular epenthetic vowel. However, the three languages each choose different vowels: Spanish /e/, Japanese /i/ and Telugu /u/. Archangeli

associates this with the fact that there are three ways of representing the five-vowel system with maximal underspecification in such a way that one vowel is totally unspecified. The underlying matrices she proposes for these languages are given in (13b-d). In (13a) I give the fully specified system.

(13) (a)

	i	e	a	o	u
high	+	-	-	-	+
low	-	-	+	-	-
back	-	-	+	+	+
round	-	-	-	+	+

(b) Spanish

	i	e	a	o	u
high	+	.	.	.	+
low	.	.	+	.	.
round	.	.	.	+	+

(c) Japanese

	i	e	a	o	u
high	.	.	-	-	.
low	.	-	.	.	.
round	.	.	.	+	+

(d) Telugu

	i	e	a	o	u
high	.	-	.	-	.
low	.	.	+	.	.
round	-	-	.	.	.

The principles governing the construction of the matrices of (13b-d) are (i) that the number of features used must be minimal (i.e. the fewest necessary to distinguish all phonemes); (ii) that no features should mark all the segments of a matrix; and (iii) that no feature should mark any two different segments with different values. Further details of Archangeli's proposals will be presented in the next subsection.

2.2.2. *The Polish vowel system.* Rubach (1984: 30) proposes the following inventory of underlying vowels for Polish:

(16)

	i	ĩ	u	ĩ	ĩ	ē	e	o	a
high	+	+	+	+	+	-	-	-	-
low	-	-	-	-	-	-	-	-	+
tense	+	+	+	-	-	+	-	-	-
back	-	+	+	-	+	-	-	+	+
round	-	-	+	-	-	-	-	+	-

Of these, two vowels are abstract entities in the sense that they never surface

(the jers /i, ĩ/), while /ē/, a tense front mid vowel, has the odd status of being phonemic underlyingly for Rubach even though its surface distribution is always predictable. This is because /ē/ invariably surfaces between palatal/palatalized consonants. Rubach's /ē/ replaces the abstract underlying vowel /æ/ in Gussmann's analysis.²

Rubach follows Gussmann in claiming that two sorts of non-high front vowel have to be present in the underlying system to account for alternations such as *wiedzieli* 'they (masc.) knew', *wiedziały* 'they (fem.) knew'. Rubach states (ch. 6, fn. 2) that these alternations are the consequences of a 'minor rule' while Gussmann (64ff) suggests handling the exceptions to his Backing rule (which accounts for these alternations) by allowing surface phonetic forms to be idiosyncratically input to word formation rules. Both of these suggestions are equivalent to treating the relationship as a morpho-lexical rule in the technical sense of this term to be described. In fact, these alternations are a paradigm example of morpholexical relationships on the criterion of Marantz (1982) (see below Section 3.1).

(i) Underlying *ie* fails to alternate with *ia* before nonpalatalized ('hard') dental: *bieda* 'misery' vs. *biada!* 'woe!'.

(ii) Underlying *ia* fails to alternate with *ie* before a soft dental: *jasny* 'clear' vs. *jaśniejszy* 'clearer'.

(iii) Underlying *ie* alternates exceptionally with *ia* before a soft dental: e.g. in any adjective of the form *biały* 'white (masc. nom. sg.)', *biali* 'masc. nom. pl.' (**bieli*); cf. *bielić* 'to whiten'. The contrast with verb past tenses is striking here, since these tense forms are etymologically and morphosyntactically related to participles which have adjectival declensions.

(iv) Underlying *ia* alternates exceptionally with *ie* in positions other than before a soft dental: *lać* 'to pour' (cf. *lał/lali* 'past tense, sg./pl.') vs. *lej!* 'imperative', *odlewianie* 'pouring'.

If this reasoning is accepted there will be no need to set up a further underlying vowel. Other consequences of the /e, ē/ distinction set up by Rubach can be accounted for on the assumption that /ē/ is really /je/ in underlying representations, an assumption that is discussed in greater detail in Section 3. As it happens, the argument concerning e/∅ alternations is not seriously affected by the inclusion of /ē/ in the underlying inventory.

I assume, then, an underlying inventory of the vowels /i, ĩ, u, e, o, a/. Of the five main features which distinguish these vowels (on Rubach's assumptions) only three are needed for the minimally specified representation. Applying Archangeli's reasoning we conclude that there are four maximally

[2] Much of the motivation behind these abstract underlying vowels comes from the need to account for the complex facts of the palatalizations. It is worth noting that in the Lexical Phonology framework Rubach has to admit as underlying phonemes all the affricates, palatals etc. which are the result of palatalizing velars and dentals. In an SPE framework it would have been possible to economize on the consonant inventory in exchange for this more 'expensive' vowel system. Rubach, however, has to pay both costs.

underspecified matrices for these vowels, using the features [high, back, round], which have maximally unspecified vowels /i, ɪ, a, e/. The matrix of interest to us is that in which the vowel /e/ is given no feature specifications at all (17).

(17)

	i	ɪ	u	e	o	a
high	+	+	+	.	.	.
back	.	+	.	.	.	+
round	.	.	+	.	+	.

The strongest claim would be that (17) and only (17) can account for the vowel phonology of Polish. Whether this can be demonstrated I do not know. However, it is easy to establish a rather weaker claim, namely that there is a maximally unspecified matrix, the maximally unspecified vowel of which is /e/. For completeness, I provide a set of redundancy rules in (18) for (17).

(18)

[] → [-high]	
[] → [-back]	
[] → [-round]	
[] → [+low]	/ $\left[\begin{array}{c} + \text{back} \\ - \text{round} \end{array} \right]$
[] → [-low]	/ $\left[\begin{array}{c} - \text{back} \\ + \text{high} \end{array} \right]$
[] → [-low]	
[] → [+back]	/ $\left[\begin{array}{c} - \text{high} \\ + \text{round} \end{array} \right]$
[] → [+tense]	/ $\left[\begin{array}{c} - \text{round} \\ + \text{high} \end{array} \right]$
[] → [-tense]	

The context-sensitive rules in (18) are Default Rules (some of which will be provided by Universal Grammar according to Archangeli). These are self-explanatory. The rules of the form [] → [αF] are Complement Rules, with F a feature name in the minimal (underspecified) feature system such that α is the opposite value from that chosen in the underspecified matrix. In effect, the Complement Rules fill in the blanks left by the specification in underlying representation on the principle of binary representation. On occasions, these Complement Rules may be overridden by more specific redundancy rules providing different specifications. These are in general ordered disjunctively with respect to other redundancy rules by the Elsewhere Condition (cf. Kiparsky, 1982). Archangeli refers to the operation of these redundancy rules as 'Alphabet Formation'.

To summarize the results of this section: I have shown that if non-linear representations are postulated there is an explanation for the vowel-zero

alternations of Polish available which does not appeal to fully specified abstract underlying segments. Moreover, the phonological rule of Lower required on a linear analysis of these alternations is not necessary if Archangeli's theory of underspecification is assumed. The two assumptions taken together provide an account which is therefore superior to the Gussmann/Rubach account inasmuch as its rules and representations resort to less unmotivated abstraction and are better justified.

It is important to note that the analysis proposed is still 'abstract' in the sense that representations are assumed which go well beyond what is immediately apparent on the surface. I am appealing, therefore, to an implicit assumption that the increased reliance on representational capacity embodied in the so-called non-linear approach will provide a grammar which will be preferred to the Gussmann/Rubach grammar by the Evaluation Metric, brings greater promise of achieving explanatory adequacy, and addresses more satisfactorily the problem of how the grammar of Polish is learnt by children.

The abstract underlying phonemes in the Gussmann/Rubach analysis are motivated by their role throughout the phonological and morphophonological system of Polish, particularly by their interaction with palatalization rules. The conclusions of this section will therefore be of little significance without a wholesale reanalysis of the phenomena motivating these abstract elements. This is the topic of the next section.

3. MORPHOLEXICAL RULES AND PALATALIZATION

3.1. Morpholexical rules

Lieber (1982) discusses proposals extant in the literature for handling cases of phonological alternations which are morphologically or lexically governed. She claims that theories involving such devices as 'minor rules' (Schane, 1973), 'morphophonemic rules' (Hooper, 1976) or readjustment rules (Chomsky & Halle, 1968; Aronoff, 1976) all suffer from the defect that they do not permit the statement of important allomorphic generalizations. She refers to such theories collectively as 'R' theories and proposes an alternative in which allomorphs are listed in the lexicon so as to be available for word formation. The allomorphs of a morpheme are related to each other by lexical redundancy rules called 'morpholexical rules', which express the morphophonological regularities captured by the corresponding minor phonological rules, etc. Being redundancy rules, Lieber argues, they cannot be given an extrinsic ordering. Lieber's most convincing example of a morpholexical rule comes from an analysis of the interaction between a morpholexical rule of Warlpiri and reduplication. Marantz (1982) makes use of Lieber's notion in discussing reduplication in Dakota. He characterizes morpholexical rules as rules embodying processes which '...do not apply to all morphemes meeting their structural description. For each morpheme, one must learn

separately whether or not the process will apply (although there may be some generalizations regarding the classes of morphemes which undergo or do not undergo the process). The processes also have morphological rather than purely phonological environments'. (Marantz, 1982: 465).

The strong justification for morpholexical rules, then, comes primarily from their interaction with reduplication, which is not itself an uncontroversial phenomenon (cf. Carrier-Duncan, 1984). Fortunately, Spencer (1984b, 1985) presents two cases of morpholexical rules, one from Spanish, the other from Czech, which do not involve reduplication. It is shown that clear morphological regularities will be totally obscured unless apparent phonological processes are treated as morpholexical rules, defined as redundancies stated over listed allomorphic variants. It is also shown that the morpholexical rules can be regarded as a type of phonological rule provided we accept alphabetic triggering diacritic features conditioning their application (see Zonneveld, 1978, for extensive justification of the exclusive use of such diacritics for handling exceptionality). Such rules, it turns out, fall into the hierarchy of cyclic rules predicted by Kiparsky's theory of Lexical Phonology (Kiparsky, 1982). However, for expository purposes I will couch morpholexical rules in Lieber's format in what follows.

3.2. Palatalization in Polish

3.2.1. *Rubach's analysis.* Rubach's analysis of palatalization relies on the interaction of several extrinsically ordered cyclic rules operating over abstract underlying representations. I give here for reference a list of the rules relevant to my discussion stated informally (based on Rubach 1984: 242ff) and a brief annotation explaining how they generate the data discussed in Section 1.2. It must be borne in mind that Rubach follows Halle and Stevens (1979) in regarding palatals as [+coronal].

- (19) j-insertion
 $\emptyset \rightarrow j / _ V \check{V}]_{\text{verb}}$
 (\check{V} = lax vowel)
- (20) Vowel Deletion
 $V \rightarrow \emptyset / _ V]_{\text{verb}}$
- (21) Affricate Palatalization
 $c/3 \rightarrow \check{c}/\check{3} / _ i, e, j$
- (22) First Velar Palatalization
 $k/3/x \rightarrow \check{k}/\check{3}/\check{s} / _ i, e, j$
- (23) Second Velar Palatalization
 $\check{c}/\check{3} \rightarrow c/z / _ i, e$
 $\check{s}/\check{z} \rightarrow s/z / _ i$
- nom. pl.
dat./loc.
Adv.

- (24) Spirantization
 $\check{z} \rightarrow \check{z} / [+ \text{sonor}] _$
- (25) Coronal Palatalization

$$\begin{Bmatrix} t/d \\ s/z \\ n \\ l \\ r \end{Bmatrix} \rightarrow \begin{Bmatrix} \check{c}/\check{3} \\ \check{s}/\check{z} \\ \check{n} \\ l' \\ r' \end{Bmatrix} / _ i, e, j$$
- (26) Iotation

$$\begin{Bmatrix} \check{c}/\check{3} \\ \check{s}\check{c}/\check{s}\check{z} \\ \check{s}/\check{z} \end{Bmatrix} \rightarrow \begin{Bmatrix} c/3 \\ \check{s}\check{c}/\check{s}\check{z} \\ \check{s}/\check{z} \end{Bmatrix} / _ i, e$$
- (27) j-deletion
 $j \rightarrow \emptyset / \begin{Bmatrix} [+ \text{coron}] _ \\ - \{ C \\ \# \} \end{Bmatrix}$
- (28) Fronting
 $i, \check{x} \rightarrow i, e / [- \text{anter}] _$
 Condition: if /x/ then \neq inflectional ending
- (29) Lower
 $\check{i}/\check{i} \rightarrow \check{x}/e / _ C_0 \check{i}, \check{i}$
- (30) Labio-velar j-insertion
 $\emptyset \rightarrow j / \begin{Bmatrix} p, b, m, \\ k, g, x \end{Bmatrix} _ e$

Affricate Palatalization and 1st Velar effect the changes that occur with /c, 3/ and velars before front glides and vowels. Affricate Palatalization applies to such forms as //kupic + ikĩ// to derive *kupczyk* 'merchant (dim.)' (after the postcyclic rules of jer-deletion and Retraction of /i/ to /ĩ/). The role of 1st Velar in deriving *kroczać* 'stepping' from the underlying representation //krok + i + onc// is shown in (31).

- | | | | | |
|------|-------------|---------------|---------|-----------------------------|
| (31) | Cycle 2 | +k+i+onc | Cycle 3 | $\check{c}+i+onc$ |
| | j-insertion | | | $\check{c}+j+i+onc$ |
| | V-deletion | | | $\check{c}+j+\emptyset+onc$ |
| | 1st Velar | $\check{c}+i$ | | $\check{c}+\emptyset+onc$ |
| | j-deletion | | | [kročonc] |

Notice that the rules of j-insertion and j-deletion apply vacuously in this derivation. Notice also that it is not in fact necessary for the rules to apply

on two cycles. It is sufficient here, as in ALL of Rubach's derivations (except for some involving prepositional prefixes), that the rules apply in a single cycle.

An innovation introduced by Rubach is to reformulate 2nd Velar in such a way that it applies to the output of 1st Velar in certain morphological environments. He intends his rather complex rule to have the secondary function of palatalizing /š, ž/ to /ś, ź/ in the masc. nom. pl. Two derivations illustrating 2nd Velar are given in (32).

(32) (a)	drodzy 'dear (nom. pl.)'	(b)	Czeši 'Czechs (nom. pl.)'
	drog+i		čex+i
1st Velar	drož+i		češ+i
2nd Velar	droż+i		ces+i
Cor Pal	—		ceś+i
Retraction	drożi		—
	[droʒi]		[češi]

Derivation (32b) also illustrates the rule of Coronal Palatalization, a relatively straightforward rule with wide application conditioned by any front vowel or glide which includes the tense front mid vowel /e/ in Rubach's formulation. Thus we have //idjot+ej+ć// → *idjo[ć]ieć* 'to become idiotic', //let+e+ć// → *le[ć]ieć* 'to fly'. It also includes the verb desinence, lax /e/ as in //griz+e// → *gry[ż]ie*.

Iotation corresponds roughly to traditional Jotovanie. Although it applies in a few restricted contexts to nominals, its main function is to account for root allomorphy in certain types of verbs. Polish verbs fall into two broad classes: consonant stems and vowel stems. The vowel stems interpose a vowel or vowel+glide between the root proper and inflexional endings. The consonant stems add desinences directly to the root. Rubach notes that Iotation is only observed in the former classes of verbs. The rule is conditioned by the glide /j/ which is invariably absent from underlying representations. Its appearance is the result of j-insertion which puts /j/ in exactly the places it is needed. This /j/ is only retained after labials. Two illustrative derivations in which the inserted /j/ triggers Iotation are given in (33a, b). (33c) provides a derivation with a labial stem for comparison.

(33) (a)	koszā 'they mow'	(b)	piszā 'they write'
Cycle 2	kos+i		pis+a
j-insertion	—		—
V-deletion	—		—
Cor. Pal.	koś+i		—
Iot.	—		—
j-deletion	—		—

Cycle 3	koś+i+om	pis+a+om
j-insertion	koś+j+i+om	pis+ja+om
V-deletion	koś+j+om	pis+j+om
Cor Pal.	—	piś+j+om
Iot.	koś+j+om	piś+j+om
j-deletion	koś+om	piś+om
	[košom]	[pišom]

(33) (c)	kopia 'they dig'
Cycle 3	kop+a+om
j-insertion	kop+ja+om
V-deletion	kop+j+om
Cor. Pal.	—
Iot.	—
j-deletion	—
Surface Palatalization	kop'+j+om
	[kop'jom]

These derivations are opaque in the sense that they crucially involve segments which never materialize in the paradigm in question (notably the /j/ in verbs such as *kosić*, *писаć*). However, it is important to notice that the theme vowel in these verbal forms can be motivated for each verb from forms elsewhere in the paradigm in which it does surface, e.g. *pis+a+ć*, *kop+a+ć*, *kos+i+ć*. The -i- theme of *kosić* distinguishes this verb, which undergoes Iotation by virtue of its two adjacent vowels in UR, from *paść*, a consonant stem verb which does not therefore undergo Iotation (see derivation (33d) for the latter).

(33) (d)	pasie 'it grazes'
Cycle 2	pas+e
Cor. Pal.	paś+e
	[paše]

The analysis of these alternations involving the interaction of j-insertion, V-deletion, Coronal Palatalization, Iotation and j-deletion is nothing if not ingenious. It is descriptively impeccable in all but one respect. In the imperative of verbs such as *kosić* we expect derivation (34a) paralleling the (correct) derivation (34b) from *писаć*.

(34) (a)	*kosz 'mow!'	pisz 'write!'
Cycle 3	kos+i+ī	pis+a+ī
j-insertion	kos+j+i+ī	pis+ja+ī
V-deletion	kos+j+ī	pis+j+ī
Cor. Pal.	koś+j+ī	piś+j+ī
Iot.	koś+j+ī	piś+j+ī
j-deletion	koś+ī	piś+ī
jer-deletion	koś	piś
	*[koš]	[piš]

Unfortunately, the imperative of *kosić* is *koś*, which exhibits no trace of Iotation. Rubach accounts for this discrepancy by looking in some detail at the allomorphy of the imperative affix. He shows that there are independent grounds for setting up a second imperative allomorph, related to the usual allomorph /-ĩ/ by means of two word-formation rules (Allomorphy rules in the sense of Aronoff, 1976). Only the second of these, Front V Truncation, is relevant here, formulated in (35).

- (35) Front V Truncation
i, e → Ø / — ĩ

Both of the word formation rules Rubach sets up would no doubt be viewed by Lieber as morpholexical rules. For our purposes it is sufficient to note that (35) provides the appropriate input from which to derive the imperative *koś*. The underlying representation //kos+i+ĩ// becomes //kos+ĩ// by virtue of (35), and this satisfies the structural description only of Coronal Palatalization and jer-deletion.

3.2.2. *A re-examination.* I begin my examination of Rubach's analysis with an observation about the two varieties of /e/ which appear in Polish. We may say that, superficially, in addition to a non-palatalizing /e/ there is a palatalizing variety which figures in certain inflexional contexts. At the same time other tokens of /e/ cause palatalization of certain consonants but do not give rise to Velar Palatalization, Coronal Palatalization or Affricate Palatalization. The first, 'strongly palatalizing', variety is exemplified by the dat./loc. sg. ending. This conditions 2nd Velar and also induces a rule of Labio-velar j-insertion. Thus, we find //renk+e// → *rę[c]e*, 'hand' and //ślup+e// → *ślup[j]e* 'post'. The third type conditions Labio-velar j-insertion with velars but not with labials. It is exemplified by the adjectival endings -e, -ego, -emu, -ej, -em. It conspicuously fails to condition any variety of palatalization other than that caused by the inserted /j/. Thus we find *niemego* 'dumb (gen.)' not **niemiego*, *czarnego* 'black' not **czarniego*, *welkiego* 'large' not **welczego*. Rubach accounts for these facts by appeal to the rule of Fronting (which is independently motivated for high vowels) and the assumption that Polish has another abstract underlying segment, a mid back unrounded vowel /ɤ/. This vowel is Fronted when it follows a velar but only after a stage in the derivation at which the palatalizations have applied. Thus, it conditions no rules other than Labio-velar j-insertion and subsequent (postcyclic) Surface Palatalization. After a labial or any other consonant, however, it remains a back vowel to be spelled out as /e/ late in the derivation by a rule of V-Spell Out (which Rubach motivates in his discussion of nasal vowels).

Despite its ingenuity and its descriptive adequacy we must reject this solution for two reasons. Firstly, it introduces another abstract element which never reaches the surface, while we are eschewing such entities *ex hypothesi*. Second, if /ɤ/ is an underlying phoneme, then there will be no

minimal feature specification for underlying vowels which predicts that /e/ is the default vowel for association, and thus we would lose the generalization captured in Section 2.2. In fact, there is no need to set up an abstract underlying mid back unrounded vowel, provided we make two assumptions: (i) that the strongly palatalizing variety of /e/, namely the dat./loc. sg. as opposed to the adjectival endings, is underlyingly /je/; (ii) that the palatalizations are not conditioned by /e/. I shall justify the second, more sweeping claim in due course. First, I turn to the claim that the loc. sg. of *ręka*, *ślup* is //renk+je//, //ślup+je//. Rubach mentions this possibility *en passant* only to reject it immediately (1984: 167–8), for on his assumptions, underlying /j/ would trigger Coronal Palatalization and then Iotation in a form such as //but+je// to give **buce*. In fact, Iotation never applies to nouns, so only Coronal Palatalization applies (*bu[ć]ie*). However, if there were no such rule as Iotation, or if Iotation were prevented from applying to such forms, there would be no reason for not setting up underlying /je/ for all the cases in which /je/ surfaces after labial consonants and hence there would be no need (given these data, at least) for an underlying abstract /ɤ/.

One solution will be to discard the phonological rule of Iotation altogether and reanalyse it as a morphologically conditioned rule, i.e. a morpholexical rule. This is a somewhat contentious move, for Iotation does not, for example, fit the criterion for morpholexical status given by Marantz. Although it overapplies in the sense that it applies when there is no trace of its conditioning /j/ in underlying representation, it never underapplies; that is, there is no form with coronals followed by /j/ which has been palatalized by Coronal Palatalization but which does not undergo Iotation. It is not difficult to see why this is so. The rule is morphologically conditioned in a covert fashion. The /j/ which conditions it is only introduced in verb forms and the vowel sequence which triggers the j-insertion is only provided to certain verbs. We thus have a case of a morphologically restricted phenomenon captured by means of phonological rules and representations. Because the relationships can be captured by phonology in an elegant fashion, the fact of morphological conditioning is obscured.

If this reasoning is correct then Iotation has very much the status of a minor rule in an 'R' theory (in Lieber's sense). It must be confessed, however, that this is a highly uncharitable interpretation of Rubach's analysis, given that all the elements of every underlying form and of every intermediate derivational stage can be justified within the verb paradigm. Moreover, it is not possible to point to convincing arguments from allomorphic variation of a straightforward kind to show that Iotation has to be a morpholexical rule. On Rubach's analysis Iotation applies only to verb forms and a handful of denominal adjectives and deverbal nouns. As we have seen, this restriction to verb forms comes about largely by virtue of the fact that it is fed by a rule of j-insertion which itself is morphosyntactically restricted to verbs. It might be possible therefore to reanalyse Iotation as a rule applying essentially to

verbs, with other targets perhaps being marked as positive exceptions. It would then be necessary to assume that the underlying representations of forms such as *pa[š]iesz* 'thou graze' *ly[š]iejesz* 'thou becomest bald' and *le[č]isz* 'thou fliest' are respectively //pas+ē+š//, //lys+ēj+eš//, //let+ē+iš//, where /ē/ is the tense variety of /e/ posited by Rubach. This solution would leave the argument that /e/ is the maximally unspecified vowel unaffected, while still dispensing with the offending abstract underlying vowel /ɤ/.

As will become apparent, to take this approach would deprive the morphophonemic solution required for other phenomena of much of its generality. In a sense, then, it would be redundant to suggest such a revised phonological solution. Instead, I shall pursue the logic of the Lieber-Marantz proposals to its limit and adopt the rather more radical stance that lotation is simply a morpholexical rule.

I have shown that it is possible to consider the dat./loc. ending to be underlyingly /je/. In the absence of other considerations we are obliged to make this assumption, since this is the simplest underlying representation compatible with all the surface manifestations of that affix. I therefore conclude that the first of my claims is established. The second claim was that the palatalizations affecting /k, g, x, c, ʒ/ are not conditioned by /e/. Once this claim is established there will be virtually no justification for setting up an underlying /ɤ/. The crux of my argument is that Affricate Palatalization and the Velar Palatalizations are morpholexical rules and therefore, by definition, could not be conditioned by /e/.

The core of Rubach's analysis of velar stem alternations is his rule of 1st Velar Palatalization. Viewed as a purely phonological rule 1st Velar overapplies in the context of certain morphemes; for instance, before the adjectival affix -n- and the diminutive -(e)k. Superficially, these morphemes do not meet the phonological description of an environment-conditioning 1st Velar. At the same time, before other morphemes 1st Velar fails to apply even though its structural description is met, namely the adjectival endings in -e. These endings even condition the insertion of a palatal glide, /j/, which again does not condition 1st Velar. By Marantz's interpretation of Lieber's theory 1st Velar is, *ceteris paribus*, a morpholexical rule.

Affricate Palatalization is an innovation of Rubach's. It functions very much like 1st Velar except that it takes as its input underlying dental affricates. These affricates have often been derived from underlying velars in previous analyses (recapitulating history) but Rubach, in reviewing that work, argues convincingly that a separate palatalization, which he formalizes with a rule of Affricate Palatalization (given as (21) in Section 3.2.1 above), is involved and that the affricates are present underlyingly. The output of Affricate Palatalization, however, resembles the output of 1st Velar applied to /k, g/. Viewed as morpholexical rules, 1st Velar and Affricate Palatalization share output forms but have different input forms. Thus, Rubach's

arguments for separating these two rules point in the same direction as the morpholexical alternative, which is unable in principle to derive both palatalizations from an underlying velar. However, the morpholexical analysis will permit the two palatalizations to be linked formally by means of the curly brackets notation (see below example (36)), whereas for Rubach this is impossible, first because the rules as formulated in distinctive feature notation only allow collapsing of the conditioning environment, and secondly because another rule (Nominal Strident Palatalization) with a very different format intervenes between Affricate Palatalization and 1st Velar on Rubach's analysis.

As a result of these morpholexical relationships the lexicon will make available palatalized as well as non-palatalized root allomorphs for word formation in the manner suggested by Lieber (1980, 1982), who does not however discuss exactly how this selection takes place. More explicit proposals are made in Spencer (1984b).

I turn now to the most obvious candidate for the status of morpholexical rule, 2nd Velar Palatalization (see rule (23), Section 3.2.1). This is a most odd phonological rule, for almost the whole of its phonologically defined environment is redundant: the morphological conditioning features of the determinant almost entirely exhaust the domain of applicability of the rule (and would do so completely if the feature 'nom. pl.' in rule (23) were replaced by 'masc. animate nom. pl.'). As it happens there is no case of over- or underapplication, but this is clearly because the rule is, in effect, already stated as a morpholexical rule! What is disturbing now about Rubach's treatment is that we find a morpholexical rule ordered extrinsically amongst cyclic phonological rules.

I come finally to the last remaining cyclic palatalization rule under discussion in Rubach's system, Coronal Palatalization. As it is formulated, Coronal Palatalization underapplies; for instance, before those adjectival desinences which, according to Rubach, have underlying /ɤ/. There seems to be no case of overapplication. Given that the rule is a natural enough phonological process it would be reasonable to follow Rubach in regarding it as a cyclic rule, but limiting its conditioning environment to /j, i/ to prevent underapplication. However, another alternative is open to us. Recall that I pointed out that 1st Velar Palatalization both underapplied and overapplied and hence qualified as a morpholexical relationship. This is something of an oversimplification. For in specified morphological environments the process of palatalization undergone by velars is exceptionless, applying even to recent loan words (as Rubach is at pains to make clear). In a sense, then, we are dealing with an automatic morphophonological alternation. This sort of productive, but morphologically conditioned alternation is not the kind which Lieber and Marantz had in mind in their original discussions. This productivity and regularity is the only factor which separates rules such as 1st Velar Palatalization from the morpholexical rules of Lieber and Marantz.

Rather than regarding this as an overriding consideration and thus treating 1st Velar as a phonological rule, let us assume that morpholexical redundancy rules can apply in a perfectly regular and exceptionless fashion. Morpholexical rules are defined over allomorphs listed in what Lieber refers to as the 'permanant lexicon'. In general these rules will be restricted by diacritic features identifying the subset of entries which undergo the rule from those that do not. The exceptionless rules will be just those rules which do not appeal to any such classificatory diacritics. This means that we can regard such rules as purely formal (i.e. phonological) rules which happen to apply only at the level of lexical entries, relating basic allomorphs to derived variants which figure in morphologically complex contexts. These are rules which I have dubbed 'Level O' rules (Spencer, 1984a, 1985).

An aspect of morphophonology which is not discussed in any detail by either Lieber or Marantz is the important question of how a given affix selects the appropriate allomorph. Space does not permit detailed investigation of this problem, but it is sufficient to point out that affixes and root allomorphs must be supplied with selectional features to guarantee that the correct allomorph is chosen. For example, according to Lieber (1982), both allomorphs of the morpheme 'house' (namely /haus/ and /hauz/) are listed, and the plural morpheme selects the second of these. But the plural morpheme can only do this if it recognizes that allomorph and can distinguish it from the first. Lieber does not explain how this is achieved, but it should be clear that in the most general case selection is essentially arbitrary. In particular, it cannot be accomplished by appeal solely to phonological form. This means that each allomorph must be marked by a diacritic which will allow affixes to recognize it. What would seem to distinguish the exceptionless morpholexical rules from the more general type is that no such diacritic is needed. In this case purely phonological criteria are sufficient to guide affixation processes. This, then, provides a motivation for the distinction between restrictive and exceptionless application of a morpholexical rule.

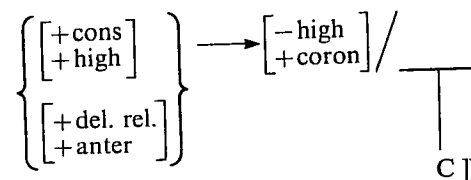
✱ It is a short step from this to suggesting that all lexical phonological rules operating in morphologically derived environments be regarded in the same light.³ Thus, where we have a phonologically regular rule such as Coronal Palatalization limited in its operation to word-internal sandhi positions we can represent this in the grammar by a morpholexical rule relating roots ending in dentals to allomorphs ending in prepalatals and providing certain affixes with selection features which in effect seek out the distinctive features [+high, +back]. I refrain from detailed speculation as to how this should be achieved since it is the subject of work currently in progress. It is worth pointing out, however, that if the Lieber-Marantz framework is to capture

[3] Jerzy Rubach (personal communication) has suggested to me the possibility of regarding all cyclic rules as morpholexical relationships. This is not to say that he would agree with my implementation of the idea.

all the regularities of the morphophonological systems they discuss, they too will have to get to grips with this problem.

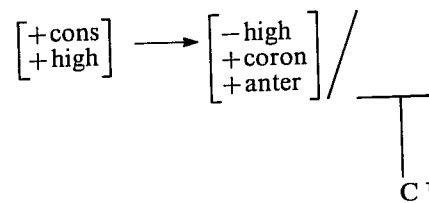
In the remainder of this subsection I provide in outline formalizations of the main morpholexical rules postulated here. I adopt essentially the format used by Lieber. However, I shall assume without discussion that these rules are to be couched over underspecified phonological matrices. Since it is well beyond the scope of this paper to motivate the details of such an analysis I shall present the merest skeleton here. A fully worked-out analysis is in preparation.

(36) 1st Velar/Affricate Palatalization:

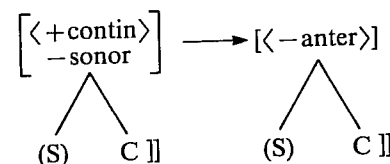


(where]] represents a morpheme boundary).

(37) 2nd Velar Palatalization:

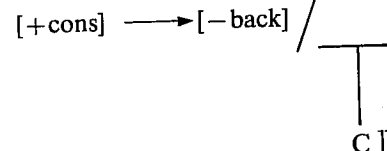


(38) Iotation:



(where S represents /s/ or /z/)

(39) Coronal Palatalization:



In each of these palatalizations plosives alternate with affricates. I assume that this can be factored out of the set of rules in some way. However, since affricates are the subject of continuing controversy I shall leave that refinement unformalized. It seems worthwhile, too, to investigate the possibility of collapsing these rules in such a way as to factor out the fact that they all apply to stem-final consonants. The feature sets on the left hand side of (36)–(39) are intended to represent underspecified matrices; thus [+cons] is the maximally underspecified consonant, i.e. /t/.

The only phonological relationship that Rubach captures and which does not seem to be available on the present account is the appearance of /j/ after the root labial of verbs such as *kopać*. This is one of the phenomena which motivate Rubach's rule of j-insertion. To say that this is simply a question of affix allomorphy which is morphosyntactically conditioned seems rather weak. I shall leave this as a problem to be tackled when the morpholexical rules are worked out and when a proper theory of the relationship between morpholexical relationships and selection of allomorphs is developed.

The advantages to the present analysis are (i) a superior analysis of Havlík's Law; (ii) a better-motivated analysis of morphologically conditioned rules; (iii) an analysis which does not have to resort to any form of absolute neutralization in the traditional sense of this term within linear theories of phonology. A further advantage is that a good many extrinsic ordering statements have also been rendered redundant. This point will be taken up in the next section when I justify the 'concrete' analysis with an informal argument from considerations of learnability.

4. DISCURSIVE ARGUMENTS FROM TYPOLOGY AND LEARNABILITY

In this final section I present two arguments favouring the present analysis based on considerations of learnability. These arguments suggest very strongly that it is necessary to take seriously the approach advocated here, for they challenge to some extent customary assumptions about evaluation of competing theories.

4.1 Havlík's Law

On any account I would claim that my reanalysis of Havlík's Law is superior to the Gussmann/Rubach account couched in a linear framework. First, I make use of fewer rules. In particular, I do not need to appeal to any rule of Lower or Jer-Deletion. Further, I appeal to no segment more abstract than the unlinked V slot. Compared to the two abstract high lax vowels which the Polish scholars posit, this is a very mild concession to abstractness. Third, the choice of vowel in the vowel-zero alternations is provided for by very general principles of grammar (namely the theory of underspecification). In effect, I am claiming that it is a systemic property of Polish vowels that the alternating vowel should turn out to be /e/. On the Gussmann/Rubach

account this fact has to be derived by means of stipulative rules and underlying representations.

Since my analysis of Havlík's Law is descriptively superior to the Gussmann/Rubach analysis it is *a fortiori* more explanatorily adequate. However, the fact that it appeals to less abstract entities than its competitor also contributes to its superiority at the level of explanation. For it is reasonable to assume that the language learner will project hypotheses which cannot be justified by the data he is presented with only to the extent that this is absolutely necessary to account for the data. Universal Grammar must presumably make available devices such as unlinked slots if, for example, the Keyser and Kiparsky (1984) analysis of Finnish gradation is correct. Therefore, the learner will never project any hypothesis more abstract than the (reasonably concrete) unlinked V-slot hypothesis. Hence, even if the two competing accounts were comparable in descriptive adequacy we would be obliged to favour the present analysis.

4.2. An argument from Czech

The Gussmann/Rubach analysis of Polish morphophonology lays great stress on the interaction between abstract underlying vowels (jers) which never surface and palatalization phenomena. I have suggested that some of the elegance of this essentially phonological solution to the descriptive problem must be sacrificed in favour of a morpholexical approach, claiming that the phonological regularities these authors have uncovered are not all part of the synchronic grammar of the language. Further confirmation of the correctness of the morpholexical tack comes from a closely related language, Czech.

The underlying Czech phoneme inventory is given in (40, 41).

(40) Vowels:

i, i, e, a, o, u, i:, i:, e:, a:, o:, u:, ej, aj, oj, uj, ew, aw, ow

(41) Consonants:

p	t	c	č	t'	k
b	d			d' (g)	
f	s		š		x
v	z		ž		fi
m	n			n'	
l	r	ř	j		

Superficially, Czech phonology is somewhat different from Polish in that it has fewer surface vowel phonemes (for instance it has no nasal vowel and no difference between high front and high central unrounded vowels) and fewer consonants. In particular, Czech lacks the rich array of prepalatal consonants so characteristic of the sound pattern of Polish. Consequently, there is correspondingly less palatalization evident on the surface. The only

coronal consonants which palatalize are /t, d, n, r/; there is no palatalized congener of /s, z, l, š, ž, č/, nor do labials or velars suffer surface palatalization. Furthermore, the only occasion when the coronal consonants palatalize is when they precede /j/ and certain types of /i/ (represented orthographically as *i* to distinguish it from the nonpalatalizing high front vowel *y*). The simplest assumption to make regarding these two vowels is that the palatalizing variant is underlyingly front and the nonpalatalizing variant underlyingly back with a late alphabetic rule neutralizing the distinction on the surface. Thus, we could represent *chudý* ([xudi:] 'poor' masc. sg) and *chudi* ([xud'i:] 'poor' masc. pl.) underlyingly as //xudi:// and //xudi:/. I concede this case of absolute neutralization simply for the sake of argument.

Czech retains typical adjectivizing affixes such as *-sk* and *-n*. The latter must presumably be furnished with an unassociated V slot (corresponding to a jer) because we find e/Ø alternations just as in Polish on those occasions when adjectives appear in predicative form, e.g. *šťastný* vs. *šťasten* 'happy'. It must be admitted, however, that the predicative forms with *-en* are somewhat rare in the modern language (cf. Smilauer, 1966). More substantial evidence for underlyingly unassociated V slots comes from diminutives which are very similar to their Polish equivalents. Thus, we find *Mírek*, *Mírku* (proper name, diminutive of Miroslav derived from *Mir* + *ek*).

As might be expected given the almost wholesale loss of palatalization in Czech, these affixes do not trigger palatalization in coronal consonants. Thus, from the root *pán* 'lord' we have *pa[n]í* 'lady' with palatalizing /i/ but *pá[n]ský* 'feudal'. (We also have *pa[n]na* 'virgin' but this would be expected even if *-n* conditioned palatalization since the word would then undergo Noncontinuant Depalatalization, a rule very similar to that described in Polish by Rubach, Section 4.7.) However, with velars the situation is somewhat different. Czech has /k, x, h/, the last phonetically a voiced laryngeal fricative corresponding to /g/ in most other Slav languages (/g/ appears in Czech only in recent loans). These undergo both 1st Velar Palatalization and 2nd Velar Palatalization, but only in certain morphosyntactically defined contexts. The context for 2nd Velar Palatalization is rather similar to that for Polish, e.g. masc. anim. nom. pl. *soudru[h]* (sg.) *soudru[ž]* 'comrade', *Če[x]* (sg.) *Če[š]* 'Czech'. (It is argued in Spencer, 1985, that 2nd Velar in Czech must be analysed as a morpholexical rule if certain exceptionless generalizations about morpheme selection are to be captured.) Likewise, 1st Velar Palatalization is observed very commonly in certain morphological environments. In particular, it is found after the adjectivizing affixes whose Polish cognates give rise to palatalization in velars and coronals. Thus we find *zvuk* 'sound' *zvu[č]ný* 'sonorous', *Praha* 'Prague', *pra[ž]ský* 'adj.', etc. However, it is not an automatic (phonological) alternation since we observe exceptions to it such as *pěkný* ([pjekni:]), in which the /n/ is presumably part of the root.

What this implies is that Czech has factored out the phonological

determinant of palatalization, leaving just the morphological conditioning, for we cannot easily claim that the *-n* adjectivizing affix has an underlying high front jer in Czech. If that were so, why do we not observe coronal palatalization in predicative adjectives such as *šťasten*? And yet with the velars we observe precisely the pattern of palatalization found in other Slav languages. While it is not impossible that a phonological solution could be found for Czech under which lax high front vowels condition only velar palatalizations, it seems highly suspicious that affixes such as *-n* and *-sk* should condition velar palatalization without showing the least sign of triggering any other kind. Indeed, from the phonological point of view it is remarkable that only the velar palatalizations should have survived more or less intact the massive loss of phonological palatalization which has occurred in Czech, and despite even the shift from [g] to [h]. This strongly suggests that the velar palatalizations were essentially morpholexical/morphosyntactic phenomena at a rather early stage in the development of West Slavic, since then we would have an explanation for their immunity to phonological change which has so affected other palatalizations.

4.3. Learnability and morpholexical rules

It could plausibly be argued that the machinery of a phonological system provided with extrinsic rule ordering, abstract underlying segments and opaque derivations is nonetheless superior to a morpholexical account, which inevitably will appear unable to capture 'linguistically significant generalizations'. Such an argument is essentially an argument from learnability (cf. also Dresher, 1981). The Evaluation Metric (i.e. the language learner) will select that grammar which captures the linguistically significant generalizations most effectively. The question which invariably stands in danger of being begged is, of course: 'What constitutes a linguistically significant generalization?' The problem is acute in research which subscribes to Chomsky's mentalistic program: there is, as is well known, always the danger that generalizations will be stated over the data which do not correspond to the generalizations which comprise the native speaker's competence. In other words, it is always possible to confuse what Chomsky (1986) has recently called grammars of 'E' languages with grammars of 'I' languages. Put in more traditional parlance, there may sometimes arise a conflict between perceived descriptive adequacy and perceived explanatory adequacy. As I have hinted, the extremely elegant and insightful Gussmann/Rubach analysis might on some counts be preferred by the classical Evaluation Metric over more direct morpholexical alternatives. However, it must be recalled that this will only be true under certain ideality assumptions. For instance, it is only true on the assumption that language learning takes place instantaneously in one bound. This is an obviously false assumption, but one which can be adopted without detriment in the majority of cases.

However, I shall argue that if a slightly more sophisticated notion of language acquisition is adopted (though one which is still highly idealized) then a different picture emerges.

Let us suppose that language learning takes place instantaneously but in a small number of discrete stages, n . Let us suppose further that at each stage the learner is presented with only a subset of the data relevant to language acquisition. In this way the final grammar can only be approached between stages $n-1$ and n , for only then will the child have available all the data. Assume that passage from one stage to the next is instantaneous and that at a given stage the learner instantaneously revises his current grammar on the basis of the newly presented evidence. Thus total acquisition time will remain zero, although the acquisition process itself will be somewhat more structured than on the usual idealization.

It would require a degree of mathematical sophistication which at present is unavailable to explore all the formal implications even of such a minor relaxation of the instantaneity idealization. Nonetheless, intuitively we can say that the new view differs from the classical view in that the Evaluation Metric will have to choose between competing grammars not once but n times. Moreover, the Metric will be applied to partial grammars, not to complete grammars. Finally, even this very mild change in boundary conditions would perhaps radically alter our views on the formal nature of learnability in the domain of phonology (if we had any), for the learning function would now be critically sensitive to the order of presentation of data (in all probability).

Without making any particular assumption about the order of presentation of data, let us consider the case of the Polish language learner. In order to learn the grammar Rubach proposes, the child must be able to determine for a variety of verb classes (including some I haven't discussed) the following:

- (a) the set of inflexional categories and conjugation classes;
- (b) the underlying representations of each affix corresponding to the items in (a);
- (c) a set of phonological rules relating underlying to surface representations;
- (d) the (unique) extrinsic ordering mapping defined over the items of (c);
- (e) a set of morpholexical statements and other morphological rules relating to morphosyntactic categories not covered under (a)–(d).

Note also that Rubach countenances phonological rules with quite detailed morphosyntactic conditioning. This means that decisions taken over one subdomain of the learning problem will possibly affect decisions taken over others. For instance, the shape of a phonological rule might be crucially dependent on a correct morpholexical and morphosyntactic analysis of the conjugational system. It is difficult to see how the learner could perform this

feat unless he were in possession of all the facts. Consider the case of Rubach's Iotation rule. This rule is similar in its environment and its phonetic effects to a number of palatalization rules from which Rubach is at pains to distinguish it. A slight error in the formulation of one of those other rules by the language learner will make it well nigh impossible to hit upon a correct formulation of Iotation. This is not to argue that it is impossible to arrive at the correct solution. For the child could easily trace through the steps followed by Gussmann and Rubach in earlier analyses and asymptote to Rubach's analysis eventually. But this could be achieved only if all the data were available to the child (as it was to Rubach). Similarly, it is vital for the child to establish the correct rule ordering. Iotation is fed by the rules of j-insertion and V-deletion as well as by Coronal Palatalization. It must apply in a (marked) counterbleeding order with respect to j-deletion. Thus the child must determine the form and order of all the rules of the system if he is to formulate any one of them with surety.

Under the classical idealization it should be no more difficult for the child to abduce the final grammar than it is for the linguist. Indeed, it should be easier, since the child is able to project hypotheses by virtue of innate principles of mind. Under the n -stage model it will presumably be somewhat more difficult to arrive at the correct grammar. For a set of grammars compatible with the partial data presented at the first $n-1$ stages might bear little relation to the true grammar. Thus, at some stage or stages considerable restructuring might have to take place.

Recall that Lieber (1982), Marantz (1982) and Spencer (1985) have presented strong arguments in favour of a morpholexical analysis of certain apparently phonological alternations. Recall too that in Rubach's approach some alternations must be handled by means of word-formation rules. Thus, the learner is in general able to project two types of hypothesis to cover alternations: either he can project a phonological rule, possibly with attendant abstract underlying representations, morphological conditioning and extrinsic ordering mappings, or he can project a morpholexical relationship or some similar morphologically defined relationship (ultimately he might just list the forms as he comes across them). Let us make the standard assumption that the child tries to make as much sense out of the data presented as he can, i.e. that he abduces grammars rather than lists. At any stage between 1 and $n-1$ the child is constructing a partial grammar which presumably he must treat as the grammar of the language (assuming that he doesn't know the number of stages he must pass through). But it is rather unlikely that at any of these stages there will be sufficient data for the child to hypothesize with any reliability a grammar which depends on the presentation of all relevant data. A morpholexically biased grammar does not place heavy reliance on the systemicity of a phonologically biased grammar. Morpholexical conditioning features can be added or dropped without any serious effects on the rest of the developing grammar (a point I assume, though I would need

to demonstrate this for a reasonably large set of morpholexical rules formally defined in order to justify this claim fully). Therefore, given the choice, the child is much more likely to opt for a morpholexical solution over an abstract phonological solution at stages 1 to $n-1$.

The crucial step is the abduction of the final grammar between stages $n-1$ and n . We have concluded that the child has been developing a morpholexically biased grammar until this point. In order to develop Rubach's grammar the child will have to assimilate the last increment of data and then effect a massive reorganization of his morphophonemic system in order to accommodate the linguistic generalizations he has just spotted. On the other hand, on the morpholexical approach the transition from penultimate stage to mature competence will be marked simply by a greater refinement of the current grammar in a process of steady accretion which characterized stages 1 to $n-1$.

It is not impossible that such a sudden transition from morpholexical bias to phonological bias will provide the best model of acquisition. However, it seems to me that the alternative is initially far more plausible. Put crudely, if the child has been developing a perfectly serviceable grammar all along, thoroughly compatible with the dictates of Universal Grammar and at the same time descriptively adequate, why should he ever want to totally reorganize it at a late stage in acquisition? This question becomes particularly acute when it is realized that the majority of the relationships concerned involve what is essentially a closed class of items, namely the morphophonemically complex lexical items of the language. The rules concerned do not, in general, apply productively to the rest of the phonological forms of the language (for they are morpholexically and morphosyntactically conditioned) and even those relationships that do apply productively to novel lexical items can easily be cast in the form of productive morpholexical relationships if these are regarded as lexical redundancy rules.

This argument from learnability must be distinguished from somewhat cruder arguments from the empirical facts of language acquisition which are sometimes adduced in discussion of matters such as these. I am not suggesting that psycholinguistic experimentation can presently serve to distinguish between competing linguistic theories. The relationship between language development in real time (by real children) and linguistic theory is far too complex to allow us to draw any firm conclusions from psycholinguistics about most questions in linguistics. The argument hinges on the plausible behaviour of the idealized language learner and as such is of a piece with the usual arguments relating to explanatory levels of adequacy. Moreover, it hinges crucially on the recent arguments of Lieber, Marantz, and Spencer on the nature of morpholexical relationships. Their research shows conclusively that some allomorphic variation previously held to be essentially phonological in nature must be captured in the form of redundancy rules defined over listed allomorphs. Hitherto, it had always been possible

to argue that such variation could be incorporated into the phonology by appeal to readjustment rules, minor rules or whatever. The crucial new link in the logical chain is the corollary that the language learner must be allowed at any stage to project the hypothesis that the variation he is confronted with is morpholexical (in the recent technical sense) rather than necessarily phonological with morphological conditioning. This slight change in the logic of the problem has the intriguing effect of shifting the burden of proof for the first time onto those who subscribe to more abstract phonological analyses in this domain.

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'Me Tarzan, you Jane!' Adequacy, expressiveness, and the creole speaker¹

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I. INTRODUCTION

Although linguists like to claim that all human languages are equal in a general sense, differing from systems of animal communication in possessing 'design features' like arbitrariness and productivity (Hockett, 1958), they sometimes join non-linguists in expressing the view that some languages are inadequate with respect to the cognitive or expressive resources which they offer their speakers. In the Middle Ages, this charge was commonly levelled against the European vernaculars, and it was sometime before Spanish and Italian were recognized as having autonomous grammatical and lexical resources comparable in regularity and power to classical Greek and Latin (Scaglione, 1984). By the middle of the twentieth century, following on the descriptive work of Boas, Sapir and others, the notion that the languages of 'primitive' peoples were fundamentally inadequate had also been eroded, at least in linguistics, anthropology, and other academic circles (Kay & Kempton, 1984:65). Yet, as Hall (1966:106) notes, there is still one group of languages which constitutes the 'last refuge' of the concept of inadequate grammatical or lexical resources: pidgins and creoles.

PIDGINS are contact vernaculars – native to no one – used for communication between speakers of different native languages, for instance the Chinook-based jargon used for trade among American Indians in the Northwest (Thomason, 1983), or the pidginized varieties of English which developed on Hawaiian sugar plantations for communication between workers from different countries (Bickerton, 1981:7). Pidgins usually involve admixture from the native languages of their users and appear reduced in comparison with their source languages. CREOLES are pidgins which have been functionally extended and structurally expanded, either through acquisition as a native language by children born and reared in the contact situation, or through use

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