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***HYDRA, Nasality and Palatalization in Polish**[1]

Abstract

The paper proposes that the phonological make-up of segments is influenced by the activity of the constraint *HYDRA, which penalizes the presence of more than one headed element per one phonological expression. *HYDRA influences the shape of the inventories and the phonological behaviour of nasal vowels in languages such as French and Brazilian Portuguese. At the same time, the behaviour of nasal vowels in Yoruba shows that *HYDRA is a violable constraint. In Polish, the high ranking of *HYDRA proves necessary to account for the absence of Surface Velar Palatalization before the front nasal vowel /ɛ̃/. It also allows us to formulate a unified account of the 1st Velar and Anterior Palatalization, which have very different structural descriptions but take place before the same set of derivational affixes.

Keywords

Element Theory, Optimality Theory, headedness, palatalization, nasalization

Streszczenie

Artykuł postuluje, iż kształt reprezentacji segmentów mowy w językach świata jest regulowany przez aktywność zasady *HYDRA, która wskazuje jako nacechowane takie reprezentacje segmentalne, w których więcej niż jeden element pełni funkcję elementu nadrzędnego. W artykule wykazujemy, iż w językach takich jak francuski czy portugalski zasada *HYDRA ma decydujący wpływ zarówno na kształt inwentarza samogłosek nosowych, jak i na wyniki pewnych procesów fonologicznych. Równocześnie zachowanie samogłosek nosowych w języku joruba wskazuje na nieabsolutną naturę

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zasady *HYDRA. W języku polskim aktywność tej zasady jest niezbędna do zrozumienia zjawiska braku zmiękczenia spółgłosek tylnojęzykowych w kontekście samogłoski nosowej /ɛ̃/ oraz mechanizmów odpowiedzialnych za fakt, iż morfonologiczne zmiękczenia spółgłosek tylnojęzykowych, wargowych i zębowych mają miejsce w kontekście tych samych przyrostków słowotwórczych.

Słowa kluczowe

teoria elementów, teoria optymalności, elementy nadrzędne, palatalizacja, nazalizacja

1. Introduction

Element headedness, employed in Element Theory-based analyses since the 1990s, assumes the privileged acoustic and phonological status of some elements. The early works assumed the existence of the licensing relation between the headed elements and operator elements. The licensing relations between heads and operators were formulated in terms of licensing constraints: inviolable constraints, which regulated the shape of lexical representations of segments as well as the outputs of phonological processes (see Charette, Göksel 1996, 1998; Ploch 1999; Kaye 2001; Charette forthcoming). Importantly, these approaches assumed that only one element in the phonological make-up of a segment functions as the head, the other elements obligatorily functioning as operators.

Backley's (2011) proposal is a prominent alternative to the head-licenser approach and assumes (i) that elements have cross-linguistically stable phonetic interpretations, which depend on their status as headed or non-headed, and (ii) that more than one element in a given segment may have the status of the head. In fact, in Backley's approach there are no constraints on the number of headed elements per one segment. It may be the case that all the elements in a given segment enjoy the status of the head.

The approach postulated in this study takes the middle ground between the approaches outlined above. It is argued that although more than one element may play the role of the head in a single phonological expression, the presence of more than one head is marked and provokes the violation of constraint *HYDRA.

Given that nasal vowels contain element |L|-head (see Ploch 1999; Breit 2017), the high ranking of *HYDRA influences the sizes of the nasal vowel inventories by preventing other elements from functioning as headed. French and Portuguese are argued to be such languages. In addition, the high ranking of *HYDRA contributes to the raising of the stressed nasalized vowel /a/ in Brazilian Portuguese.

At the same time, the details of the process of vowel harmony and nasal stability facts in Yoruba testify to the violable nature of *HYDRA.

In Polish, the high ranking of *HYDRA accounts for the absence of Surface Velar Palatalization before the front nasal vowel /ɛ̃/. Since palatalization is obligatorily accompanied by the promotion of element |I| in the vowel to the status of the head, the palatalization by a nasal (i.e. |L|-headed) vowel would result in the violation of *HYDRA.

In addition, the assumption concerning the marked status of doubly-headed expressions allows one to formulate a unified element-based analysis of the 1st Velar and Anterior Palatalization. The two processes are derived by the integration of an autosegmental Place node headed by elements |A| and |I| into the structure of the stem-final velars, dentals and labials.

Section 2.1 introduces the key facts concerning Element Theory and the notion of element headedness. Section 2.2 presents the proposal concerning the elemental representations of Polish consonants and vowels, while section 2.3 summarizes the main assumptions of the Two-Level Containment approach (Zimmermann, Trommer 2016). Sections 3.1-3.3 provides the cross-linguistic evidence for the availability and the violable nature of constraint *HYDRA. Sections 4.1 and 4.2 contain the analyses of the non-palatalization of velars before /ɛ̃/ as well as the 1st Velar and Anterior Palatalization. Section 5 concludes the article.

2. Theoretical preliminaries

2.1. Element Theory and element headedness

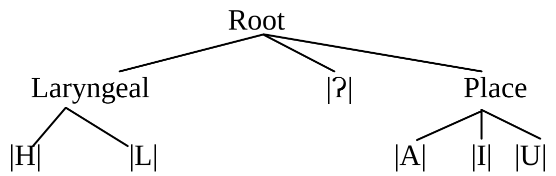
Element Theory (see Kaye, Lowenstamm, Vergnaud 1985; Harris 1994; Harris, Lindsay 1995; Backley 2011; Gussmann 2007; Cyran 2010, 2014 for Polish) assumes that segments constitute sets of monovalent primes called elements. Elements are cognitive primes as their primary role is to encode phonologically relevant distinctions between segments. Elements are extracted from and mapped onto certain acoustic patterns produced by the speakers. The acoustic correlates of elements together with their articulatory execution are summarized in (1) after Harris (1994), Harris and Lindsay (1995) as well as Backley (2011).

(1)

Element	Acoustic correlate	Exemplary articulatory execution
A	high F1, low F2, formant transitions typical of coronal/guttural consonants	maximal expansion of oral tube, maximal constriction of pharyngeal tube, articulation involving tongue tip and/or blade etc.
I	low F1, High F2, formant transitions typical of palatal/post-alveolar consonants	maximal constriction of oral tube, maximal expansion of pharyngeal tube, articulation involving tongue front, body of the tongue moved forward etc.
U	low F1, low F2, formant transition typical of labial consonants	trade-off between the expansion of the oral and pharyngeal tube, lip rounding, activity of the back of the tongue etc.
ʔ	abrupt and sustained drop in amplitude	blockage of airflow
L	low fundamental frequency, broad resonance peak at the lower end of the frequency range, negative VOT	slack vocal folds, lowered velum
H	high fundamental frequency, VOT lag	stiff vocal folds

Elements are geometrically arranged into a subsegmental structure presented in (2) and adopted from Harris (1994: 129).

(2)



It is assumed that a given element may play the role of a head or of an operator. Being a head, as opposed to an operator, is typically correlated with greater acoustic prominence, typological markedness and greater resistance to deletion (see Backley 2011). By convention, elements that function as heads are underlined.

In the earlier analyses, the head-operator asymmetry was conceived of as a licensing relation, where the head element was the licenser and the operator elements were licensed. Whether particular elements could play the role of the head and license operators was defined by a set of inviolable licensing constraints. (3) illustrates the two licensing constraints proposed in Charette and Göksel (1996, 1998) for Turkish.

(3)

a. A is not a licenser

b. U must be head

Constraints (3) correctly derive the set of complex phonological expressions that form the vocalic system of Turkish presented in (4) and, at the same time, account for certain facts concerning the vowel harmony in the language.

(4) Turkish vowels (Charette, Göksel 1998: 74)

a. i {I}	c. ü {I.<u>U</u>}	e. u {<u>U</u>}	g. ı {_}
b. e {A.<u>I</u>}	d. ö {I.A.<u>U</u>}	f. o {A.<u>U</u>}	h. a {<u>A</u>}

Charette and Göksel assumed that (i) vowel harmony involves element |U|-head licensing itself in the target position, (ii) elements do not switch their lexical head/operator status in Turkish, and (iii) only one element may be the head in a phonological expression. These assumption and the licensing constraints in (3), allow their approach to correctly predict the impossibility of element |U|-head to spread onto the vowel /a/ (4h), to derive a back rounded vowel /o/.

Backley's (2011) version of Element Theory dispenses with the licensing relation between heads and operators and assumes that headedness influences the phonetic interpretation of elements. Importantly, for Backley (2011) more than one element may play the role of the head in a phonological expression. Consequently, certain segments are composed only of headed elements. For example, a high peripheral high-toned vowel /í/ is represented as elements |I|-head, realized as close front vocalic resonance, and |H|-head (high tone), i.e. $\{\underline{\mathrm{I}}.\underline{\mathrm{H}}\}$. Similarly, a bilabial implosive consonant /ɓ/ is represented as $\{\underline{\mathrm{U}},\underline{\mathrm{ʔ}}.\underline{\mathrm{L}}\}$, where the headed |U| defines labial resonance, the headed |ʔ| is interpreted as the glottalic release phase found in implosives, while |L|-head represents voicedness.

The position taken in this work is that, although some languages allow for more than one headed element per segment, such segments are treated by the grammar as marked.

2.2. Element Theory and the phonological system of Polish

In Polish, element headedness is employed to express the contrast between the peripheral front high vowel /i/, represented with the headed element $|\underline{\mathrm{I}}|$, and the centralized /ɨ/, represented as a non-headed structure possessing element |I|-operator (see e.g. Gussmann 2007: 43).

This distinction has important consequences for the phonotactics of the language. The vowel /i/ is found in Polish only after palato-labials, prepalatals, palato-velars, the semi-vowel /j/ and the lateral /l/. Given these facts, it seems natural to assume that palato-labials, prepalatals, palato-velars, /j/ and /l/ as well as the vowel /i/ must all be |I|-headed segments. I take the distinction between the |I|-headed and non-|I|-headed consonants to be the major distinction cross-classifying the system of Polish consonants.

(5) summarizes the elemental make-up of Polish consonants proposed in this work. The segments which do not constitute part of the underlying system of Polish are represented in square brackets ([…]).

(5)

labials	/p/-{U.ʔ.H}	/b/-{U.ʔ.H.L}	/f/-{U.H}	/v/-{U.H.L}	/m/-{U.ʔ.L}
palato-labials	/pʲ/-{U.<u>I</u>.ʔ}	/bʲ/-{U.<u>I</u>.ʔ.H.L}	/fʲ/-{U.<u>I</u>.H}	/vʲ/-{U.<u>I</u>.H.L}	/mʲ/-{U.<u>I</u>.ʔ.L}
dentals	/t/-{A.ʔ.H}	/d/-{A.ʔ.H.L}	/s/-{A.H}	/z/-{A.H.L}	/n/-{A.ʔ.L}
dental affricates	/t͡s/-{A.I.ʔ.H}	/d͡z/-{A.I.ʔ.H.L}			
alveolars/ retroflexes	/t͡ʂ/-{<u>A</u>.I.H.ʔ}	/d͡ʐ/-{<u>A</u>.I.ʔ.H.L}	/ʂ/-{<u>A</u>.I.H}	/ʐ/-{<u>A</u>.I.H.L}	
prepalatals	/t͡ɕ/-{A.<u>I</u>.H.ʔ}	/d͡ʑ/-{A.<u>I</u>.ʔ.H.L}	/ɕ/-{A.<u>I</u>.H}	/ʑ/ - {A.<u>I</u>.H.L}	/ɲ/-{A.<u>I</u>.ʔ.L}
velars	/k/-{_.ʔ.H}	/g/-{_.ʔ.H.L}	/x/-{_.H}	/ŋ/-{_.ʔ.L}	
palato-velars	[c]-{<u>I</u>.ʔ.H}	[ɟ]-{<u>I</u>.ʔ.H.L}	[ç]-{<u>I</u>.H}		
sonorants	/r/-{A}	[w] = {U}	/l/-{A.<u>I</u>.ʔ}	/ł/-{A.U.ʔ}	/j/-{<u>I</u>}

Apart from distinguishing between the soft, i.e. I-headed, and hard, i.e. non-I-headed consonants, headedness is employed in (5) to represent the distinction between the place of articulation of dental affricates /t͡s/ and /d͡z/ and the retroflex affricates and fricatives /t͡ʂ/, /d͡ʐ/, /ʂ/ and /ʐ/. Since the latter have been extensively argued to be retroflexes (see Lorenc 2018 and references found there) and since Backley (2011: 92) analyses retroflexes as |A|-headed, I take /t͡ʂ/, /d͡ʐ/, /ʂ/ and /ʐ/ to be |A|-headed consonants.

The current study follows Nasukawa and Backley (2008) and Backley (2011) who analyse affricates as plosives with complex resonance or place specification, which must involve a prolonged burst in order to help the listener recover the cues that allow them to identify the place of articulation of the segment.

(6) contains the postulated representations of Polish vowels.

(6)

Vowel	Representation	Examples	Glosses
/i/	{<u>I</u>}	/i/*gła, l*/i/*tr, dług*/i/	‘needle’, ‘litre’, ‘long’
/ɨ/	{I}	*r*/ɨ/*ba, t*/ɨ/*p*	‘fish’, ‘type’

/ɛ/	{I.A}	*t*/ɛ/*n, s*/ɛ/r,	‘this’, ‘cheese’,
[e]	{I̲.A}	*si*[e]*rp, ki*[e]*dy*	‘sickle’, ‘when’
/a/	{A}	*t*/a/*ma, cz*/a/*s*	‘dam’, ‘time’
/ɔ/	{U.A}	*r*/ɔ/*k*, /ɔ/*ko*	‘year’, ‘eye’
/u/	{U}	*n*/u/*ta, c*/u/*d*	‘note’, ‘miracle’
/ɛ̃/	{I.A.L̲}	*k*/ɛ̃/*s*, /ɛ̃/*zym, rz*/ɛ̃/*sa*	‘bit’, ‘enzyme, ‘eyelash’
/ɔ̃/	{U.A.L̲}	*w*/ɔ̃/*ż, s*/ɔ̃/	‘snake’, ‘they are’

Polish nasal vowels are represented with element |L|-head. The headed status of the front high vowel /i/ has been justified above.[2] The fourth headed object is the raised allophone of the front mid vowel /ɛ/, i.e. [e].

The close-mid front vowel is the output of the process of vowel raising which affects Polish vowels after soft (i.e. |I|-headed) consonants. Although the process of vowel raising after soft consonants has been included in most descriptions of the phonetic system of Polish (see e.g. Wierzchowska 1980; Sawicka 1995; Wiśniewski 2000), it has not figured very prominently in the phonological analyses of the language.[3] The analysis presented in section 4, shows that the front mid vowel raising is a necessary corollary of the process of Surface Velar Palatalization (SVP) to the extent that the blocking of vowel raising leads to the blocking of SVP.

Below I discuss some more particular aspects of the element-based representations of Polish consonants and vowels.

2.2.1. The representation of velars

In (5), velars are unspecified for resonance elements (for that purpose I use the underlining notation: ‘_’). This stands in opposition to the approach promoted in Backley (2011), where velar consonants are represented with non-headed element |U|.

In fact, the assumption that velars are represented as unspecified for place is not new in the phonological literature. Many arguments supporting the claim that the velar place of articulation is the phonetic realization of non-specified place nodes can be found in Rice (1996). Rice (1996) refers to

[2] This paper assumes that the vowels /i/ and /ɨ/ are both part of the underlying inventory of the language (for the most recent discussion of the underlying status of /ɨ/ see Rydzewski 2016).

[3] See, however, Ćavar (2004, 2007), who encodes the distinction between /e/ and /ɛ/ by means of the feature [+/-ATR].

Czaykowska-Higgins (1992), who postulates the existence of two classes of nasal consonants in Polish: one of the two classes possesses fully specified Place nodes, which may be lexically marked as palatal, labial or coronal. The other class is underspecified for place and obtains it in the course of phonological derivation. Rice claims that the underspecified nasals which end up with the velar place of articulation do so as a result of the interpretation of the bare Place node.

In Element Theory literature, representing Polish velars as not equipped with resonance elements is an established practice. Gussmann (2007) and Cyran (2010) assume exactly that.

In sum, I follow the established analyses of Polish velars presented in Rice (1996) as well as Gussmann (2007) and Cyran (2010) and treat velar place of articulation as the realization of the unspecified Place node.

2.2.2. The realization of element |L|

The second aspect of the representations in (5-6) which has to be addressed in detail is the assignment of the headed and non-headed status to the nasality/low tone element |L|. The representations postulated above conform to the established tradition of encoding the nasality and voicing in obstruents by means of the same prime: the 'low tone' |L| (see Ploch 1999, 2000, and Nasukawa 1998, 2005). The Element Theory literature is much less uniform when it comes to the assignment of the head-operator status to the element |L|, depending on whether it defines nasality or voicedness/low tone. Ploch claims that the |L| that represents voicing should be treated as the head in consonants and that nasal consonants should be represented with |L|-operator. At the same time, he claims that the nasality should be treated as |L|-head in vowels. Backley (2011) treats nasality as non-headed |L| in both consonants and vowels, while Breit (2017) argues for the headed status of nasality in consonants and vowels.

This study proposes that consonants in Polish possess only element |L|-operator and that the externalization of |L| as voicing or nasality is regulated by the interpretational conventions in (7).

(7) Phonetic interpretation of element |L| in consonants

(a) |L| → voicing / {H....}

(b) |L| → nasality / elsewhere

The convention (7a) says that element |L| is realized as the phonetic category ‘voicing’ if it co-occurs with the element |H|, which defines the class of obstruents. Elsewhere, it is realized as nasal resonance (7b). Given the conventions in (7), it is not necessary to postulate the lexical headed/headless distinction for element |L| as its phonetic realization is fully predictable in consonants. The idea of the context-dependent interpretation of element |L| is not new and has already been postulated in Botma (2004: ch.1), where |L| was claimed to be interpreted as nasality or voicing, depending on the manner specification.[4]

Some arguments in favour of the treatment of element |L| as headed in nasal vowels come from the behaviour of this class of vowels in French. The vowels of the standard dialect of the north of France (NF) described in Féry (2003) are presented in (8) together with their proposed ET representations. The vowels placed in brackets are found only in a subset of speakers.

(8) The vocalic system of Northern French (based on Féry 2003)

/i/ - {$\underline{\text{I}}$}, /y/ - {$\underline{\text{I}}$.U}   /u/- {$\underline{\text{U}}$}

/e/ - {$\underline{\text{I}}$.A}, /ø/-{$\underline{\text{I}}$.A.U}   /o/ - {$\underline{\text{U}}$.A}

/ə/ - {_}

/ɛ/ - {I.A}, /ɛ̃/ - {I.A.$\underline{\text{L}}$}   /ɔ/ - {U.A}, /ɔ̃/ - {U.A.$\underline{\text{L}}$}

/œ/ - {I.A.U}, (/œ̃/ - {I.A.U.$\underline{\text{L}}$})

/a/ - {$\underline{\text{A}}$}, /ɑ̃/ - {A.$\underline{\text{L}}$} (/ɑ/ - {A})

[4] I do not wish to claim that element |L| never appears as a head in consonants. Rather this situation is the peculiarity of element |L| in Polish (and perhaps some other languages). Two facts point to the conclusion that the conventions in (7) are not universal. Firstly, there are languages in which nasals and voiced obstruents occur in free variation and for which conventions (7) are inadequate, e.g. Central Rotokas (see Firchow, Firchow 1969). Secondly, some languages, e.g. Burmese and Jalapa Mazatec, possess voiceless nasals, represented with elements |L| and |H| (see Backley 2011: 150).

According to Féry (2003) tense and nasal vowels in NF are bimoraic, while lax vowels are monomoraic. Given the moraicity of coda consonants and the strict requirement for syllables to be maximally bimoraic, tense and nasal vowels are found only before consonantal clusters syllabified as onsets of defective, nucleusless syllables. Thus, words in (9a) are grammatical and attested, as the clusters such as /tʁ/, /kl/ and /pl/ are legitimate onsets in NF. On the other hand, clusters such as /ʁt/ or /lk/ cannot be syllabified as onsets, hence they cannot follow bimoraic vowels (see 9b).

(9) No bimoraic vowels before codas in French (after Féry 2003: 12)

a. *contre* /kɔ̃tʁ/ 'against', *autre* /otʁ/ 'other', *oncle* /ɔ̃kl/ 'uncle', *simple* /sɛ̃pl/ 'simple' etc.

b. **conrte* /kɔ̃ʁt/, **aurte* /oʁt/, **onlque* /ɔ̃lk/ etc.

The question that suggests itself given the distributional properties of the vowels in NF is what property shared by the tense and nasal vowels allows them to act together as a class. The representations postulated in (9) suggest that the prerequisite for a vowel in NF to be bimoraic is headedness, i.e. only headed vowels may be bimoraic.[5] The representation of tense/[+ATR] vowels as headed has been an established practice in the ET since the 1990s (see Walker 1995; Cobb 1997). Thus, the contrast between the tense NF /o/ and the lax /ɔ/ is justifiably represented in (8) as the contrast between the |U|-headed expression {$\underline{\text{U}}$.A} and a headless expression {U.A}. Note, however, that nasal vowels in NF are qualitatively lax. On the assumption that it is the head-operator status of resonance elements that decides about the positioning of a vowel in the articulatory/acoustic space, one is forced to conclude that it is not resonance elements that function as headed in nasal vowels. On such an assumption, element |L| is the most natural candidate for the headed element in NF nasal vowels.

[5] At the same time, however, not all headed vowels are necessarily bimoraic. For example, headed /a/ is monomoraic as evidenced by the availability of words such as *cart* /kaʁt/ 'card' or *arbre* /aʁbʁ/ 'tree'.

2.3. Two-Level Containment

This work follows a general approach to the relation between the input and generated candidates known as Containment Theory, originally formulated in McCarthy and Prince (1993) and assumed in van Oostendorp (2006, 2007), Revithiadou (2007), Trommer and Zimmermann (2014) and Zimmermann and Trommer (2016), among others. McCarthy and Prince's original formulation of Containment is presented in (10).

(10) Containment (McCarthy, Prince 1993: 21)

> No element may be literally removed from the input form. The input is thus contained in every candidate form.

One of the consequences of (10) is that the literal deletion of a feature, node or segment from representation is not possible, as such a step would mean removing a piece of the input representation. Following Trommer and Zimmermann (2014), I assume that that Containment extends to association lines, which are never removed from the representation. Instead, they may be marked as invisible to phonetic interpretation.[6] The specific theory of visibility that I assume here has been laid out in Trommer and Zimmermann (2014) and Zimmermann and Trommer (2016), where it was referred to as Two-Level Containment. According to Trommer and Zimmermann, the generation of candidates may include the addition of epenthetic association lines and marking of association lines as phonetically invisible. In the latter case, the nodes and features which are located lower than the marked association lines are unparsed and unrealized, i.e. phonetically invisible. Epenthetic association lines are always visible to phonetic interpretation. Trommer and Zimmermann (2014) and Zimmermann and Trommer (2016) postulate that each markedness constraint has two versions or clones: (i) a clone that refers to

[6] As pointed out by one of the reviewers, another way of implementing the idea that association lines may be present in the representation but invisible to phonetics is found in the works on Turbidity Theory. Turbidity has been applied to element-based representations in de Castro-Arrazola et al. (2015) and Cavirani (2022), among others.

what they call the Integrated Structure, i.e. the structure which includes all kinds of association lines, nodes and features regardless of whether they are phonetically visible or invisible; and (ii) the phonetic clone, which refers only to the phonetically visible structure. I will refer to the former as the I-constraints, and to the latter as P-constraints.

As shown by Zimmermann and Trommer (2016), the material which is marked as invisible to phonetics may trigger or block phonological processes. In particular, they show that the unrealized intervocalic consonants in Lomongo block the gliding of the preceding vowel: a process which applies in the language before vowels, but not before consonants. In a similar vein, in section 4.1, I show that the presence of a non-realized element responsible for nasality contributes to the blocking of the process of Surface Velar Palatalization in Polish.

Importantly, the division into I-constraints and P-constraints concerns only markedness constraints, faithfulness constraints simply compare the phonetically realizable representation of a morpheme with the lexical representation of that morpheme and penalize the differences between the two representations.

3. *HYDRA

This section argues for the activity of constraint *HYDRA, which penalizes the presence of more than one headed element in the representation of a segment. It also shows that *HYDRA is not absolute: there are languages in which certain contexts call for the violation of the constraint.

3.1. French

In section 2.2 it was reported, after Féry (2003), that the nasal vowels attested in Northern French are lax and qualitatively mid-open, which translates into the non-headed status of the resonance elements is such vowels. The fact that they pattern with tense (i.e. headed) vowels in being bimoraic follows from the fact that they are headed by the nasality element |L|. The lax nature of nasal vowels is not peculiar to Northern French, Charette (forthcoming) shows the same to be true for Montreal French vowels.

Let us postulate that the preference for the lax/lower quality of nasal vowels as well as the general avoidance of headedness-based contrasts in nasal vowels is the consequence of the mutual ranking of the classes of violable constraints summarized in (11).

(11)

a. *OP(ERATOR) |E|: assign a violation for every instance of the element |E| which is not a head

b. *HYDRA: assign a violation whenever a phonological expression contains more than one headed element

c. IDENTHEAD |E|: assign a violation whenever the headedness status of element |E| in the output is different from the headedness status of the same element in the input

d. MAX |E|: assign a violation for every element |E|, which is integrated into the prosodic structure in the input, but is not realized phonetically

Constraint (11a) expresses the preference of elements to enjoy the status of the head. In short, given that being the head is associated with a greater acoustic prominence and resistance to lenition, it is better for an element to be the head than to be an operator.[7]

However, the observations concerning the dispreference for tense nasal (i.e. |L|-headed) vowels in French (and for nasal vowels which would contrast in the headedness of elements in general) points to certain constraints on the number of headed elements that may feature in a phonological expression. Constraint *HYDRA (11b) is meant to capture this dispreference and to penalize expressions in which more than one element functions as the head.

Constraints (11c) and (11d) are faithfulness constraints, which penalize the switch in the headedness status of elements and the non-realization of elements which are parsable, i.e. pronounceable, in the input.

[7] A reviewer points out that it is the headed status of elements that is marked given that it is a departure from the more basic status of elements. I think, it is an open empirical issue whether we need constraints that penalize the status of elements as heads (for the sake of the economy of representations) or as operators (due to the preference for greater acoustic/perceptual prominence) or whether we need both such families of constrains. In short, I do not preclude the possibility by which *OP |E| constraints are counterbalanced by *HEAD |E| constraints.

The ranking of *HYDRA above *OP |A|/|I|/|U| derives the systems in which nasal vowels are headed exclusively by element |L|. This is the case for French. The tableau generating the French word *crainte* /kʀɛ̃t/ 'fear' is presented in (12).

(12) *crainte* /kʀɛ̃t/ 'fear' (French)

INPUT: /kʀɛ̃t/	*HYDRA	IDENTHEAD |L|	MAX |L|	MAX |I|	*OP |I|	*OP |A|
a. ☞ [kʀɛ̃t] ({A.I.L̲})					*	*
b. [kʀẽt] ({A.I̲.L̲})	*!					*
c. [kʀæ̃t] (A̲.I.L̲)	*!				*	
d. [kʀèt] (A.I̲.L)		*!				*
e. [kʀet] ({A.I̲.L̲})			*!			*
f. [kʀɑ̃t] (A.I̲.L̲)				*!		*

The optimal candidate (12a) violates both the constraints against the operator status of elements |I| and |A|. Candidates (12b, c) contain headed versions of elements |I|/|A| and |L| and are eliminated by *HYDRA. Candidate (12d) avoids the violation of *HYDRA by switching the headedness status of element |L|. The resulting representation contains the low-toned close mid vowel [è]. This provokes the violation of high-ranked faithfulness constraint IDENTHEAD |L|. Finally, candidates (12e–f) avoid the violation of *HYDRA by rendering the elements |L|-head and |I|-head invisible to phonetic interpretation. Conventionally, the phonetically invisible material is presented as shaded. The high ranked constraints MAX |L| and MAX |I| protect the relevant elements against being unrealized and decide about the suboptimal status of candidates (12e–f).

Before I demonstrate the role of constraint *HYDRA in other languages, let me briefly address the potential of the faithfulness constraint from the IDENTHEAD-family. The IDENTHEAD-family of constraints is necessary for the oral lax vowels (i.e. headless vowels) to ever surface in natural languages. This is the case as the IDENTHEAD |E| constraints are meant to counterbalance the *OP |E| constraints, which require all elements to be headed in the output.

Given the existence of the IDENTHEAD |E| constraints, one is justified to ask if the laxness of nasal vowels cannot be derived simply by ranking appropriate faithfulness constraints above the *OP |E| constraints. For example (12), such a solution would simply call for the ranking of constraints IDENTHEAD |I| and IDENTHEAD |A| above *OP |I| and *OP |A|. If that were possible, no reference to *HYDRA would be necessary.

However, a set of data provided by the variety of French spoken in Montreal and presented in Charette (forthcoming) shows that the constraint IDENTHEAD |I| cannot be ranked high enough to block the switch in headedness of the element |I|. According to Charette, Montreal French shows a variation between the short tense/headed [e] and the short lax/headless [ɛ] in open syllables (see 13).

(13) The /e/ - /ɛ/ variation in Montreal French (Charette (forthcoming: 11))

a. *céder* [sede] ~ [sɛde] 'to give up'
b. *péter* [pete] ~ [pɛte] 'to fart'
c. *crémer* [kreme] ~ [krɛme] 'to cream'
d. *saigner* [seɲe] ~ [sɛɲe] 'to bleed'

On the assumption that the underlying vowel is the headless /ɛ/ represented as {A.I},[8] the observed variability points to the constraint *OP |I| and IDENTHEAD |I| being ranked as equal.

If any one of these constraints were ranked higher than the other, the output would have to either contain the tense vowel [e] (if *OP |I| > IDENTHEAD |I|) or the lax /ɛ/ (if IDENTHEAD |I| > *OP |I|). If, on the other hand, the two constraints are ranked together, the candidates which violate either of them are equally optimal. The evaluation results in a tie, which derives free variation.

Importantly, the facts concerning the behaviour of nasal vowels in Montreal French are the same as in Northern French as discussed by Féry (2003): nasal vowels behave like bimoraic vowels despite being lax. As illustrated by the data in (13), the constraint IDENTHEAD |I| cannot be ranked higher than *OP |I| in Montreal French. As a consequence, it cannot be responsible for the elimination of the

[8] This assumption is motivated by the fact that /ɛ/ is found in morphologically underived forms such as *pet* /pɛt/ 'fart' or *crème* /krɛm/ 'cream'. If we assumed the underlying status of the tense /e/ is such stems, we would have to postulate the obligatory process of laxing in closed syllables plus the optional process of laxing in open syllables for the data in (13). On the assumption that the lexical vowel is /ɛ/, only the optional tensing illustrated in (13) has to be postulated.

suboptimal candidate [kʀẽt] in (12b). Instead, this candidate is eliminated by the high ranking of *HYDRA, which penalizes the presence of two headed elements in the close-mid nasal vowel.

3.2. Brazilian Portuguese

Further evidence for the activity of constraint *HYDRA is provided by the behaviour of nasal vowels in Brazilian Portuguese.

BP features a process of vowel reduction. Stressed syllables in BP host seven oral vowels illustrated in (14a). In the pretonic position, the open-mid vowels /ɛ/ and /ɔ/ are raised to /e/ and /o/. This results in the five vowel system found in (14b).[9] In the word-final unstressed position /e/, /o/ and /a/ are raised to /i/, /u/ and /ɐ/, respectively. Thus, the final unstressed position in BP accommodates only three oral vowels (see 14c).

(14) Brazilian Portuguese vowel reduction

a. stressed	b. pretonic	c. word-final (unstressed)
s[i]*lo* 'silo' {I}	[i]*dade* 'age' {I}	*viv*[i] 's/he/it lives' {I}
b[u]*la* 'bull' {U}	[u]*sar* 'use' {U}	*fot*[u] 'photo' {U}
b[ɛ]*la* 'beautiful, fem.' {$\underline{A}$.I}	-	-
m[ɔ]*rte* 'death' {$\underline{A}$.U}	-	-
s[e]*lu* 'seal' {A.I}	*cam*[e]*lô* 'street vendor' {A.I}	-
b[o]*la* 'a kid of cake' {A.I}	*t*[o]*lete* 'stick' {A.U}	-
b[a]*la* 'bullet' {$\underline{A}$}	[a]gora 'now' {$\underline{A}$}	*jur*[ɐ] 's/he swears' {A}

The vowel reduction gives rise to alternations such as *b*[ɛ]*la* 'beautiful, fem.' - *b*[e]*leza* 'beauty', *m*[ɔ]*rte* 'death' - *m*[o]*rtal* 'deadly', *viv*[i] 's/he/it lives' - *viv*[e]*mus* 'we live', *fot*[u] 'photo' - *fot*[o]*grafia* 'photography' and *vir*[a]*r* 'turn, inf.' - *vir*[ɐ] 'you turn'.

The vowel reduction in BP illustrates a conspiracy, which results in the gradual elimination of the element |A| from the representation of the vowels. The first stage of the reduction involves the demotion of element |A| from the status of the head to that of the operator in mid vowels. In the second

[9] In some dialects of BP, the post-tonic /o/ is reduced to /u/, while the post-tonic /e/ remains unreduced. The data presented in this section come from Wetzels (1995), Mateus and d'Andrade (2000), Bisol and Veloso (2016) and Kenstowicz and Sandalo (2016).

stage, element |A| is eliminated from the representation of mid-vowels altogether and demoted to the status of an operator in the open vowel.

In order to derive the BP vowel reduction, let us assume the positional faithfulness constraints summarized in (15), which prevent the changes in the vowels which are found in the syllables bearing the primary stress and the pre-tonic syllable.[10]

(15)

a. IDENTHEAD |E| MAIN: do not change the headedness status of elements in the vowels bearing primary stress

b. IDENTHEAD |E| REC(ESSIVE): do not change the headedness status of elements in the vowel in the recessive position of the foot bearing the main stress

c. MAX |E| MAIN: elements in the vowels bearing primary stress must be realized phonetically

d. MAX |E| REC(ESSIVE): elements in the vowel in the recessive position of the foot bearing the main stress must be realized phonetically

Unlike constraints (15a) and (15c), constraints (15b) and (15d) are dominated by segmental inventory constraints *{A̲.I} and *{A̲.U}, which penalize the presence of vowels /ɛ/ and /ɔ/ in the representation. Given the ranking of constraints IDENTHEAD |E| REC below MAX |E| REC, the relevant ranking derives the reduction of phonological expressions {A̲.I} and {A̲.U} to {A.I} and {A.U}, respectively in the pre-tonic syllables (see 16).

[10] See Kenstowicz and Sandalo (2016) for the proposal concerning the metrical underpinnings of BP vowel reduction in terms of the grid theory.

(16) *b*[e]*leza* ‘beauty’
m[o]*rtal* ‘deadly’

Input: *b*{$\underline{\text{A}}$.I}*leza* *m*{$\underline{\text{A}}$.U}*rtal*	IdentHead |E| main	Max |E| main	*{$\underline{\text{A}}$.I}	*{$\underline{\text{A}}$.U}	Max |E| rec	IdentHead |E| rec
a. {$\underline{\text{A}}$.I}/{$\underline{\text{A}}$.U}			*!			
b. ☞{A.I}/{A.U}						*
c. {$\underline{\text{A}}$.I}/{$\underline{\text{A}}$.U}					*!	

Furthermore, the ranking of the constraints *{A.I} and *{A.U} below IdentHead |E| rec and Max |E| rec and above Max |A| derives the reduction of the word-final /e/ and /o/ to the corner vowels /i/ and /u/ (see 17).

(17) *viv*[i] ‘s/he/it lives’

fot[u] ‘photograph’

Input: {A.I}/{A.U}	IdentHead |E| rec	Max |E| rec	*{A.U}	*{A.I}	IdentHead |I|	IdentHead |U|	Max |A|
a. {A.I}/{A.U}			*!				
b. {A.$\underline{\text{I}}$}/{A.$\underline{\text{U}}$}					*!		
c. ☞{A.I}/{A.U}							*

In addition, assuming that constraint Max |A| is ranked higher than IdentHead |A| and *op |A|, the non-realization of element |$\underline{\text{A}}$| in the underlying /a/ is not an option. The optimal reaction to the constraint *{$\underline{\text{A}}$} is the demotion of |$\underline{\text{A}}$| to the status of an operator. The phonological expression {A} is realized phonetically as the open-mid central vowel /ɐ/ (see 18).

(18) *vir*[ɐ] ‘you turn’

INPUT: {A̲}	IDENTHEAD |E| REC	MAX |E| REC	*{A̲}	MAX |A|	IDENTHEAD |A|	*OP |A|
a. {A̲}			*!			
b. {A̲}				*!		
c. ☞{A}					*	*

The inventory of nasal vowels attested in BP is presented in (19).

(19) BP nasal vowels

/ĩ/ /ũ/

/ẽ/ /õ/

/ɐ̃/

The nasal vowels attested in BP are qualitatively the same as the vowels which constitute the output of vowel reduction at its different stages. In other words, BP nasal vowels are never headed by resonance elements. This is consistent with the high ranking of the constraint *HYDRA. That *HYDRA is ranked high in BP is confirmed by the existence of alternations between the open oral vowel /a/ and the nasal vowel /ɐ̃/ attested when the former is nasalized (see Battisti and de Oliveira 2019 and references found there). Oral vowels[11] in Portuguese undergo regular allophonic nasalization when found in stressed syllables before a nasal intervocalic consonant /n/, /m/ and most prominently /ɲ/.[12] In Brazilian Portuguese, this leads to the alternation illustrated in (20).

[11] The information concerning the behaviour of the mid-open vowels /ɛ/ and /ɔ/ in the nasalization context is extremely scarce and ambiguous. For example, Battisti and de Oliveira (2019) vaguely suggest that those vowels resist nasalization and point out that Portuguese shows a situation which is the reverse of French, in which only open-mid and open vowels may be nasalized.

[12] I some dialects pre-tonic vowel may also be nasalized before /m/ and /n/ and have to be nasalized before /ɲ/, see Wetzels (1997).

(20)

a. ˈ[ɐ̃]*mo* ‘I love’ - [a]ˈ*mar* ‘love, inf.’
b. ˈ*gr*[ɐ̃]*ma* ‘grass’ - *gr*[a]ˈ*mado* ‘turf’
c. *ba*ˈ*n*[ɐ̃]*na* ‘banana’ - *ban*[a]ˈ*nal* ‘banana plantation’
d. ˈ*k*[ɐ̃]*ma* ‘bed’ - *k*[a]*ma*ˈ*reira* ‘room maid’

Note that the raising of /a/, represented with element |A|-head, to /ɐ̃/ represented as {A.<u>L</u>}, shows that in BP *HYDRA is ranked higher than IDENTHEAD |E| MAIN, which penalizes the switch in the headedness of the element attested in the syllable bearing the primary stress. Let us assume that the spreading of nasality is enforced by the high ranking of the constraints in (21).

(21)

a. SHARE |L|$_{\acute{V}N}$: assign a violation for every stressed oral vowel followed by nasal consonant

b. *OP |L|$_{v}$: assign a violation for every instance of element |L|-operator in a vowel

The evaluation that derives the raising of nasalized /a/ is illustrated in (22).

(22) *gr*/am/*a* →ˈ*gr*[ɐ̃m]*a* ‘grass’

INPUT: *gr*/am/*a*	SHARE |L|$_{\acute{V}N}$	*HYDRA	*OP |L|$_{v}$	IDENTHEAD |E| MAIN	IdentHead |A|
a. *gr*/am/*a* = V C | | <u>A</u> L	*!				
b. *gr*/ãm/*a* = V C | | <u>A</u>.<u>L</u><<L		*!			
c. *gr*/àm/*a* = V C / \ / <u>A</u> L			*!		
d.☞*gr*/ɐ̃m/*a* = V C | | A.<u>L</u><<L				*	*

Candidate (22b), in which element |A| retains the status of the head is eliminated by the high ranking of the constraint *HYDRA. Candidate (22c), in which element |L| spreads without changing the headedness status, derives the low-toned vowel /à/. This mapping is eliminated by the constraint *OP $|L|_v$, which bans low-toned vowels in BP. In the optimal candidate (22d), element |A| is demoted to the status of the operator, while element |L| plays the role of the head in the vowel and of the operator in the consonant, thus violating the low ranked IDENTHEAD |A|.

The phonology of French and Portuguese nasal vowels justifies postulating the constraint *HYDRA as active in the two languages. Note, however, that in these languages *HYDRA is undominated. Below I demonstrate that the behaviour of Yoruba nasal vowels shows that *HYDRA is a violable constraint.

3.3. Yoruba

The lexical vowel system of Yoruba includes seven oral and, according to different sources, from three to five nasal vowels. These are presented in (23) after Pulleyblank (1988), Archangeli and Pulleyblank (1989), Yétúndé and Shleicher (2008) and Ọrie (2014).

(23) The vocalic system of Yoruba

/i/, /ĩ/				/u/, /ũ/
	/e/		/o/	
	/ɛ/ (/ɛ̃/)		/ɔ/ (/ɔ̃/)	
		/a/ (/ã/)		

The status of the non-high nasal vowels in Yoruba requires a comment. According to Pulleyblank (1988: 237), the front mid-open nasal /ɛ̃/ is attested in Standard Yoruba only in a few dialectal borrowings, while /ɔ̃/ is the optional realization of /ã/. At the same time Yétúndé and Shleicher (2008) treat /ɛ̃/ as a regular member of the inventory. Ọrie (2014) treats /ã/, /ɛ̃/ and /ɔ̃/ as dialectal variants. Importantly, all the sources agree that Yoruba does not allow lexical close-mid nasal vowels /ẽ/ and /õ/.

Given our most general assumptions concerning vocalic systems, Yoruba might be considered to constitute a well-behaved, *HYDRA-obeying system, in which close-mid vowels, headed by elements |I| and |U|, cannot be nasal as nasality is represented as |L|-head. The facts, are, however, more complicated.

One of the most thoroughly examined properties of the vocalic system of Yoruba is the vowel harmony, which requires the mid vowels to agree in tongue root advancement. In the seminal works by Pulleyblank (1988) and Archangeli and Pulleyblank (1989) the process has been analysed as the propagation of feature [-ATR] to the left. The requirement for the uniform [ATR] specification is well-attested root-internally (see Ọrie 2001) but its effects are also visible on certain prefixes. Let us assume that the domain of the harmony is a binary foot, which, due to independent reasons, must be aligned with the left edge of the relevant morphological domain. Importantly, Yoruba [-ATR]-harmony divides the vowels of the language into two classes: those that require the preceding vowel to show tongue root advancement and those that require them to show tongue root retraction. This division is illustrated in (24) after Blake et al. (2013: 186), on the basis of the behaviour of an agentive prefix. For clarity of exposition, the tonal specification of the vowels is ignored.

(24) Harmony in Yoruba agentive marker /ɔ/

		Class I vowels
a.	/ɔ/ + /i/	[o-ʃiʃɛ] AG-do.work ‘workman’
b.	/ɔ/ + /e/	[o-ʃewe] AG-do.book ‘publisher’
c.	/ɔ/ + /o/	[o-toʃi] AG-sting.poor ‘poor person’
d.	/ɔ/ + /u/	[o-ʃuka] AG-make into ball.encircle ‘porter’s headpad’
e.	/ɔ/ + /ĩ/	[o-fĩrã] AG-provoke a quarrel ‘contentious person’
f.	/ɔ/ + /ũ/	[o-ʃũwã] AG-measure ‘measuring container’

Class II vowels

g.	/ɔ/ + /ɛ/	[ɔ-fɛbĩrĩ] AG-love.women ‘a man overfond of women’
h.	/ɔ/ + /a/	[ɔ-kawe] AG-read.book ‘reader’
i.	/ɔ/ + /ɔ/	[ɔ-kɔʃɛ] AG-refuse.message ‘a person who refuses to run errands’
j.	/ɔ/ + /ã/	[ɔ-mãwe] AG-know.book ‘educated person’

With Class I vowels the agentive marker is realized as the close-mid [+ATR] vowel [o] (24a–f). With Class II vowels (24g–j), the affix is realized as the open-mid [-ATR] vowel [ɔ]. Interestingly, nasal vowels in Yoruba do not behave in a uniform way with respect to the [ATR] harmony: the close nasal vowels are Class I vowels, while the open/non-close nasal vowel belongs to Class II.

The most natural interpretation of the [ATR] harmony in Yoruba in terms of ET assumes the representation of the retracted tongue root or the [-ATR] feature as the headed status of element |A|. Under such an assumption, the harmony is enforced by the high ranking of the constraint found in (25).

(25)

AGREE $|\underline{A}|_{FOOT}$: within a foot, element |A| in a vowel may be headed only if followed by an |A|-headed vowel

Given this interpretation of the harmony facts, the open nasal vowel /ã/ must contain element |A|-head. On the assumption that nasality is represented as headed |L|, the vowel /ã/ must contain two headed elements: {$\underline{A}$.$\underline{L}$}. This representation violates *HYDRA, which must be assumed to be dominated by the faithfulness constraint IDENTHEAD |A|. Importantly, the relative high ranking of IDENTHEAD |A| does not preclude the possibility of the derivation of [+ATR] vowel [o] form the underlying /ɔ/. This is illustrated in (26), which contains the relevant aspects of the evaluation of the noun *ò-tòṣì* [otoʃi] ‘poor person’.

(26) /ɔ-toʃĩ/ → [otoʃĩ] ‘poor person’ (Yoruba)

Input: /ɔ-toʃĩ/ = /{$\underline{A}$.U}t{A.$\underline{U}$}ʃĩ/	AGREE $\lvert\underline{A}\rvert_{FOOT}$	IDENTHEAD |A|	*HYDRA	*OP |U|	IDENTHEAD |U|
a. [{$\underline{A}$.U}t{A.$\underline{U}$}ʃĩ]	*!			*	
b. [{$\underline{A}$.U}t{$\underline{A}$.$\underline{U}$}ʃĩ]		*	*!	*	
c. [{$\underline{A}$.U}t{$\underline{A}$.U}ʃĩ]		*		*!*	
d. ☞ [{A.$\underline{U}$}t{A.$\underline{U}$}ʃĩ]		*			*

The faithful candidate (26a) violates constraint (25) as the element |A| found in the stem vowel is non-headed. The promotion of the element |A| found in the stem vowel results in the fatal violation of *HYDRA (26b). This may be avoided by the demotion of element |U| in the stem vowel to the status of the operator and the derivation of a sequence of [-ATR] vowels /ɔ/-/ɔ/ (see candidate 26c). The result is, however, the fatal violation of constraint *OP |U|. The winning candidate (26d) switches the status of elements |A| and |U| in the prefix.

The violable nature of *HYDRA is illustrated even more clearly by the behaviour of nasality in the context of vowel hiatus. In Yoruba, vowel hiatus may result in the deletion of the first vowel or the total vowel assimilation depending on whether the item to the left is mono- or bi-syllabic. If the final vowel of the item to the left is nasal, the nasality is retained and realised on the resulting vowel. As illustrated in (27), the nasal stability effect results in the derivation of nasal mid vowels, which are not part of the lexical inventory of many dialects of Yoruba.

(27) Nasal stability in Yoruba (Ọrie 2014: 51)

a. /pĩ/ /owo/ → [põwo] ‘divide money’
b. /pĩ/ /ɛba/ → [pɛ̃ba] ‘divide eba’
c. /gũ/ /oke/ → [gõke] ‘divide plantain’
d. /fã/ /eso/ → [fẽso] ‘scatter fruit’
e. /pã/ /ɛnu/ /la/ → [pɛ̃nu la] ‘lick lip with tongue’
f. /fɛrã/ /owo/ → [fɛrõ õwo] ‘love money’
g. /nirã/ /ere/ → [nirẽ ẽre] ‘remember a play’
h. /ɛʃĩ/ /ɔba/ → [ɛʃɔ̃ ɔ̃ba] ‘king’s horse’
i. /okũ/ /ɛra/ → [okɛ̃ ɛ̃rã] ‘goat leash’

Given that mid vowels in Yoruba are headed by one of the elements |A|, |I| or |U|, the anchoring of the nasality element on such vowels results in the violation of constraint *HYDRA. Nasal stability may be straightforwardly accounted for as the effect of the ranking of constraint MAX |L| above *HYDRA.

This section demonstrated that *HYDRA is an active constraint which keeps check on the number and quality of nasal vowels derived in languages such as French and Portuguese by penalising the derivation of tense/headed nasal vowels. At the same time, the presence of the |A|-headed /ã/ as well as the nasal stability facts attested in Yoruba point to *HYDRA being a violable constraint that may be dominated by faithfulness constraints from the IDENTHEAD |E|- and MAX |E|-families.

4. The activity of *HYDRA in Polish

4.1. Non-palatalization by underlying nasal vowels

In Polish, the concatenation of affixes that lexically begin in the vowels /ɨ/ and /ɛ/ is accompanied by two processes illustrated in (28) and (29) on the basis of the behaviour of the Genitive singular affix *-y* /ɨ/ and the Instrumental singular affix *-em* /ɛm/. The two vowels trigger the palatalization of velar plosives (see 28d-e and 29d-e). Moreover, both vowels are fronted and raised to [i] and [e] in the context of a soft (prepalatal or palatal) consonant (see 28c–e and 29c–e).

(28)

a. *ra*[t]-*a* 'instalment' - *ra*[t-ɨ] 'gen, sg.'
b. *ma*[p]-*a* 'map' - *ma*[p-ɨ] 'gen, sg.'
c. *na*[tɕ] 'parsley tops' - *na*[tɕ-i] 'gen, sg.'
d. *fo*[k]-*a* 'seal' - *fo*[c-i] 'gen, sg.'
e *no*[g]-*a* 'leg' - *no*[ɟ-i] 'gen, sg.'

(29)

a. *ko*[t] 'cat' - *ko*[t-ɛm] 'inst, sg.'
b. *sę*[p] 'vulture' - *sę*[p-ɛm] 'inst, sg.'
c. *goś*[tɕ] 'guest' - *goś*[tɕ-em] 'inst, sg.'
d. *ro*[k] 'year' - *ro*[c-em] 'inst, sg.'
e. *wró*[g] 'enemy' - *wro*[ɟ-em] 'inst, sg.'

The process referred to as the Surface Velar Palatalization (see Rubach 1984, 2019; Szpyra 1995) has been analysed in Zdziebko (in press) as the result of the interaction of the following set of constraints.

(30)

a. SINGLE PLACE ELEMENT CONDITION (SPEC): a place node must be specified for one and only one element

b. DEP LINK |E| - assign violation for every instance of a link which is present in the output but not present in the input and which connects element |E| with a root node

c. AGREE $|\underline{\mathrm{I}}|_{CV}$: if a vowel contains a place node marked for element |I|-head the place node of the preceding consonant must also possess element |I|-head

d. AGREE HEAD/OPERATOR |I| (AGR H/O |I|): element |I| cannot play a different head/operator role in the vowel and the preceding consonant

Constraint SPEC (30a) penalizes the presence of velars, whose Place nodes are melodically unspecified (see Rice 1996; Gussmann 2007; Cyran 2010 among others).[13] The violation of SPEC is avoided by the spreading of element |I| from the following vowel.[14] This violates constraint DEP LINK |E| (adopted from Torres-Tamarit 2016),[15] which punishes the introduction of new links between elements and Root nodes. Constraints (30c) and (30d) are undominated in Polish and derive the distribution of vowels /i/ and [e], attested only after |I|-headed consonants. and /ɨ/ and /ɛ/, banned from after |I|-headed consonants. The following tableau shows the derivation of SVP and fronting/raising of /ɨ/ and /ɛ/ in the Genitive singular and Instrumental singular contexts.

[13] A reviewer inquires about the consequence of the postulated constraint for the representations of Polish consonant and vowels found in (5) and (6) above, many of which contain more than one resonance element. The answer is that such segments violate the relevant constraint, but the high ranking of constraints form the MAX |E|-family protects the lexically associated elements against non-realization/deletion.

[14] The spreading of elements from the preceding vowels is blocked by the high ranking of the constraint CRISP EDGE (Itô, Mester 1999), which penalizes the spreading of material between prosodic units. In the relevant case the prosodic units are Onset-Nucleus or CV pairs, which have been argued to form licensing domains in Charette (1991) and Cyran (2010).

[15] Two alternatives to the DEP LINK family of constraints are: (i) OCP/E/ constraints postulated in Castro-Arrazola et al. (2015) and (ii) *MULTIPLE (α) constraints postulated in Polgárdi (1998). As far as I can see, the OCP/E/ family differs from DEP LINK constraints in that it penalizes only the spreading between adjacent segments. Unlike DEP LINK constraints, *MULTIPLE (α) constraints penalize also the lexical instances of multiply-linked elements.

(31) *rę*/k-ɨ/ → *rę*[ci] 'arm, gen, sg.'
ro/k-ɛm/ → *ro*[cem] 'year, instr, sg.'

INPUT: *rę*/k-ɨ/ *ro*/k-ɛm/	*{I.ʔ.H}	AGREE |I̲|$_{CV}$	AGR H/O |I|	SPEC	IDENTHEAD |I|	DEP LINK |I|
a. [kɨ]/[kɛm] = C V | | (_) I/I.A				*!		
b. [ki]/[kem] = C V | | (_) I/I̲.A		*!		*	*	
c. C V | | I <<I/I.A	*!					*
d. [cɨ]/[cɛm] = C V | | I̲ <<I/I.A			*!			*
e. ☞ [ci]/[cem] = C V | | I̲ <<I̲/I̲.A					*	*

The faithful candidates (31a) are eliminated by SPEC, which penalizes the presence of the unspecified Place nodes realized as the velar place of articulation. Candidates (31b), in which the element |I| is promoted to the status of the head giving rise to raising/fronting, fail on AGREE |I̲|$_{CV}$. Candidates (31c), in which element |I| spreads as an operator, are eliminated by the inventory constraint which does not allow for the phonetic realization of the expression composed of element |I|-operator, occlusion (|ʔ|) and the 'obstruency' element |H|. Candidates (31d), in which element |I| plays the role of the head in the consonant but of an operator in the vowel fatally violate AGR H/O |I|. The winning candidates involve the spreading of element |I| onto the velar and the promotion of this element to the status of the head in the vowel and the consonant. In surface terms, this results in the derivation of the palatal plosive [c] and the raised/fronted vowels [i] and [e].

In sum, the analysis postulated in Zdziebko (in press) and summarized above treats SVP and the ɛ-raising/ɨ-fronting as mutually dependent. As illustrated by the suboptimal status of candidates (31b) and (31d), raising/fronting without palatalization and palatalization without raising/fronting are ungrammatical. Thus, if one of the two processes were to be blocked, the other could not apply.

This sort of blocking is observed in the environment of the front nasal vowel -*ę* /ɛ̃/, which realizes the Accusative singular of feminine nouns and the 1st person singular non-past tense in verbs. As illustrated in (32), velar plosives do not undergo SVP in the relevant environment. Note that the nasal vowel /ɛ̃/ normally undergoes a process of denasalization (see Laskowski 1975: 117; Gussmann 2007: 69) and is realized with nasality only in guarded formal speech.

(32) No SVP before (denasalized) /ɛ̃/

a. *fo*/k-ɛ̃/ → *fo*[kɛ]/[kɛ̃] **fo*[ce] 'seal'
b. *rę*/k-ɛ̃/ → *rę*[kɛ]/[kɛ̃] **rę*[ce] 'hand'
c. *sztu*/k-ɛ̃/ → *sztu*[kɛ]/[kɛ̃] **sztu*[ce] 'play'
d. *wlo*/k-ɛ̃/ → *wlo*[kɛ]/[kɛ̃] **wlo*[ce] 'I drag'
e. *no*/g-ɛ̃/ → *no*[gɛ]/[gɛ̃] **no*[ɟe] 'leg'
f. *Ry*/g-ɛ̃/ → *Ry*[gɛ]/[gɛ̃] **Ry*[ɟe] 'Riga'
g. *sa*/g-ɛ̃/ → *sa*[gɛ]/[gɛ̃] **sa*[ɟe] 'sage'
h. *mo*/g-ɛ̃/ → *mo*[gɛ]/[gɛ̃] **mo*[ɟe] 'I can'

The blocking of SVP in the environment of /ɛ̃/ is the consequence of the high ranking of constraint *HYDRA. Let us assume that the relevant version of *HYDRA is violated by the phonetically realized and the phonetically unrealized material. The impact of *HYDRA on the evaluation of the input in which a stem terminating in a velar stop is concatenated with -*ę* /ɛ̃/ is illustrated in (33).

(33) *fo*/k-ɛ̃/ → *fo*[kɛ]/[kɛ̃] 'seal, acc. sg.'

INPUT: /k-ɛ̃/ = C V | | (_) A.I.L	*OP |L|$_V$	AGR H/O |I|	*HYDRA	SPEC	*ɛ̃	MAX |L|
a. ☞[kɛ] = C V | | (_) A.I.L				*		*

b. ☞[kɛ̃] = C V | | (_) A.I.<u>L</u>				*	*	
c. [cɛ] = C V | | <u>I</u> <<I.A.<u>L</u>		*!				*
d. [ce] = O N | | <u>I</u> <<<u>I</u>.A.<u>L</u>			*!			*
e. [ce] = O N | | <u>I</u> <<<u>I</u>.A.L	*!					*

In candidate (33c) the element |I| functions as an operator in the vowel and as head in the consonant, which leads to the fatal violation of constraint AGR H/O |I|. Candidate (33d), in which the element |I| is promoted to the status of the head in the vowel, violates the constraint *HYDRA, which is ranked higher than SPEC.[16] Candidate (33e) is eliminated by the constraint *OP $|L|_V$, which blocks the presence of low-toned vowels in Polish. The winner is either the candidate (33a), in which the element |L|-head is marked as unrealized, or the faithful candidate (33b), which violates the inventory constraint *ɛ̃. Since constraints *ɛ̃ and MAX |<u>L</u>| are ranked together, candidates (33a) and (33b) are both optimal and their exact distribution within the speech of the native speakers is regulated by extra-phonological factors. Neither of the winning candidates contains the palatalization of the velar.

The crucial assumptions of the above analysis are that the phonetically unrealized |L|-head element is contained in the phonological representation and that *HYDRA is an I-constraint, i.e. it is sensitive also to the presence of the phonologically present but phonetically unrealized material.

[16] One of the reviewers argues that forms such as [fɔce] (candidate (33d)) are merely artifacts of OT-style analysis and are historically unmotivated. This is not true. In many regional dialects of north-eastern Poland velar consonants underwent palatalization before the historical reflexes of the nasal vowel /ɛ̃/. Thus, according to Górnowicz (1971), the dialects of Eastern Masuria palatalize(d) velars before the accusative singular affix in words such as *ryn*[ce] 'arm', *no*[ɟe] 'leg' and before the 1st person singular affix as in *mo*[ɟe] 'I can'. In such dialects, the vowel /ɛ̃/ underwent a complete denasalization, which means that element |L|-head is absent from its lexical representation and the constraint *HYDRA is inert.

4.2. Deriving the 1st Velar and Anterior Palatalization

Apart from Surface Velar Palatalization, which arguably lends itself to a phonological analysis, Polish has a selection of palatalization processes which have been treated as morphophonological phenomena by a large portion of the literature. The 1st Velar and Anterior Palatalization, illustrated in (34) and (35), belong to this class.

(34) The 1st Velar Palatalization

	Examples	Input → Output
a.	*bura*[k] ‘beet’ - *bura*[t͡ʂ-a]*ny* ‘of beet’	{_.ʔ.H} → {$\underline{A}$.I.ʔ.H}
	krza[k] ‘bush’ - *krza*[[t͡ʂ-a]*sty* ‘bushy’	
b.	*wa*[g]-*a* ‘weight’ - *wa*[ʐ] → [ʂ] ‘weight, imper.’ [17]	{_.ʔ.H.L} → {$\underline{A}$.I.H.L}
	dro[g]-*a* ‘road’ - *dro*[ʐ-n]*y* ‘unblocked’	
c.	*mia*[zg]-*a* ‘pulp’ – *zmia*/ʐd͡ʐ/ → [ʂt͡ʂ] ‘crash, imper.’	{_.ʔ.H.L} → {$\underline{A}$.I.ʔ.H.L}
d.	*bla*[x]-*a* ‘brass’ - *bla*[ʂ-a]*k* ‘tin hut’	{_.H} → {$\underline{A}$.I.H}
	u[x]-*o* ‘ear’ - *u*[ʂ-u] ‘ears, gen.’	

The 1st Velar Palatalization derives the voiceless retroflex affricate from /k/ and the voiced retroflex spirant when the input is /g/. If the input /g/ is preceded by a spirant, the output is the retroflex affricate (see 34c).[18] The velar spirant gives rise to the voiceless retroflex fricative (34d). As illustrated in (34), the 1st VP involves the mapping between the resonance-less representation of velars and the |A|-headed representation of retroflex consonants.

(35) Anterior Palatalization

	Examples	Input → Output
a.	*dru*[t] ‘wire’ - *dru*[t͡ɕ-a]*ny* ‘of wire’	{A.ʔ.H} → {A.$\underline{I}$.ʔ.H}
b.	*sło*[d]-*ycz* ‘sweetness’ - *sło*[d͡ʑ-a]*k* ‘cutie-pie’	{A.ʔ.H.L} → {A.$\underline{I}$.ʔ.H.L}
c.	*pa*[s] ‘stripe’ - *pa*[ɕ-a]*sty* ‘striped’	{A.H} → {A.$\underline{I}$.H}
d.	*gry*[z] ‘bite (noun)’ - *gry*/ʑ/ → [ɕ] ‘bite, imper.’	{A.H.L} → {A.$\underline{I}$.H.L}
e.	*ka*[r]-*a* ‘punishment’ – *ka*/ʐ/ → [ʂ] ‘punish, imper.’	{$\underline{A}$} – {$\underline{A}$.I.H}
f.	*popió*/ɫ/ → [w] ‘ash’ - *popie*[l-a]*ty* ‘grey’	{A.U.ʔ} → {A.$\underline{I}$.ʔ}
g.	*ogo*[n] ‘tail’ - *ogo*[ɲ-a]*sty* ‘tailed’	{A.ʔ.L} → {A.$\underline{I}$.ʔ.L}

[17] In Polish, word-final voiced obstruents undergo the general process of Final Obstruent Devoicing (see Cyran 2014 and references found there).

[18] One of the reviewers points out that the issue of the mapping between /g/, /ʐ/ and /d͡ʐ/ is too important not to be addressed in the main text. I agree, but since it is not essential to the main point of the paper, I address it in the Appendix.

h. *s*[p]-*ać* ‘sleep’ - *ś*[pʲ-ɔ]*ch* ‘drowsy head’ {U.ʔ.H} → {U.I̲.ʔ.H}
i. *kol*[b]-*a* ‘cob’ - *kol*[bʲ-a]*sty* ‘cob-shaped’ {U.ʔ.H.L} → {U.I̲.ʔ.H.L}
j. *sło*[m]-*a* ‘straw’ - *sło*[mʲ-a]*n-y* {U.ʔ.L} → {U.I̲.ʔ.L}
k. *Gol*[f] ‘Volkswagen Golf’ - *gol*[fʲ-a]*rz* ‘Golf driver’ {U.H} → {U.I̲.H}
l. *tra*[v]-*a* ‘grass’ - *tra*[vʲ-a]*st-y* ‘grassy’ {U.H.L} → {U.I̲.H.L}

Anterior Palatalization derives prepalatals and palato-labials from dental and labial segments. This generally involves the augmentation of the representation containing elements |A|/|U| with the palatality element |I|-head.[19]

Two facts illustrated in (34) and (35) motivate the account proposed here. First, 1st VP and Anterior Palatalization very often take place before vowels which do not contain the palatalizing element |I|. In the case of the imperative forms, found in (34b) and (35d–e), the changes do not have segmental conditioning at all. As a result, the relation between the structural changes of the two types of palatalization and the environment in which they take place cannot be defined in surface-true phonological terms (see Gussmann 1978, 1980; Rubach 1984, 2003, 2017; Schwartz 2013 for particular analyses).

Given the opaque nature of the 1st VP and Anterior Palatalization, many scholars classified these changes as part of the morphophonological rather than the phonological system of the language (see Dressler 1985; Spencer 1986; Czaykowska-Higgins 1988; Gussmann 1992, 2007; Czaplicki 2013 and Zdziebko 2015). Most of these works propose that the derivation of the relevant alternations calls for the reference to certain lexical or/and morphological information specific to the affixes that accompany the relevant alternations.

Secondly, despite involving different structural changes, the 1st VP and Anterior Palatalization are very often observed in the environment of the same affixes. Both types of palatalization take place before the adjectival affixes -*an*- and -*ast*- (see 34a, b; 35a, j and 35c, g, i, l), the nominal affix -*ak*- (32d and 33b), the Imperative, as well as in the infinitives of certain verb classes (e.g. *po*[t] ‘sweat’ - *po*[tɕ]-*ić* ‘sweat, inf.’ and *stra*[x] ‘fear’ - *stra*[ʂ]-*yć* ‘scare, inf.’) and in the paradigms of adjectives

[19] The exception is the derivation of the retroflex spirant [ʐ] from the underlying /r/ (see 35e). This change is highly idiosyncratic and will not be addressed here in any detail. I follow the vast majority of the literature on Polish morphophonology and assume that the lateral /l/ is derived from the underlying velarized /ɫ/, which never surfaces in Standard Polish and instead is realized as [w] (see 35f).

derived from animate nouns (e.g. *ko*[t] ‘cat’ - *ko*[tɕ-ɔ̃] ‘feline, fem, acc, sg.’ and *smo*[k] ‘dragon’ - *smo*[t͡ʂ-ɔ̃] ‘of dragon, fem, acc, sg.’) as well as several other affixes, which are not illustrated here for reasons of space.[20]

Zdziebko (2015) proposes that the morphophonological palatalizations, such as the 1st VP and the Anterior Palatalization, involve the integration of floating pieces of autosegmental representation into the structure of the stems. The floating autosegments were assumed to constitute the lexical representation of particular inflectional categories. Without getting into detail, let me point out that the proposed account was only partially successful as it did not account for the fact that many affixes trigger changes as different as the 1st VP and Anterior Palatalization. In short, the analysis presented in Zdziebko (2015) was unable of accounting for such alternations by means of a single floating autosegment.

In what follows I propose an analysis in which the 1st VP and Anterior Palatalization are derived by the integration of one and the same floating autosegment. Let me assume that the affixes in the environment of which both those changes are observed are lexically represented with a floating Place node hosting elements |A|-head and |I|-head (see 36).

(36)

Place
/ \
$\underline{A}$ $\underline{I}$

The integration of the floating autosegment into the structure of the stem is enforced by the high ranking of the constraint presented in (37a), which is the Containment Theory version of a constraint proposed by Wolf (2005). In addition, let me postulate the activity of the markedness constraint *2PLACE, which requires Root nodes to host only one Place node. The relevant version of *2PLACE is sensitive only to phonetically visible material.

(37)

[20] See Gussmann (2007: ch. 4) for other examples of derivational affixes which trigger the 1st VP and Anterior Palatalization.

a. *FLOAT: assign a violation for any instance of a floating, i.e. non-integrated, node/element found in the output
b. *2PLACE: assign violation for every Root node connected to more than one Place node

The concatenation of a stem terminating in /k/ with an exponent of the adjectival head containing (36), is evaluated as in (38). The candidates do not include the inflectional endings, which do not affect the evaluation.

(38) *smo*/k/-/[Pl[A.I]]/-*y* → *smo*[t͡ʂ]-*y* 'of dragon'

INPUT: smo/k/-/[Pl[A.I]]/	*FLOAT	*2PLACE	*HYDRA	IDENTHEAD |A|	IDENTHEAD |I|	MAX PLACE
a. smo/k/-[Pl[A.I]]	*!		*			
b. Root / \ Place Place / \ A I		*!	*			
c. Root / \ Place Place / \ A I			*!			*
d. Root / \ Place Place / \ A I				*!		*
e. ☞ [t͡ʂ] = Root / \ Place Place / \ A I					*	*

The faithful candidate (38a) does not integrate the autosegment and thus fatally violates *FLOAT. The integration of the floating Place node into the structure of the velar violates the constraint *2PLACE (38b). This may be avoided by marking the association line between the root node and the lexical Place node of the velar as invisible to phonetic interpretation, thus rendering the Place node unparsable (candidates 38c–e). Since the floating autosegment contains two headed elements, its faithful integration violates constraint *HYDRA. This, in turn, may be avoided by demoting one of the elements to the status of the operator. Since IDENTHEAD |A| is assumed to be ranked higher than IDENTHEAD |I|, it is the latter element that is demoted giving rise to an expression composed of |A|-head and |I|-operator (38e), which is phonetically realized as the retroflex place of articulation in Polish.

The integration of the relevant floating autosegment into the structure of the dental consonant calls for the employment the constraint (39), which belongs to the same family as *2PLACE and which bans the presence of two instances of the same element in a single segment.

(39)

*2|E|: assign a violation for every Place node hosting more than one element |E|

(40) *ko*/t/-[Pl[A.I]]-*a* → ko[tɕ]-*a* ‘feline, fem.’

INPUT: ko/t/-/[Pl[A.I]]/	*FLOAT	*2PLACE	MAX |A|	*2|E|	*HYDRA	IDENTHEAD |A|	IDENTHEAD |I|
a. *ko*/t/-[Pl[A.I]]	*!				*		
b. Root / \ Place Place | / \ A A I		*!			*		
c. Root / \ Place Place | / \ A A I			*!		*		
d. Root / \ Place Place | / | \ A A I				*!	*		
e. Root / \ Place Place | / | \ A A I					*!		
f. Root / \ Place Place							*!

	/	\ A <u>A</u> I							
g. ☞ [t͡ɕ] = Root / \ Place Place 	/	\ A A <u>I</u>							

As illustrated in (40c), the non-realization of the lexical Place node prevents the violation of *2PLACE, but incurs the violation of a high marked faithfulness constraint MAX |A|, which punishes the non-realization of element |A| found in the final consonant of the stem. The violation of MAX |A| may be prevented by reassociation of |A| to the newly integrated lexically floating Place node. This, however, results in the relevant Place node hosting two instances of element |A| and provokes the fatal violation of *2|E| (see candidate 40d). Candidate (40e) avoids the violation of *2|E| by rendering phonetically unrealized the headed element |A|, which was originally associated with the floating Place node. Crucially, this repair strategy does not violate constraint MAX |A| as under the definition of the MAX-family of constraints presented in (11d) and repeated below for convenience, MAX |E| constraints are violated only by elements which have been integrated into the prosodic structure in the input. The relevant instance of |A|-head was part of the floating autosegment and thus not integrated into the prosodic structure in the input.

(41) = (11d)

MAX |E|: assign a violation for every element |E|, which is integrated into the prosodic structure in the input, but is not realized phonetically

At the same time, the structure (40d), which violates constraint *HYDRA, may be subject to further optimization. The reader will recall that *HYDRA is and I-constraint and is violated by the material that is not realized phonetically. As a consequence, the non-realized element |A|-head contributes to the violation of *HYDRA. Importantly, the demotion of the non-realized |A|-head to the status of the operator does not violate the faithfulness constraint IDENTHEAD |A|. This is the case as faithfulness constraints may be violated only by the phonetically realized material. Since element |A|-head is not realized phonetically in candidates (40e–g), candidate (40f) does not induce the violation of IDENTHEAD |A|. This fact decides about the optimal status of the candidate (40g), which realizes phonetically the combination of element |A|-operator and |I|-head and thus derives the prepalatal obstruents.

Finally, the tableau in (42), summarizes the integration of the floating Place node (36) into the structure of a stem terminating in a labial consonant.

(42) *ża*/b/-[Pl[A.I]]-*a* → *ża*[b^j]-*a* ‘of frog, fem.’

INPUT: *ża*/b/-/[Pl[A.I]]/	MAX |U|	*{U.A.I.ʔ.H.L}	*HYDRA	IDENTHEAD |A|	IDENTHEAD |I|
a. Root / \ Place Place | / \ U A I	*!		*		
b. Root / \ Place Place | / | \ U A I		*!	*		
c. Root / \ Place Place | / | \ U A I			*!		
d. ☞d. Root / \ Place Place | / | \ U A I					

Candidate (42a), which avoids the violation of *2PLACE, is eliminated by the high ranking of MAX |U|. The relinking of element |U| found in the labial gives rise to a combination of elements which is eliminated by an inventory constraint *{U.A.I.ʔ.H.L}. Candidate (42c) fatally violates *HYDRA. In the winning candidate, element |A|-head is both demoted to the status of an operator and unparsed. This does not violate faithfulness constraints as (i) the relevant instance of |A|-head was unintegrated and phonetically uninterpretable in the input, (ii) it is not phonetically visible in the output and hence its demotion to the status of an operator does not violate constraint IDENTHEAD |A|.

5. Conclusion

This paper has argued that the presence of more than one headed element in a phonological expression in a marked configuration that triggers the violation of the constraint *HYDRA. It has been shown that the high ranking of *HYDRA influences the shapes of the inventories of nasal vowels in languages such as French and Brazilian Portuguese. At the same time, the data from Yoruba point to the violable nature of the constraint. It has been shown that the activity of *HYDRA blocks the rising of the nasal vowel /ɛ̃/ and thus does not allow the vowel to trigger Surface Velar Palatalization in Polish. Moreover, the marked status of doubly-headed expressions and the activity of *HYDRA have been argued to play the crucial role in the unified account of the 1st Velar and Anterior Palatalization.

Appendix: The spirantization of /g/

The output of the application of the 1st Velar Palatalization to the voiced velar plosive /g/ results in the derivation of the voiced retroflex spirant [ʐ] (A1) or the voiced retroflex affricate [d͡ʐ] (A2).

(A1)

a. *no*/g/-a ‘leg’ - *no*[ʐ]-*ny* ‘of leg’
b. *uwa*/g/-*a* ‘attention’ - *zauwa*/ʐ/-*yć* ‘notice’
c. *ul*/g/-*a* ‘relief’ – *ul*/ʐ/-*yć* ‘relieve’

(A2)

a. *mó*/zg/ ‘brain’ - *mó*[ʐd͡ʐ]-*ku* ‘brain, dim, gen, sg.’
b. *ró*/zg/-*a* ‘rod’ – *ró*[ʐd͡ʐ]-*ek* ‘wand, gen, pl.’
c. *mia*/zg/-*a* ‘pulp’ – *mia*[ʐd͡ʐ]-*yć* ‘smash’

The spirant surfaces if the input /g/ follows a sonorant. If the lexical /g/ is preceded by /z/, it surfaces as [d͡ʐ], while /z/ has to assume the retroflex place of articulation.

Let us assume that the spirantization of /g/ observed in (A1) is provoked by the high ranking of the markedness constraint *d͡ʐ. Let us also assume that the spirantization in the context of /z/ would derive a sequence of adjacent spirants /ʐʐ/, which is illegal in Polish, hence no spirantization is attested after /z/.

Given that /d͡ʐ/ differs from /ʐ/ in the presence of the occlusion element |ʔ|, we must conclude that the repair strategy selected by the grammar to avoid the derivation of /d͡ʐ/ is the suppression of element |ʔ|. This provokes the violation of the low-ranked faithfulness constraint MAX |ʔ|.

The apparently problematic aspect of this analysis is that elements |A|-head and |I|-head, which define the place of articulation of the /d͡ʐ/ derived from /g/, are not lexically integrated in the prosodic structure and their being marked as unrealized does not violate MAX constraints. Hence, the non-realization of |A|-head (deriving a voiced palatal plosive [ɟ] – {A.I̲.ʔ.H.L}) or |I| and |A| (deriving [g] - {A.I̲.ʔ.H.L}) seem to be a more optimal strategies to avoid the violation of *d͡ʐ, than the non-realization of the lexically associated |ʔ|.

Note again, that MAX constraints are violated only by the non-realization of the elements and nodes which have been integrated in the prosodic structure in the input or lexical representation. This is the case as the task of MAX constraints is to maintain the status of elements/nodes as phonetically interpretable and only such elements/nodes are phonetically interpretable as are integrated in the prosodic structure. This requirement has been formalized in Trommer and Zimmermann (2014: 471) as one of their 'Axioms of phonetic realization' (see A3).

(A3)

> A phonological node is phonetically realised if and only if it is dominated by the highest prosodic node of the candidate through an uninterrupted path of phonetically visible association lines.

Does that mean that the non-realization of elements which are part of floating autosegmental nodes comes for free? I want to argue that the answer to this question is negative. The non-realization of elements that enter phonological computation as part of the floating autosegments incurs the violation of constraints from the PARSE family. The PARSE constraints are one of the better established and the oldest family of constraints. The general formulation of PARSE is presented in (A4), after van Oostendorp (2007).

(A4) PARSE (van Oostendorp (2007: 125))

Every phonological element needs to be parsed into the prosodic structure.

PARSE constraints are more general than MAX constraints in that they promote the realization of any element or node, whether it was prosodically integrated in the input of not.

On the assumption that being parsed into the prosodic structure translates into being phonetically realized, the non-realization of elements that are part of floating autosegments incurs the violation of PARSE constraints.

If we further assume that constraints PARSE |A| and PARSE |I| are ranked higher that MAX |ʔ| (and PARSE |ʔ|), but lower than MAX |A|/ MAX |U|, than we derive the correct output of the application of the 1st VP to /g/ as well as the application of Anterior Palatalization.

The ranking of constraints PARSE |A| and PARSE |I| above constraints IDENT HEAD |A| and IDENT HEAD |I| is also important for the elimination of candidates in which the floating place node is integrated into the representation of the stem-final consonant, and simultaneously the elements associated with it are marked as unrealized phonetically (see A5).

(A5)

```
Root                          Root
  |                          /    \
Place     Place   →    Place Place
  |        /  \            |      /   \
A/U       I    A         A/U   I    A
```

Note that this strategy causes elements |A|-head and |I|-head to be unrealized phonetically, which in turn means that switching the headedness status of any of those elements does not to provoke the violation of IDENTHEAD constraints. However, it does provokes the violation of PARSE constraints. Given the ranking in (A6), the mapping (A5) is suboptimal.

(A6)

MAX |A|; MAX |U| > *HYDRA > SPEC > PARSE |A|; PARSE |I| > IDENTHEAD |A| > IDENTHEAD |I|

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