PATTERNS IN POLISH VOWEL~ZERO ALTERNATIONS*

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1. Introduction

Vowel~zero alternations in Polish, a phenomenon most commonly found in nouns, has proven in the past to be quite complex. In many Polish nouns, as in the first column of data (1), a vowel present in a word ending in a consonant is not present when that same word is followed by a vocalic suffix. In other words, the vowel breaks up two consonants when they are word-final. The two obvious ways of accounting for these alternations phonologically are through either epenthesis or syncope. In an epenthesis analysis, a vowel would be inserted between two consonants when they are word-final. In a syncope analysis, a vowel would be deleted between two consonants when they are followed by a vocalic suffix.

(1)	**Alternating noun roots**	**Non-alternating noun roots**
		Always V
a.	[lɛv-Ø] 'lion' ~ [lv-ɛm] (Instr. Sg.)	[zlɛv-Ø] 'sink' ~ [zlɛv-ɛm] (Instr. Sg.)
b.	[pʲɛs-Ø]'dog' ~ [ps-a] (Gen. Sg.)	[bʲɛs-Ø] 'devil' ~ [bʲɛs-a] (Gen. Sg.)
		Always Ø
c.	[wask-a] 'stoat' ~ [wasɛk-Ø] (Gen. Pl.)	[wask-a] 'grace' ~ [wask-Ø] (Gen. Pl.)
d.	[trumn-a] 'coffin' ~ [trumʲɛn-Ø] (Gen. Pl.)	[kɔlumn-a] 'column' ~ [kɔlumn-Ø] (Gen. Pl.)

(from Rubach 1984:28 and Gussmann 2007:186)

However, the complexity of vowel~zero alternations is highlighted when we compare the data in the first column with the data of non-alternating roots in the second column. The examples in the second column of data (1a,b) show nouns where the vowel [ɛ] is present throughout the paradigm in the same consonantal environment as the examples in the first column. Therefore, the data suggests that vowel~zero alternations cannot be a consequence of a process of syncope since there is no obvious way of explaining why deletion would occur in the first column but not in the second. On the other hand, the examples in the second column of data (1c,d) show nouns where there is never a vowel throughout the paradigm in the same consonantal environment as the alternating vowel in the examples in the first column. Therefore, the data suggests that

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vowel~zero alternations cannot be a consequence of a process of epenthesis either since there is no obvious way of explaining why epenthesis would occur in the first column but not in the second.

2. Previous Analyses

In the past, linguists took their inspiration from Proto-Slavic ultra-short vowels called *yers* in order to account for synchronic vowel~zero alternations in Polish and other Slavic languages. One such linguist was Rubach (1984), who defined synchronic *yers* as high [-tense] "abstract" vowels, one front and one back, parallel to [+tense] /i/ and /ɨ/, and transcribed as /ĭ/ and /ɨ̆/ (Rubach 1984:28-29). According to Rubach (1984), there are two major mechanisms that affect synchronic *yers* in nominal paradigms: Yer Lowering (2) and Yer Deletion (3). Yer Lowering states that /ĭ/ or /ɨ̆/ surface as the vowel [ɛ] when followed by another *yer* in the next syllable. Yer Deletion, on the other hand, states that *yers* that are not followed by another *yer* in the following syllable delete by default.

(2) Yer Lowering {ĭ ɨ̆} → ɛ / ___ C_0 {ĭ ɨ̆}
(adapted from Rubach 1984:31 (41a))

(3) Yer Deletion {ĭ ɨ̆} → 0
(adapted from Rubach 1984:31 (41b))

Supported by these rules, Rubach (1984) analyzes the phonetically null nominative singular ending of masculine nouns and genitive plural ending of feminine and neuter nouns as underlyingly the *yer* /-ɨ̆/. This explains the presence of alternating [ɛ] in words such as those in (4) below, where the suffixed *yer* deletes by default, resulting in a closed syllable.

(4)	Masc: *pies* 'dog, nom.sg.'	/pĭs+ɨ̆/ →	[pʲɛs]
	psy 'dog, nom. pl.'	/pĭs+ɨ/ →	[psɨ]
	Fem: *owiec* 'sheep, gen.pl.'	/ovĭts+ɨ̆/ →	[ovʲɛts]
	owca 'sheep, nom. sg.'	/ovĭts+a/ →	[ovtsa]
	Neut: *źródeł* 'spring, gen.pl.'	/ʑrudĭw+ɨ̆/→	[ʑrudɛw]
	źródło 'spring, nom. sg.'	/ʑrudĭw+ɔ/→	[ʑrudwɔ]

(from Rubach 1984:31)

More recently, Gussmann (2007) reinterpreted synchronic *yers* as floating vowels within the framework of Government Phonology. Using a mechanism of Melody Association, floating vowels attach to their nucleus when the following nucleus has no melody attached to it (Gussmann 2007:191). Therefore, in cases where the following nucleus is empty, often due to a zero inflectional ending, the floating vowel will be vocalized. However, when the following nucleus has a melody attached to it, such as in the case of a vocalic inflectional suffix, the floating vowel will not be vocalized since "an unassociated melody is not pronouncable" (Gussmann 2007:192).

However, although both Rubach (1984) and Gussmann's (2008) analyses are able to account for the irregularity in vowel~zero alternation data, they are not optimal if we consider Mellander's (2000) EMPIRICALLY ADEQUATE constraint, which can be violated if an analysis fails to recognize the patterns and generalizations about where the alternations occur. To take an example from Mellander (2000), who also analyzed vowel~zero alternations, Czech and Slovak data reveals a complete absence of final consonant clusters with rising sonority. Similar sonority factors may be observed in Polish data as well. Positing an underlying abstract vowel in the lexicon (as Rubach and Gussmann have done) allows us to only list things, whereas to deal with patterns, we need rules or constraints. Therefore, an analysis that is able to take the phonological patterns into consideration is more optimal than one that does not, and it is precisely the explanation of these patterns that forms the crux of my analysis.

3. Consonant Neutralization

One aspect of vowel~zero alternations that has complicated previous analyses is palatalization. Recall that Rubach's (1984) analysis includes two abstract vowels, one [-back] and one [+back]. The apparent need to distinguish between these two types of *yers* can be exemplified by the following data:

(5)	a.	*dzień* 'day, Nom. Sg.'	[dʑɛɲ]
		dnia 'day, Gen. Sg.'	[dɲa]
	b.	*den* 'bottom, Gen. Pl.'	[dɛn]
		dno 'bottom, Nom. Sg.'	[dnɔ]
	c.	*wieś* 'village, Nom. Sg.'	[vʲɛɕ]
		wsi 'village, Gen. Sg.'	[vɕi]
	d.	*wesz* 'louse, Nom. Sg.'	[vɛʃ]
		wszy 'louse, Gen. Sg.'	[vʃɨ]

Traditionally (as in Rubach 1984), the belief was that a front *yer* caused palatalization on the preceding consonant (5a,c), while a back *yer* did not (5b,d). Under this analysis, the first consonant in a cluster broken up by vowel~zero alternations was always underlyingly plain. However, distinguishing between two types of *yers* becomes unnecessary if we assume that the first consonant in (5a,c) is palatal underlyingly. An answer to why palatal consonants surface as non-palatal when the epenthetic vowel is absent can be found if we consider neutralization patterns. For example, the contrast between plain and palatal consonants is lost in certain pre-consonantal environments. This is most often made evident when two consonants are brought together through affixation (6).

(6)		<u>noun</u>	<u>adjective</u>	
	a.	sɛkrɛ**t**	sɛcrɛ**t**-n-ɨ	'secret'
		bru**d**	bru**d**-n-ɨ	'dirt'
		ɕa**n**-ɔ	ɕɛ**n**-n-ɨ	'hay'
	b.	vilgɔ**tɕ**	vilgɔ**t**-n-ɨ	'humidity'
		tʂɛla**dʑ**	tʂɛla**d**-n-ɨ	'household'
		kɔ**ɲ**	kɔ**n**-n-ɨ	'horse'

(adapted from Kenstowicz 1994:245)

Therefore, this same phenomenon may be active in (5a,c). I hypothesize that the initial consonants in *dzień* and *wieś* are palatal underlyingly, and that they lose their palatal feature due to neutralization in pre-consonantal position. The process of neutralization adds to the argument central to this paper—abstract vowels are unnecessary to account for vowel~zero alternations in Polish nouns. Assuming that consonants are palatal underlyingly eliminates the need for a distinction between palatalizing and non-palatalizing vowels, including eliminating the need for two *yers*.

4. Non-Syllabic Roots

4.1 Optimality Theory and Syllabification

Both Mellander (2000:222) and Laskowski (1975:29) point out asyllabic roots as the most straightforward environment where underlying *yers* may be deemed completely unnecessary. I define asyllabic roots in Polish as those that may only have an epenthetic vowel that alternates with zero. Therefore, this assumes that some examples of vowel~zero alternation do not have any underlying vowel (7a), while their non-alternating counterparts do (7b).

(7) a. *lew* 'lion' /lv/ → [lɛv] b. *zlew* 'sink' /zlɛv/ → [zlɛv]
pies 'dog' /pʲs/ → [pʲɛs] *bies* 'devil' /bʲɛs/ → [bʲɛs]

As asyllabic roots, words such as those in (7a) above need an epenthetic vowel in order to be syllabified. In Optimality Theory, this is a result of the interaction of DEP (8) and constraints on syllable structure (9).

(8) DEP = Every segment of the output has a correspondent in the input.
(i.e. prohibits epenthesis.)

(9) NUCLEUS[1] = every word must have at least one syllable, and every syllable must have a vocalic nucleus.

(10) NUCLEUS >> DEP

When NUCLEUS is ranked above DEP (10) it results in an epenthetic vowel in the environment of an asyllabic root with a zero affix, as shown in Table 1, as opposed to complete faithfulness of the output to the input.

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[1] The NUCLEUS constraint above is used as shorthand for three separate rules/constraints:
(1) Every phonological word must contain at least one syllable.
(2) NUC = syllables must have nuclei (Prince & Smolensky 1993:96).
(3) *P/C = C may not associate to Peak (NUC) nodes. In other words, consonants may not be nuclei. (Prince & Smolensky 1993:96).

Table 1: /lv+Ø/ = [lɛv] = 'lion, Nom. Sg.'

/lv+Ø/	NUCLEUS	DEP
lv	*!	
☞ lɛv		*

On the other hand, when an asyllabic root is inflected with a vocalic morpheme, the NUCLEUS constraint is not violated, and epenthesis is ruled out by DEP, as in Table 2.

Table 2: /lv+ɨ/ = [lvɨ] = 'lion, Nom. Pl.'

/lv+ɨ/	NUCLEUS	DEP
☞ lvɨ		
lɛvɨ		*!

However, the NUCLEUS constraint alone cannot account for the location of the epenthetic vowel within an asyllabic root. To ensure that the epenthetic vowel appears in the middle of the root, we need the constraints ALIGNR (11) and *COMPLEXCODA (12) ensure that the epenthetic vowel does not surface at the end or at the beginning of the asyllabic root, as in Table 3.

(11) ALIGN-R = the right edge of the input must coincide with the right edge of the output

(12) *COMPLEXCODA = one violation per every segment in a coda beyond one (i.e. codas are allowed to consist of at most one segment)

Table 3: /lv+Ø/ = [lɛv] = 'lion, Nom. Sg.'

/lv+Ø/	NUCLEUS	DEP	*COMPLEXCODA	ALIGN-R
lv	*!			
☞ lɛv		*		
ɛlv		*	*!	
lvɛ		*		*!

These same two constraints can be used to determine epenthetic vowel placement in tri-consonantal asyllabic roots. Since *COMPLEXCODA is violated when there is more than one consonant in a coda, the optimal place for vowel insertion would be between the last two consonants of a tri-consonantal root. Note that in Table 4 there are no factors other than *COMPLEXCODA that could explain the position of the epenthetic vowel—in terms of sonority, [kr] and [rv] are perfectly well formed onsets and codas respectively. Thus vowel~zero alternations in contemporary Polish have predictable placement.[2]

[2] Note that *COMPLEXCODA is sometimes violated. Polish does allow words of the form CVCC, for example [tʂɛrv] 'redness, Nom. Sg.' However, coda clusters occur only in cases where the vowel is underlying, rather than in asyllabic words exhibiting vowel~zero alternations. This in turn tells us that DEP >> *COMPLEXCODA.

Table 4: /krv+Ø/ = [krɛv] = 'blood, Nom. Sg.'

/krv+Ø/	NUCLEUS	DEP	*COMPLEXCODA	ALIGN-R
krv	*!			
☞ krɛv		*		
kɛrv		*	*!	
krvɛ		*		*!
kɛrɛv		**!		

4.2 Irregular Epenthetic Vowel Placement

Although the epenthetic vowel in asyllabic roots will most often occur between the final two consonants, exceptions to this rule can be found in two words: *cześć* [tʂɛɕtɕ] 'honour, Nom. Sg.'; and *chrzest* [xʂɛst] 'baptism, Nom. Sg.'. Their phonetic transcriptions show that the epenthetic vowel occurs between [tʂ] and [ɕ] in the case of 'honour' and between [ʂ] and [s] in the case of 'baptism'. Therefore, irregular epenthetic vowels in asyllabic roots are found to occur before a coronal fricative that differs from the preceding consonant in secondary place of articulation. It is safe to make this generalization because coronal obstruent-fricative sequences of differing secondary place of articulation are not attested anywhere in the Polish language.[3] I therefore posit an OCP constraint (13) to eliminate any candidate that exhibits such consonant sequences. This shows a preference for neighbouring consonants to share features.

(13) OCP-CORONAL = coronal fricatives cannot follow another coronal consonant specified for a different secondary place of articulation

Furthermore, as the data shows, the OCP-CORONAL constraint is satisfied through the placement of an epenthetic vowel, as opposed to other possibilities. Therefore, two more constraints are involved: the MAX constraint (14), which will eliminate any instance of deletion; and the IDENT constraint (15), which will eliminate any instance of assimilation or dissimilation.

(14) MAX = one violation per every segment present in the input that is not present in the output

(15) IDENT = every segment in the output must be identical to its corresponding segment in the input

(16) OCP-CORONAL, IDENT, MAX >> *COMPLEXCODA

All three constraints introduced in this section must be ranked above *COMPLEXCODA (16) to ensure that the epenthetic vowel surfaces between the two coronal fricatives. Furthermore, there is evidence that the DEP constraint must be ranked above *COMPLEXCODA in order to eliminate candidates with more than one epenthetic vowel, as illustrated in Tables 5 and 6.

[3] See Bargiełówna 1950 cited in Jarmasz 2008:27-29,84-86 for a list of attested and unattested consonant sequences.

Table 5: /tʂɕtɕ+Ø/ = [tʂɛɕtɕ] = 'honour, Nom. Sg.'

/tʂɕtɕ+Ø/	NUC	OCP-CORONAL	IDENT	MAX	DEP	*COMPLEX CODA
tʂɕtɕ	*!					
tʂɕɛtɕ		*!			*	
☞ tʂɛɕtɕ					*	*
tʂʂɛtɕ			*!		*	
tʂɛtɕ				*!	*	
tʂɛɕɛtɕ					**!	

Table 6: /xʐst+Ø/ = [xʐɛst] = 'baptism, Nom. Sg.'

/xʐst+Ø/	NUC	OCP-CORONAL	IDENT	MAX	DEP	*COMPLEX CODA
xʐst	*!					
xʐsɛt		*!			*	
☞ xʐɛst					*	*
xɛʐst		*!			*	**
xʐʂɛt			*!		*	
xʐɛt				*!	*	
xʐɛsɛt					**!	

On the other hand, we get forms such as (17a,b) when the roots are made syllabic through a vocalic suffix. Therefore, in these cases, the OCP-CORONAL constraint is satisfied through deletion.

(17) a. /tʂ**ɕ**tɕ+i/ → [tʂtɕi] 'honour, Gen. Sg.'
b. /xʐ**s**t+u/ → [xʐtu] 'baptism, Gen. Sg.'

An explanation for this phenomenon may be found if we consider the implications of an epenthetic segment in these forms. Polish has regular main stress on the penultimate syllable. Therefore, if forms with vocalic suffixes had an epenthetic vowel, then the main stress would fall on that epenthetic vowel. However, many languages conspire against stressing and footing epenthetic segments (Alderete 2000). Alderete 1995 posits a HEAD-DEPENDENCE constraint (18) to account for these phenomena in various languages.

(18) HEAD-DEPENDENCE = one violation per every stressed segment in the output that is not present in the input

(19) PENULTSTRESS[4] = main stress must be on the penultimate syllable, if the word is not monosyllabic

[4] PENULTSTRESS is shorthand for the set of constraints that generate regular penultimate stress in Polish, particularly: ALIGN(PW,R,Ft,R) = align the right edge of a foot with the right edge of a word; and FT-FORM(Trochaic) = stress the first of two syllables in a foot. See also Idsardi (1994) for a discussion about Polish stress and OT constraints.

(20) OCP-CORONAL, IDENT, HEAD-DEP, PENULTSTRESS >> MAX

Crucially, if HEAD-DEP and regular stress constraints (19) are ranked above MAX (20), then deletion is a possible means of satisfying the OCP constraint. Furthermore, OCP-CORONAL and IDENT must also be ranked above MAX in order to eliminate the faithful and assimilation candidates. When HEAD-DEP and PENULTSTRESS eliminate candidates with stress on an epenthetic segment and candidates with stress on the ultimate syllable, the optimal candidate is one with a deleted consonant, as in Tables 7 and 8.

Table 7: /tʂɕtɕ+i/ = [tʂtɕi] = 'honour, Gen. Sg.'

/tʂɕtɕ+i/	NUC	OCP-COR	IDENT	PENULT STRESS	HEAD-DEP	MAX	DEP
ˈtʂɕtɕi		*!					
tʂɛ.ˈɕtɕi				*!			*
ˈtʂɛ.ɕtɕi					*!		*
ˈtʂʂtɕi			*!				*
☞ ˈtʂtɕi						*	

Table 8: /xʐst+u/ = [xʐtu] = 'baptism, Gen. Sg.'

/xʐst+u/	NUC	OCP-COR	IDENT	PENULT STRESS	HEAD-DEP	MAX	DEP
ˈxʐstu		*!					
xʐɛ.ˈstu				*!			*
ˈxʐɛ.stu					*!		*
ˈxʐʂtu			*!				*
☞ ˈxʐtu						*	

5. Sonority Hierarchy

While epenthesis can easily account for vowel~zero alternations in asyllabic roots, the question still remains of what drives epenthesis in roots that are underlyingly syllabic. As Mellander (2000) pointed out in his analysis of Czech and Slovak, the answer can be found in sonority. Drawing on Laskowski (1975), who provides a description of the types of environments in which vowel~zero alternations occur, I compared consonant sequences that exhibit vowel~zero alternations with those that do not. The results of this task allowed me to devise a sonority hierarchy for Polish codas.[5]

[5] Note that I can only claim this hierarchy to be true for codas because Polish appears to be much more lenient with respect to onset well-formedness.

(21) Sonority Hierarchy for Polish Codas

Highest ↑

w	sonorants
n	
r	
j	palatal segments
ɕ, ʑ	
tɕ, dʑ	
l	
ɲ	
mʲ, fʲ, vʲ, pʲ, bʲ	palatalized labials
m	labial nasal
x, ʂ, ʐ, s, z, f, v, k, g, t, d, ts, p, b	plain obstruents

Lowest ↓

It is possible to call this ranking a sonority hierarchy because it does in fact follow some generally accepted sonority trends. Namely, more phonetically sonorous segments such as the semi-vowel [w] and the nasal [n] are ranked high on the hierarchy, whereas less phonetically sonorous segments such as plain stops and fricatives are ranked low on the hierarchy. The main place where the hierarchy in (21) diverges from the accepted phonetic hierarchy is with respect to palatal segments, which form a group of their own between sonorants and obstruents.[6] However, it has been noted (Steriade 1982)[7] that the sonority hierarchy may differ across languages. Furthermore, it is possible to think of this hierarchy as a more abstract or formal kind of sonority (Rice 1992) rather than a purely (acoustic) phonetic one. Accounting for sonority factors in Optimality Theory turns out to be a simple process if we assume that there is a single constraint (22) that is violated when the sonority hierarchy is violated.

(22) CODASONORITY = segments must not increase in sonority away from the nucleus

(23) CODASONORITY, MAX >> DEP, ALIGN-R

When CODASONORITY is ranked above DEP, it permits epenthesis to take place in coda consonant clusters of rising sonority. Furthermore, MAX and ALIGN-R eliminate candidates that attempt to resolve the sonority hierarchy through deletion or epenthesis at the word edge respectively, as in Table 9.

Table 9: /ɕfʲatw+Ø/ = [ɕfʲatɛw] = 'light, Gen. Pl.'

/ɕfʲatw+Ø/	CODA SONORITY	MAX	DEP	ALIGN-R
ɕfʲatw	*!			
☞ ɕfʲa.tɛw			*	
ɕfʲa.twɛ			*	*!
ɕfʲaw		*!		

[6] Note that although [l] is a sonorant, it behaves as the palatal counterpart to [w] in Polish phonological phenomena.

[7] See in particular Steriade 1982 Chapter I Section 3.4.

On the other hand, when the same consonant sequences are not in a coda, epenthesis does not take place, as in Table 10. The CODASONORITY constraint no longer motivates epenthesis, while HEAD-DEP is fatally violated by an epenthetic segment in the penultimate syllable.

Table 10: /ɕfʲatw+ɔ/ = [ɕfʲatwɔ] = 'light, Nom. Sg.'

/ɕfʲatw+ɔ/	HEAD-DEP	CODA SONORITY	MAX	DEP	ALIGN-R
☞ ɕfʲatwɔ					
ɕfʲatɛwɔ	*!			*	

6. Exceptions to Sonority-Based Epenthesis

Although the Sonority Hierarchy for Polish Codas can account for many instances of vowel~zero alternations, there are certain exceptions that are often the counterexamples to straightforward deletion or epenthesis accounts.

6.1 Native vs. Borrowed Vocabulary

In comparing roots that have a coda cluster of rising sonority, the group of words that do not exhibit vowel~zero alternations appears to be entirely made up of foreign borrowings. Kiparsky (1982:132), in his discussion of the [±Foreign] diacritic feature, notes that "loanwords are characteristically exceptions not just to one rule, but to a large number of rules." In Polish, foreign borrowings not only fail to exhibit vowel~zero alternations, but also fail to exhibit many other vowel alternations found in the language. Similarly, Mellander (2000:222) also points out that foreign borrowings exhibiting vowel~zero alternations in Slovak do not conform to the regular pattern of vowel harmony.

With the understanding that borrowed vocabulary will behave differently from native vocabulary, I propose a constraint that may only be violated in cases of roots marked with a [+Foreign] diacritic (24).

(24) DEPFOREIGN = one violation per every segment present in the output of a morpheme of foreign origin that is not present in the input (i.e. no epenthesis within a foreign morpheme).

In order for the constraint to eliminate epenthesis within words of foreign origin, it must be ranked above CODASONORITY and DEP (25). Additionally, ALIGN-R is required to rank above CODASONORITY in order to eliminate epenthesis at the edge of the word. The contrast between native and borrowed vocabulary is shown in Tables 11 and 12.[8]

(25) DEPFOREIGN, ALIGN-R >> CODASONORITY >> DEP

[8] Note that whether or not the [m] in an [mn] cluster is palatal does not make a difference since both segments are lower on the sonority hierarchy than [n].

Table 11: Native vocabulary: /trum^{j}n+Ø/ = [trum^{j}ɛn] = 'coffin, Gen. Pl.'

/trum^{j}n+Ø/	DEPFOREIGN	ALIGN-R	CODASONORITY	DEP
trumn			*!	
trumnɛ		*!		*
☞ trum^{j}ɛn				*

Table 12: Borrowed vocabulary: /kolumn+Ø/ = [kolumn] = 'column, Gen. Pl.'

/kolumn+Ø/	DEPFOREIGN	ALIGN-R	CODASONORITY	DEP
☞ kolumn			*	
kolumnɛ		*!		*
kolumɛn	*!			*

6.2 Affix Contiguity

There is also lack of epenthesis in coda sequences of rising sonority in some native vocabulary. An examination of the data reveals that epenthesis does not occur in words that are a combination of root plus derivational affix, as in (26b) where /-izn/ is a nominalizing suffix, but does in monomorphemic stems (26a).

(26) a. *błazen* /bwazn+Ø/ → [bwazɛn] 'fool, Nom. Sg.'
błazna /bwazn+a/ → [bwazna] 'fool, Gen. Sg.'
b. *bielizn* /b^{j}ɛl+izn+Ø/ → [b^{j}ɛlizn] 'undergarment, Gen. Pl.'
bielizna /b^{j}ɛl+izn+a/ → [b^{j}ɛlizna] 'undergarment, Nom. Sg.'

Therefore, I propose a new constraint that is violated by affixes (27).

(27) DEPAFFIX = one violation per every segment present in the output of an affix that is not present in the input.

(28) DEPAFFIX, ALIGN-R >> SONORITY >> DEP

Just like DEPFOREIGN in the previous section, when ranked above SONORITY and DEP (28), DEPAFFIX results in a lack of epenthesis in coda sequences that are part of affixes, as in Table 14.

Table 13: /bwazn+Ø/ = [bwazɛn] = 'fool, Nom. Sg.'

/bwazn+Ø/	DEPAFFIX	ALIGN-R	CODASONORITY	DEP
bwazn			*!	
bwaznɛ		*!		
☞ bwazɛn				*

Table 14: /b^{j}ɛl+izn+Ø/ = [b^{j}ɛlizn] = 'undergarment, Gen. Pl.'

/ b^{j}ɛl+izn +Ø/	DEPAFFIX	ALIGN-R	CODASONORITY	DEP
☞ b^{j}ɛlizn			*	
b^{j}ɛliznɛ		*!		*
b^{j}ɛlizɛn	*!			*

Furthermore, the DEPAFFIX constraint is violated not only when epenthesis occurs within an affix but also when it occurs at the edge of an affix (specifically, between the affix and the stem). Consider the data in (29) below and note that a [ptɕ] cluster violates the Sonority Hierarchy for Polish Codas.

(29)	a.	*kapeć-Ø*	[kapɛtɕ]	'slipper, Nom. Sg.'
		kapci-a	[kaptɕa]	'slipper, Gen. Sg.'
	b.	*babć-Ø*	[baptɕ]	'grandmother, Gen. Pl.'
		babci-a	[baptɕa]	'grandmother, Nom. Sg.'

In (29a), epenthesis occurs as predicted in order to break up a coda cluster with rising sonority. However, the same fails to occur in (29b), which can be deconstructed into the stem *bab* '(old) woman', and the suffix *–ć* 'diminutive'. Therefore, once again epenthesis occurs in monomorphemic words (Table 15) but does not occur in bimorphemic words (Table 16).

Table 15: /kaptɕ+Ø/ = [kapɛtɕ] = 'slipper, Nom. Sg.'

/kaptɕ+Ø/	DEPAFFIX	ALIGN-R	CODASONORITY	DEP
kaptɕ			*!	
kaptɕɛ		*!		
☞ kapɛtɕ				*

Table 16: /bab+tɕ+Ø/ = [babtɕ] = 'grandmother, Gen. Pl.'

/bab+tɕ+Ø/	DEPAFFIX	ALIGN-R	CODASONORITY	DEP
☞ babtɕ			*	
babtɕɛ		*!		*
babɛtɕ	*!			*

To summarize the effects of DEPAFFIX, DEPFOREIGN and ALIGN-R one can say that all epenthetic vowels must be internal to a native root.

6.3 Unmarked Vowel Deletion

The final exception shows an apparent presence of epenthesis where it is not expected. Consider the sequence [sk] in the following data:

(30)	a.	*pisk* [pisk] 'squeal, Nom. Sg.'	*piski* [piski] 'Nom. Pl.'
	b.	*pasek* [pasɛk] 'belt, Nom. Sg.'	*paski* [paski] 'Nom. Pl.'
	c.	*łaska* [waska] 'grace, Nom. Sg.'	*łask* [wask] 'Gen. Pl.'
	d.	*łaska* [waska] 'stoat, Nom. Sg.'	*łasek* [wasɛk] 'Gen. Pl.'

An [sk] sequence has a steady sonority cline, so there should be no need for epenthesis. However, we may find a reason for the alternations in (30b,d) if we return to the question of derivational morphemes. Common derivational affixes found in noun stems reveal three different phonological patterns.

(31) a.	[-ɛts]~[-ts]	b.	[-b]	c.	[-izn]
	[-ɛk]~[-k]		[-tɕ]		[-isk]
	[-ɛɲ]~[ɲ]		[-(r/l)ɲ]		[-ɔɕtɕ]

Group (31a) is the most interesting for the purposes of this paper because the affixes that form part of the group exhibit vowel~zero alternations. The affixes in group (31b) never exhibit any vowel, whereas the affixes in group (31c) always exhibit a vowel. Note that the vowel in group (31a) is *always* [ɛ], whereas the vowel in group (31c) is *never* [ɛ]. Therefore, I propose that an unmarked vowel [ɛ] in a derivational affix will delete when the affix is followed by a vocalic inflectional suffix. The motivation for this can be found if we return to the issue of stress. New constraints are needed to both penalize stress on unmarked vowels (i.e. [ɛ]) (32) and eliminate stress within affixes (33).

(32) STRESS-TO-WEIGHT[9] = light/unmarked vowels should not be stressed

(33) *STRESSAFFIX = affixes should not be stressed

However, neither of these individual constraints is consistently satisfied in Polish. It is important to note that unmarked vowels may be stressed when not in an affix, and vowels in affixes may be stressed when they are not unmarked. In order to prevent overgenralization, a constraint conjunction that combines STRESS-TO-WEIGHT and *STRESSAFFIX must be created (34).

(34) [STW & *STRESSAFFIX] = unmarked vowels in affixes should not be stressed

(35) [STW & *STRESSAFFIX], PENULTSTRESS >> MAX >> STW, *STRESSAFFIX

When the conjoined constraint is ranked above MAX and MAX is ranked above STRESS-TO-WEIGHT and *STRESSAFFIX individually (35), it paves the way for deletion to occur in the affixes found in (31a), as in Table 18, while at the same time ensuring that deletion does not take place for all unmarked vowels or in all affixes.[10] Furthermore, recall that PENULTSTRESS is ranked above MAX and therefore eliminates any candidate with irregular stress.

[9] The definition of this constraint is used with the assumption that unlike the other vowels in the system, [ɛ] is not specified for any features, and as such is defined as a "light" vowel. See Chociej (2009) for further support of this claim. The status of [ɛ] as the unmarked vowel is further supported by its status as the epenthetic vowel. See also Dresher & van der Hulst (1993).

[10] See Smolensky (1995:4) where he states that universally C_1 & C_2 >> C_1, C_2 and that two constraint violations are worse when they occur in the same location.

Table 17: /was+εk+Ø/ = [wasεk] = 'stoat, Gen. Pl'

/was+εk+Ø /	[STW & *STRESSAFFIX]	PENULT STRESS	CODA SONORITY	MAX
wásk				*!
wasέk	*!	*		
☞ wásεk				

Table 18: /was+εk+a/ = [waska] = 'stoat, Nom. Sg.'

/was+εk+a/	[STW & *STRESSAFFIX]	PENULT STRESS	CODA SONORITY	MAX
☞ wáska				*
wasέka	*!			
wásεka		*!		

On the other hand, faithful candidates of mono-morphemic stems do not violate any constraints, as in Tables 19 and 20.

Table 19: /wask+Ø/ = [wask] = 'grace, Gen. Pl'

/wask+Ø/	[STW & *STRESSAFFIX]	PENULT STRESS	CODA SONORITY	MAX
☞ wásk				

Table 20: /wask+a/ = [waska] = 'grace, Nom. Sg.'

/wask+a/	[STW & *STRESSAFFIX]	PENULT STRESS	CODA SONORITY	MAX
☞ wáska				

7. Conclusion

Unlike many previous analyses of vowel~zero alternations, this paper brings to the foreground the patterns found in the Polish data. The patterns show that it is in fact possible to account for certain cases of vowel~zero alternations through a process of epenthesis, and other cases through a process of deletion, without having to resort to abstract or floating vowels. Although there are some contexts in which vowel~zero alternations cannot be explained through the above means, the patterns highlighted in this paper cannot be ignored, and explaining vowel~zero alternations through encoding the lexicon with abstract vowels cannot show the whole story of how phonological processes work in Polish.

References

Alderete, J. (1995). 'Faithfulness to Prosodic Heads'. Manuscript [Rutgers Optimality Archive 94, http://roa.rutgers.edu]

Alderete, J. (2000). 'Head dependence in stress-epenthesis interaction'. In Hermans & van Oostendorp, eds. *The Derivational Residue in Phonological Optimality Theory*. Amsterdam: John Benjamins.

Bargiełówna, M. (1950). 'Grupy fonemów spółgłoskowych współczesnej polszczyzny kulturalnej'. *Biuletyn PTJ* 10: 1-25.

Chociej, J. (2009). *Patterns in Polish Vowel~Zero Alternations: An Optimality Theory Analysis*. Manuscript. University of Toronto MA Forum Paper.

Cyran, E. (2005). 'Sound patterns of Polish: phonotactic paradoxes at the right edge of words'. *Studies in Polish Linguistics* 2, 61-89.

Dresher, B. E. and van der Hulst, H. (1993). 'Head-dependent asymmetries in phonology'. Toronto Working Papers in Linguistics 12.2.

Gussmann, E. (2007). *The Phonology of Polish*. Oxford: Oxford University Press.

Idsardi, W. (1992). *The Computation of Prosody*. Massachusetts Institute of Technology PhD Dissertation.

Idsardi, W. (1994). 'Optimality, Alignment and Polish Stress'. Paper presented at LSA conference in Boston January 1994.

Jarmasz, L. (2008). *Complexity of Structure and Distinctness in the Polish Coronal Inventory*. University of Toronto Generals Paper.

Kenstowicz, M. (1994). *Phonology in generative grammar*. Oxford: Wiley-Blackwell.

Kiparsky, P. (1982). *Explanation in Phonology*. Dordrecht: Faris.

Kochetov, A. (2002). *Production, Perception, and Emergent Phonotactic Patterns*. New York: Routledge.

Kowalik, K. (1997). *Struktura morfonologiczna współczesnej polszczyzny*. Kraków: Wydawnictwo Instytutu Języka Polskiego.

Laskowski, R. (1975). *Studia nad morfonologią współczesnego języka polskiego*. Wrocław: Wydawnictwo Polskiej Akademii Nauk.

McCarthy, J. J. & Prince, A. (1995). 'Faithfulness and reduplicative identity'. In Jill Beckman, Laura Walsh Dickey & Suzanne Urbanczyk (eds.), *Papers in Optimality Theory. University of Massachusetts Occasional Papers* 18. Amherst, Mass.: Graduate Linguistic Student Association. pp. 249-384. [Rutgers Optimality Archive 60, http://roa.rutgers.edu]

Mellander, E. (2000). 'Teasing Apart Synchronic Yers and Epenthetic Vowels in Czech and Slovak'. *Proceedings of the 1999 Annual Conference of the Canadian Linguistic Association*, 213-224.

Mędak, S. (2003). *Słownik odmiany rzeczowników polskich*. Kraków: Universitas.

Prince, A. & Smolensky, P. (1993). *Optimality Theory: Constraint Interaction in Generative Grammar*. Rutgers University Center for Cognitive Science Technical Report 2.

Rice, K. (1992). 'On deriving sonority: a structural account of sonority relationships'. *Phonology* 9, pp. 61-99.

Rubach, J. (1984). *Cyclic and Lexical Phonology. The Structure of Polish*. Dordrecht: Foris Publications Holland.

Saloni, Z., Wróblewska, T., and Szafran, K. (1994). *Ortograficzny Słownik Ucznia*. Warszawa: Wydawnictwo Naukowe PWN.

Smolensky, P. (1995). 'On the Internal Structure of the Constraint Component *Con* of UG'. Handout of talk at UCLA 4/7/95. [Rutgers Optimality Archive 86, http://roa.rutgers.edu]

Steriade, D. (1982). *Greek prosodies and the nature of syllabification*. MIT PhD Thesis.

Sussex, R. and Cubberly, P. (2006). *The Slavic Languages*. Cambridge: Cambridge University Press.