LANGUAGE is published quarterly by the LINGUISTIC SOCIETY OF AMERICA, 428 East Preston Street, Baltimore, MD 21202. Second-class postage paid at Baltimore, MD, and at additional mailing offices.

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Printed in the United States of America

ISSN: 0097-8507

This journal is printed on acid-free paper.

LANGUAGE

JOURNAL OF THE LINGUISTIC SOCIETY OF AMERICA

VOLUME 68, NUMBER 2 JUNE 1992

EDITED BY

SARAH GREY THOMASON

PUBLISHED BY THE LINGUISTIC SOCIETY OF AMERICA
AT THE WAVERLY PRESS INC., BALTIMORE, MD. 21202

WHITNEY, R. 1983. The syntactic unity of Wh-movement and Complex NP shift. Linguistic Analysis 10.299–319.
ZIV, YAEL, and GLORIA SHEINTUCH. 1979. Indirect objects reconsidered. Chicago Linguistic Society 15.390–403.

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[Received 26 February 1991;
revision received 29 August 1991;
accepted 18 December 1991.]

GHOST SEGMENTS IN NONLINEAR PHONOLOGY: POLISH YERS

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Nonlinear phonology has proposed several new approaches to the issue of 'ghost segments'—segments which have phonological effects of various kinds, but which either never surface or surface only under special circumstances. Mobile vowels in Polish, traditionally known as yers, fall into this category. They have recently been analyzed in terms of syllable-driven epenthesis, as empty vowels, and as floating vocalic matrices. The present paper examines these proposals, points to their problematic aspects, and offers a novel feature-geometric interpretation of yers. They are viewed as empty root nodes whose vocalization, determined by syllable structure, permits the full prosodification of consonants.*

1. INTRODUCTION. Perhaps no problem of Polish phonology, and of Slavic phonology in general, has attracted more attention than the vowel-zero alternation (illustrated in 1), or the issue of mobile vowels, frequently known as yers:[1]

(1)

NOMINATIVE SG.	GENITIVE SG.	
sen	*sn-u*	'dream'
rubel	*rubl-a*	'ruble'
koper	*kopr-u*	'dill'

There are two reasons for this considerable interest. First, the complex and challenging nature of the phenomenon lends itself to various, often conflicting interpretations and thus provides an excellent testing ground for the descriptive abilities and explanatory power of competing linguistic models. And secondly, the problem of yers has theoretical implications that extend beyond Slavic languages. Yers belong to the category of so-called 'ghost segments,' which differ from other vowels and consonants in that, although they have phono-

* I owe my sincere thanks to Edmund Gussmann, Morris Halle, John McCarthy, Loren Trigo, and the anonymous reviewers for their criticism and valuable comments on this paper. It was written mostly while I was a visiting scholar at the University of Massachusetts at Amherst under the Fulbright-Hays Program. I am very grateful to CIES for the grant.

[1] The majority of the examples in this paper are given in their orthographic form. The following peculiarities of Polish orthography should be noted: *c, dz* = dental affricates; *cz, dż* = postalveolar affricates; *ć/ci, dź/dzi* = palatal affricates; *sz, rz/ż* = postalveolar fricatives; *ś/si, ź/zi* = palatal fricatives; *ń/ni* = palatal nasal; *h/ch* = voiceless velar fricative; *ł* = labiovelar glide; *w* = voiced labiodental fricative; *j* = palatal glide; *pi, bi, mi, wi, ki, gi* = palatalized consonants (transcribed phonetically with an apostrophe); *ó* = high back rounded vowel (also spelled as *u*); *y* = high retracted unrounded vowel; *ę, ą* = nasal vowels. Word-final obstruents are devoiced, and clusters of obstruents agree in voicing. The letter *i* is pronounced as the high front vowel only before consonants and word-finally; before vowels it marks the palatalization of the preceding consonants. On the pronunciation of nasal vowels, see n. 12. Hyphens indicate the morphological division of words and are employed only in those instances where the structure of words can help the reader follow the line of argument.

The following abbreviations are used in examples: ADJ = adjective, COMP = comparative, DIM = diminutive, FEM = feminine, GEN = genitive, IMPER = imperative, IMPERF = imperfective, NOM = nominative, PEJOR = pejorative, PERF = perfective, pl. = plural, sg. = singular.

logical effects, they are either not realized at all phonetically or surface only in certain contexts. Segments of this kind have been reported for a variety of languages, e.g. French (Anderson 1982, Clements & Keyser 1983), Turkish (Clements & Keyser 1983), Seri (Marlett & Stemberger 1983), Finnish (Keyser & Kiparsky 1984), Slovak (Kenstowicz & Rubach 1987), and Hungarian (Vago 1989). Nonlinear phonology has brought with it new descriptive resources to account for these phenomena in an insightful way. Nevertheless, the issue of how to represent ghost segments and account for their behavior is far from being settled. The present paper is meant as a contribution to this debate.

Over the years the analysis of mobile vowels in Polish has been the focus of several interesting studies, each of them reflecting the current state of phonological theory. In the standard generative framework (e.g. Lightner 1972, Steele 1973, Gussmann 1980), the distinction between yers and non-yers was attributed to the phonological contrast between lax and tense vowels. Lax vowels were claimed to alternate with zero, while tense vowels did not. This solution involves absolute neutralization (Polish lacks a contrast between long and short vowels), and it was subsequently criticized heavily for its excessive abstractness and lack of phonetic justification. More recently, the autosegmental concept of the skeleton, distinct from the phonetic content of sounds, has provided further options for the treatment of yers. According to Spencer 1985, mobile vowels in Polish should be regarded as empty vocalic slots whose melodies are phonologically absent and are supplied by language-specific rules as well as universal conventions. In Rubach's 1986 view, yers are not empty vowels, but are floating vocalic matrices which have no association with the skeleton at the underlying level and which are assigned a timing slot in the course of phonological derivation. In other words, in Spencer's and Rubach's approaches yers differ from non-yers in their failure to be represented simultaneously on the skeletal and melodic tiers. Finally, the reintroduction of the syllable into phonological description has led to the revival of Laskowski's 1975 epenthetic analysis of yers, now couched in syllabic rather than segmental terms (Gorecka 1988, Czaykowska-Higgins 1988, Piotrowski 1988). According to these authors, the question of representing yers at the phonological level does not arise at all, as these vowels are absent there and are inserted to achieve syllabic well-formedness.

The present paper reexamines the issue of mobile vowels in Polish, offering a critical assessment of the nonlinear approaches to this problem and proposing a novel interpretation of yers and their vocalization in terms of feature geometry and syllable structure. Section 2 argues that underlying yers must be recognized and that syllable-driven epenthesis should be rejected. Section 3 examines the phonological properties of yers and points to problems with interpreting them either as empty vowels or as floating melodies. A new representation of yers that makes crucial use of underspecification is suggested in §4. Finally, §5 discusses the process responsible for the vocalization of yers, Lower; difficulties with the current formulation of Lower are identified and a new rule is proposed—a phonetically motivated process closely connected with Syllabification and the prosodic status of consonants adjacent to yers. It is hoped that

the interpretation of mobile vowels proposed here will be of relevance to the issue of ghost segments in general.

Before we consider the validity of an epenthesis approach to the analysis of yers, some basic facts that pertain to the phenomenon should be briefly introduced. Of all the vowels of Polish, the main one that has the property of alternating with zero is *e*;[2] this alternation occurs in roots (2a), suffixes (2b), and prefixes (2c). Following a well-established tradition, I adopt the convention of denoting yers by capital E.

(2) a. *pudEr* 'powder (NOM.sg.)' : GEN.sg. *pudr-u*
łEz 'tear (GEN.pl.)' : NOM.sg. *łz-a*
b. *lal-Ek* 'doll (GEN.pl.)' : NOM.sg. *lal-k-a*
krusz-Ec 'ore (NOM.sg.)' : GEN.sg. *krusz-c-a*
c. *wE-zwać* 'call (PERF)' : IMPERF *w-zywać*
zE-słać 'send (PERF)' : IMPERF *z-syłać*

The *e*~zero alternation can be observed in native words (3a) as well as borrowings (3b):

(3)

	NOMINATIVE SG.	GENITIVE SG.	
a.	*łEb*	*łb-a*	'head (pejor.)'
	piEń	*pni-a*	'tree trunk'
b.	*mebEl*	*mebl-a*	'piece of furniture'
	robEr	*robr-a*	'rubber (in bridge)'

However, in numerous instances the front mid vowel does not alternate with zero, but occurs throughout the whole paradigm, as in 4:

(4)

NOMINATIVE SG.	GENITIVE SG.	
ser	*ser-a*	'cheese'
gen	*gen-a*	'gene'
rower	*rower-u*	'bicycle'

This means that phonetically identical front mid vowels fall into two types, alternating and nonalternating; this is particularly clearly shown by the minimal and near-minimal pairs in 5:

(5)

bez	'meringue (GEN.pl.)'	: NOM.sg.	*bez-a*
bEz	'lilac (NOM.sg.)'	: GEN.sg.	*bz-u*
bies	'devil (NOM.sg.)'	: GEN.sg.	*bies-a*
piEs	'dog (NOM.sg.)'	: GEN.sg.	*ps-a*
seter	'setter (NOM.sg.)'	: GEN.sg.	*seter-a*
swetEr	'sweater (NOM.sg.)'	: GEN.sg.	*swetr-a*

[2] The high unrounded vowels *i* and *ɨ* also alternate with zero in verb pairs in which one member is a derived imperfective:

(i) *po-sł-ać* 'send (PERF)' : IMPERF *po-sył-ać*
u-rw-ać 'tear off (PERF)' : IMPERF *u-ryw-ać*

A similar change affects a group of borrowings such as:

(ii) lekcj-a 'lesson' : DIM *lekcyj-k-a*
misj-a 'mission' : ADJ *misyj-n-y*

For the treatment of these alternations, see n. 24.

The alternating segments have been dubbed 'yers'—the term originally used in reference to the high lax vowels of the oldest attested Slavic. Since Lightner 1972 the generative tradition has been to assume that lax vowels are also synchronically present in the phonological structure of Slavic languages, and it is exactly these segments that underlie the vowel~zero alternations. Such vowels are subject to either vocalization or deletion, whereas nonalternating vowels escape these processes by virtue of being phonologically tense.[3] In other words, this approach accounts for the phenomenon under investigation in terms of deletion, and encodes the distinction between the alternating (lax) and nonalternating (tense) vowels in the phonological structure of the language. This view has recently been challenged by proponents of an epenthetic analysis of yers, which will be discussed in the following section.

2. YERS AND EPENTHESIS. The assumption that yers are underlying units rather than epenthetic segments (made by, for instance, Gussmann 1980, Rubach 1984, Szpyra 1989) is based on the observation that Polish abounds in consonantal clusters that fail to be broken by an inserted vowel. Yet in recent years several scholars (Gorecka 1988, Czaykowska-Higgins 1988, Piotrowski 1988) have maintained that, once syllable structure is taken into account, an epenthesis solution turns out to be not only possible but, in fact, far superior to any deletion analysis. In their view yers are absent from the phonological structure of Polish and are inserted only in those instances in which syllable structure is violated. Inherent in this proposal is the assumption that, in spite of numerous surface counterexamples, Syllabification in Polish is rule-governed and observes universal restrictions on consonant sequencing in onsets and codas, as expressed by the Sonority Principle (Selkirk 1982, Steriade 1982). Further research (Bethin 1989, Rubach & Booij 1990, Gussmann 1990, 1991) has supported these findings (although no agreement as to the details of the syllabification process has been reached).[4]

The proponents of the insertion analysis claim that vowel epenthesis is a strategy that permits the syllabification of otherwise unsyllabifiable strings. It takes place, for instance, when a word ends in an impermissible cluster of an obstruent and a sonorant, or consists of consonants only and is therefore unpronounceable.

Indeed, in numerous cases epenthesis appears well motivated. Consider the following examples:

(6)	GENITIVE PL.	NOMINATIVE SG.	
	dEn	*dn-o*	'bottom'
	pchEł	*pchł-a*	'flea'
	źdźbEł	*źdźbł-o*	'stalk'

[3] This is not to say that modern yers always correspond to historical yers. The former are frequently postulated in cases where they were historically absent (e.g. in many borrowings), and many historical yers do not survive as modern alternating vowels.

[4] These disagreements do not bear on the results of this study as long as the assumption of the sonority distance in onsets and codas is maintained. In this paper the subsyllabic structure, since it is not directly relevant to the discussion, is not indicated.

Here the presence of E in the forms without an overt inflectional desinence can simply be accounted for as epenthesis motivated by the impossibility of words that consist of consonants only (Polish has no syllabic consonants): **dn, *pchł, *źdźbł.* In the NOM.SG. forms in 7, the mid front vowel breaks the obstruent-sonorant clusters that violate universal sonority conditions on codas.

(7)	NOMINATIVE SG.	GENITIVE SG.	
	kufEr	*kufr-a*	'trunk'
	stempEl	*stempl-a*	'stamp'
	kundEl	*kundl-a*	'mongrel'

There is no doubt that, on theoretical grounds, syllable-driven epenthesis is preferable to a deletion approach; the latter treats the presence of mobile vowels as an unpredictable and idiosyncratic property of lexical items (some contain yers, others do not), while the former regards the occurrence of such segments as a consequence of syllable structure, i.e. as phonetically predictable. To put it differently, underlying yers require that the language learner memorize them, whereas syllabically-motivated epenthesis involves the acquisition of a phonetically-based rule. It is also significant that epenthesis eliminates the need for the phonetically arbitrary tense-lax distinction. Under this analysis the necessity of distinguishing between yers and non-yers disappears altogether, which can be regarded as one of its strong points.

Unfortunately, in spite of the considerable appeal of syllabic epenthesis, it cannot be viewed as a viable approach to the analysis of Polish yers, since, as noted by other authors (e.g. Laskowski 1975, Gussmann 1980), the occurrence of mobile E can be predicted only in a limited number of cases. Thus, the mid front vowel frequently fails to break consonant clusters that violate the sonority requirements. To make it worse, E can often be found in contexts where it is not justified by syllable structure. Below are selected examples of both types of situation.

As mentioned earlier, epenthesis is particularly strongly motivated in the case of word-final clusters comprising consonants of increasing or the same sonority, i.e. sequences of an obstruent plus a sonorant or a sonorant followed by another sonorant. Although mobile E frequently does occur in this context, the pattern is by no means regular; many such clusters fail to be broken by the vowel. In Table 1 representative examples of both kinds are given.

The problem with lists like the one in Table 1 is that they may contain isolated examples; they do not show the frequency of occurrence and nonoccurrence of E in consonant clusters. Let us therefore look at a table (taken from Laskowski 1975) that does show such frequencies—specifically, the presence vs. absence of yers in word-final sequences of a consonant plus *r* (capital letters represent both voiced and voiceless consonants, E marks the presence of a yer, and Ø marks its absence). Table 2 shows that Cr clusters are broken by *e* only in about 63% of the cases. The examples without E are too numerous to be treated as exceptions, and the logical conclusion is that the presence vs. absence of yers is largely unpredictable and must therefore be marked in the lexical representation of the relevant items.

tr:	*futEr*	'fur (GEN.pl.)'	: NOM.sg. *futr-o*
	wiatr	'wind (NOM.sg.)'	: GEN.sg. *wiatr-u*
dr:	*pudEr*	'powder (NOM.sg.)'	: GEN.sg. *pudr-u*
	cedr	'cedar (NOM.sg.)'	: NOM.pl. *cedr-y*
pr:	*kopEr*	'dill (NOM.sg.)'	: GEN.sg. *kopr-u*
	kopr	'copra (GEN.pl.)'	: NOM.sg. *kopr-a*
br:	*bimbEr*	'moonshine (NOM.sg.)'	: GEN.sg. *bimbr-u*
	bóbr	'beaver (NOM.sg.)'	: NOM.pl. *bobr-y*
kr:	*jaskiEr*	'buttercup (NOM.sg.)'	: GEN.sg. *jaskr-a*
	masakr	'massacre (GEN.pl.)'	: NOM.sg. *masakr-a*
gr:	*szwagiEr*	'brother-in-law (NOM.sg.)'	: GEN.sg. *szwagr-a*
	podagr	'gout (GEN.pl.)'	: NOM.sg. *podagr-a*
fr:	*kufEr*	'trunk (NOM.sg.)'	: GEN.sg. *kufr-a*
	cyfr	'figure (GEN.pl.)'	: NOM.sg. *cyfr-a*
vr:	*kliwEr*	'jib (NOM.sg.)'	: GEN.sg. *kliwr-a*
	manewr	'maneuver (NOM.sg.)'	: NOM.pl. *manewr-y*
bl:	*szabEl*	'sword (GEN.pl.)'	: NOM.sg. *szabl-a*
	debl	'double (NOM.sg.)'	: GEN.sg. *debl-a*
kl:	*pukiEl*	'lock (NOM.sg.)'	: GEN.sg. *pukl-a*
	cykl	'cycle (NOM.sg.)'	: NOM.pl. *cykl-e*
śl:	*kisiEl*	'jelly (NOM.sg.)'	: GEN.sg. *kiśl-u*
	myśl	'thought (NOM.sg.)'	: NOM.pl. *myśl-i*
sw:	*susEł*	'gopher (NOM.sg.)'	: GEN.sg. *susł-a*
	pomysł	'idea (NOM.sg.)'	: GEN.sg. *pomysł-u*
dm:	*siedEm*	'seven'	: ordinal *siódm-y*
	kadm	'cadmium (NOM.sg.)'	: GEN.sg. *kadm-u*
tn:	*płóciEn*	'linen (GEN.pl.)'	: NOM.sg. *płótn-o*
	pięt n	'mark (GEN.pl.)'	: NOM.sg. *pięt n-o*
pń:	*stopiEń*	'step (NOM.sg.)'	: NOM.pl. *stopni-e*
	wapń	'calcium (NOM.sg.)'	: GEN.sg. *wapni-a*
śń:	*mięsiEń*	'muscle (NOM.sg.)'	: GEN.sg. *mięśni-a*
	baśń	'fairy tale (NOM.sg.)'	: NOM.pl. *baśni-e*
źń:	*więziEń*	'prisoner (NOM.sg.)'	: GEN.sg. *więźni-a*
	przyjaźń	'friendship (NOM.sg.)'	: NOM.pl. *przyjaźni-e*
rń:	*durEń*	'fool (NOM.sg.)'	: GEN.sg. *durni-a*
	cierń	'thorn (NOM.sg.)'	: GEN.sg. *cierni-a*
mn:	*trumiEn*	'coffin (GEN.pl.)'	: NOM.sg. *trumn-a*
	hymn	'hymn (NOM.sg.)'	: GEN.sg. *hymn-u*

TABLE 1. The occurrence of yers in word-final CC clusters.

Sr		Pr		Tr		Kr		Nr		Together	
e	ø	e	ø	e	ø	e	ø	e	ø	e	ø
9	6	24	7	50	42	17	3	2	1	102	59

TABLE 2. The occurrence of yers in word-final Cr clusters.

A particularly interesting situation arises in the case of word-final clusters of consonant plus labiovelar glide (which is phonologically a lateral; see Gussmann 1980). Here E can be found in many nouns, but it is never found in verbs, in which *-ł* is the preterite marker:

(8)	NOM.SG.		GEN.PL.		VERB	
dw:	*wahadł-o*	:	*wahadEł*	'pendulum'	*jad-ł*	'he ate'
tw:	*światł-o*	:	*światEł*	'light'	*plót-ł*	'he blabbed'
gw:	*śmigł-o*	:	*śmigiEł*	'propeller'	*leg-ł*	'he lay'
kw:	*kukł-a*	:	*kukiEł*	'puppet'	*wlók-ł*	'he dragged'
zw:	*węzEł*	:	*węzł-óaw*	'knot'	*gryz-ł*	'he bit'
sw:	*wiosł-o*	:	*wiosEł*	'oar'	*pas-ł*	'he pastured'
rw:	*perł-a*	:	*perEł*	'pearl'	*dar-ł*	'he tore'

Several minimal pairs of nouns and verbs derived from the same roots can be found; as a rule, E breaks consonant clusters in nouns, where *-ł* is the nominalizing suffix. No vowel occurs before the past tense suffix *-ł* in verbs. In all these pairs the segmental and syllabic contexts are identical:

(9)	ROOT	NOM.SG.	GEN.PL.		VERB	
	miot-	*miot-ł-a*	*miot-Eł*	'broom'	*miót-ł*	'he swept'
	piek-	*piek-ł-o*	*pieki-Eł*	'hell'	*piek-ł*	'he baked'
	sprzęg-	*sprzęg-ł-o*	*sprzęgi-Eł*	'clutch'	*sprząg-ł*	'he joined'

Such cases are problematic for any insertion analysis (which predicts the occurrence of E in all the examples in 9). But they present no difficulty once underlying yers are assumed, because then the two *-ł* suffixes can be claimed to have different phonological structures: the nominalizing suffix contains a yer (i.e. /-Eł/) which emerges before zero inflection and is deleted elsewhere, while the preterite suffix is phonologically monoconsonantal (i.e. /-ł/) and appears as such on the surface.

It should be added that under the epenthesis approach not only numerous individual items but also various suffixes would have to be treated as exceptions. A case in point is the suffix *-izm*, as in 10:

(10)				
	ras-izm	'racism'	*real-izm*	'realism'
	marks-izm	'Marxism'	*komun-izm*	'communism'

Here the *zm* sequence constitutes a violation of sonority in codas, yet no vowel breaks this cluster. While the lack of vowel insertion in this suffix could be explained by its clearly foreign nature, this explanation is not available for the native nominalizing formative *-izn(a)*, in which the spirant plus nasal cluster is consistently preserved word-finally:

(11)	NOM.SG.	GEN.PL.	
	gol-izn-a	*gol-izn*	'nakedness'
	strom-izn-a	*strom-izn*	'steepness'
	opalen-izn-a	*opalen-izn*	'suntan'

The failure of the vowel to break unsyllabifiable consonant clusters is not restricted to the word-final position; it can be observed inside words as well. In 12 I present some examples of this kind—that is, of sonorants trapped between two obstruents (12a), between a sonorant and an obstruent (12b), between an obstruent and a sonorant (12c), and between two sonorants (12d):

(12) a.	*czosnku*	'garlic (gen.sg.)'
	zadnieprski	'lying beyond the Dnieper'

b.	*permski*	'Permian'
	żandarmski	'gendarme (adj.)'
c.	*myślnik*	'hyphen'
	krnąbrny	'unruly'
d.	*karmnik*	'bird feeder'

In none of these instances can the medial sonorant be syllabified either as part of the onset or as part of the coda (if the sonority distance within these constituents is to be preserved), yet no epenthesis takes place to remedy this highly undesirable situation.

However, E frequently does occur when no violation of syllable structure can be observed. For example, word-final sequences of sonorants and obstruents are often broken by a yer even if such clusters are perfectly well-formed codas; but in other cases of the same sort the vowel is absent—which, again, points to the unpredictability of its occurrence:

(13)	*walEc*	'cylinder (NOM.sg.)'	: GEN.sg. *walc-a*
	walc	'waltz (NOM.sg.)'	: GEN.sg. *walc-a*
	torEb	'bag (GEN.pl.)'	: NOM.sg. *torb-a*
	korb	'crank (GEN.pl.)'	: NOM.sg. *korb-a*
	kojEc	'play-pen (NOM.sg.)'	: GEN.sg. *kojc-a*
	bejc	'mordant (GEN.pl.)'	: NOM.sg. *bejc-a*

Similarly, a yer often emerges inside words even though syllable structure does not necessitate it. For instance, an obstruent found between two sonorants can syllabify either as the coda of the preceding syllable or as the onset of the following one, and yet E can break such clusters as well:

(14)	*walEcz-n-y*	'brave'	: *walk-a* 'battle'
	folwarcz-n-y	'farm (adj.)'	: *folwark* 'farm (noun)'
	haniEb-n-y	'shameful'	: *hańb-a* 'shame'
	podkomend-n-y	'subordinate'	: *komend-a* 'command'
	słonEcz-nik	'sunflower'	: *słońc-e* 'sun'
	zgiełcz-n-y	'noisy'	: *zgiełk* 'turmoil'

The final argument against the epenthetic nature of yers comes from the behavior of words whose stems terminate in the voiceless velar plosive. When *-k* is a suffix (diminutive or feminine) before inflectional zero, it appears as *-Ek* regardless of the character of the preceding consonant:

(15)	*ser-Ek*	'cheese (DIM; NOM.sg.)'	: GEN.sg. *ser-k-a*
	syn-Ek	'son (DIM; NOM.sg.)'	: GEN.sg. *syn-k-a*
	snob-Ek	'snob (fem.GEN.pl.)'	: NOM.sg. *snob-k-a*
	boż-Ek	'idol (NOM.sg.)'	: GEN.sg. *boż-k-a*

In none of these cases is the occurrence of the yer motivated by syllable structure, since sequences of sonorant plus *k* and obstruent plus *k* appear frequently in the word-final position:

(16)	*kark*	'nape'	*wilk*	'wolf'	*szejk*	'sheikh'
	szynk	'pub'	*kask*	'helmet'	*blask*	'radiance'

As a matter of fact, there are many minimal pairs that differ only in the presence vs. absence of E:

(17)	*bark*	'shoulder'	versus	*barEk*	'bar (DIM)'
	park	'park'	versus	*parEk*	'couple (DIM.GEN.pl.)'
	szynk	'pub'	versus	*szynEk*	'ham (GEN.pl.)'

In these examples an attempt can be made to salvage the insertion analysis by appeal to Strict Cyclicity; the vowel occurs between the stem and the suffix, i.e. in a derived environment (*bar-Ek*), but it fails to appear inside morphemes (*bark*). This approach, however, cannot be employed in the numerous cases in which the yer is found before *k* even if the velar plosive is not a part of the suffix but belongs to the root itself, as in 18:

(18)	GEN.PL.	NOM.SG.	
	lasEk	*lask-a*	'walking stick'
	fajEk	*fajk-a*	'pipe'
	szelEk	*szelk-a*	'suspender'

In other words, while E occurs regularly with the suffix *-k*, its appearance in roots that end in the velar plosive is unpredictable. This indicates that the yer is a part of the phonological representation of the suffix as well as of some lexical morphemes. Vowel epenthesis is unworkable.

To sum up, this section has demonstrated that yer epenthesis based on syllabification and sonority requirements cannot be maintained, since the occurrence of E is characterized by a considerable amount of idiosyncrasy. Thus, yers often fail to appear when syllable structure is violated (the *metr* type) and emerge on the surface when no such violations can be found (the *torEb* type). An insertion approach therefore yields numerous exceptions and, in consequence, little seems to be gained by proposing it. I feel justified, then, in assuming that yers are present in the underlying structure of Polish.[5]

[5] The epenthesis approach proposed in Gorecka 1988 is much more complicated than my presentation shows; it makes crucial reference to such notions as Strict Cyclicity, lexical and postlexical rules, and the reanalysis of any *ek* sequence as a suffix. Space limitations prevent me from giving a more detailed argument against Gorecka's analysis. Suffice it to say that the examples discussed in this section are problematic for it (as well as for Itô's 1989 proposal to handle vowel~zero alternations in various languages by epenthesis). Another option worth examining is Bethin's 1989 assumption that yers are sometimes underlying and sometimes epenthetic. This suggestion, however, also faces the problem of numerous exceptions to any rule of epenthesis.

A comment on the vowel~zero alternation in prefixed forms is also in order (for a detailed discussion, see Szpyra 1989). Prefixes occur in two shapes, with and without E: *z-/zE-*, *w-/wE-*, *od-/odE-*, *pod-/podE-*, *ob-/obE-*, and *nad-/nadE-*. The prefix yer emerges on the surface if the root contains a yer. When the yer is absent in the stem, the prefix vowel is not pronounced. These facts cannot be accounted for by an insertion analysis since, as shown below, the segmental and syllabic structure of verbs may be identical (in surface terms), yet the mobile vowel surfaces only in some instances:

(i)	*podE-słać*	'send'	versus	*pod-słuchać*	'eavesdrop'
	odE-brać	'take away'	versus	*od-brązowić*	'defame'
	zE-drzeć	'tear off'	versus	*z-drzemnąć*	'take a nap'
	odE-przeć	'resist'	versus	*od-przedać*	'sell off'
	obE-trzeć	'wipe off'	versus	*ob-trzepać*	'dust off'

3. PHONOLOGICAL PROPERTIES OF YERS. Since yers belong to the phonological inventory of Polish, it is crucial to examine the exact character of these segments, i.e. to specify the properties that differentiate them from the vowels that do not alternate with zero.

The first distinctive characteristic of yers, as argued in Rubach 1986 and Bethin 1987, 1989, is their failure to undergo Syllabification. The major arguments for this claim are repeated below (for a more extensive discussion see Bethin 1989).

The comparative degree suffix in Polish has two allomorphs, *-ejsz(y)* and *-sz(y)*. Their distribution is rule-governed: the former is attached to the stems whose final consonant is unsyllabifiable, i.e. when the adjective ends in a cluster of either increasing or the same sonority, as in 19a, and the latter is attached elsewhere, i.e. after syllabifiable stems, as in 19b:[6]

(19) a.	*mądr-y*	'wise'	:	*mądrz-ejsz-y*
	rozległ-y	'vast'	:	*rozlegl-ejsz-y*
	fajn-y	'nice'	:	*fajni-ejsz-y*
	zimn-y	'cold'	:	*zimni-ejsz-y*
b.	*głup-i*	'silly'	:	*głup-sz-y*
	mił-y	'pleasant'	:	*mil-sz-y*
	tward-y	'hard'	:	*tward-sz-y*
	prost-y	'simple'	:	*prost-sz-y*

If /š/ is taken to represent the underlying comparative morpheme, the occurrence of the longer suffix can be accounted for by the following allomorphy rule:

(20) COMPARATIVE ALLOMORPHY:

$\emptyset \rightarrow ej$ / *C ___ $-\check{s}]_{\text{COMP}}$

where *C = unsyllabified consonant

Some adjectives can be shown to contain a yer before the stem-final consonant:

(21) *pewiEn* : *pewn-y* 'certain' ← /pev'En/
godziEn : *godn-y* 'worthy' ← /god'En/
świat-Eł 'light (GEN.pl.)' : *świat-ł-y* 'enlightened' ← /śv'at-Eł/

Rubach & Booij (1990), as well as Bethin (1989), argue that, since allomorphy rules generally precede phonological rules proper, Comparative Allomorphy is an earlier rule than Yer Deletion.[7] This means that at the stage when Comparative Allomorphy takes place yers are present in the adjectival stems in 21. If yers were syllabified just like other vowels, i.e. if they functioned as syllable nuclei, such stems would end in single and therefore syllabifiable consonants and select the shorter comparative suffix. In other words, regular syllabification

[6] While the suffix *-ejsz(y)* in all instances triggers Palatalization (see 19a), *-sz(y)* does so only in some cases. Since the majority of comparatives with *-sz(y)* do not show the reflexes of this process, some of its allomorphs will have to be marked as palatalizing.

[7] Additionally, in the lexical framework adopted in Rubach & Booij 1990 the ordering of Comparative Allomorphy and also Imperative Allomorphy before Yer Deletion follows from the different status of these rules: the former two are morphologized and therefore cyclic, and must precede Yer Deletion, which is claimed to be postcyclic.

of yers would block the operation of Comparative Allomorphy in these adjectives:

(22) *pev'En - š (-i)* → *[pevnši]
σ σ

This is not, however, what happens; in all the relevant instances the longer allomorph is added, as if the stem-final consonant were outside the last syllable:

(23)	*pewn-y*	: *pewni-ejsz-y*	'certain'	(**pewnszy*)
	godn-y	: *godni-ejsz-y*	'worthy'	(**godnszy*)
	świat-ł-y	: *świat-l-ejsz-y*	'enlightened'	(**światlszy*)

As Rubach (1986) and Bethin (1989) claim, these facts can be accounted for under the assumption that yers are invisible to Syllabification and that the consonants they separate are adjacent for the purposes of this process as well as Comparative Allomorphy. Since in all cases the consonants in question form impermissible codas (they are sequences of obstruent plus sonorant), the stem-final segment will remain outside the coda and trigger the application of Comparative Allomorphy:

(24) *pev'En-š(-i)* —Comp. Allom.→ *pev'En-ej-š(i)*
σ *n
—other rules→ [pevńejši]

An identical situation obtains in the case of Imperative Allomorphy. As shown in Bethin 1987, 1989 and Rubach 1986, the distribution of the imperative suffix allomorphs also depends on the syllabic structure of the stem: *-ij* generally attaches to verbs whose final consonant is unsyllabifiable, as in 25a, and the palatalizing (phonetically zero) suffix is used elsewhere (25b):[8]

[8] Two comments on the imperative forms are necessary. First, the distribution of the imperative allomorphs, although undoubtedly determined by the syllabic structure of the verb stem, is less regular than of the comparative allomorphs. Thus, some verbs admit two imperative forms, as in (i):

(i) a. *ostrz-yć* 'sharpen' < *ostrz*, *ostrz-yj* b. *przyjąć* 'receive' < *przyjm*, *przyjm-ij*

The overall tendency is to select the shorter variant; for a more detailed discussion, see Bethin 1989.

Second, there is no agreement as to the shape of the rule responsible for imperative allomorphy. Rubach 1986 postulates the insertion of /ij/ after an extrasyllabic consonant, while Bethin 1989 opts for two floating feature matrices as the representation of the imperative desinence. When the verb stem is unsyllabifiable, Imperative Allomorphy assigns a timing slot to these matrices. In other cases floating /ij/ remains unpronounced. While the issue in question is interesting, it is not of primary importance to the problem of yers. I shall assume the (simplified) version of Imperative Allomorphy in (ii):

(ii) $\emptyset \rightarrow ij$ /*C ___]$_{\text{IMPER}}$

A full description of imperative forms must also account for the palatalization of the stem-final consonants before what is phonetically zero. On palatalizing, segmentally zero morphemes in Polish see Gussmann 1988.

(25)

	INFINITIVE	IMPERATIVE	
a.	*dudn-ić*	*dudn-ij*	'ramble'
	tęskn-ić	*tęskn-ij*	'long'
	olśn-ić	*olśn-ij*	'dazzle'
	nagl-ić	*nagl-ij*	'urge'
b.	*maz-ać*	*maż*	'smear'
	pis-ać	*pisz*	'write'
	gwizd-ać	*gwiżdż*	'whistle'
	milcz-eć	*milcz*	'be silent'

Verbs whose stems contain yers invariably pattern with those in 25a and take the longer allomorph:

(26)

ADJECTIVE		INFINITIVE	IMPERATIVE	
winiEn	'guilty'	*uniewinn-ić*	*uniewinn-ij*	'acquit'
pewiEn	'certain'	*upewn-ić*	*upewn-ij*	'make sure'

In other words, in these stems the final consonant behaves as if it were extrametrical, in spite of the fact that it is preceded by a yer. This phenomenon can be given the same explanation as in the case of Comparative Allomorphy: yers escape Syllabification and the stem-final consonants, being of the same sonority as or more sonorous than the preceding segments, remain extrasyllabic and trigger Imperative Allomorphy:[9]

(27) (*u-*)*pev'En* —Imper. Allom.→ (*u-*)*pev'En-ij* —other rules→ [upevńij]

σ **n*

Further evidence that yers are invisible to Syllabification comes from the operation of two phonological rules, Raising and Nasal Backing.

Polish has an alternation between the mid back vowel [o] and the high back vowel [u]. This process is restricted to lexically specified items and shows a considerable amount of irregularity (Gussmann 1980). Nevertheless, within the words in which it operates the distribution of the vowels is quite clear: [o] occurs in open syllables, while [u] appears in closed syllables (Czaykowska-Higgins 1988, Bethin 1989):

(28)

NOMINATIVE SG.	GENITIVE PL.	
zi[o]*ł-o*	*zi*[u]*ł*	'herb'
dr[o]*g-a*	*dr*[u]*g*	'rood'
m[o]*d-a*	*m*[u]*d*	'fashion'

[9] An alternative approach to the analysis of comparative and imperative forms is suggested in Szpyra 1989, where Comparative Formation and Imperative Formation are regarded as morphological processes that take phonetic forms as their input. This means that adjectives and verbs undergo the operation of phonological rules before they are subject to Comparative and Imperative Formation. My current research, however, points to the necessity of restricting this procedure to cases involving morphological truncation. Consequently, I believe that the facts presented here can be better accounted for if yers escape Syllabification—a contention that finds further support in the analysis of Raising and nasal Backing, as we shall see.

The rule of Raising, restricted to the context of a following voiced oral consonant in the coda position, can be formulated as follows (after Bethin 1989:356):

(29) RAISING: *o* → *u* / ___ $X_{]\sigma}$

root [+cons]

sl

[+voice] [−nasal]

Raising occurs in inflected forms of lexically specified nouns and verbs as well as in diminutives with the yer suffixes *-Ek*, *-Ek(a)* and *-Ek(o)*.[10] These diminutive forms provide insight into the nature of yers. The nominative forms of feminine and neuter diminutives, as in 30, cause no descriptive difficulties; here the high back vowel occurs in syllables that are phonetically closed:

(30) a.

pszcz[o]*ła*	'bee'	: DIM	*pszcz*[u]*łka*
br[o]*da*	'beard'	: DIM	*br*[u]*dka*
p[o]*le*	'field'	: DIM	*p*[u]*lko*

b. *pole* *pulko*

σ σ σ σ

It can be assumed that Raising takes place after the yer of the diminutive suffixes has been removed. The vowel [u] also appears, however, in the genitive forms of these diminutives, i.e. in phonetically open syllables:

(31) *pszcz*[u]*łek* *br*[u]*dek* *p*[u]*lek*

pulek

σ σ

The problem is that if yers are syllabified just like other vowels, no Raising should occur in words like those in 31:

(32) *polEk* → **polek*

σ σ

The yer, being a vowel, attracts the preceding consonant as the onset of the syllable of which it is the nucleus and destroys the context for Raising. If, however, yers are ignored by Syllabification, the root-final consonant can be syllabified together with the preceding vowel, which creates a closed syllable and thus the proper conditions for Raising, as in 33:

[10] While Raising is regular in feminine and neuter diminutives, in masculine nouns there are exceptions like those in (i) (Gussmann 1980:119):

(i)

NOMINATIVE SG.	GENITIVE SG.	DIMINUTIVE	
dzi[u]*b*	*dzi*[o]*b-u*	*dzi*[o]*b-ek*	'beak'
d[u]*ł*	*d*[o]*ł-u*	*d*[o]*ł-ek*	'ditch'

(33) *pol-Ek* —Raising→ *pul-Ek* —Lower→ [pulek]
σ σ

Thus, the operation of Raising in diminutives requires that yers be invisible to Syllabification. Obviously, once yers are vocalized they form syllable nuclei and, on resyllabification, the high back vowel in 33 is found in an open syllable. It follows that Raising must precede the vocalization of yers.

The alternation of the nasal vowels [ō] and [ē] provides a similar type of evidence for the extrasyllabic character of yers. The distribution of nasal vowels resembles that of [o] and [u]: the front vowel occurs in open syllables and the back vowel in closed ones (Czaykowska-Higgins 1988, Bethin 1989).[11]

(34) a. *z*[ō]*b* 'tooth (NOM.sg.)' : GEN.sg. *z*[ē]*b-a*
w[ō]*ż* 'snake (NOM.sg.)' : GEN.sg. *w*[ē]*ż-a*
świ[ō]*t* 'holiday (GEN.pl.)' : NOM.pl. *świ*[ē]*t-a*

b. *zōb* *zēba*
σ σ σ

The rule of Nasal Backing has the following informal shape (after Bethin 1989:358):

(35) Nasal Backing:

$$\bar{e} \rightarrow \bar{o} \; / \; \_\_\_\_]_{\sigma\ \text{INFL}}$$

In diminutive forms with the yer suffixes *-Ek*, *-Ek(a)*, and *-Ek(o)*, Nasal Backing can be observed both in closed and open syllables:[12]

(36) GEN.sg.	DIM.GEN.sg.	DIM.NOM.sg.	
z[ē]*b-a*	*z*[ō]*b-k-a*	*z*[ō]*b-ek*	'tooth'
kr[ē]*g-u*	*kr*[ō]*ż-k-a*	*kr*[ō]*ż-ek*	'circle'
goł[ē]*bi-a*	*goł*[ō]*b-k-a*	*goł*[ā]*b-ek*	'pigeon'

Again, these facts constitute a puzzle if yers are syllabified in the same fashion as other vowels:

(37) *zēb-Ek* → *[zēbek]
σ σ

[11] Like Raising, Nasal Backing is not a fully regular process; there are numerous exceptions (see Gussmann 1980, Bethin 1989). Note that both Raising and Nasal backing take place in inflectional forms and in diminutives. This puzzle can be explained if, following Walińska 1990, we assume that the diminutive suffix *-Ek* is in fact inflectional.

[12] Actually, thanks to the process of Nasal Assimilation before noncontinuants, nasal vowels are realized as sequences of an oral vowel followed by a nasal consonant homorganic with the next segment. Consequently, on the surface the vowels in question before noncontinuants always occur in closed syllables, as in (i):

(i) *zomp* 'tooth (NOM.sg.)' GEN.sg. *zemba*
σ σ σ

Clearly, the rule of Nasal Backing must precede Nasal Assimilation. The examples given here are in the shape prior to the operation of Nasal Assimilation.

In 37 the consonant following the nasal vowel is attracted as the onset of the syllable whose nucleus is a yer, and this syllabification blocks Nasal Backing. The result is clearly incorrect.

If yers fail to syllabify, however, the operation of Nasal Backing becomes unproblematic:

(38) *zēb-Ek* —Nas. Back.→ *zōb-Ek* —other rules→ [zombek]
σ σ

Here, at the stage when Nasal Backing takes place, yers do not function as syllable nuclei and the root-final consonant is syllabified together with the nasal vowel. The change in question occurs, yielding the correct result. Obviously, Nasal Backing must operate before yers are vocalized and syllabified.

The evidence accumulated so far seems sufficient to justify the claim that yers escape Syllabification. A question of considerable significance is whether these segments are completely invisible to this process, i.e. whether the consonants they separate belong to the same syllable or to two different syllables. In other words, the question arises as to which of two possible syllabifications of the sequence VC_1EC_2V, where C_1C_2 is a well-formed onset, holds true:

(39) a. V C_1 E C_2 V b. V C_1 E C_2 V
σ σ σ σ

To put it still another way, we are asking if C_1 and C_2 are adjacent for the purposes of Syllabification, as shown in 39a, or if the presence of E blocks this process, as in 39b.

The operation of Raising and Nasal Backing in diminutives again provides some evidence that yers block Syllabification, i.e. that 39b and not 39a is the correct description. Consider the diminutive forms *kózka* 'nanny goat' and *gałązka* 'twig', from phonological /koz-Ek-a/ and /gałēź-Ek-a/. There are two possible syllabifications of these strings: according to the pattern in 39a, which treats yers as invisible to Syllabification (40a), and according to the pattern in 39b, in which yers block Syllabification (40b):

(40) a. *koz-Ek-a* → *[koska] *gałēź-Ek-a* → *[gawēska]
σ σ σ σ σ

b. *koz-Ek-a* —Raising→ *kuz-Ek-a* —other rules→ [kuska]
σ σ σ σ

gałēź-Ek-a —Nas. Back.→ *gałōź-Ek-a* —other rules→ [gawōska]
σ σ σ σ σ σ

It is clear that only 40b yields the correct result: yers block Syllabification, so the preceding syllables are closed and both Raising and Nasal Backing can apply. In 40a the alternating vowels occur in open syllables, so the rules in

question are blocked. It should be added that the sequences of spirants and plosives in these examples are well-formed onsets (Bethin 1989, Gussmann 1991), as is shown by many items, e.g. those in 41:

(41) *skała* 'rock' *skóra* 'skin'
szkapa 'jade' *szkoda* 'damage'

If yers were truly invisible to Syllabification, the pattern in 39a would be followed, as Polish holds to the principle of open syllables and onset maximization (Bethin 1989, Gussmann 1991). The conclusion is straightforward: not only do the yers escape Syllabification, but they also block it, making the consonants they separate syllabically nonadjacent.

What remains to be briefly mentioned is the role of yers in processes of Palatalization. Traditionally (Laskowski 1975, Gussmann 1980, Rubach 1984), yers have been assumed to fall into two types, palatalizing (front) and non-palatalizing (back), since the consonants they precede are either palatalized or not. As argued in more recent studies (Spencer 1985, Bethin 1989, Gussmann 1988), however, there is much evidence that palatalized consonants should be admitted into the phonological inventory of Polish (morphological arguments are provided in Szpyra 1991), and that the ability to palatalize is a property of certain affixes rather than of individual vowels. This means that if, on the attachment of yer-initial suffixes, Palatalization is observed, the whole suffix, and not the yer alone, may be held responsible for triggering this process. A consequence of this approach is the rejection of the link between yers and Palatalization and also, logically, the distinction between front and back yers.[13]

4. THE PHONOLOGICAL REPRESENTATION OF YERS. The phonological properties of yers discussed in §3 raise the question of how such segments should be represented at the underlying level. The first issue is that of differentiating the yers from other vowels. This, in itself, is not a difficult task; it was successfully handled within the traditional framework (Lightner 1972, Gussmann 1980), where (as mentioned in §1) a distinction between lax and tense vowels was introduced with the specific purpose of isolating yers from non-yers.

In more recent models, however, this solution cannot be maintained. First of all, the tense-lax distinction finds no support in the phonetic facts of Polish and is no more than a diacritic—that is, it is phonetically arbitrary. Secondly, and more importantly, representing yers as lax vowels does not account for their peculiar properties, i.e. their failure to undergo Syllabification together with their ability to block this process. There is nothing in the nature of lax vowels that would produce this particular effect. If yers are represented as lax vowels, then, their properties do not follow from their structure, but must be stipulated.

Nonlinear phonology, with the autonomous skeletal and melodic tiers, has made available several ways of representing segments whose phonological

[13] Yers have also been claimed (e.g. by Gussmann 1980 and Rubach 1984) to play some role in such processes as J-Deletion, Derived Imperfective Tensing, and Nasal Assimilation. All of them, however, are subject to nonlinear reanalyses which involve no reference to yers.

properties set them apart from other segments. The assumption that the two tiers are independent of each other leads to the logical conclusion that the number of elements on the tiers need not be the same. If we represent timing units as X and feature matrices as [F], then in the most common type of situation a single melody is associated with a single skeletal slot:

(42) [F]
|
X

There are at least four possible mismatches between the two tiers:

(43) a. [F] b. [F] [F] c. ∅ d. [F]
X X X X ∅

Ex. 43a outlines a case in which two skeletal positions are associated with one melody. This is a typical nonlinear representation of long vowels and geminates. Ex. 43b represents a situation found in contour segments such as affricates and prenasalized stops, in which a single skeletal slot is linked to two melodies. The remaining cases illustrate deficient or incomplete segments, with either the melody (43c) or the timing slot (43b) missing; 43c thus shows an empty (or floating) skeletal slot and 43d a floating melody.

It is fairly clear that neither 43a nor 43b is a suitable candidate for representing yers. The yers do not behave as long vowels, and they cannot be viewed as contour segments, since they are pronounced with just one articulatory configuration throughout.

Exx. 43c and 43d, however, offer promising possibilities for representing not only yers but other 'ghost segments' as well. Interestingly, both have been suggested in the literature, and an analysis of these two proposals, as well as the major consequences of adopting them, will be considered in what follows.

The idea of empty segments represented on the skeletal tier, but with no melody associated with them at the phonological level, recurs in numerous autosegmental studies. Empty consonants have been postulated in French (*h*-aspiré), Finnish (Clements & Keyser 1983), Seri (Marlett & Stemberger 1983), Hungarian (Vago 1989), and Onondaga (Goldsmith 1990), while floating vocalic slots have been proposed for French (the schwa; Anderson 1982), Turkish (Clements & Keyser 1983), and Finnish (Keyser & Kiparsky 1984). In all instances where empty skeletal units have been posited, there are phonological rules that refer to such segments. These rules usually disregard the phonetic quality of empty consonants and vowels, and refer only to the presence of C-slots and V-slots. As many of the authors note, this type of representation leads to less abstract analyses, since no decision as to the quality of empty segments has to be made; this is particularly important in those cases where an underlying C or V never surfaces. When such segments are realized phonetically, the missing melodies are supplied by late default rules. Unrealized segments are removed at the end of the phonological derivation by general convention (on the need to constrain the use of empty segments, see Dresher 1985).

Spencer 1985 applies these mechanisms to Polish and proposes to view yers

as empty vowel slots unassociated with any melodic features at the underlying level. In his framework the word *sEn* 'dream' (alternating with GEN.sg. *sn-u*) can be represented as follows (on inflectional yers, see §5):

(44) *s n*
| |
C V C V

The rule of yer vocalization supplies the missing melody to all empty V-slots except the rightmost one. The last yer in a word, by virtue of being extrametrical (extrametricality is marked with a star in 45) never receives any melody and is deleted by convention:

(45) *s n* —extrametr.→ *s n*
| | | |
C V C V C V C V*

—yer vocaliz.→ *s e n* —yer erasure→ *s e n*
| | | | | |
C V C V* C V C

The 'empty vowel' approach to yers has several advantages. First, it does away with the phonetically arbitrary tense-lax distinction; alternating and non-alternating vowels differ now in terms of structure rather than in feature composition. Secondly, this solution expresses the predictable character of yers as well as the fact that *e* is the maximally underspecified segment in Polish, in agreement with Archangeli's 1984 theory of underspecification. At this point it should be added that *e* is also employed as an epenthetic vowel, for example in phrases such as those in 46:

(46) *wE wtorek* 'on Tuesday' : *w środę* 'on Wednesday'
zE stali 'of steel' : *z drewna* 'of wood'

It can be assumed that Epenthesis inserts empty vowel slots which are then filled with phonetic material by means of a default rule.[14] If *e* is the least specified vowel in Polish, then it comes as no surprise that it occurs in two independent processes that affect the segmental make-up of words. Finally, the 'empty vowel' approach eliminates the need for a rule that deletes final yers, since unassociated slots are removed by universal convention.

Nevertheless, closer analysis of the properties of yers presented in §3 leads to the rejection of the 'empty vowel' type of representation. Recall that yers both block Syllabification and fail to undergo this process. There seems to be no reason why V-slots should escape Syllabification, since in a sequence of C V C the mere presence of a vowel ensures its status as a syllable nucleus (as mentioned above, Polish has no syllabic consonants). In other words, while in the case of consonant and vowel clusters Syllabification must have access to their melodies in order to determine their place in syllable structure, any vowel, regardless of its quality, will be syllabic when found in a string consisting otherwise of consonants. If empty vowels are syllabifiable, it logically follows that they cannot block Syllabification and make the preceding consonants syllable-final, which is required for the proper operation of Raising and Nasal Backing. In spite of its initial appeal, therefore, the 'empty vowel' approach must be rejected.

[14] It is usually assumed (e.g. in Itô 1989) that, if the identity of the epenthesized element is predictable, then epenthesis should not mention the melodic features of the inserted element.

According to Rubach 1986, yers in Polish—and, according to Kenstowicz & Rubach 1987, yers in Slovak—are not empty vowels, but floating vocalic matrices that lack association with the skeleton. Thus, any vowel can be defined as a yer as long as there is no association line between the melody and the timing slot. To account for the facts of Palatalization and the so-called Derived Imperfective Tensing, Rubach postulates four yers in Polish. In his framework the word *sEn* 'dream' receives the following representation:

(47) *s e n i*
| |
X X

The rule that vocalizes yers assigns an X-slot dominated by the Nucleus to all yers but the last one. As in Spencer's approach, unvocalized yers are erased:

(48) *s e n i* —Yer vocal.→ *s e n i* —Yer erasure→ *s e n*
| | | | | | | | |
X X X X X X X X X
| |
N N

Bethin 1989, while accepting the floating melody proposal, points to some of its problematic aspects. By postulating as many as four floating vowels, Rubach 1986 fails to express the fact that the phonetic quality of vocalized yers is predictable.[15] In Rubach's approach the identity of epenthetic and deleting vowels is also left unexpressed. Finally, as Bethin points out, admitting several floating vowels introduces considerable indeterminacy in underlying representations. For instance, inflectional yers, which are never vocalized and whose feature composition is undetermined, cannot be set up in a nonarbitrary fashion in Rubach's framework. An example is the inflectional yer in *sen* (as in 44 and 47), which can be any back vowel.

To eliminate these difficulties, Bethin (1989) proposes to treat yers not as fully specified vocalic matrices, but as the floating feature [−consonantal], which is not linked to the skeleton at the underlying level. In her description the word *sen* has the following (simplified) structure:

(49) *s* [−cons] *n* [−cons]
| |
X X

This representation indicates that the melodic properties of yers, as predictable,

[15] In this respect Polish, with only one alternating vowel, clearly differs from other Slavic languages, such as Russian and Slovak, in which several types of yers can be isolated and in which the phonetic content of the yers, since it is unpredictable, must be marked in their phonological representations.

need not be phonologically specified. Moreover, in the case of inflectional yers no decision as to their phonetic contents needs to be made; they are vowels whose features are not known and are not relevant. In this respect Bethin's representation of yers shares the advantages of Spencer's proposal. In the course of phonological derivation, the rule of vocalization supplies a skeletal slot to nonfinal yers. A late default rule interprets such segments as the mid front vowel, and unvocalized yers undergo erasure:

(50) *s* [−cons] *n* [−cons] —Yer vocal.→ *s* [−cons] *n* [−cons]
X X X X X
—default→ *s e n* [−cons] —Yer erasure→ *s e n*
X X X X X X

The 'floating melody' type of representation, in both Rubach's and Bethin's versions, has been proposed mainly in order to account for the behavior of yers in the processes of Comparative Allomorphy and Imperative Allomorphy, i.e. to account for the failure of these segments to take part in Syllabification. In these authors' opinion, Syllabification is an operation performed on the skeleton; if a segment lacks a timing slot, it is ignored by this process even if it has some melodic features.

This approach suffers, however, from some empirical and theoretical difficulties. Let us assume, for the sake of the argument, that floating melodies do indeed escape Syllabification by virtue of the missing timing slot. But then such segments are totally invisible to this process and are incapable of blocking it. In other words, if Syllabification operates on skeletal slots, it ignores yers altogether and treats the consonants that flank them as adjacent for the purposes of this rule. An immediate consequence of this approach is the following syllabification of the string VC_1EC_2V, where C_1C_2 is a well-formed onset:

(51) V C_1 E C_2 V
σ σ

As demonstrated in §3, this is not what happens in Polish; the presence of a yer makes the consonants it separates nonadjacent for the purposes of Syllabification, which amounts to the blocking of this process.[16]

An important theoretical problem raised by floating melodies should also be pointed out. The claim that yers are invisible to Syllabification is based on the tacit assumption that the skeletal and melodic tiers are not only autonomous,

[16] That this is indeed the correct interpretation of floating matrices can be seen in the syllabification of the word *wiadro* 'pail' (alternating with GEN.pl. *wiadEr*) given by Bethin (1989:210; simplified here):

(i) *v'ad*[−cons]*ro*
σ

It should be added that neither Rubach 1986 nor Bethin 1989 deals with the blocking of Syllabification by yers.

but also underivable and present at the deepest level of representation. To put it differently, since the mismatches between the tiers are unpredictable, this fact must be encoded in the phonological structure of the language. As various authors (most notably McCarthy & Prince in their numerous works, e.g. 1986, 1988, and also Goldsmith 1990) observe, the skeleton does not always have to be a descriptive primitive. As a matter of fact, in languages in which quantity plays no distinctive role (i.e. languages with no long vowels or geminates) the skeletal tier is fully melody-driven. As McCarthy & Prince (1988) note, if lexical representations are composed only of nonredundant properties, then such languages will not contain any skeletal information at all, because the timing tier can be derived from the melody by exceptionless rules. According to Goldsmith 1990, this means that the underlying representations consist of linear strings of consonants and vowels, and that the first constructive rule would be to assign a C-position on the skeleton to each consonant and a V-position to each vowel. The only cases in which this type of melody-to-skeleton mapping is inadequate involve underlying geminates and long vowels and/or representations with empty C-slots and V-slots.

Since Polish has no true geminates[17] or long vowels and, as has been argued, no empty vowel slots, it can be assumed that the skeletal tier is not given, but is derivable in all instances. If this reasoning is correct, and every Polish vowel and consonant can project its own timing slot, there is nothing to prevent a 'floating melody' from projecting a skeletal unit of its own.[18] In other words, if the requirement of nonredundant lexical representations is to be maintained, the skeleton must be treated as derived and melody-driven. This in turn means that at the underlying level all vowels and consonants, and not only yers, are 'floating'. Consequently, this property cannot serve to distinguish deleting from nondeleting vowels. Note that if yers could project timing slots they would automatically be subject to Syllabification and could not block this process; but then they would not have the characteristics required by the Polish facts. In sum, the 'floating melody' representation of yers is beset with empirical and theoretical problems that make the approach untenable.

Having rejected both empty and floating vowels as representations of yers, we are faced with the necessity of seeking a more acceptable solution. As we have seen, the basic possibilities of the autosegmental framework presented in

[17] Polish does have some borrowings with geminates, e.g. *Budda* 'Buddha', *Mekka* 'Mecca', and *lasso* 'lasso'. They can be represented as sequences of two consonants whose melodies merge due to the operation of the Obligatory Contour Principle (OCP). Geminates in native Polish words can be shown to contain an intervening yer at the phonological level, so that they are not true geminates at all:

(i) *pann-a* 'maiden (NOM.sg.)' : GEN.pl. *paniEn*
wann-a 'bathtub' : DIM *waniEn-k-a*

[18] Bethin (1989) is aware of this consequence of the floating vowel analysis; in order to prevent yers from projecting skeletal slots associated with the Nucleus, she introduces a convention according to which only vowels with melodic features get N assigned to them. Clearly, this is only an ad-hoc device, since in the sequence CVC the vowel becomes the syllable nucleus regardless of its melodic features.

43 have already been exhausted. Models of Feature Geometry (e.g. Clements 1985, Sagey 1986, McCarthy 1988), however, provide new descriptive options for the treatment of yers. Following McCarthy & Prince 1986, 1988, as well as Goldsmith 1990, I will assume that in Polish the skeleton is not a primitive, but is derived from the phonemic tier. This means that the representation in 52a (or representations which contain more melodic features) will automatically produce the structure in 52b:

(52) a. b. X

root [−cons] root [−cons]

The structures in 52, which can be taken to be a feature geometric equivalent of empty vowel representations, cannot represent yers, because segments specified as [−cons] are subject to syllabification processes.

I would like to suggest that yers be represented as empty root nodes devoid of any melodic features such as [consonantal]:

(53) root

Since the root node is a part of a segment's melody, it will project a timing slot (that is, if the skeletal tier turns out to be necessary—for arguments against it, see McCarthy & Prince 1986, 1988).[19]

(54) X

root

In other words, the proposal is to recognize underlying segments that are neither vowels nor consonants, i.e. units that are maximally underspecified even with respect to major class features. Such segments do not undergo Syllabification, since without the feature [consonantal] they cannot be assigned any place in the syllable. It will further be assumed that an unsyllabified unit cannot be found inside a syllable, in accordance with the claim that only peripheral material may be extrametrical.[20] This means that a melodic element, including an empty root node, when found outside a syllable, will block Syllabification. Thus, yers viewed as empty root nodes will escape Syllabification and at the same time be nontransparent with regard to it—exactly the characteristics required for these elements.

[19] McCarthy 1988 argues that the root node is, in fact, a feature bundle composed of the features [cons] and [son]. They differ from other features in that they never spread, delink, or exhibit OCP effects. There seems to be no reason why these features could not be subject to underspecification if their values are predictable.

[20] Extrametricality is usually assumed to be restricted to the edges of words, i.e. to the elements that occupy peripheral positions in words. In a framework that admits nonexhaustive syllabification, extrasyllabic elements can be found inside words as well. What should be ruled out, in my view, are extrasyllabic segments inside syllables. Thus, during syllabification, when each syllable is built, yers are unsyllabified and peripheral with respect to the preceding and the following syllables. After syllabification, at the word level, yers are no longer peripheral with respect to the word and must be vocalized or lost. I am grateful to one of the reviewers for bringing this issue to my attention.

The rule that vocalizes yers can be seen as supplying the feature [−consonantal] to empty root nodes (the exact context of the rule will be discussed in detail in §5):

(55) X → X

root root [−cons]

Once yers become specified as [−consonantal], other features are filled in by universal as well as language-specific rules. Thus, universally:

(56) [−cons] → [+sonor, +voice, +cont]

Since nasal vowels probably must be marked as such at the underlying level (Bethin 1989), the other vowels will automatically become oral by a language-specific redundancy statement:[21]

(57) [−cons] → [−nasal]

The only features that remain to be supplied to vocalized yers are their place specifications. Following Spencer 1985, Bethin 1989, and Gussmann 1988, I assume that the mid front vowel is the maximally unmarked or unspecified vowel, and that its place features are filled in by default:

(58) [−cons] → [−back, −high, −low]

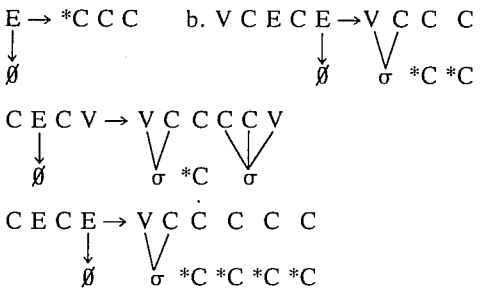
Since the epenthetic vowel is also realized as [e] and Epenthesis can be shown to operate in phrases, the default rule in 58 should probably be assigned to the phrase level as well.

The representation of yers proposed here is in agreement with Archangeli's 1984 theory of underspecification in that all predictable features, both redundant and unmarked, are left unspecified. The claim is, then, that the only unpredictable property of yers concerns their placement in lexical items, all other features being derivable by rules (vocalization and redundancy statements). It appears that even the fact that yers are realized as vowels is not accidental: as argued in the next section, yer vocalization is strictly connected with the process of Syllabification and plays a crucial role in the preservation of syllable well-formedness. If the basic Polish syllable has the structure of CCVC, i.e. admitting two consonants in the onset and one in the coda (Bethin 1989), then—since yers are found only between consonants—their realization as consonants would lead to the rise of heavy clusters that violate the syllabic template.

Let's examine some typical situations in which yers occur and consider the consequences of realizing these segments as consonants.[22]

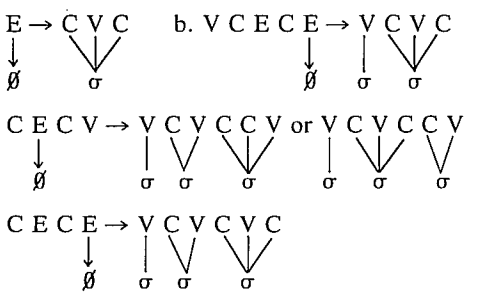
[21] An interesting question is the exact placement of such redundancy rules. Unfortunately, no conclusive evidence can be provided in this respect, except for the feature [voice] which must be supplied prior to the operation of Voice Assimilation at the phrase level (Gussmann 1990).

[22] As observed by one of the reviewers, if yers are unspecified with respect to the feature [cons], one might expect them to become [+cons] when initial in onsetless syllables. This situation, however, never arises, because yers occur exclusively after consonants.

(59) a. C E C E → *C C C b. V C E C E → V C C C


In 59a a three-segment string with a yer in the middle becomes an impossible three-consonant word. In 59b the nonfinal yer turned into a consonant creates an impermissible three-consonant coda, and in 59d this procedure results in as many as four unsyllabifiable consonants. In 59c one consonant can be incorporated into the preceding syllable and two consonants into the following syllable (let us assume that they constitute a well-formed onset), which still leaves one consonant stranded and unsyllabified.

If yers are vocalized, however, the resulting strings are perfectly syllabifiable:[23]

(60) a. C E C E → C V C b. V C E C E → V C V C


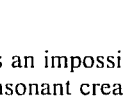
In all these instances the vocalization of nonfinal yers allows for the complete syllabification of the input strings. We can conclude that syllabic well-formedness might be the force behind the process of turning unspecified root nodes into vowels.

This section has demonstrated that neither an empty vowel nor a floating vowel can be viewed as an adequate representation of yers in Polish, since both approaches fail to reflect the properties of these segments, and in addition they pose major theoretical problems. My proposal is to represent yers instead as empty root nodes, i.e. as maximally underspecified segments. Such root nodes do not undergo Syllabification, because they lack the feature [consonantal]. They are, however, capable of blocking this process, since Syllabification cannot continue across a melodic element. Yer vocalization, operating in accordance with syllabic well-formedness, supplies the feature [−cons] to

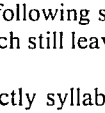
[23] In all these examples yers are separated from each other by single consonants. As shown in Ruszkiewicz 1989, consonant clusters between yers are extremely rare.

such (nonfinal) segments. The remaining features are filled in by universal and language-specific redundancy rules, and the place specification is provided by default.[24] The approach to yers formulated here is consistent with Archangeli's 1984 theory of Radical Underspecification (for a useful discussion of different types of underspecification, see Mester & Itô 1989).

Thus, the interpretation of yers proposed here regards them as neither vowels nor consonants, but as timing units devoid of any melodic features. Empty vowels (V-slots) and empty consonants (C-slots) expressed in feature-geometric terms can be taken to be the structures in 61a and 61b, respectively:

(61) a. X b. X

root [−cons] root [+cons]

The representation of yers in 62 is therefore nothing other than a frequently postulated empty X-slot:

(62) X

root

The proposal, then, is to recognize three basic representations of 'ghost segments'—V-slots, C-slots, and X-slots—which are identical on the skeletal level but differ in the degree of root specification. Exx. 61a and 61b will characterize segments which have the properties of vowels or consonants, but whose other features are either fully predictable or undetermined. The third option (62) is reserved for those units, such as Polish yers, whose only unpredictable property is their placement in lexical items.

5. LOWER. This section deals with the process responsible for the emergence of yers on the surface. After discussing some problems with the traditional formulation known as Lower, I will propose a new rule which puts to use the properties of yers and which crucially depends on syllable structure.

Gussmann (1980), and following him many other phonologists, formulate the rule of Lower as in 63 (a simplified version):

(63) $\text{yer} \rightarrow \begin{cases} e \,/\, \_\_\ \text{C yer} \\ \emptyset \end{cases}$

According to the upper expansion of the rule, a yer is realized as the mid front vowel when followed by another yer, and according to the lower expansion

[24] As mentioned in n. 2, the vowel~zero alternation in which the alternating vowel is high and unrounded takes place in derived imperfectives; the process displays various peculiarities, discussed in Szpyra 1989. I propose to account for these cases in a manner similar to that of Bethin 1989, claiming that the yers which underlie such alternations are assigned the features [−cons] and [+high] in derived imperfectives of lexically marked words. The *i/i* ~ Ø alternation in borrowings such as *lekcj-a* 'lesson' : ADJ *lekcyj-n-y* can be accounted for by the high-vowel deletion rule proposed by Rubach & Booij 1990.

the last yer in a word gets deleted. In other words, all yers but the last one are turned into [e]. This is illustrated with the derivation of the noun *piesek* 'puppy':

(64) /p'Es-Ek-E/
Lower *e e Ø*
[p'esek]

In 64 three yers are present; the first two vocalize and the last one deletes.

Within the nonlinear frameworks it has been claimed (e.g. by Spencer 1985, Rubach 1986, and Bethin 1989) that the deletion clause of 63 is unnecessary, because unvocalized yers are erased by the universal convention known as Stray Erasure (Steriade 1982). The main clause of the rule, however, has not been modified in any significant way under the nonlinear interpretation of yers, the assumption being that it is correct and adequate—or quite possibly because, following recent trends in linguistics, more attention has been given to the issue of representations than to the rule itself.

Nevertheless, there are significant reasons to believe that the traditional formulation of Lower is problematic and, in fact, untenable. First, the very shape of the rule seems somewhat peculiar. It is not clear why the surfacing of one yer should be contingent upon the presence of another yer, or why final yers should always delete. Furthermore, the requirement that at least two yers must be present in a word in order for the first of them to vocalize often forces highly abstract phonological representations for many items in which yers are postulated even if they never occur on the surface. A case in point is that of inflectional yers in the nominative singular of masculine nouns and adjectives and the genitive plural of feminine and neuter nouns, before which yers in the stems are claimed to vocalize:

(65) *bimbEr* 'moonshine': /bimbEr-E/ → [b'imber]
winien 'guilty': /v'in-En-E/ → [v'iṅen]
torEb 'bag (GEN.pl.)': /torEb-E/ → [toreb]

A related problem concerns the quality of inflectional yers; since they always delete, there is not much evidence as to their phonetic content. As shown in §4, in those frameworks in which several different types of yers are posited this leads to a considerable indeterminacy of underlying representations.

At this point it should be mentioned that in the standard generative model (e.g. Gussmann 1980) inflectional yers were postulated for several significant reasons. First, they were needed as triggers of Lower and Palatalization (see §4 for a discussion of the latter). Secondly, they blocked the deletion of word-final palatal glides in addition to preventing sequences of oral vowels and nasal consonants from turning into nasal vowels at the end of words. They also figured in the environment of such rules as Nasal Backing and Raising. The final argument for inflectional yers was more general: since all other cases have overt phonetic desinences, positing the final yer achieved regularity in the declension system.

In recent nonlinear and syllable-based analyses of Polish, most of the phonological arguments for inflectional yers have become invalid. To simplify

somewhat, the occurrence of the palatal glide depends on its position in the syllable and the deletion rule is no longer necessary (Bethin 1989). Similarly, final yers are not needed to block Nasalization as more and more evidence becomes available (Czaykowska-Higgins 1988, Bethin 1989) that nasal vowels must be recognized as underlying units of Polish. Nasal Backing and Raising are also more adequately expressed by reference to syllable structure (see §3) than by reference to yers. We are thus left with the triggering of Lower as the only phonological function of yers.[25]

But there are cases in which Lower appears to operate in spite of the fact that no conditioning yer can be found in a word. Two numerals contain the mobile vowel:

(66) *siedEm* 'seven (NOM.sg.)' : masc.GEN.pl. *siedm-iu*
osiEm 'eight (NOM.sg.)' : masc.GEN.pl. *ośm-iu*

Interestingly, E also surfaces in the compounds in 67, even though there is no independent evidence for another yer in these items:[26]

(67) *siedEm-naście* 'seventeen' *siedEm-dziesiąt* 'seventy'
osiEm-naście 'eighteen' *osiEm-dziesiąt* 'eighty'

Observe that yers are found here in the string C E N C V, where N = nasal consonant and C = any consonant.

As Loren Trigo has pointed out (personal communication, 1991), the operation of Lower is also peculiar in a group of verbs in which nasal vowels alternate with Ø:

(68)

INFINITIVE	PAST TENSE 3rd pl.	PAST PARTICIPLE	FUTURE TENSE 1st sg.	
za-pią-ć	*za-pię-l-i*	*za-pię-t-y*	*za-pn-ę*	'button up'
wy-gią-ć	*wy-gię-l-i*	*wy-gię-t-y*	*wy-gn-ę*	'bend'
za-czą-ć	*za-czę-l-i*	*za-czę-t-y*	*za-czn-ę*	'begin'

This alternation suggests the underlying presence of yers in the verbal stems (since only yers alternate with zero), and the yers are supposed to undergo Lower in the context of the following yer. The problem is that in the past-tense forms and the past participles in 68 there is no yer other than the one in the root, e.g.:

[25] This claim is strikingly confirmed by the use of yers in verbal forms. To obtain the desired vocalization of the root yer in *szEd-ł* 'he went', another yer has to be posited after the preterite suffix *-ł*. The presence of this segment is morphologically justified; it marks the masculine gender (all other genders have overt vocalic desinences). However, to trigger the vocalization of the gender yer in the first person singular form, yet another yer has to be postulated (Gussmann 1980:94): /šEd-łE-mE/. Clearly, the final yer is not motivated by any morphological considerations and is introduced with the sole purpose of serving as the environment for Lower.

[26] One could claim that the second elements of these compounds begin with a yer. This seems rather implausible, however, because the latter are independent stems in such forms as *nast-o-latka* 'female teenager' and *dziesięć* 'ten'. In addition, as mentioned above, no cases are known of words that begin with a yer. Another option is to posit a yer as a linking element between two roots. This move would raise morphological objections, as the connecting morpheme is *-o-* (in rare cases *-u-* or zero), but never a yer.

(69) /za-p'En-l-i/ → *za-pię-l-i*
/vi-g'En-t-i/ → *wy-gię-t-y*

Consequently, the yer in question should not vocalize, but delete; this does not happen, however, and the vowel emerges on the surface. To put it differently, in these verbs yer vocalization appears to take place even if the conditioning yer is absent.[27] Note the phonological context in which the vocalized yer occurs, i.e. C E N C V, and recall that this case is analogous to that of the numerals in 67.

All these observations indicate that the formulation of Lower with a yer in its structural description should be abandoned and that a more satisfactory solution must be sought. It is also evident that the new rule should make use of the phonological properties of yers, particularly the fact that these segments escape Syllabification and prevent the consonants they separate from being syllabified together.

Let us identify three contexts in which yer vocalization takes place (ignoring inflectional yers): word-internally before a consonant and another yer, as in *torEb-k-a* 'handbag' (70a); before a consonant followed by word boundary, as in *torEb* 'bag (GEN.pl.)' (70b); and before a CC cluster in which the first C is nasal, as in *siedEm-dziesiąt* 'seventy' (70c).

(70) a. V C E C E C V b. V C E C c. V C E N C V
↓ ↓ ↓ ↓
e Ø *e* *e*

What these three environments have in common becomes clear once the syllabification of the strings in 70 is examined:

(71) a. V C_1 E C_2 E C_3 V b. V C_1 E C_2 c. V C_1 E N C_2 V
\ / \ / \ / \ / \ /
σ $*C_2$ σ σ $*C_2$ σ $*N$ σ

Since yers block Syllabification, a consonant trapped between two yers (C_2 in 71a) cannot be syllabified with either the preceding or the following consonant (C_1 or C_3 in 71a). Similarly, in 71b the consonant between the yer and word boundary, i.e. C_2, is prevented from being syllabified with C_1 by the presence of the yer. In 71c the yer is followed by two consonants, the first of which is nasal. Note that the nasal cannot form a syllable with either C_1 or C_2; the former option is blocked by the yer, the latter by the sonority restrictions on onsets—an onset cannot have the structure NC, regardless of the quality of the C (neither nasal + obstruent nor nasal + sonorant consonant is a well-formed onset). The conclusion is that in all three instances the yer subject to vocalization is followed by an unsyllabifiable consonant. Note that the second yer in 71a, which deletes instead of vocalizing, occurs before the consonant

[27] In Gussmann's 1980 account of Polish phonology the alternation between nasal vowels and zero in verbs is not a problem: vowels are nasalized before two consonants, the first of which is nasal, and they escape the operation of Lower, which affects only oral vowels. A separate rule is needed to vocalize nasal vowels. Under my new formulation of Lower (see below), no special treatment of this alternation is necessary.

syllabified with the following vowel. The connection between yer vocalization/deletion and the prosodic status of the following consonant is therefore firmly established. Lower can now be formulated as follows:[28]

(72) LOWER: yer → [−cons] / ___ *C
(where *C = unsyllabified consonant)

Some theoretical assumptions behind this approach should be explicated. In this study, following Bethin 1989 and Gussmann 1990, 1991, it has been assumed that Core Syllabification, which is a very early process ordered at the beginning of the phonology, leaves a certain number of segments unsyllabified (a case of 'contingent extrasyllabicity'; see Goldsmith 1990). These include yers as well as some consonants. The requirement of full prosodification, however, necessitates some strategy to remedy the situation. Thus, the extrasyllabicity of these segments is only transitional. The vocalization of yers creates new syllable nuclei to which hitherto unsyllabified consonants can attach and become prosodically licensed. When no such need arises, because the next consonant is already prosodified, Lower does not apply, and the preceding yer remains unvocalized. Viewed in this fashion, Lower has a clear phonetic function—namely, that of permitting the syllabification of consonants and ensuring the syllabic well-formedness of lexical items.[29]

Itô 1989 argues that languages adopt two strategies for dealing with unsyllabified consonants: vowel epenthesis (whose site is determined by the direction of syllabification) and the erasure of such segments. It seems that Polish adds a third option—the vocalization of adjacent unsyllabified slots, i.e. yers, which allows for the prosodification of neighboring consonants.

The status of unvocalized yers also deserves a brief consideration. As mentioned in §4 and at the beginning of this section, according to some authors (e.g. Rubach 1986, Bethin 1989), the deletion of yers is not effected by any rule, but is due to Stray Erasure, which removes unlicensed elements. However, the validity of Stray Erasure is in serious doubt. Several studies (e.g. Dell & Elmedlaoui 1988, Goldsmith 1990, Bagemihl 1991) argue that unsyllabified segments often play a significant role in the phonologies of such languages as Bella Coola, Berber, and Turkish, and cannot be removed by Stray Erasure. Recent works on Polish (e.g. Bethin 1989, Gussmann 1990, and also the present paper) support these findings.[30]

[28] For the sake of convenience and long-lasting tradition I use the term 'Lower' even if no actual lowering of yers is involved in the process.

[29] One might be tempted to treat Lower as part of the syllabification process itself. However, examples in which the consonants preceding yers are unsyllabified and yet yer vocalization does not take place show that syllabification pressure alone is not sufficient to trigger Lower:

(i) *sEn-u* → [snu] 'dream' *lEn-u* → [lnu] 'linen'
\ /
Syllabification *s σ *l σ

I am grateful to one of the reviewers for pointing this out to me.

[30] I am indebted to Morris Halle for a discussion of Stray Erasure and for bringing to my attention some papers that deal with this issue.

In view of the problems with Stray Erasure, as well as the lack of any evidence that unvocalized yers have any phonological function after the operation of Lower, I propose to regard the deletion of these segments as part of the rule in question, in agreement with the traditional two-clause formulation. The modified Lower now has the following shape:

(73) LOWER (final version):

$$\overset{\bullet}{\text{root}} \rightarrow \begin{cases} \overset{\bullet}{\text{root}}\ [-\text{cons}] \ /\ \_\ {}^{*}\text{C} \\ \emptyset \end{cases}$$

Rule 73 means that an empty root node is assigned the feature [−cons] (i.e. becomes a vowel) before an unsyllabified consonant, and deletes in any other context.

The operation of the new Lower will now be illustrated with some sample derivations. First, cases 70a and 70b will be considered—yer vocalization before another yer and before a word-final consonant. The examples in 74 are *cukiereczek* 'candy' and its genitive singular form *cukiereczka*:

(74)

	/cukEr-Ek-Ek/	/cukEr-Ek-Ek-a/
Syllabification:	σ *r *k *k	σ *r *k σ
Lower:	e e e	e e ∅
other rules:	k' č	k' č
	[cuk'ereček]	[cuk'erečka]

In *cukiereczek* all three yers are followed by unsyllabified consonants and are therefore vocalized. In *cukiereczka* only the first two yers are turned into the mid front vowel, because the third one occurs before the consonant that syllabifies with the desinential vowel *-a*.

Case 70c involves yer vocalization before a consonant cluster that is not a possible onset. In 75, derivations of the numeral *siedemnaście* 'seventeen' and the verb *zaczęty* 'begin (past participle)' and *zacznę* 'I will begin' are presented:

(75)

	/śedEm-nast-e/	/za-čEn-t-i/	/za-čEn-ē/
Syllabification:	σ *m σ σ	σ *n σ	σ σ
Lower:	e	e	∅
other rules:	ść	–	–
	[śedemnaśće]	[začenti]	[začnē]

Here the stem-final nasal consonants fail to be syllabified into the onset of the following syllable because neither a sequence of two sonorants (*mn*) nor a sequence of sonorant plus obstruent (*nt*) is a well-formed onset.[31] Consequently, the yers in the first two items are vocalized. In *zacznę* the situation is different: here the nasal consonant is followed by a vocalic inflectional suffix with which it forms a syllable. As a result the root yer is subject to deletion rather than vocalization.

[31] This does not mean that such sequences cannot occur word-initially, as in e.g. *mnożyć* 'multiply', *mdleć* 'faint'. The initial nasal is extrasyllabic and becomes incorporated into the phonological word by the rule of Initial Adjunction (Bethin 1989). The claim, however, is that NC is not a well-formed onset and does not conform to the basic syllable template in Polish.

The new Lower rule in 73 thus accounts for those cases which were handled by the old formulation in 70a–b. In addition, it deals successfully with cases like 70c, which were problematic under the previous approach.

There are also further advantages of the proposed solution. The problem with inflectional yers disappears altogether for the simple reason that they are not needed at all. Their only phonological function was to trigger Lower, and under the modified formulation of the rule there is no further justification for their presence.[32] Consider the derivations of *robEr* 'rubber', GEN.sg. *robr-a*, and *wiosEn* 'spring (GEN.pl.)', which required inflectional yers under the earlier approach:

(76)

	/robEr/	/robEr-a/	/v'osEn/
Syllabification:	σ *r	σ σ	σ *n
Lower:	e	∅	e
	[rober]	[robra]	[v'osen]

In both the NOM.sg. *rober* and the GEN.pl. *wiosen* the stem-final consonant is unsyllabified because it is preceded by a yer; consequently, Lower takes place. The GEN.sg. form *robra* has a vocalic desinence that forms a syllable with the preceding consonant. Here the root yer deletes instead of vocalizing, since it is not needed for the purpose of syllabifying the following consonant. Thus, in all instances the correct results are yielded without inflectional yers.

One more puzzle appears to be solved under the proposed interpretation of Lower, namely the failure of yer vocalization in the nominalizing suffix *-stw(o)*. As observed by Gussmann (1980:78), this suffix must start with a yer, because its attachment brings about the appearance of the mobile vowel in the root:

(77)

diabł-a	'devil (GEN.sg.)'	: *diabEl-stw-o*	'devilishness'
posł-a	'deputy (GEN.sg.)'	: *posEl-stw-o*	'mission'
błazn-a	'fool (GEN.sg.)'	: *błazEń-stw-o*	'foolery'

An interesting point is that the suffix-initial yer never occurs on the surface, even in the genitive plural:

[32] One might wish, however, to retain inflectional yers for purely morphological reasons i.e. as case markers. This decision would have no serious consequences for my analysis, which works regardless of whether inflectional yers are posited or not. Consider the derivation of the word *robEr* 'rubber', in which the yer of the nominative singular is included:

(i)

	/robEr-E/
Syllabification:	σ *r
Lower:	e ∅
	[rober]

Here the stem-final consonant is trapped between two yers and, therefore, remains unsyllabified and triggers Lower.

(78) *diabEl-stw* (**diabelestw*)
posEl-stw (**poselestw*)
błazEń-stw (**błazeniestw*)

Gussmann concludes that the suffix-initial yer must be marked as an exception to Lower.

Under the new approach to Lower, the puzzling behavior of the yer in *-stw(o)* finds a simple explanation: this segment fails to vocalize not because it is exceptional, but because it is not present in this suffix at all. Consider the derivation of two items, *błazeństwo* 'foolery' and its GEN.sg. *błazeństw*:

(79)

	/błazEn-stv-o/	/błazEn-st v/
Syllabification:	σ **n* σ	σ **nstv*
Lower:	*e*	*e*
other rules:	*w ń f*	*w ń f*
	[bwazeństfo]	[bwazeństf]

In both words the root-final nasal is unsyllabified because it cannot be incorporated into either the preceding or the following syllable. Thus, Lower is triggered by the extrametricality of the nasal consonant and not by a suffix-initial yer.[33]

In sum, the new Lower accounts not only for all the cases that the previous rule handled, but also for several cases that caused problems for the traditional formulation.[34]

[33] For the sake of clarity, the discussion of the suffix *-stw(o)* disregards the second yer in this formative, which surfaces in diminutives but fails to appear in the GEN.pl.:

(i) DIM.NOM.sg. GEN.pl.
błazEń-stEw-k-o *błazEń-stw* 'foolery'
diabEl-stEw-k-o *diabEl-stw* 'devilishness'

Such irregularities characterize not only *-stw(o)* but also several other formatives, such as *-arni(a)* and *-b(a)*, in which yers are vocalized before yer suffixes but not before zero inflection:

(ii) *kawi-arni-a* 'cafe (NOM.sg.)' : DIM *kawi-arEn-k-a* : GEN.pl. *kawi-arń*
służ-b-a 'service (NOM.sg.)' : ADJ *służ-Eb-n-y* : GEN.pl. *służ-b*

For the treatment of such cases, see n. 34. It should also be noted that the absence of the initial yer in *-stw(o)* can be established only if Palatalization is treated as a process triggered by whole suffixes. Under the latter assumption, the need for yers in many other suffixes (such as *-sk(i)*, *-sk(o)*, and *-czyk*) vanishes. Thus, initial yers must be postulated primarily in those cases in which direct alternations with zero are observed.

[34] I do not claim that the new formulation of Lower solves all the problems concerning vowel~zero alternations in Polish. As noted by many authors, the process is characterized by a certain amount of irregularity. The most frequent exceptions are those in which the stem yer regularly surfaces before suffixes but fails to occur before zero inflection:

(i) *wiatr* 'wind' : DIM *wiatEr-Ek*
walk 'battle (GEN.pl.)' : *walEcz-n-y* 'brave'

It is striking that the exceptional forms all involve the word-final position, while the regular occurrence of vocalized yers is observed inside words. I propose to account for the exceptional cases in a manner similar to that of Piotrowski 1988 and suggest that some nouns as well as suffixes are marked to undergo Final Adjunction, whereby the final consonant is prosodically adjoined to the phonological word:

Finally, it should be added that Lower cannot be a cyclic rule. Consider the tentative cyclic derivation of *kotek* 'kitten (NOM.sg.)' and its GEN.sg. *kotka* in 80:

(80)

		/kot-Ek/	/kot-Ek/
Cycle 2:	Syllabification:	σ **k*	σ **k*
	Lower:	*e*	*e*
Cycle 3:		/kotek/	/kotek-a/
	Syllabification:	σ σ	σ σ σ
	Lower:	–	–
		[kotek]	*[koteka]

On Cycle 2 both words have the same structure. Syllabification produces unsyllabified final consonants that subsequently trigger Lower. But this is incorrect in the case of *kotka*, where the yer must delete and not vocalize.

(ii) *form* 'form (GEN.pl.)'

	/forEm/
Syllabification:	σ
Final Adjunction:	ω
Lower:	ø
	[form]

Here Syllabification leaves the final consonant outside the syllable. Final Adjunction incorporates it into the phonological word, and the yer fails to vocalize because the following consonant is already prosodified. To put it differently, the proposal is to treat such items not as exceptions to Lower but as exceptions to Final Adjunction, which operates here before Lower. Note that the situation is different inside words:

(iii) *forEm-k-a* 'form (DIM)'

	/forEm-Ek-a/
Syllabification:	σ **m* σ
Final Adjunction:	–
Lower:	*e* ø
	[foremka]

In this case Final Adjunction, restricted to operating in word-final position, cannot license prosodically the unsyllabified medial consonant. Yer vocalization is thus the only way of making full prosodification possible, so Lower takes place.

Apparently, for some items the operation of Final Adjunction is optional, as a result of which some doublets occur:

(iv) *sarn/sarEn* 'doe (GEN.pl.)' *weln/welEn* 'wool (GEN.pl.)'
bitw/bitEw 'battle (GEN.pl.)' *kalk/kalEk* 'carbon paper (GEN.pl.)'

Interestingly, no such variation can be found inside words, i.e. when yer-initial suffixes are appended; in all instances yers are obligatorily vocalized:

(v) *sarEn-k-a* 'doe (DIM)' *welEn-k-a* 'wool (DIM)'
bitEw-n-y 'battle (ADJ)' *kalEcz-k-a* 'carbon paper (DIM)'

The correct results can be obtained if the entire words become available for Syllabification and Lower:

(81)

	/kot-Ek/	/kot-Ek-a/
Syllabification:	σ *k	σ σ
Lower:	e	∅
	[kotek]	[kotka]

In 81, only in the NOM.sg. is the stem-final consonant unsyllabified and thus a trigger for Lower. In the GEN.sg. the yer is followed by a prosodified consonant and therefore undergoes deletion. Clearly, then, Lower cannot be cyclic.

To recapitulate, this section has dealt with the process of yer vocalization and deletion. I have argued that the traditional formulation of the rule responsible for these modifications is inadequate because it requires unnecessarily abstract lexical representations; moreover, in some cases the effects of Lower can be observed in a context not specified by the traditional rule, i.e. where the allegedly conditioning yer is absent. A novel formulation of Lower is therefore proposed here. This new rule supplies the feature [−consonantal] to empty root nodes—the yers—before an unsyllabified consonant, in three cases: (i) when the consonant is final; (ii) when the consonant is followed by another yer; and (iii) when the consonant is followed by another consonant and the CC cluster is not a possible onset.

The extrasyllabicity of consonants that trigger yer vocalization has its sources in the properties of yers which block Syllabification (cases i and ii) and in the restrictions on consonant sequencing in onsets (case iii). Once yers are turned into vowels, they can act as syllable nuclei and permit the syllabification of the adjacent consonants. The remaining features of vocalized yers are filled in by redundancy rules and default. Yers found in environments other than those specified in cases (i)–(iii) delete; this change is also effected by Lower. The final conclusion is that Lower cannot be a cyclic rule.

The new Lower has been shown to have numerous advantages over the traditional rule. Apart from its phonetically nonarbitrary character, the new Lower allows for a considerable simplification of phonological representations as well as decreasing their abstractness. Yers can now be posited almost exclusively in those instances in which direct vowel~zero alternations are observed. They are no longer needed as inflectional desinences and suffix-initially in *-stw(o)*. Furthermore, the modified rule successfully accounts for the vocalization of yers in those cases where there are no conditioning empty root nodes, i.e. in numerals (the *siedEmnaście* type) and verbs (the *zaczęty* type).

6. CONCLUSION. The present paper has offered a novel interpretation of 'ghost segments' in Polish, i.e. yers, as well as a new formulation of the rule responsible for their emergence and nonemergence on the surface. First, I have demonstrated that the occurrence of yers in lexical items is, to a large extent, unpredictable, and that an insertion analysis—whether couched in segmental or syllabic terms—is not workable. Yers must belong to the underlying inventory of Polish. I have further argued that yers cannot be treated either as empty vowels or as floating melodies, because these representations fail to capture

the complex properties of the yers, in particular the fact that they escape Syllabification while at the same time blocking this process. My proposal is to enlarge the repertoire of phonological structures employed in representing 'ghost segments' (such as empty V-slots and C-slots) with empty root nodes (i.e. X-slots) unspecified with respect to other features. Yers viewed as empty root nodes lack the feature [−consonantal] and by virtue of this fact are not subject to Syllabification. They block the process in question because Syllabification cannot continue across a melodic element. These properties of yers are directly reflected in the process of vocalization: a yer vocalizes whenever the consonant that follows it cannot be incorporated into any syllable. In this approach Polish is claimed to be a language which, when faced with unsyllabified consonants, does not erase them or insert a vowel, but vocalizes adjacent empty root nodes—thus creating novel syllable nuclei to which the neighboring consonants can become prosodically adjoined. The function of the rule is to ensure syllabic well-formedness.

It is hoped that the analysis of yers presented in this paper, apart from offering a more adequate treatment of mobile vowels in Polish, can be of use in the description of other languages with similar types of 'ghost segment' phenomena.

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[Received 27 November 1990;
revision received 21 October 1991;
accepted 19 December 1991.]

CAN [CONSONANTAL] SPREAD?

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Current versions of feature geometry generally locate the features [consonantal] and [sonorant] as annotations on the root node, rather than as normal dependents of that or some other node. This geometry is intended to reflect the observation that, unlike other features, the major class features do not participate in phonological processes such as assimilation (spreading of a feature) or dissimilation (delinking of that feature). This article disputes the empirical observation concerning [consonantal]: several examples are provided where vowels or glides become consonantal next to consonants (assimilation) and where consonants become vowels or glides next to consonants (dissimilation). The feature geometry is modified to allow for such processes by placing [consonantal] as a daughter of the root node.*

INTRODUCTION

1. In recent years, phonologists have returned to a classical question of phonological theory: what natural and recurring segmental processes are found in the grammars of languages? Autosegmental and metrical phonology have shown us how powerful a hierarchically organized phonological representation can be, and phonologists are now approaching the classical question with this comparatively new representational tool. By arranging the distinctive features into subsets which typically act together, we arrive at a theory of 'feature geometry' (Clements 1985, Sagey 1986). We notice, for instance, that processes frequently refer to all the place features of a segment (recall for instance the typical rule assimilating place in nasals), but rarely if ever does a process refer piecemeal to one place feature, one manner feature, one voicing feature, and one major class feature. Thus features like [coronal], [labial], [high], and [anterior] should be grouped together; features like [labial], [continuant], [aspirated], and [sonorant] should not. McCarthy 1988, in a fine summary and expansion of the evidence for feature geometry, shows how the grouping together of certain features can be argued for from three lines of evidence: assimilation, dissimilation, and reduction of features. To take a familiar example, if one segment assimilates to another with respect to place, including coronality, height, and anteriority, we can show this by spreading all of the features

* Special thanks are due to Reinhard Hahn, Larry Hyman, Christine Kamprath, David Odden, Jan-Olof Svantesson and Draga Zec. They provided much data and analysis of individual languages discussed here. Thanks also to Colin Ewen, Tracy Hall, Sharon Hargus, Harry van der Hulst, John McCarthy, Bill Poser, Pieter van Reenen, Jurek Rubach, Patricia Shaw, Norval Smith, Alice Taff, Leo Wetzels, Martha Youngscholten, and two anonymous *Language* referees for their help in tracking down examples and thinking about their consequences. Audiences of Lund University, the Free University of Amsterdam, The University at Leiden, Manchester University and the University of Washington provided provocative and helpful comments. All should be absolved for the misuses to which I may have put their suggestions. Portions of this work were supported by NEH grant FE-25621-91.

The following abbreviations are used in this paper for features: ant = anterior, asp = aspirated, bk = back, cons = consonantal, cont = continuant, cor = coronal, dist = distributed, dor = dorsal, hi = high, lab = labial, lar = laryngeal, lat = lateral, nas = nasal, and voi = voice.