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RESEARCH

Contrast preservation in Polish Palatalization

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There is a great deal of work on the role of contrast preservation in phonology and morphology (Flemming 1996; Padgett 2009; Hall 2011; Mackenzie 2013, among others). This article illustrates contrast preservation with the example of Coronal Palatalization in Polish (Rubach 1984; Gussmann 2007). The basic idea is that contrast is preserved between lexical items despite palatalization due to the choice of different allomorphs as suffixes for original and derived pre-palatals. If the same suffixes were selected for original and pre-palatal consonants, contrast would be neutralized between them in output forms. The analysis will be couched in the framework of PC ('preserve contrast') Theory (Łubowicz 2012). Cross-linguistic evidence and implications of the proposal will be examined.

Keywords: contrast; Polish palatalization; allomorphy; OT

1 Background on contrast in phonology

There is a significant amount of work on the role of contrast in the grammar. The main question is where contrast and opposition fits into the grammar. Is contrast an independent principle in the grammar or a derivative of the system?

In generative approaches to phonology, contrast falls out from other elements of the phonological system (i.e., rules, representations and/or constraints). In rule-based approaches, for example, contrast is neutralized if a phonological rule takes place (see 1). Forms that contrast in the input in final obstruent voicing map onto the same output. In the absence of a phonological rule, contrast is preserved (see 2). Forms that contrast in obstruent voicing in the input map onto different outputs.

(1) Language with final devoicing (e.g., Polish) – *contrast neutralization*

Input	/bu**g**/	'god'	/bu**k**/ 'beech'
Final devoicing	buk		n/a
Output	[bu**k**]		[bu**k**]

(2) Language without final devoicing (e.g., English) – *contrast preservation*

Input	/bæ**g**/	'bag'	/bæ**k**/ 'back'
No rule of final devoicing	n/a		n/a
Output	[bæ**g**]		[bæ**k**]

In classic Optimality Theory (Prince & Smolensky 1993/2004), contrast preservation and neutralization is the result of a constraint ranking. If a *Markedness* constraint outranks a conflicting *Faithfulness* constraint, contrast is neutralized (see 3). If *Faithfulness* outranks

Markedness, on the other hand, contrast is preserved (see 4). This is illustrated in the following tableaux (see also Kager 1999).[1]

(3) Final devoicing (M >> F) (cf. 1) – *contrast neutralization*

/bu**g**/	CODADEVOICING	IDENT(voice)
☞a. bu**k**		*
b. bu**g**	*!	

/bu**k**/	CODADEVOICING	IDENT(voice)
☞a. bu**k**		
b. bu**g**	*!	*

(4) No final devoicing (F >> M) (cf. 2) – *contrast preservation*

/bæ**g**/	IDENT(voice)	CODADEVOICING
a. bæ**k**	*!	
☞b. bæ**g**		*

/bæ**k**/	IDENT(voice)	CODADEVOICING
☞a. bæ**k**		
b. bæ**g**	*!	*

However, this article argues that based on cross-linguistic evidence a different view of contrast is needed – one where contrast exists as an imperative in a phonological system. This view is supported by prior research (see Flemming 1995; Padgett 1998).

The core evidence for contrast as an imperative in the grammar comes from instances of so-called *contrast transformation* where a given underlying contrast is preserved in the output but expressed as a different surface contrast. In the examples below, obstruent voicing contrast cannot be preserved in the output as such but is transformed into preceding vowel length contrast (see 5ac) and/or vowel height contrast (see 5b).

(5) Transformations of the voicing contrast

a. Intervocalic flapping in American English (Fischer & Hirch 1976)

ri[**d**]er vs. wri[**t**]er → r[**a:y**ɾ]er vs. wr[**ay**ɾ]er ‘rider’ vs. ‘writer’

b. Vowel raising in Polish (Gussmann 1980; Rubach 1984)[2]

ro[**g**]i vs. ro[**k**]i → r[**u**]k vs. r[**o**]k ‘horn’ vs. ‘year’

c. Vowel lengthening in Friulian (Hualde 1990; Repetti 1992; 1994; 2000; Torres-Tamarit 2015)

la[**d**]e vs. la[**t**]e → l[**a:**]t vs. l[**a**]t ‘gone’ (m.) vs. ‘milk’

In the examples in (5), forms that contrast in obstruent voicing in the input map onto outputs that differ by preceding vowel length and/or preceding vowel height. Although the relevant obstruents are pronounced the same, the outputs are kept distinct in a different way – through the preceding vowel contrast.

Contrast transformation cannot be accounted for in approaches with contrast as a derivative unless they are amended in some way. However, it can be explained by direct reference to contrast in the grammar. Consider final devoicing in Polish that is accompanied by vowel raising before underlyingly voiced obstruents. The interaction between raising and devoicing in Polish is *opaque* and standard OT cannot deal with opacity. The tableau

[1] This is consistent with the fact that OT is a theory of constraint interaction and although it may refer to phonological representations, it is not about representations per se. See Mackenzie (2013) for how contrast can be dealt with in OT.

[2] Vowel raising also applies before non-nasal sonorants (i.e. boje – b[u]j, wory – w[u]r, doły – d[u]ł). There are also exceptions to this process where it applies outside of its principal context and there are morphological restrictions on this process. For more examples and further discussion, see Gussmann (2007: 261–269).

below illustrates where the problem lies in standard OT. The hand pointing left indicates the incorrectly predicted candidate.

(6) In Polish: /ro**g**/ → [ru**k**], *[**ro**k] – wrong result

	/ro**g**/	CODA DEVOICING	IDENT (voice)	IDENT (high)	/ro**k**/	CODA DEVOICING	IDENT (voice)	IDENT (high)
Actual Output	☞a. ru**k**		*	**!*!**	a. ru**k**			!*!
Wrong winner	☜b. ro**k**		*		☞b. ro**k**			

In Polish, the contrast in voicing /ro**g**/ vs. /ro**k**/ is transformed into vowel height contrast, [r**u**k] vs. [r**o**k], respectively. But standard OT, as shown in (6), does not admit contrast transformation and points to the wrong candidate. It chooses candidate (b) as optimal with devoicing but no raising. Raising shown in candidate (a) incurs a seemingly unmotivated faithfulness violation, IDENT(high).

The key proposal in this paper is that contrast exists as an independent principle in the grammar rather than a derivative of the system (Flemming 1995; Padgett 1998; Lubowicz 2003; 2012; Hall 2011; Mackenzie 2013). There is a long tradition of research positing contrast as a central issue in phonology, starting with Trubetzkoy (1939). This paper contributes to prior research on contrast by analyzing *Polish Coronal Palatalization* as contrast transformation. The proposal will be implemented using a modification of Optimality Theory, called PC theory for "preserve contrast" (Łubowicz 2003/2012). It can be traced back to work on recoverability in phonology (Kaye 1975; Kisseberth 1976, among others). Implications of the proposal will be examined.

2 Statement of the problem: Polish palatalization

In Polish, there is a process of Coronal Palatalization by which alveolars and dentals (t d n s z) turn into prepalatals (tɕ dʑ ɲ ɕ ʑ) before front vowels (Gussmann 1980; Rubach 1984). The following are examples of palatalization before the locative singular suffix of masculine and neuter nouns and the vocative masculine singular [–e]. The examples in this paper also mark final obstruent devoicing in Polish where word-final obstruents surface as voiceless (see Rubach 1984 for more discussion). For clarity of exposition, the underlying form of the obstruent is indicated in the leftmost column throughout the article.[3]

(7) Coronal palatalization: /t d n s z/ → [tɕ dʑ ɲ ɕ ʑ]/_e

underlying		*nominative* SG.	*locative* SG.	*gloss*
t → tɕ	:	lis[t]	o liś[tɕ] + e	'letter'
d → dʑ	:	obia[t]	o obie[dʑ] + e	'dinner'
n → ɲ	:	ok[n] + o	o ok[ɲ] + e	'window'
s → ɕ	:	bruda[s]	o bruda[ɕ] + e	'dirty man'
z → ʑ	:	łobu[s]	o łobu[ʑ] + e	'troublemaker'

[3] In this article, I will use the following transcription system (the forms in brackets indicate spelling): *ʦ (c)* – voiceless alveolar affricate, *ʣ* – voiced alveolar affricate, *ʃ (sz)* – voiceless postalveolar fricative, *ʒ (rz or ż)* – voiced postalveolar fricative, *ʧ (spelled as cz)* – voiceless postalveolar affricate, *ʤ (spelled as dż)* – voiced postalveolar affricate, *ɕ (ś)* – voiceless prepalatal fricative, *ʑ (ź)* – voiced prepalatal fricative, *tɕ (ć)* – voiceless prepalatal affricate, *dʑ* (*dź)* – voiced prepalatal affricate, and *ɲ (ń)* – prepalatal nasal.

It is important to note that Coronal Palatalization is in part morphologically conditioned. That is, only certain front vowel suffixes are triggers (see Rubach 1984). Thanks to an anonymous reviewer for this point.

Interestingly, underlying prepalatals take the back high vowel [–u] suffix and not the front mid vowel [–e] suffix in the locative.

(8) Original prepalatals

underlying		*nominative* SG.	*locative* SG.	*gloss*
tɕ	:	liś[tɕ]	o liś[tɕ] + u	'leaf'
dʑ	:	narzę[dʑ] + e	o narzę[dʑ] + u	'tool'
ɲ	:	ko[ɲ]	o ko[ɲ] + u	'horse'
ɕ	:	łoso[ɕ]	o łoso[ɕ] + u	'salmon'
ʑ	:	pa[ɕ]	o pa[ʑ] + u	'type of butterfly'

Similarly, in dative (and locative) of feminine nouns there is palatalization before [–e] (see 9) but original prepalatals take a different suffix [–i] in the dative (see 10).

(9) Coronal palatalization

underlying		*nominative* SG.	*dative* SG.	*gloss*
t → tɕ	:	pso[t] + a	pso[tɕ] + e	'prank'
d → dʑ	:	wo[d] + a	wo[dʑ] + e	'water'
n → ɲ	:	stro[n] + a	stro[ɲ] + e	'page'
s → ɕ	:	ka[s] + a	ka[ɕ] + e	'register'
z → ʑ	:	ska[z] + a	ska[ʑ] + e	'shortcoming'

(10) Original prepalatals

underlying		*nominative* SG.	*dative* SG.	*gloss*
tɕ	:	koś[tɕ]	koś[tɕ] + i	'bone'
dʑ	:	łó[tɕ]	ło[dʑ] + i	'boat'
ɲ	:	baś[ɲ]	baś[ɲ] + i	'fairly-tale'
ɕ	:	ka[ɕ] + a	ka[ɕ] + i	'proper name'
ʑ	:	ma[ɕ]	ma[ʑ] + i	'sticky substance'

These are examples of *opaque allomorphy*. In (7) and (8), there are two allomorphs for the locative singular suffix, [–e] and [–u]. From the surface form alone, the selected allomorph cannot be determined. The same logic applies in (9) and (10). The choice of the locative allomorph depends on whether the prepalatal in stem final position is underlying or derived. Derived prepalatals, as in (7), take the [–e] ending, while original prepalatals, as in (8), take the [–u] ending.

The main question is why original and derived prepalatals take different suffixes in the locative. In an output-oriented approach to phonology, such as Optimality Theory (OT; Prince & Smolensky 1993/2004), there should be no difference between underlying and derived prepalatals in their choice of the allomorph. Since derived and underlying prepalatals are articulated in the output in the same way (Wierzchowska 1971), they should select the same suffix in the locative.

The study of allomorphy has received a lot of attention in OT. Allomorph distribution has been shown to be determined by phonological factors, such as stress (Mester 1994; Drachman et. al 1995; Kager 1996; Antilla 1997), syllable structure (McCarthy & Prince 1993; Prince & Smolensky 1993/2004; Mascaró 1996; Tranel 1996; 1998; Hargus & Tuttle 1997; Rubach & Booij 2001; Bonet 2004; Łubowicz et. al. 2006), and phonotactics (Oostendorp 1998; Antilla 2002; Yip 2004; Bermúdez-Otero 2006), as well as paradigmatic uniformity and contrast (Kurisu 1998; Urbanczyk 1998; 1999; Steriade 2000;

Gafos & Ralli 2002; Kenstowicz 2005; McCarthy 2005; Rebrus & Törkenczy 2005; Łubowicz 2006; 2007; Bernouss 2010).[4] This article investigates the role of contrast in allomorph selection.

The proposal is that the different allomorphs of the locative suffix preserve a contrast that would be otherwise neutralized on the surface. Allomorph distribution preserves the original contrast between dentals/alveolars vs. prepalatals in stem-final position: /list/ vs. /liɕtɕ/ map onto [liɕtɕ + e] vs. [liɕtɕ + u]. If both forms took the same suffix [–e], the contrast between them would be neutralized on the surface due to palatalization, /list/ vs. /liɕtɕ/ would both map onto [liɕtɕ + e]. The analysis will be couched within the framework of PC ('preserve contrast') theory (Łubowicz 2003; 2012), which is extended to the area of allomorphy (see also Łubowicz 2007).

Further details of the allomorph distribution in Polish outside of the alveolar and prepalatal contexts are given in section 4.2 and incorporated into the analysis. It will be shown that [u] is the default allomorph for back consonants and [e] occurs with front consonants.

The rest of the paper is organized as follows. Section 3 presents the framework: PC theory. For extensive cross-linguistic motivation of the proposal beyond Polish the reader is referred to Łubowicz (2012). Section 4 gives the analysis of Polish palatalization in PC framework. Section 5 discusses typological predictions of the proposed analysis and examines the role of recoverability in contrast transformation. Section 6 compares the PC analysis with previous approaches to allomorphy. Section 7 is the conclusion.

3 The framework: PC theory

Contrast plays an essential role in a number of phonological and morphological processes. Some of the early works on contrast include Martinet (1952), Trubetzkoy (1971), Kaye (1974; 1975), Gussmann (1976), Kisseberth (1976) & Hualde (1990), among others. There is a great deal of work on the role of contrast in OT, including:

- phonological mappings (Łubowicz 2003; 2004; 2012; Tessier 2004)
- segmental inventories (Flemming 1995; 1996; 2004; Padgett 1997; 2001; Hall 2011)
- historical change (Padgett 2003; Padgett & Zygis 2003; Ito & Mester 2004; 2006; Oxford 2015)
- feature co-occurrence restrictions (Cote 2000; Mackenzie 2013)
- morpho-phonological processes (Crosswhite 1997/1999; Kurisu 1998; Steriade 2000; Horwood 2001; Downing et. al. 2005; Łubowicz 2007; 2012)
- tonal and accentual phenomena (Alderete 2001; Barrie 2006; Guillaume 2008)
- stress-epenthesis interaction (Kenstowicz 2005; Łubowicz 2003/2012)
- syntactic structure (Flack 2007)

In the rest of this section, the elements of PC theory are described with particular emphasis on Polish. I first describe the candidate over which contrast is evaluated and then discuss the constraints that evaluate contrast.

The framework of PC theory is described in detail in Łubowicz (2012) with examples from chain shifts primarily in Finnish and stress-epenthesis interaction in Arabic dialects. Polish allomorphy is argued to be yet another case where contrast preservation applies. This paper contributes to our understanding of Coronal Palatalization in Polish as opaque allomorphy. For more details of the framework, further discussion of the predictions of the PC theory, and motivation of the analysis beyond the Polish example, the reader is referred to the aforementioned manuscript. In the following sections the tools of the theory are

[4] For non-OT accounts, see Hudson (1974); Siegel (1974) & Carstairs-McCarthy (1988). For a more complete list of references, see McCarthy (2004).

described sufficiently to understand and motivate the Polish case. Predictions and comparison with alternatives are presented in subsequent sections.

3.1 The candidate

To evaluate contrast, a candidate is a set of input-output mappings, called a scenario (Łubowicz 2003; cf. Flemming 1995; 1996; 2004; Padgett 1997; 2000; 2001; 2003; Tessier 2004). The key idea is that phonological mappings are not evaluated in isolation but in the context of other mappings in the same system. This is different from standard OT (Prince & Smolensky 1993/2004), where mappings are evaluated in isolation. For similar ideas see output-output faithfulness (Benua 1997; Gouskova 2004) and the allomorphic model of Burzio (1998). For a detailed description of the scenario construction in PC theory, see Łubowicz (2012: 12–17).

Below is the actual scenario in Polish over which contrast is evaluated. Forms that contrast in the quality of the stem final consonant, li[st] vs. li[ɕtɕ], take different suffixes in the locative, [–e] vs. [–u], respectively. The contrasts are represented in bold font.

(11) The actual scenario (cf. 7 and 8)

Input		*Output*
li**st**, {+e, +u}	⟶	liɕtɕ + **e**
li**ɕtɕ**, {+e, +u}	⟶	liɕtɕ + **u**

In case of affix allomorphy, the inputs of the scenario consist of a set of stems and allomorphs. The allomorphs are language-particular. In Polish, it is a set of two vowels {+e, +u}. It is standard to assume that the idiosyncratic allomorphs are listed in the lexicon (Kager 1996; 1999).

The input also contains stems to which allomorphs attach. I propose that input strings to which allomorphs attach are generated by the function GEN, similar to GEN in Correspondence Theory (McCarthy and Prince 1995). The forms generated by GEN consist of any combination of phonological properties P, which are essentially any properties governed by standard faithfulness constraints, such as height, voicing, and so on. Each form from the set of input strings generated by Gen is paired up with the language-particular set of allomorphs.

(12) The inputs of the scenario

Gen (list, {+e, +u}) = list, {+e, +u}; liɕtɕ, {+e, +u}; teɕtɕ, {+e, +u} etc.

It is helpful to think of inputs as distributed in a multi-dimensional space. Inputs generated by Gen form a network, the dimensions of which are determined by the P properties. Here is a subset of the input network defined by three distinct P properties: (a) consonant height in stem-final position (x axis), (b) vowel rounding (y axis), and (c) nasality (z axis) (Figure 1).

(13) The input network

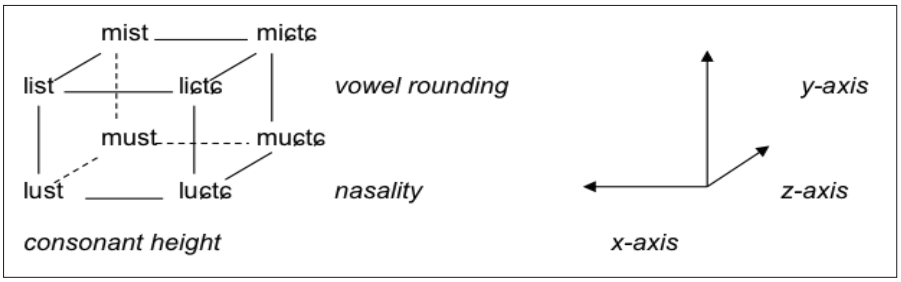

Figure 1: The input network

The various P properties define the space of inputs in a scenario. This includes not only actual minimal pairs but any combinations of properties P. Contrast preservation does not need exact minimal pairs to be evaluated.[5]

Since scenarios contain a set of input-output mappings, it is also necessary to define what outputs are included in a scenario. Following Łubowicz (2012: 15–17), I propose that the output of a scenario is a subset of the input. There is nothing in the output of a scenario that is not also in the input. This limits the space of mappings that are evaluated. Gen pairs up each input with an output form and thus scenarios are formed.[6]

In effect, scenarios represent various mapping coexistence patterns. The scenario is a candidate, and thus, the actual scenario is compared to other scenarios in the same candidate set, which is represented below. In the diagram below, inputs are represented on the bottom line in traditional slanted brackets and outputs are on the top line in square brackets. (The same representation is adopted in Łubowicz 2012 and is kept consistent here.) The tableaux and scenarios below only show two forms at a time but the scenarios are larger in size.[7]

(14) Scenarios in a candidate set (for other scenarios, see section 5.)

Scenario	Actual		Contrast-neutralizing	
Output	[liɕtɕ + e]	[liɕtɕ + u]	[liɕtɕ + e]	
Input	/list, {+e, +u}/	/liɕtɕ, {+e, +u}/	/list, {+e, +u}/	/ liɕtɕ, {+e, +u}/

Scenarios are submitted for evaluation to EVAL. The optimal scenario is chosen by the constraints on contrast interacting with each other and with conflicting markedness constraints. There are also constraints on recoverability (see section 5).

It is important to emphasize that the way the scenarios are formed in PC theory, contrast is more than just homophony avoidance. Contrast preservation is important not only for potential homophones (*list* and *liɕtɕ*) but it is also important for forms that do not result in homophony (*koɕtɕ 'bone' – koɕtɕ + i* (DAT.SG.) vs. *krost + a 'pimple' – kroɕtɕ + e* (DAT.SG.)). Although minimally contrasting words *kroɕtɕ* and *kost + a* do not exist, they are part of inputs of the scenario and thus PC constraints that evaluate contrast (see next section) ensure that the actual form *koɕtɕ* vs. hypothetical *kost* and the actual *krost + a* vs. hypothetical *kroɕtɕ + a* map onto different outputs when enriched with suffixes. The actual form *koɕtɕ* maps onto *koɕtɕ + i* (DAT.SG.) while the hypothetical form *kost* would map onto *koɕtɕ + e*. Similarly, the actual form *krost + a* maps onto *kroɕtɕ + e* (DAT.SG.) while the hypothetical form *kroɕtɕ + a* would map onto *kroɕtɕ + i* (DAT.SG.). This is to preserve the original contrast in palatalization of the stem final consonant(s).[8]

[5] Thank you to an anonymous reviewer for comments on this point. As the reviewer points out, there are very few exact minimal pairs in the lexicon like *list vs. liɕtɕ* and therefore it is important that contrast preservation applies even when the creation of an exact minimal pair with an item in the lexicon is not at stake. The architecture of PC theory ensures that this is indeed the case.

[6] As pointed out by a reviewer, in case of morphologically complex inputs as in allomorphy, the subset relation refers to morphological entities as well as phonological ones.

[7] There is a limit put on the size of a scenario by putting a limit on segmental epenthesis (see Łubowicz 2012: 14). It is also ensured that scenarios in a candidate set have the same inputs but differ on the set of outputs and/or input-output relations even if outputs are the same.

[8] I would like to thank an anonymous reviewer for comments on this point. Another reviewer points out that the need to preserve contrast could predict unattested long distance effects where multiple suffixation exhibits the same set of facts as forms with one suffix. For example, a hypothetical set of suffixes */list-en-{e,u}/* → *liɕtɕ-eɲ-e* would contrast with */liɕtɕ-en-{e,u}/* → *liɕtɕ-en-u* where the final suffix is selected by the need to preserve contrast between stems */list/* vs. */liɕtɕ/*. The constraint PC_{IN}(high) would be satisfied

3.2 Constraints on contrast

The core of the proposal is that contrast exists as an imperative in the phonological system, formulated as a family of rankable and violable constraints, called PC constraints.[9] The definitions are given below. The PC constraint is defined in (15) relying on the notion of contrast, and contrast is defined in (16).

(15) $PC_{IN}(P)$

For each pair of inputs contrasting in P that map onto the same output in a scenario, assign a violation mark. Formally, assign one mark for every pair of inputs, in_a and in_b, if in_a has P and in_b lacks P, $in_a \rightarrow out_k$, and $in_b \rightarrow out_k$.[10]
"If inputs are distinct in P, they need to remain distinct in the output (not necessarily in P)."

(16) Contrast in P

A pair of forms, in_a and in_b, contrast in P, when corresponding segments in those forms, seg_a and seg_b, are such that seg_a has P and seg_b lacks P (same for outputs).

PC constraints refer to phonological properties P like height, rounding, voicing, presence vs. absence of a segment, and so on, In fact, any change that can be evaluated by standard faithfulness constraints can constitute the property of a PC constraint and be evaluated for contrast preservation. In this article, the relevant property will be the difference in height between the stem final consonants.

PC constraints are like faithfulness constraints in that they evaluate two levels of representation, inputs and corresponding outputs, but they are different in that they look at pairs of inputs and outputs and not at an individual input-output mapping. Unlike standard faithfulness, PC constraints allow a given underlying contrast to be realized as a different surface contrast. In the Polish locative, the contrast in the quality of the stem-final consonant is manifested as a surface contrast in the quality of the allomorph.

In addition to input-oriented PC constraints as defined in (15), there are also output-oriented PC constraints that evaluate differences between scenarios. Although they are not needed for the analysis of Polish allomorphy, I will retain the subscript PC_{IN} for input-oriented PC constraints to differentiate them from output-oriented PC constraints that are also needed in the theory (see Łubowicz 2012: 21–23).[11]

The analysis presented in the following section applies to opaque allomorphy. It is important to note that PC theory has been shown to be successful with both opaque and transparent phonological phenomena (see Łubowicz 2012: 31–33). In fact, that is what makes PC theory unique and what differentiates it from prior approaches to opacity that require special mechanisms to be successful.[12] (But see Harmonic Serialism approaches in OT, McCarthy 2010 and section 6.)

4 The analysis

This section presents the analysis. The core argument is in 4.1. Section 4.2 gives details of allomorph distribution in Polish outside of the alveolar and pre-palatal contexts. The following sections further extend the analysis.

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by this pathological scenario despite palatalization. PC theory (Łubowicz 2012) proposes that such long distance effects are ruled out by local PC constraints, called PC-DOMAIN(P) (Łubowicz 2012: 79). Such constraints demand that contrast displacement is local to a prosodic domain. In Polish palatalization, the relevant prosodic domain is a syllable.

[9] This proposal is different from Alderete (2001) and Horwood (2001) who define contrast as anti-faithfulness.

[10] Both outputs have the same subscript _k since they are meant to represent the same output onto which the inputs neutralize.

[11] Thank you to an anonymous reviewer for comments on this point.

[12] I would like to thank an anonymous reviewer for bringing this up.

4.1 Core argument

In Polish, Coronal Palatalization (Rubach 1984; 2003) turns anterior consonants such as dentals and alveolars /t d n s z/ into prepalatals [tɕ dʑ ɲ ɕ ʑ] before front vocoids [i], [e], and [j] (see also Ćavar 2004; Kochetov 2011). Palatalization creates derived prepalatals. Prepalatals are: "(…) produced with the body of the tongue in the front position. The tongue is tense and the lips are spread. The air escapes through a very narrow channel made between the post-alveolar region of the palate and the middle of the tongue." (Wierzchowska 1967; 1980; Keating 1988; Ladefoged & Maddieson 1996; Cavar 2004; see Figure 2). Rubach (1984) describes prepalatals as [+high, –back].[13]

(17) Coronal palatalization

[+anterior, +coronal] → prepalatal / ____ [-cons, –back]

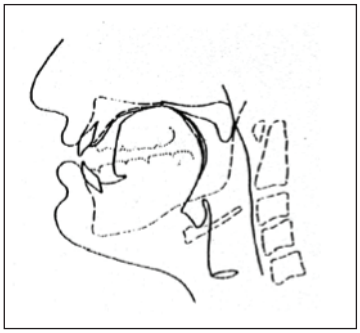

Figure 2: The articulation of prepalatals.

Examples of palatalization are given in (18).

(18) Coronal palatalization (cf. 7)

underlying		*nominative* SG.	*locative* SG.	*gloss*
t → tɕ	:	lis[t]	o liś[tɕ] + e	'letter'
d → dʑ	:	obia[t]	o obie[dʑ] + e	'dinner'
n → ɲ	:	ok[n] + o	o ok[ɲ] + e	'window'
s → ɕ	:	bruda[s]	o bruda[ɕ] + e	'dirty man'
z → ʑ	:	łobu[s]	o łobu[ʑ] + e	'troublemaker'

To account for palatalization, I propose that there exists a markedness constraint PAL that outranks a constraint on preserving contrast between underlying and derived prepalatals, called PC_{IN}(high). As a result of palatalization, the contrast is neutralized between underlying dentals/alveolars and prepalatals. I will refer to it as the height contrast. The relevant markedness and faithfulness constraints are given below.

(19) PAL

No anterior coronal followed by a front vowel.[14]

(20) PC_{IN}(high)

"If inputs are distinct in height, they need to remain distinct in the output."

[13] The featural representation of prepalatals will be crucial for the subsequent analysis.

[14] As pointed out by an anonymous reviewer, PAL is restricted to morphologically derived environments in Polish. There is no palatalization in morpheme-internal anterior coronal + front vowel sequences (as in *teras*, **tʃeras* "now") (see Łubowicz 2002). Furthermore, as the reviewer points out, not all front vowel suffixes trigger palatalization (see Gussmann 2007) and thus PAL needs to be indexed to a set of suffixes that trigger palatalization to distinguish between palatalizing versus non-palatalizing suffixes. Another approach to differentiate palatalizing and non-palatalizing suffixes would be to assume more abstract underlying forms of the suffixes (Rubach 1984).

The ranking for palatalization is given in (21) and illustrated with a tableau in (22).

(21) Palatalization ranking

PAL >> PC_{IN}(high)

(22) Palatalization neutralizes the height contrast

	Scenarios	PAL	PC_{IN}(high)
A. Contrast-preserving	/pas + e/ → pas + e /paç + e/ → paç + e	*!	
B. Contrast-neutralizing ☞	/pas + e/ → paç + e /paç + e/ → paç + e		*

The scenario that fails to palatalize, scenario A, is eliminated. The forms are hypothetical and are meant to illustrate the consequences of palatalization in the phonological system.

In the locative allomorphy, the height contrast between derived and original prepalatals is preserved on the surface despite palatalization and realized by different suffixes.

(23) The role for allomorphy (cf. 11)

Input		*Output*
li**st**, {+e, +u}	⟶	liçtç + **e**
li**çtç**, {+e, +u}	⟶	liçtç + **u**

Derived prepalatals take the [–e] allomorph while underlying prepalatals take the [–u] allomorph. Thus, the contrast in height is preserved.

(24) Allomorphy preserves the contrast in height

	Scenarios	PAL	PC_{IN}(high)
A. Contrast-neutralizing	/list, {+e, +u}/ → liçtç + e /liçtç, {+e, +u}/ → liçtç + e		*!
B. Contrast-preserving (=Actual) ☞	/list, {+e, +u}/ → liçtç + e /liçtç, {+e, +u}/ → liçtç + u		
C. Contrast-preserving	/list, {+e, +u}/ → list + e /liçtç, {+e, +u}/ → liçtç + e	*!	

Scenario B wins. It palatalizes but also preserves the contrast in height. Scenario C fails to palatalize. Scenario A palatalizes but merges the contrast in height.

In summary, though palatalization can neutralize the height contrast, the locative allomorphy preserves the height contrast despite palatalization. In effect, allomorphy keeps apart forms that the regular phonology would otherwise neutralize. In Polish, allomorphy compensates for palatalization.[15]

[15] Also, since there are underlying prepalatals in Polish, the constraint on preserving the height contrast PC_{IN}(high) outranks the constraint against prepalatals *[+high, –back]: PC_{IN}(high) >> *[+high, –back].

4.2 Allomorph distribution

In this section I discuss how the allomorphs are distributed in other contexts in Polish locative. The allomorphs are in complementary distribution. The front vowel allomorph is selected for front consonants and the back allomorph is selected for back consonants.[16] The front vowel allomorph [–e] is also after labials & labio-dentals {p, b, m, w, f, v}. The back vowel allomorph [–u] is also after post-alveolars {ʃ, ʒ, tʃ, dʒ}, the palatal {j}, velars {k, g, x}, alveolar affricates {ts, dz}, and the lateral {l}. More information on the distribution of these suffixes across Slavic can be found in Janda (1996).

(25) Front and back stems

a. Front consonants (labials and labio-dentals)[17]

underlying	*nominative* SG.	*locative* SG.	*gloss*
p → p'j:	chło[p]	o chło[p'] + je	'peasant'
b → b'j:	ara[p]	o ara[b'] + je	'Arab'
m → m'j:	gra[m]	o gra[m'] + je	'gram'
f → f'j:	gra[f]	o gra[f'] + je	'graph'
v → v'j:	ró[f]	o ro[v'] + je	'ditch'

b. Back consonants (post-alveolars, the palatal, velars, alveolar affricates and the lateral)

underlying		*nominative* SG.	*locative* SG.	*gloss*
ʃ	:	ko[ʃ]	o ko[ʃ] + u	'basket'
ʒ	:	tale[ʃ]	o tale[ʒ] + u	'plate'
tʃ	:	królewi[tʃ]	o królewi[tʃ] + u	'prince'
dʒ	:	bry[tʃ]	o bry[dʒ] + u	'bridge'
j	:	kra[j]	o kra[j]+u	'country'
k	:	so[k]	o so[k] + u	'juice'
g	:	ró[k]	o ro[g] + u	'corner, horn'
x	:	stra[x]	o stra[x] + u	'fear'
ts	:	ko[ts]	o ko[ts] + u	'blanket'
dz	:	wi[ts]	o wi[dz] + u	'viewer'
l	:	nauczycie[l]	o nauczycie[l] + u	'teacher'

This is also true of borrowings.

(26) Borrowings

a. Front consonants

underlying	*nominative* SG.	*locative* SG.	*gloss*
t:	gadże[t]	o gadże[tɕ] + e	'gadget' (English)
d:	Harwar[t]	o Harwar[dʑ] + e	'Harvard' (English)
s:	autobu[s]	o autobu[ɕ] + e	'bus'
z:	trape[s]	o trape[ʑ] + e	'trapeze' (French)
n:	badminto[n]	o badminto[ɲ] + e	'badminton' (English)

[16] This roughly corresponds to Rubach's (1984) classification as [+anterior] for front consonants and [–anterior] for back consonants.

[17] There are two other mappings with coronal palatalization: r → ʒ (rowe[r] ~ o rowe[ʒ] + e 'bicycle'), and w → l (ko[w] + o ~ o ko[l] + e 'circle'). In both cases, the locative suffix is [–e], whereas the same segments present underlyingly take the [-u] suffix, e.g. ryce[ʃ] /ʒ/~ ryce[ʒ]+u 'knight', and po[l]+e ~ po[l]+u 'field'.

b. Back consonants

underlying	*nominative* SG.	*locative* SG.	*gloss*
dʒ:	bry[tʃ]	o bry[dʒ] + u	'bridge' (English)
l:	alkoho[l]	o alkoho[l] + u	'Alkohol' (German)
ʃ :	zam[ʃ]	o zam[ʃ] + u	'Sämisch' (German)
ʒ :	gara[ʃ]	o gara[ʒ] + u	'garage' (French)
k:	Nowy Jor[k]	o Nowym Jor[k] + u	'New York'

To account for complementary distribution, I will assume that [u] is preferred over [e] (*e >> *u) but not after front consonants (*Front/u >> *e).[18]

(27) *Front/u

No back vowels after front consonants.

(28) Allomorph distribution

*Front/u >> *e >> *u

In effect, back consonants select the back allomorph (see 29) while front consonants select the front allomorph (see 30).

(29) Back consonants select [–u]

/tale[ʒ], {+u, +e}/	*Front/u	*e	*u
☞ a. tale[ʒ] + u			*
b. tale[ʒ] + e		*!	

(30) Front consonants select [–e]

/gra[f], {+u, +e}/	*Front/u	*e	*u
a. gra[f] + u	*!		*
☞ b. gra[f'] + je		*	

4.3 The role for contrast

Given the palatalization facts and the articulation of prepalatals, I assume that prepalatals followed by [-e] are unmarked (see 31). Thus, the allomorph [-u] after original prepalatals is unexpected (see 32). Given the markedness ranking so far, underlying prepalatals in (32) and derived prepalatals in (31) choose the [–e] suffix over the [-u] suffix.

(31) Derived prepalatals

/li[st], {+u, +e}/	*Front/u	*e	*u
a. li[st] + u	*!		*
☞ b. li[ɕtɕ] + e		*	

[18] *Front/u is a member of the family of no linkage constraints (see Ito, Mester & Padgett 1995). This preference is only active in allomorph selection. Both sequences surface when underlying: PC_{IN}(high/back/round) >> *Front/u.

(32) Underlying prepalatals – wrong result

/li[ɕtɕ], {+u, +e}/	*Front/u	*e	*u
a. li[ɕtɕ] + u	*!		*
☞ b. li[ɕtɕ] + e		*	

To ensure that derived and original prepalatals select different allomorphs, I propose that the constraint on contrast compels the marked allomorph [–u].

(33) The role of contrast

	Scenarios	PC_{IN}(high)	*Front/u
A. Contrast-preserving ☞	/li[st], {+e, +u}/ → li[ɕtɕ] + e /li[ɕtɕ], {+e, +u}/ → li[ɕtɕ] + u		*
B. Contrast-neutralizing	/li[st], (+e, +u}/ → li[ɕtɕ] + e /li[ɕtɕ], {+e, +u}/ → li[ɕtɕ] + e	*!	

Scenario A wins since it preserves the contrast between derived and original prepalatals despite choosing the marked allomorph [–u]. The marked allomorph retains the contrast between the two sets of prepalatals.

4.4 Conclusion

In summary, palatalization takes place but allomorphy preserves the contrast in height despite palatalization. Contrast preservation and the need to palatalize compel the marked allomorph after underlying prepalatals.

(34) Summary tableau

	Scenarios	PAL	PC_{IN}(high)	*Front/u
A. Contrast-neutralizing	/li[st], {+e, +u}/ → li[ɕtɕ] + e /li[ɕtɕ], {+e, +u}/ → li[ɕtɕ] + e		*!	
B. Contrast-preserving ☞	/li[st], {+e, +u}/ → li[ɕtɕ] + e /li[ɕtɕ], {+e, +u}/ → li[ɕtɕ] + u			*
C. Contrast-preserving	/li[st], {+e, +u}/ → li[st] + e /li[ɕtɕ], {+e, +u}/ → li[ɕtɕ] + e	*!		

(35) Summary ranking

PAL >> PC_{IN}(high) >> *Front/u >> *e >> *u

The key idea is that with different allomorphs in the locative for derived and underlying prepalatals, palatalization is non-neutralizing. The contrast in height is preserved despite palatalization. The ranking established so far is summarized below.

(36) Ranking established so far[19]

PAL
|
PC_{IN}(high)
|
*Front/u
|
*e
|
*u

4.5 Additional examples

There are other examples in Polish where allomorphy preserves the contrast between original prepalatals and underlying dental/alveolar consonants (for more examples of morpho-phonological allomorphy in Polish, see Gussmann 2007). The examples below illustrate contrast-preserving allomorphy in nominative plural of masculine non-personal inanimate nouns (see 37) and contrast-preserving allomorphy in nominative singular of neuter nouns (see 38). In both cases stems ending in underlying versus derived prepalatals take different suffixes.

(37) [–ɨ] vs. [–e] allomorphy (nom. plural of masculine non-personal inanimate nouns)

a. Non-palatals

underlying		*nominative* SG.	*nominative* PL.	*gloss*
t	:	bile[t]	bile[t] + ɨ	'ticket'
d	:	kod[t]	kod[d] + ɨ	'code'
n	:	dzwon[n]	dzwo[n] + ɨ	'bell'
s	:	interes[s]	intere[s] + ɨ	'business'
z	:	wó[s]	wo[z] + ɨ	'cart, wagon'

b. Original prepalatals

underlying		*nominative* SG.	*nominative* PL.	*gloss*
tɕ	:	liś[tɕ]	liś[tɕ] + e	'leaf'
dʑ	:	narzę[dʑ] + e	narzę[dʑ] + a	'tool'
ɲ	:	ko[ɲ]	ko[ɲ] + e	'horse'
ɕ	:	łoso[ɕ]	łoso[ɕ] + e	'salmon'
ʑ	:	pa[ɕ]	pa[ʑ] + e	'type of a butterfly'

(38) [–o] vs. [–e] allomorphy (nominative SG. of neuter nouns)

a. Non-palatals

underlying		*nominative* SG.	*gloss*
t	:	la[t] + o	'summer'
d	:	gniaz[d] + o	'nest'
n	:	ziar[n] + o	'seed'
s	:	mię[s] + o	'meat'
z	:	awi[z] + o	'notification, notice' (or awiz)

[19] For more discussion see Łubowicz (2012).

b. Original prepalatals

underlying		*nominative* SG.	*gloss*
tɕ	:	przejś[tɕ] + e	'passage'
dʑ	:	narzę[dʑ] + e	'tool'
ɲ	:	nasie[ɲ] + e	'seed'
ɕ	:	pro[ɕ] + ę	'young pig'
ʑ	:	podwo[ʑ] + e	'under-carriage'

Though the details of the distribution in the above examples differ from the leading example, they further support the observation that the height contrast is preserved in Polish morphophonology. That is stems that end in palatalized and non-palatalized consonants select different suffixes in nominative plural of masculine non-personal inanimate nouns (shown in 37) and in nominative singular of neuter nouns (shown in 38). [20]

These forms also contrast in the locative singular and follow the contrast-preserving pattern examined in the article. The nominative forms *la[t]* + ***o*** vs. *przejś[tɕ]* + ***e*** are realized in the locative singular as *o le[tɕ]* + ***e*** vs. *o przejś[tɕ]* + ***u***, respectively. The contrast preserving allomorphy in the locative singular of neuter nouns is given below.

(39) Locative singular of neuter nouns

a. Coronal palatalization

underlying		*nominative* SG.	*locative* SG.	*gloss*
t	:	la[t] + o	o le[tɕ] + e	'summer'
d	:	gniaz[d] + o	o gnieź[dʑ] + e	'nest'
n	:	ziar[n] + o	o ziar[ɲ] + e	'seed'
s	:	mię[s] + o	o mię[ɕ] + e	'meat'
z	:	awi[z] + o	o awi[ʑ] + e	'notification'

b. Original prepalatals

underlying		*nominative* SG.	*locative* SG.	*gloss*
tɕ	:	przejś[tɕ] + e	o przejś[tɕ] + u	'passage'
dʑ	:	narzę[dʑ] + e	o narzę[dʑ] + u	'tool'
ɲ	:	nasie[ɲ] + e	o nasie[ɲ] + u	'seed'
ɕ	:	pro[ɕ] + ę	o pro[ɕ] + u	'young pig'
ʑ	:	podwo[ʑ] + e	o podwo[ʑ] + u	'under-carriage'

This data opens avenues for future research into other aspects of Polish morphophonology.[21]

[20] The –o/-e allomorphy in (38) offers another option of preserving contrast. As suggested by an anonymous reviewer, an alternative way to preserve contrast to the actual scenario *la[t]* + *o* vs. *przejś[tɕ]* + *e* would be a scenario with the same back vowel suffix –o, *la[t]* + *o* vs. *przejś[tɕ]* + *o*. Both scenarios satisfy palatalization and preserve contrast in height. The only difference between them is the output well-formedness, *przejś[tɕ]* + *e* vs. *przejś[tɕ]* + *o* with the initial form being more optimal in Polish morphophonology.

[21] As pointed out by an anonymous reviewer, some front vowel suffixes in Polish are contrast neutralizing. For example, the diminutive suffix /+ek/ has both a palatalizing and a non-palatalizing version, such as *li[st]* becomes *li[ɕtɕ]* + *ik* (palatalizing diminutive) while *mo[st]* becomes *mo[st]* + *ek* (non-palatalizing diminutive). One way to account for these facts is to assume that there are two diminutive suffixes in Polish in the input, one palatalizing and one non-palatalizing (Rubach 1984: 186) and thus the difference in the realization of the stem final consonants. An alternative is to consider a complex morphological structure of this suffix (Gussmann 2007: 145). The diminutive suffix also depalatalizes the stem final consonant where underlying stem final prepalatal *li[ɕtɕ]* becomes *li[st]* + *ek* and thus neutralizes with underlying non-palatal consonants *mo[st] mo[st]* + *ek*. PC theory does not rule out contrast neutralizing scenarios when other constraints are ranked higher than the PC_{IN}(high) constraint. I leave the analysis of diminutives for future work. It is worth noting that the contrast between *li[ɕtɕ]* vs. *li[st]* is preserved in the diminutive, *list* + *ek vs. liɕtɕ* + *ik*, respectively.

5 The typology

The observation so far is that the grammar maintains contrast that the regular phonology would otherwise neutralize. Underlying prepalatals take the [–u] allomorph while derived prepalatals take the [–e] allomorph. But there are other scenarios that need to be considered. We need to ensure that under the analysis the actual scenario wins over other competitors.[22]

5.1 Other scenarios

Formally, considering the two inputs, /list/ vs. /liɕtɕ/, and the two allomorphs {+e, +u}, there are 16 logical scenarios to consider. These are shown below. The actual scenario is number (i) and is represented in a bold box. I divide the scenarios into contrast-preserving and contrast-neutralizing.

(40) Logical scenarios

Contrast-preserving scenarios			
(i)	/list, {+e, +u}/ → liɕtɕ + e /liɕtɕ, {+e, +u}/ → liɕtɕ + u	(ix)	/list, {+e, +u}/ → liɕtɕ + u /liɕtɕ, {+e, +u}/ → liɕtɕ + e
(ii)	/list, {+e, +u}/ → list + u /liɕtɕ, {+e, +u}/ → liɕtɕ + e	(x)	/list, {+e, +u}/ → liɕtɕ + e /liɕtɕ, {+e, +u}/ → list + u
(iii)	/list, {+e, +u}/ → list + u /liɕtɕ, {+e, +u}/ → liɕtɕ + u	(xi)	/list, {+e, +u}/ → liɕtɕ + u /liɕtɕ, {+e, +u}/ → list + u
(iv)	/list, {+e, +u}/ → list + e /liɕtɕ, {+e, +u}/ → liɕtɕ + e	(xii)	/list, {+e, +u}/ → liɕtɕ + e /liɕtɕ, {+e, +u}/ → list + e
(v)	/list, {+e, +u}/ → list + u /liɕtɕ, {+e, +u}/ → list + e	(xiii)	/list, {+e, +u}/ → list + e /liɕtɕ, {+e, +u}/ → list + u
(vi)	/list, {+e, +u}/ → list + e /liɕtɕ, {+e, +u}/ → liɕtɕ + u	(xiv)	/list, {+e, +u}/ → liɕtɕ + u /liɕtɕ, {+e, +u}/ → list + e
Contrast-neutralizing scenarios			
(vii)	/list, {+e, +u}/ → liɕtɕ + e /liɕtɕ, {+e, +u}/ → liɕtɕ + e	(xv)	/list, {+e, +u}/ → list + e /liɕtɕ, {+e, +u}/ → list + e
(viii)	/list, {+e, +u}/ → list + u /liɕtɕ, {+e, +u}/ → list + u	(xvi)	/list, {+e, +u}/ → liɕtɕ + u /liɕtɕ, {+e, +u}/ → liɕtɕ + u

The scenarios represent various mapping coexistence patterns. They have the same inputs but differ on the set of outputs (compare (i) and (vii)) and/or input-output relations

[22] I would like to thank an anonymous reviewer for raising the question of other competing scenarios.

(compare (i) and (ix)). Scenario (i) is the actual scenario in Polish where the two inputs take different allomorphs. Scenario (vii), on the other hand, represents a language where both inputs take the same allomorph [–e].

Some scenarios are eliminated, given the constraint ranking established so far. Any scenario that does not palatalize is ruled out. This rules out scenarios (iv)-(vi), (xii)-(xiv), and (xv). Also, any scenario that neutralizes the height contrast is ruled out. That rules out scenarios (vii), (viii), (xv), and (xvi). These are the shaded scenarios. We are left with 6 scenarios to consider. The remaining contrast-preserving scenarios are given below.

(41) Remaining contrast-preserving scenarios

(i) Actual	/list, {+e, +u}/ → liɕtɕ + e /liɕtɕ {+e, +u}/ → liɕtɕ + u	(ix)	/list, {+e, +u}/ → liɕtɕ + u /liɕtɕ, {+e, +u}/ → liɕtɕ + e
(ii)	/list, {+e, +u}/ → list + u /liɕtɕ, {+e, +u}/ → liɕtɕ + e	(x)	/list, {+e, +u}/ → liɕtɕ + e /liɕtɕ, {+e, +u}/ → list + u
(iii)	/list, {+e, +u}/ → list + u /liɕtɕ, {+e, +u}/ → liɕtɕ + u	(xi)	/list, {+e, +u}/ → liɕtɕ + u /liɕtɕ, {+e, +u}/ → list + u

All the scenarios given above satisfy PAL and PC_{IN}(high). They differ, however, on how contrast is actually preserved.

Contrast-preserving scenarios (ii), (iii), (x), and (xi) differ from the actual scenario on the set of outputs. While the actual scenario contains a prepalatal followed by the back vowel [u], the other four scenarios contain an alveolar followed by [u]. It has been shown that allomorphs in the locative are distributed on the front-back dimension where front consonants take the front allomorph and back consonants take the back allomorph. This fact is expressed by a contextual markedness constraint *Front/u. The difference between the actual scenario and the other competing scenarios above argues that consonants which are classified as front, such as alveolars and prepalatals, need to be further differentiated. In this case, I propose that the contextual markedness constraint *Front/u is divided into *Alveolar/u and *Prepalatal/u, where *Alveolar/u dominates *Prepalatal/u. It is worse for the alveolar consonant to be followed by [u] than for the prepalatal. The alveolar is more front than the prepalatal and thus more different in place of articulation from the back vowel. The ranking is given below:

(42) The scale of "frontness"

*Alveolar/u >> *Prepalatal/u[23]

The consequence of this ranking is that the Alveolar/u sequence is less optimal than the sequence of Prepalatal/u. This is illustrated below. I compare the actual scenario to a competing scenario with a more marked output.

[23] An alternative would be to have a specific constraint *Alveolar/u outranking *Front/u.

(43) The role for markedness

		PAL	PC_{IN}(high)	*Alveolar/u	*Prepalatal/u
(i)	/list, {+e, +u}/ → liçtç + e				*
☞	/liçtç, {+e, +u}/ → liçtç + u				
(ii)	/list, {+e, +u}/ → list + u			*!	
	/liçtç, {+e, +u}/ → liçtç + e				

The actual scenario, scenario (i), wins since it contains a less marked output.

5.2 The role of recoverability

We are left with one more scenario to consider, scenario (ix) – the so-called permuted scenario – where derived prepalatals take the [–u] allomorph while underlying palatals take the [–e] allomorph. It cannot be ruled out based on PC and markedness constraints alone. The permuted scenario has the same set of outputs as the actual scenario but outputs are permuted with respect to corresponding inputs.

(44) Permuted scenario (cf. 41 ix)
/list, {+e, +u}/ → liçtç + u
/liçtç, {+e, +u}/ → liçtç + e

(45) Actual scenario (cf. 41 i)
/list, {+e, +u}/ → liçtç + e
/liçtç, {+e, +u}/ → liçtç + u

Both scenarios satisfy markedness and contrast equally.

(46) A tie between scenarios

	Scenarios	PAL	PC_{IN}(high)	*Front/u
A. Permuted	/list, {+e, +u}/ → liçtç + u			*
	/liçtç, {+e, +u}/ → liçtç + e			
B. Actual	/list, {+e, +u}/ → liçtç + e			*
	/liçtç, {+e, +u}/ → liçtç + u			

To break the tie, PC theory posits constraints on the recoverability of input contrasts from the way contrasts are represented in the output. Recoverability constraints do not directly conflict with PC constraints and markedness constraints and thus it is proposed that they belong to the second stage of *Eval* after PC and markedness constraints apply. They choose a scenario which is "more recoverable" – where the input contrast can be read off from the distribution of contrasts in the output.[24]

[24] Formally, recoverability constraints could be included in the same stage of evaluation as PC and markedness constraints. However, recoverability constraints act more like a filter on the candidate set or a tie breaker and thus it is proposed that they are evaluated after PC and markedness constraints apply and trim the candidate set. Another consequence of the proposed two-stage evaluation of scenarios is that it illustrates that a PC alone approach is not enough to effectively evaluate scenarios. I would like to thank an anonymous reviewer for comments on this point.

(47) RECOVER(P)
Let a pair of inputs in_a and in_b minimally contrast in P and corresponding outputs minimally contrast in P', where P and P' refer to the same feature cue[25], if in_a has P and in_b lacks P, then out_a has P' and out_b lacks P'.
"The minimal input contrast in *P* needs to be preserved in the output in the same direction."

In Polish, this constraint demands that the higher the input stem-final consonant, the higher the suffix. Thus, given the set of two allomorphs [–u] and [–e], the form with a stem-final prepalatal should select [–u] while the form with a stem-final alveolar should select [–e].

(48) RECOVER (high)
Let a pair of inputs in_a and in_b minimally contrast in [+/– high] and corresponding outputs minimally contrast in u~e, if in_a is [+high] and in_b is [–high], then out_a has [–u] and out_b has [–e].
"The minimal input contrast in *height* needs to be preserved in the output in the same direction."

The recoverability constraint is illustrated in the following tableau.

(49) The role of RECOVER

		PAL	PC_{IN}(high)	*Front/u	RECOVER(high)
A.	/list, {+e, +u}/ → liɕtɕ+ e			*	
☞	/liɕtɕ, {+e, +u}/ → liɕtɕ + u				
B.	/list, {+e, +u}/ → liɕtɕ + u			*	*!
	/liɕtɕ, {+e, +u}/ → liɕtɕ + e				

Scenario B loses since in this scenario the height contrast is permuted and thus violates the constraint RECOVER(high). Scenario A satisfies the recoverability constraint and thus emerges as the winner.

This has parallels to a feature movement approach where the relevant feature is preserved from the input in the output but displaced from its original position. Feature movement is traditionally captured with MAX(feature) constraints (Lombardi 2001). In a feature movement approach, contrast can only be preserved by the same feature as in the input while in a contrast preservation account other representations of contrast are possible. The properties evaluated by recoverability are determined in stage 1 of Eval.

5.3 Summary ranking

The ranking is summarized below.

[25] In this definition, P and P' refer to the same feature cue. That is, they belong to the set of cues associated with the same feature. As pointed out by a reviewer, this is necessary to prevent arbitrary relationships between features in the input and output.

(50) Full ranking[26]

PAL
|
PC_{IN}(high)
|
*Alveolar/u
|
*Prepalatal/u
|
*e
|
*u

Second stage of Eval: RECOVER(high)

Under this proposal, allomorph distribution follows from the principle of contrast and morphological markedness. The constraint on contrast, PC_{IN}(high), together with a markedness constraint, PAL, force original prepalatals to take a different allomorph than underlying prepalatals. In consequence, allomorphy retains distinctions that would otherwise be neutralized in the output.[27]

6 Comparison with previous approaches

In the account of allomorphy formulated in this article, contrast in addition to markedness determines allomorph distribution. As a result, PC theory predicts the kinds of allomorphy that are not admitted by other approaches. It also restricts allomorphy generated by other approaches. Below I will consider three approaches to allomorphy, a so-called markedness-only approach, a subcategorization approach and Harmonic Serialism, and compare them to the PC approach outlined in this article.

In *markedness-only approaches* (see refs. in section 2), allomorphs are distributed based on the properties of the output alone. Thus, opaque allomorphy is not admitted. In PC theory, on the other hand, contrast and markedness determine allomorph distribution. Through the use of contrast, PC theory admits opaque allomorphy which cannot be accounted for in markedness-only terms. In addition, it predicts the kinds of allomorphy that are predicted by markedness-only approaches since markedness is also present in allomorph selection.

In a *subcategorization approach* (Booij & Lieber 1993; Paster 2005; Gussmann 2007), allomorph distribution is accounted for by subcategorization rules that assign allomorphs based on the properties of the input. There are no limits on possible subcategorization rules and thus there are no limits on possible kinds of allomorphy predicted to occur. Unlike the subcategorization approach, PC theory is significantly more restrictive. There are restrictions on the possible distribution of allomorphs since these patterns should fall out from universal constraints on markedness and contrast.[28]

[26] Other dominance relations include PC_{IN}(high) >> *[+high, –back] (ensures the contrast between prepalatals and palatals in Polish) and PC_{IN}(back), PC_{IN}(round) >> *Front/u (ensures that vowels don't change to preserve contrast).

[27] The proposal as presented does not directly extend to the cases discussed in section 4.5. Thanks to a reviewer for pointing it out.

[28] There are instances where allomorph distribution is simply not predictable from surface facts including markedness and PC and those cases would have to be listed in the lexicon. Those instances would be lexically specified rather than predicted by the phonology. PC theory, however, would apply to cases where

A more recent approach to phonology-morphology interface is *Harmonic Serialism* (Wolf 2008; Nevins 2011; Kurisu 2012). This approach is very different from the approach proposed here. The reader is referred to McCarthy & Pater (2016) for more discussion of Harmonic Serialism and its applications. A serial approach to be successful in Polish would require that [list] and [liɕtɕ] are assigned different allomorphs in Step 1 of the derivation, where /list/ is assigned [–e] while /liɕtɕ/ is assigned [–u]. Subsequently, palatalization would apply and change /list + e/ to [liɕtɕ + e]. As a result, these stems would look different on the surface, [liɕtɕ + e] vs. [liɕtɕ + u], respectively. Given the discussion in this paper, however, both stems end in front consonants (see section 4.3) and thus both should be assigned the same suffix [–e] by morphology. This is due to the markedness constraint *Front/u (see 27) which is subdivided into *Alveolar/u (**tu*) over *Prepalatal/u (**tɕu*) (see 42). The proposed contextual markedness constraint ensures that the selection of the suffix [–u] by a stem ending in a pre-palatal does not take place. This is shown below. Both the alveolar stem in (52) and the prepalatal stem in (53) select [–e] in Step 1 of the derivation.

(52) Alveolar final stem – 'letter'

a. Step 1: Allomorph selection

/list,{ + e, + u}/	*tu	*te	*tɕu	*tɕe
a. ☞ list + e		*		
b. list + u	*!			

b. Step 2: Palatalization takes place

list + e	*tu	*te	*tɕu	*tɕe
a. ☞ liɕtɕ + e				*
b. list + e		*!		

c. Step 3: Convergence

liɕtɕ + e	*tu	*te	*tɕu	*tɕe
a. ☞ liɕtɕ + e				*
b. list + e		*!		

(53) Prepalatal final stem – 'leaf'

a. Step 1: Allomorph selection (wrong result)

/liɕtɕ,{ + e, + u}/	*tu	*te	*tɕu	*tɕe
a. ☜ liɕtɕ + e				*
b. liɕtɕ + u			*!	

allomorphy is semantically based but it would necessitate further developments in the theory. Some examples of semantically-based allomorphy in Polish include *król – król + a* vs. *ból – ból + u*. I would like to thank an anonymous reviewer for comments on this point.

b. Step 2: Convergence

liɕtɕ + e	*tu	*te	*tɕu	*tɕe
a. ☜ liɕtɕ + e				*
b. list + e		*!		

As shown above, since both stems are predicted to select [–e], the stem ending in original prepalatals results in the wrong output *[liɕtɕ + e] instead of the correct [liɕtɕ + u] see (53). To be able to account for Polish opaque allomorphy, Harmonic Serialism would have to assign two different suffixes to stems ending in non-palatals versus prepalatals in Step 1 and thus preserve contrast between the two forms in the output.[29]

7 Conclusion

This article offers new insights into the morphophonology of Polish palatalization through the lense of contrast preservation. It accounts for allomorphy in Polish Coronal Palatalization based on the analysis of the locative of masculine and neuter nouns. It shows that locative allomorph distribution is opaque and can be accounted for in terms of preserving contrast between forms with original and derived pre-palatals.

The key idea is that the different allomorphs of the locative suffix keep apart forms that the regular phonology would otherwise neutralize due to Coronal Palatalization. Under this proposal, allomorph distribution follows from the principle of contrast preservation and markedness. The same analysis also extends to Polish allomorphy in the vocative of masculine nouns and dative and locative of feminine nouns, examples of which were given in section 2.

Abbreviations

ROA = Rutgers Optimality Archive (http://roa.rutgers.edu).

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Competing Interests

The authors declare that she has no competing interests.

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