Studies in Polish Linguistics vol. 19 (2024), issue 3, pp. 105–133 https://doi.org/10.4467/23005920SPL.24.005.21187 www.ejournals.eu/SPL

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# Inherent Circularity in Laryngeal Realism? Three Levels of Explanation of the Pre-sonorant Sandhi Patterns in Polish (Part 2)<sup>1</sup>

The speech sound can only be defined in terms of its relation to the phoneme. But if, in the definition of the phoneme, one proceeds from the speech sound, one is caught in a vicious circle (Trubetzkoy 1939 [1969]: 38)

#### Abstract

In the first part of the article, two approaches to laryngeal phonology - the realist and the relativist - were introduced and compared with regard to their treatment of the sandhi patterns in two major varieties of Polish. The discussion revolved around three types of circularity that result from the blurring of the line between phonology and phonetics. The current part of the article examines the theoretical consequences of the privative approach called new laryngeal realism (e.g. van der Hulst 2015; Wojtkowiak and Schwartz 2018) with respect to the pre-sonorant sandhi effects in Polish, assuming the broader framework of Onset Prominence (Schwartz 2010). While new realism does suffer from circularity to some extent, it seems to capture not only the main phonetic and phonological intuitions about the sandhi phenomena, but it also makes strong claims about the diachronic development of the two major dialects of Polish. In comparison to laryngeal relativism, it leads to a similar structure of sound systems, with strict separation of phonetics and phonology, but it places the explanation of the sandhi phenomena at the interface rather than in the phonology itself. On the other hand, the general Onset Prominence framework appears to subvert these achievements by merging phonetics, phonology and the interface into one system. A solution to this problem may be to

<sup>&</sup>lt;sup>1</sup> I would like to thank Krzysztof Jaskuła, Mateusz Urban, Sławomir Zdziebko and two anonymous Reviewers for insightful comments and suggestions.

assume that the Onset Prominence representation should not be hierarchical, as it reflects the phonetic representation alone.

#### Keywords

circularity, laryngeal realism, laryngeal relativism, levels of explanation, phonetics-phonology interface, pre-sonorant sandhi voicing, privativity

#### Abstrakt

W pierwszej części artykułu przedstawiono dwa podejścia do fonologii krtaniowej, realistyczne i relatywistyczne, i porównano je w odniesieniu do analizy zjawisk fonetyki międzywyrazowej w dwóch głównych odmianach języka polskiego. Dykusja koncentrowała się na trzech typach cyrkularności wynikających z rozmycia granicy miedzy fonologia a fonetyka. Obecna cześć artykułu zawiera pogłebiona dyskusje konsekwencji teoretycznych związanych z tzw. nowym realizmem krtaniowym (e.g. van der Hulst 2015; Wojtkowiak and Schwartz 2018) w odniesieniu do opisu fonetyki międzywyrazowej w języku polskim, zakładając szerszy kontekst reprezentacyjnego modelu Onset Prominence (Schwartz 2010). Choć nowy realizm zawiera pewien stopień cyrkularności zdefiniowanej w pierwszej części artykułu, wydaje się, że jest w stanie uchwycić nie tylko główne intuicje fonetyczne i fonologiczne dotyczące zjawisk sandhi, ale także wysuwa mocne twierdzenia o diachronicznym rozwoju dwóch głównych dialektów jezyka polskiego. W porównaniu z relatywizmem krtaniowym prowadzi on do podobnej struktury systemów dźwiękowych, ze ścisłym rozdzieleniem fonetyki i fonologii, jednak wyjaśnienie zjawisk sandhi umieszcza na styku tych obszarów, a nie w samej fonologii. Z drugiej strony ogólne ramy modelu Onset Prominence wydają się podważać te osiągnięcia, łacząc fonetykę, fonologię i interfejs w jeden system. Rozwiązaniem tego problemu może być założenie, że reprezentacja w tym modelu nie powinna być hierarchiczna, ponieważ odzwierciedla jedynie reprezentację fonetyczną.

#### Słowa kluczowe

cyrkularność, interfejs między fonologią a fonetyką, poziomy wyjaśnienia, prywatywność, realizm krtaniowy, relatywizm krtaniowy, udźwięcznienie międzywyrazowe przed spółgłoskami sonornymi

# 1. Introduction

Part 1 of this article (Cyran 2024) focused on the theoretical aspects of the representation of laryngeal contrasts and their consequences for particular analyses of the pre-sonorant voicing sandhi in two varieties of Polish: Warsaw Polish (WP) and Cracow-Poznań Polish (CPP). The two approaches discussed therein, laryngeal realism and laryngeal relativism, were considered from the point of view of three types of circularity, originating in the assumption that markedness in phonological representations is determined naturally (phonetically) rather than logically (systemically). The three circularity types are repeated in (1) for convenience.

- (1) Three types of circularity due to natural markedness
  - a. *Type 1 circularity (representation)* Phonological representation is read off the phonetic signal.
  - *Type 2 circularity (computation and representation)* Phonetically observed patterns are directly formalized into a phonological system in terms of computation, and, in consequence, also as representation presumed phonological activity.
  - c. *Type 3 circularity (cause-effect flipping)* Effects of a phonological representation or activity are mistaken for the cause.

In the current part we turn to the most recent approach to Polish laryngeal phonology, referred to as new laryngeal realism, in order to compare it to the two earlier perspectives from the point of view of the analytical mechanisms it proposes and the circularity types they entail.

# 2. New laryngeal realism in Onset Prominence

## 2.1. Introduction

New laryngeal realism (see (2c)) fills in a logical typology of representational privative proposals concerning voice languages such as Polish.

(2) Privative representation in voice languages

a.	realism	b.	relativism			c.	new realism
	natural marking		logical marki	ing	r		natural marking
	WP = CPP		WP #	£	CPP		WP = CPP
	$/b^{Lar}/ - /p^{o}/$		$/b^{\rm Lar}/-/p^{\rm o}/$		$/b^{\rm o}/-/p^{\rm Lar}/$		$/b^{o}/-/p^{Lar}/$

In laryngeal realism (2a), which assigns the laryngeal representation – in Trubetzkoyan terms – naturally (based on VOT displacement from neutral), the voiced obstruents in both dialects of Polish are marked. This system is unable to explain pre-sonorant sandhi voicing in CPP, but it neatly covers the WP situation (devoicing sandhi) because the neutral obstruent must be phonetically interpreted as voiceless. The problem with realism is that it suffers from type 1 circularity, and it can only account for the CPP sandhi voicing if it treats it as a phonological process of spreading |Lar|, that is, [voice]/|L| to the final obstruent from the word-initial sonorant (type 2 circularity).

In the relativist analysis (2b), the two dialects have opposite marking synchronically, which is assigned logically on the basis of the behaviour of the whole system. The analysis involves delaryngealization word-finally and treats the pre-sonorant voicing as an instance of regular phonetic

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interpretation of neutral obstruents. This analysis avoids both types of circularity. However, it provokes a number of questions concerning the origin of pre-sonorant voicing and the dialectal division.

As for new realism in (2c), the main representational assumption is that voice languages in fact uniformly mark the voiceless series with a phonological category |Lar|, that is, [fortis] (van der Hulst 2015; Schwartz 2016; Schwartz et al. 2021) or element |H| (Wojtkowiak and Schwartz 2018). Since the neutralized obstruents in such a system should naturally be interpreted as voiced in both dialects of Polish, the pre-sonorant voicing in CPP comes for free, as it were. What requires explanation is the absence of pre-sonorant voicing in WP, and most Slavic languages for that matter. Since the explanation cannot refer to the representation of the laryngeal contrast in obstruents, it is expected that it will be sought elsewhere, namely, in the behaviour of the boundary and/or sonorants, which is the direction taken in Wojtkowiak and Schwartz (2018), where new realism is incorporated into the model called Onset Prominence.

#### 2.2. Onset Prominence

OP is a fairly new, largely representational model of phonology which is, however, firmly grounded in phonetics (Schwartz 2010 et seq.). The prosodic structure used in this model results from two assumptions. The first assumption concerns the representation of segments as larger than one skeletal position. To this end, the universal bi-positional CV syllable is dissected into four stages on the basis of the typical sequence of acoustic events occurring in the signal in an onset-nucleus sequence. Thus, if we take, e.g. the phonetic string [pa], a bipartite CV becomes a prototypical sequence, or in fact, structure: Closure - Noise - Vocalic Onset - Vocalic Target (C-N-VO-VT), which may generally be understood as a division into two consonantal positions and two vocalic ones  $CV \rightarrow C_1 - c_2 - v_3 - V_4$ , except that the  $v_3$  position, possibly better represented as  $c_3/v_3$ , is to a great extent ambiguous as it contains acoustic aspects (vestiges) of the consonant and initial cues of the following vowel, thus constituting a transition phase from a consonant to a vowel instantiated phonetically as, e.g. vowel formant transitions, aspiration, or a glide. The ambiguous VO node may be claimed by consonantal or vocalic features and is extensively utilized in OP to account for a range of prosodic phenomena (e.g. Schwartz 2016; Wojtkowiak 2022).

The potential of the C–N–VO–VT structure as the source of phonetic categories which may be utilized in languages in various ways for expressing phonological distinctions is considerable. It is to some extent comparable to the VOT continuum, along which, contrastive phonetic categories can be established. It may also constitute a viable basis for the phonetic representation that results from implementation. For example, it is a useful structure that may map particular sound properties in their relation to being more vocalic or more consonantal, or in terms of temporal relations. In this sense, it may act as a tool for describing such phenomena as fortition, i.e. becoming more prototypically consonant-like, or lenition, i.e. becoming more prototypically vowel-like, and may constitute the basis for describing sonority relations. In other words, the structure seems to fulfil a number of requirements of phonetic representation as postulated in Ladd (2011).

The second assumption that OP makes is purely theoretical, which will be shown to have phonological consequences. The linear sequence of the acoustic stages is turned into a hierarchical tree-like phonological representation, with Closure at its top (3c). Hence the name of the model: Onset Prominence. The origin of the model is illustrated below. It is a mixture of authentic temporal relations (phonetics) and hierarchical ones (phonology), which do not show the same effects and seem to belong to two different worlds, thus resembling at times, the systematic phonetic representation in generative thinking, containing both phonological and phonetic information. In this sense, the hierarchical tree seems to take on the role of the interface itself.

(3) The origin of Onset Prominence



Given that the representation in (3c) is assumed to be phonological, we will expect it to act in ways phonological. For example, the additional structure (N–VO) should be utilized to express phonological distinctions of discrete nature (contrasts), or at least behave systematically in a given system. It will be shown below that OP representations, as they are understood today, do not seem to fulfil the above conditions.

## 2.3. Laryngeal phonology in OP (new realism)

The representation of laryngeal contrasts in OP can be viewed as essentially privative, monovalent, and to some extent substance-free. The first two aspects of the model are independent of the tree structure in (3c), while the third one, substance-freedom, strictly depends on the context of the OP tree.

Unlike in laryngeal realism, OP assumes that voicing in the voice languages is never due to the presence of a laryngeal feature. Rather, it is an enhanced instantiation of the carrier signal (Traunmüller 1994). An alternative way to understand the relationship between the Modulation Theory and phonological representation is offered in Harris (2009) within the framework of laryngeal realism. Namely, voicelessness in obstruents is viewed as a natural consequence of closure, a gesture resulting from the presence of a phonological feature or features to do with manner of articulation, and the maintenance of voicing in such conditions requires active gestures which are therefore assumed to follow from the presence of active phonological categories, e.g. [voice].

Thus, traditional realism and the new realism of OP differ in the way the active articulatory gestures leading to pre-voicing in obstruents are viewed. They are interpretative (enhanced passive voicing) in new realism and phonological (active voicing) in laryngeal realism. Both approaches, however, are realist in character in the sense that particular phonetic information is taken as unambiguous evidence for the type of laryngeal marking in the phonology. While pre-voicing constitutes positive evidence that a particular object is marked for [voice] in realism, it is positive evidence in OP that the object is unmarked (new realism).

From the point of view of logical vs natural markedness, the new realism of OP, just as the traditional one, seems to be circular (type 1 circularity): the phonological representation is read off the phonetic signal. Below we look at the role of the OP tree in laryngeal representation in a broader context of the familiar VOT typology of two-way systems and explain in what sense the representation may be viewed as substance-free.

## 2.4. VOT typology in OP

One of the most interesting aspects of OP is its expression of some typological and computational aspects of laryngeal phonology. For example, some computation does not even seem to require a formal expression, as we will see below. The VOT-based typology of laryngeal systems, which we saw in laryngeal realism (Section 4.1 of Part 1), looks different in OP. The difference between voice and aspiration systems is expressed not by means of a different category, but by means of the place or level in the OP tree, at which the same category is associated (4). In aspiration systems (4a), |Lar|<sup>2</sup> is located high in the hierarchy, and is assumed to trickle down the tree to VO, thus expressing both the hierarchical and the temporal aspect of aspiration, while in voice systems, the same category |Lar| is present in the voiceless series and lodged at the lowest possible level that can be related to a consonant, the ambiguous VO node (4c). This placement is assumed to prevent aspiration: no trickling up the tree is allowed.

(4) Aspiration vs voice systems (adapted from Wojtkowiak and Schwartz 2018: 135)<sup>3</sup>



The level at which |Lar| is associated, inflexibly producing the distinction between the phonetic category [p] in voice languages and the category [p<sup>h</sup>] in aspiration languages, enforces the phonetic interpretation of the unmarked series as either fully voiced (enhanced voicing) in the former (4d) or a range of phonetic realizations from voiceless unaspirated to voiced in the latter (4b). Thus, the unmarked series may show cross-linguistic differences (Germanic *lenes* vs Slavic voiced), as well as language internal variation (English initial or final vs intervocalic *lenes*). The flexibility of the phonetic interpretation of the unmarked series is assumed to be determined by the amount of phonetic dispersion required in a given system with respect to the stable marked object in particular positions.<sup>4</sup>

<sup>&</sup>lt;sup>2</sup> The bracketed |Lar| points to the lexical location of the laryngeal category.

<sup>&</sup>lt;sup>3</sup> For reasons of space, the graphs in (4) also include the illustration of options that OP considers viable in the absence of a vocalic melody. For example, if the obstruent is word-final, and the VT node is missing, it is assumed that the ambiguous VO may either be missing (cut-off point at solid line) or present (cut-off point at dotted line). The consequences of these options, e.g. with respect to neutralization will be discussed below.

<sup>&</sup>lt;sup>4</sup> The idea that the marked member should produce more stable segments and show less variation, while the unmarked member should exhibit more variation is attractive, but probably also wrong – it is natural and realist, therefore, verging on circularity. The stability or

In aspiration systems, the unmarked series may be sufficiently dispersed as voiceless unaspirated. This is the case in, e.g. Icelandic, which has robust aspiration, both phonetically (size of VOT) and phonologically (distribution).<sup>5</sup> The marked voiceless unaspirated objects, however, may not be sufficiently dispersed in certain contexts in English or German. This leads to positional enhanced passive voicing of the unmarked series, which to some extent points to the possibility that voicing is not just the carrier signal. The enhancement, or its absence is also largely interpretational, that is, dependent on the positional and systemic relation to the other congener. In voice systems, in which the *fortis* series (lodged at VO) are not aspirated, enhancement of the carrier signal to full voicing is enforced by the same mechanism of dispersion.

As we saw above, OP has a strong interpretational, system-specific component rooted in the phonetic (perceptual and articulatory) aspects of a given sound system. However, this component appears to be reserved mainly for the unmarked series. The structural placement of |Lar| in (4a) and (4c) is biuniquely related to aspiration in the former and its absence in the latter, while the same unmarked representation, shown in (4b) and (4d) produces a range of variants cross-linguistically, including pre-voiced (long VOT lead) obstruents as in Slavic, as well as slightly voiced, or even voiceless unaspirated ones as in Germanic. Given that the phonetic interpretation of the same category is rigidly related to its position in the tree, one may conclude that the laryngeal category itself is disassociated from particular melody (aspirated or unaspirated), and therefore to some extent substance-free.

The full potential of the model is yet to be explored, and this is no place to do it. It is worth, however, looking at two interesting effects that this model generates, which will be also relevant for the discussion of pre-sonorant sandhi voicing below. Both points are connected with defective representations in OP, that is, when VT or VO–VT are missing and there is no overt vowel. The first effect concerns the process of delaryngealization in voice languages. It will be recalled that in laryngeal realism and relativism described in Part 1, this process is due to the non-licensing context in front of the final empty nucleus ( $C^{Lar} \rightarrow C^{\circ} / _{O}$ ). Thus, a mechanism of laryngeal licensing has to be evoked as part of the phonological component. In OP, such mechanism appears to be superfluous. The delaryngealization is a natural consequence of the absence of a vowel, assuming that this entails the absence of VO as well (solid line cut-off point in (4c)). The second effect concerns the relation between

instability of particular phonetic categories can easily be related to the phonetic properties and not necessarily to phonological marking.

 $<sup>^5</sup>$  It is interesting to note that voicelessness of obstruents is not always a result of carrier signal modulation due to the presence of the active laryngeal category. If it were, then the Icelandic /p-p<sup>h</sup>/ contrast would have to be expressed non-privatively – by placement of |Lar| contrastively at VO and Closure, respectively.

the representations in (4) and the typological tendency that neutralization is more likely to occur in voice systems as in (4c–d), rather than in aspiration systems (4a–b). Given that word-finally, the absence of the overt vowel means that the nodes VO–VT are empty, deactivated, or simply absent (solid line cut-off curve), for voice languages it means that the |Lar| category is absent as well. At the same time, in aspiration systems, |Lar| remains in the representation because it is lodged at the Closure node, well above the cut-off curve (4a). Thus, the absence of the following vowel is not sufficient to cause neutralization in such systems. Here, the effect of aspiration may be reduced (less space for trickling down the tree), but the contrast is maintained. This appears to be in line with the empirical data concerning neutralization in voice and aspiration systems (e.g. Schwartz et al. 2021), and looks like a welcome prediction.

One may wonder, however, if the typological distinction in question must follow from the phonological representation or computational mechanisms, and cannot be explained in some other way. One possible explanation, independent of any phonological model mentioned above, might be that delaryngealization has a primarily phonetic motivation in the first place, followed, or not, by grammaticalization (cf. Śmiech's analogy in Section 3.2 in Part 1 of the article). The comparison between the spread glottis gesture, which is relatively simple and easy to control physiologically, and the battery of gestures that must be employed as a concerted effort to ensure pre-voicing is clearly one area to look at (e.g. Halle and Stevens 1971). In other words, a possible phonetic explanation of the tendency might be sufficient. This opens the question if in a phonetically-oriented model of phonology, a genuine phonetic explanation should be replaced with phonological formalisms, leading to circularity of type 1, as outlined in (1a) above (cf. Ohala 1990).

### 2.5. FOD and neutralization in voice languages

As mentioned above, the absence of a following vowel has two proposed consequences for the remaining structure – above the curves in (4) – depending on the fate of the ambiguous VO node. The lexical distinction /p/ vs /b/ in Polish is repeated in (5) for convenience. Minimally, the absence of a vowel yields a structure with no VT, in which the cut-off point is illustrated by the dotted curve. VO, with its |Lar| category, remains, and the two representations are still contrastive, except that the distinction is assumed not to be properly enhanced due to the absence of the vowel. The representations in (5a) and (5b) are still different. This configuration describes final obstruent devoicing (FOD) with incomplete neutralization.<sup>6</sup>

<sup>&</sup>lt;sup>6</sup> In essence, this proposal is similar to that in van der Hulst (2015), in which [fortis] is not deleted, but merely unenhanced in word-final position, leaving a trace of the lexical distinction which is observable as incompleteness of neutralization.



(5) Word-final obstruents in a voice language, e.g. Polish

In the extreme case, the cut-off point is placed above VO (solid line curve), which is lost together with its category |Lar|. This configuration also describes FOD, except that absolute neutralization occurs, where the remaining representations are identical in (5a) and (5b). It appears then, that in OP, FOD is related more to the absence of the enhancement context than to the presence or absence of the laryngeal category |Lar| or [fortis] in the structure.<sup>7</sup> One may say that in cases of incomplete neutralization FOD has phonetic conditioning, being caused by the impossibility to disperse an existing contrast, while in neutralization cases it is also phonological – there is nothing to disperse, hence a universal interpretation of the neutral obstruent as voiceless obtains.

At any rate, it is proposed in OP that either degree of structural reduction in (5) can be "selected by the speaker as a possible allophone" (Wojtkowiak and Schwartz 2018: 136), which strongly suggests that the OP trees illustrate externalized phone-based phonetic representations (e.g. Ladd 2011), and belong more to phonetics than to phonology proper. If this is the case, then the privative representation of the laryngeal contrast (b<sup>o</sup> vs p<sup>Lar</sup>) must be viewed as a genuine phonological aspect of laryngeal phonology in OP, while its association within the tree-like hierarchy is non-phonological. This casts doubt on the phonological status of the hierarchy itself. In this respect, the model still requires a phonological computational mechanism of delaryngealization, as well as a new answer to the problem of incomplete neutralization. This is because the trees in (5) show the outcomes of phonetic interpretation: neutralized or non-neutralized, but do not offer an answer as to what causes one or the other.

<sup>&</sup>lt;sup>7</sup> A question arises as to what would be the representation of the absence of FOD in, e.g. Ukrainian and Serbian because, at best, in these languages, we would be dealing with the dotted curve cut-off in (5), which defines incomplete neutralization. One would probably have to say that in such systems the structures, which involve incomplete neutralization and FOD in Polish, are for some reason fully enhanced even if no vowel follows.

The following discussion of pre-sonorant voicing in OP will be restricted to fully neutralized obstruents, as this is what follows from the acoustic study presented in Wojtkowiak and Schwartz (2018). This will also facilitate the comparison between new realism and relativism.

#### 2.6. Pre-sonorant sandhi effects in OP

Given that in OP the representation of the laryngeal contrast, that is, /p<sup>Lar</sup>/ vs /b<sup>o</sup>/, is identical for both Polish dialect groups, the explanation of the dialectal bifurcation into voicing and devoicing sandhi must be sought in the behaviour of the boundary or the representation of the sonorants (cf. (1) in Part 1). At the same time, we know that the phenomenon of pre-sonorant voicing cannot be described as spreading of a [voice] property from the sonorants in this model, because sonorants, just as any voiced segments, are never marked with a laryngeal category. This is a clear advantage of new realism over traditional frameworks. New realism automatically avoids circularity of type 2 (see (1b) above).

What remains as a possible cause of the dialectal variation is the role of the boundary. This intuition seems to be correct. It was also alluded to in Śmiech (1961) and Andersen (1986). Thus, Wojtkowiak and Schwartz (2018) assume that pre-sonorant voicing in CPP is a function of weaker boundaries in this dialect, while the devoicing WP dialect uses stronger boundaries. Admittedly, boundary strength is a rather vague notion, as strength related effects may be contradictory, and depend on the function of the boundary at a particular level of description and in a given model. For example, it will be recalled that in laryngeal relativism (Section 4.2 of Part 1), the morpho-syntactic word boundary is spelled out as a phonological object - final empty nucleus - which phonologically is a weak licenser and triggers delaryngealization of the final obstruent. At the same time the word boundary it defines is strong because it blocks phonological communication with the following context, while being neutral and ignored by phonetic interpretation mechanisms, for example, when the final obstruent is phonetically interpreted across the boundary in the same way as it is word-internally in the phonetic context (R)V.

The problem here is that in OP the representation of any type of boundary is formally difficult because the model avoids abstractness (except for the hierarchical tree) and diacritics such as #, as well as phonologically active but phonetically silent objects such as empty nuclei, or juncture phonemes as in structuralism (e.g. Trager 1962). This is understandable, given that the OP representations are heavily phonetically-based, if not phonetic. Thus, instead, the model strives to derive prosodic effects from different configurations of the OP trees. For this reason, Wojtkowiak and Schwartz (2018) build their analysis of Polish sandhi on the representation of boundary strength as defined in Schwartz (2016), namely, by referring to various degrees of cohesion expressed directly through the representation of segments, the wordinitial segments, to be precise. Thus, the strength of the boundaries in WP and CPP will be expressed by means of representational differences between the word-initial sonorants in the two dialect groups, referring not to laryngeal aspects, but rather to relative prominence. In this respect, Wojtkowiak and Schwartz (2018) want to provide a principled account of the distinction between the two dialects, which remained undefined in Śmiech (1961).

To this end, Wojtkowiak and Schwartz (2018) set up a phonetic study in order to inspect whether the initial segments in the two dialects differ. The authors hypothesize that the word-initial sonorants exhibit significant phonetic differences in terms of acoustic phonetic prominence and assume, following Schwartz (2016), that they also differ phonologically in terms of the arrangement of the OP trees. Then, in turn, "the structural properties of the initial and final segments in a sequence of lexical items play a role in determining whether a prosodic boundary appears between those items" (Schwartz 2016: 61). It is rather clear that what the authors are looking for is boundary signals (Trubetzkoy 1939 (1969); Stieber 1947; Scheer 2011, 2012), that is, phonetic correlates of boundaries, except that the role of these signals is elevated to the role of phonological triggers of boundary construction. In other words, we are dealing with a flipped cause-effect relationship, which was described in (1c) above as circularity of type 3. Since OP cannot represent boundaries as linguistic objects, and boundary strength difference is the only place where the causality can be located, the only logical choice, given that final obstruents are not distinct in the two dialects, is to represent the boundary behaviour on the initial segment of the following word.

In the phonetic study,<sup>8</sup> Wojtkowiak and Schwartz (2018) took measurements of a number of acoustic parameters in a prosodically controlled context of C#R sequences involving speakers of CPP and WP. The second word was minimally tri-syllabic, and its first syllable contained an unstressed vowel. Vowel-initial forms were not included in the study, but the results can be extended to this context (cf. (7) and (8) below), along the lines proposed in Schwartz (2016). The design of the structures is exemplified in (6). The relevant phrases involved lexically voiced and voiceless final obstruents, which were found not to preserve the lexical contrast (contrary to Strycharczuk 2012). For this reason, the final obstruent is neutral or neutralized /C°/. Given that we are in a system in which the voiceless series is marked in both dialects, we expect that the neutral obstruent should naturally be interpreted as voiced

<sup>&</sup>lt;sup>8</sup> In what follows I focus not on the methodology of the study itself but on how the results are used for theorizing about phonological representation and the explanation of the CPP–WP divide.

before a sonorant-initial word (cf. Śmiech 1961; Andersen 1986 in Section 3.2 of Part 1 of the article), which it is, but only in CPP. Therefore, in this analysis, it is the absence of pre-sonorant voicing in WP that requires an explanation.

	V	С	$V_2$	C'	V)	(C	$V_1$	R <sub>1</sub>	(6)Cº #
'raspberry juice'	у	w	0	n	i	1	а	m	sok
'or with raspberry one'	y m	w	0	n	i	1	а	m	lub
'how one cured'	0	n	0	cz			e	1	jak
'of cured people'	y c h	n	0	cz			e	1	osób

The following measurements were taken to test the hypothesis that weaker boundaries in sandhi-voicing dialects correlate with less prominent initial syllables. The first one is the strength of the initial onset ( $R_1$ ). This was calculated as the duration of the word-initial sonorant consonant relative to the duration of the following vowel ( $R_1$ – $V_1$ ). The second measurement concerned the relative prominence of the first vowel. This prominence measurement was calculated as duration, pitch and intensity ratio between the initial vowel and the stressed penultimate one ( $V_1$ – $V_2$ ).

The results of the study show no significant differences concerning the hypothesized strength of the initial sonorants ( $R_1$ ).<sup>9</sup> On the other hand, the first vowel ( $V_1$ ) appeared to be significantly less prominent in CPP than in WP with respect to two acoustic parameters: pitch and intensity ratio between  $V_1$ – $V_2$ . Based on this evidence Wojtkowiak and Schwartz (2018) assume that the left edge of words in Polish dialects has a different representation, encoding a strong boundary in WP and a weak one in CPP. These differences, in turn, lead to different degrees of cohesion between words.

In Schwartz (2016), three degrees of cohesion are defined as structural configurations in OP called *absorption*, *submersion*, and *promotion*.<sup>10</sup> Absorption and promotion are the extreme situations on the scale of cohesion. The former can be viewed as a merger of two incomplete trees into one full C–N–VO–VT structure, expressing close cohesion (weak boundary), and providing the right conditions for the pre-sonorant sandhi voicing in CPP, as demonstrated in (7). Promotion, on the other hand, prevents the merger because one of the trees is already complete. This leads to a strong boundary and the devoicing sandhi in WP, shown in (8). In (7–8) these mechanisms and the proposed analysis are illustrated by means of flattened OP trees for

<sup>&</sup>lt;sup>9</sup> This confirms the claims of Nitsch (1909), as well as the intuitions of Śmiech (1961) that there is nothing in the phonetics of the sonorant consonants that would warrant their different behaviour in WP sandhi from the expected CPP effects.

<sup>&</sup>lt;sup>10</sup> Submersion is not relevant for our discussion. Schwartz (2016) reserves this mechanism for English. Suffice it to say that it is a configuration intermediate between absorbed (close cohesion) and promoted structures (no cohesion).

two reasons. Firstly, in cohesion, we are dealing with a linear overlap of strings, or its absence, which is easier to visualize linearly. Secondly, as I argue below, the repartition of CV into C–N–VO–VT is best viewed as truly temporal and phonetic, rather than hierarchical and phonological structure.

The analysis of CPP is as follows. The final obstruent in *kot* is neutralized to C<sup>o</sup>, which follows from the results of the acoustic study. Thus, both the lexically "voiceless" /t/ in kot and the lexically "voiced" /d/ in sad 'orchard' are now phonologically neutral, as the entire lower-level structure (VO<sub>i</sub>-VT<sub>i</sub>) is missing (shaded) in (7a). As explained above in (5), as per universal default, the final obstruent is phonetically realized as voiceless (FOD), because there is no enhancing context, and, in fact, no contrast to enhance. The concatenation in (7b), on the other hand, shows that the following word Ani 'Anna, gen.sg.' or Radka 'Radek, gen.sg.' is also incomplete. Here, the "upper" part of the structure, that is, C<sub>i</sub>-N<sub>i</sub> is missing (shaded) because sonorants and vowels are typically represented at the VO-VT level. The sequence of the two defective structures in (7b) leads to absorption (merger) into one structure  $C_i - N_i - VO_i - VT_i$  in (7c), which behaves as if there was no boundary between kot / sad and Radka / Ani, e.g. kot Ani /kot°ani/ ↔ [kodani]. This provides a direct context for a lexically neutral as well as neutralized obstruent to be phonetically interpreted as voiced, just as it would word-internally, e.g. ko*dami* /kod<sup>o</sup>am<sup>j</sup>i/ ↔ [kodam<sup>j</sup>i] 'code, pl.instr.'

- (7) kot / sad Radka / Ani in CPP
  - a. Neutralization & FOD

C <sub>i</sub> –	N <sub>i</sub> –	VO <sub>i</sub> –	$VT_i$	'#' <sup>11</sup>
tº/dº		Lar/Ø		
↔[t]				

#### b. Concatenation with unpromoted sonorant-initial words

C <sub>i</sub> –	N <sub>i</sub> –	VO <sub>i</sub> –	$VT_i$	<b>'</b> #'	C <sub>j</sub> –	N <sub>j</sub> –	VO <sub>j</sub> –	$VT_j$	
							а		n i
tº/dº		Lar/Ø					r	а	d k a

c. Absorption & pre-sonorant sandhi voicing

 $\begin{array}{ccccccc} C_i - & N_i - & VO_j - & VT_j \\ | & a & n i \\ t^{o}/d^o & r & a & d k a \\ \leftrightarrow [d] \end{array}$ 

In essence, the analysis of pre-sonorant sandhi voicing in CPP in (7) is parallel to that in Śmiech (1961), Andersen (1986) and Cyran (2011), in that it assumes

<sup>&</sup>lt;sup>11</sup> '#' is used here only for clarity, to show where the word boundary lies.

a privative representation of the laryngeal contrast in which the voiceless series is lexically marked. It also allows for the possibility that the contrast is neutralized, which is taken to be the necessary condition in the other analyses. The pre-sonorant voicing comes for free in this analysis and requires no spreading of voicing from the following sonorant, making it superior to the standard realist approach to Polish voicing (e.g. Gussmann 2007).

We are ready to look at the analysis of WP in (8). Firstly, FOD in this dialect receives the same interpretation as in CPP, as shown in (8a). On the other hand, the analysis of the devoicing sandhi in WP is based on the assumption that no absorption can occur because of the promoted structure of the initial sonorants in this dialect. They are promoted from the typical VO to the now activated Closure node (8b). This has a phonetic effect of glottalization in Ania ( $-VO_{lal}-VT \rightarrow C_{(2)}-N-VO_{lal}-VT$ ). In the case of Radek, there is no phonetic effect on the strengthened [r] in Radek ( $-VO_{ir}-VT \rightarrow$  $C_{(r)}$ -N-VO<sub>[r]</sub>-VT). However, the promoted sonorant structures have an effect on cohesion. With the active Closure node in Ania and Radek in this dialect, the structure is not sub-minimal, and therefore, it cannot undergo absorption with *kot / sad*. Thus, the phonetic differences in prominence, which were only found on the first vowel in the experimental study, are represented phonologically on the sonorant consonants. This way, promotion allows Wojtkowiak and Schwartz (2018) to define the structural unity between initial vowels and other sonorants in WP. The absence of close cohesion in WP precludes the enhancement of final Cº and leads to the same effect as phrasefinally, that is, FOD, and consequently, to the devoicing sandhi.

- (8) kot / sad Radka / Ani in Warsaw Polish
  - a. Neutralization & FOD

 $\begin{array}{ccccccc} C - & N - & VO - & VT & `#' \\ | & & | & & \\ t^{o}/d^{o} & & Lar/\emptyset & & \\ \leftrightarrow [t] & & \end{array}$ 

b. Concatenation with promoted sonorant-initial words

С –	N –	VO –	VT	'#'	С –	N –	VO –	VT	
					?		а		n i
tº/dº		Lar/Ø			r		r	а	d k a
↔[t]									

Strong boundary, devoicing sandhi

One advantage of this analysis is that it provides structural means for expressing the uniform behaviour of initial sonorants in WP as opposed to CPP, for which Śmiech (1961) had to refer to some undefined mechanisms of analogy. It seems that the distinction between the representations of absorbed and promoted sonorants in (7) and (8) plays a systemic role, and is divorced from regular phonetic correlates: the initial vowels in WP need not be glottalized to trigger devoicing sandhi, and the sonorant consonants are no different from those in CPP. This would have been a welcome result phonologically in general, if it could be shown to work systematically.

As for the status of absorption and promotion, Wojtkowiak and Schwartz rather vaguely assume that these "are not processes in synchronic grammar. Rather, they are diachronic operations that create templates for the structure of prosodic constituents" (Wojtkowiak and Schwartz 2018: 138). I will return to the vague status of these structural phenomena below, arguing that, despite a diachronic origin, they may well be synchronic processes, except that they are neither phonological nor phonetic. They may be viewed as genuine effects of the interface that operate synchronically on the phonological structures to yield the phonetic one, say, similar to the OP sequence C–N–VO–VT.

# 3. Phonology, phonetics and the interfaces in pre-sonorant sandhi

While the above OP analysis, as illustrated in (7) and (8), appears to tap into correct intuitions about the role of the word boundary, there are a number of problems which follow from the phonetic approach and circularity in arriving at the phonological representation and causality. I will attempt to demonstrate why certain aspects of this analysis are simply wrong, but also suggest how the analysis could be amended by identifying what is truly phonological in OP, what is still missing there, what seems to be the status of the OP trees, and what advances can be made with respect to the understanding of the sandhi phenomena in Polish given the new realist assumption about the representation of the laryngeal contrast. I would like to claim that all the problems with the OP analysis of Polish laryngeal phonology follow from the assumption that one can find direct phonetic evidence for phonological representations. This single assumption, inherent in realist thinking, leads directly to the three types of circularity defined in (1) above, and ultimately, to a series of inconsistencies and ambiguities that undermine the real import of the proposal at hand.

## 3.1. It is "either-or" not "more-or-less"

One of the vague aspects of the OP analysis of pre-sonorant sandhi in Polish follows from the treatment of relative rather than absolute values of certain phonetic parameters as evidence for phonological decisions. The remarkable example of this is the reference to relative prominence of initial syllables determining relative strength of the boundaries in the two dialects. First of all, it must be assumed that normally, during acquisition the speaker of a given dialect of Polish has no or little access to the significant differences in prominence between WP and CPP. In fact, within a single dialect, relative prominence of the first vowel is unlikely to constitute evidence for anything. The context studied in Wojtkowiak and Schwartz (2018), that is, #RV,(CV)C'VCV involving an unstressed vowel V<sub>1</sub>, is one of a few possibilities, all of which exhibit a range of prominence values but participate in the dialectal division in equal measure: they have nothing to do with the causality of the phenomena. For example, the first syllable of the second word in the sandhi configuration ... C#(R)V... can also bear primary stress, that is, #'RV<sub>1</sub>CV, as in *mama* 'mother', or conversely, it may belong to a stressless enclitic, e.g. -my 'us', as in *nieś-my* 'let's carry', where the relative prominence cannot even be measured because there is no other vowel in the enclitic. Thus we have a range of prominence values within a single dialect, which can be measured in some way, but no absolute one which would point to one or the other dialect. The relative higher prominence in WP can only be established when two dialects are scrutinized and compared. What unites these contexts is that they are preceded by a word boundary, and that they constitute the environment for devoicing sandhi in WP and voicing sandhi in CPP. If relative prominence constituted any cue to boundary strength in the linguistic sense, and therefore, determined the presence or absence of voicing sandhi, we would expect WP speakers to produce sandhi voicing sporadically at least in the weakest prosodic configurations. However the facts seem to be binary, either speakers do voice the obstruents (CPP), or they do not (WP).

Phonetic gradience may have an effect on the regularity of voicing, or on the relative amount of voicing in the preceding obstruent within CPP, as evidenced by the results obtained by Wojtkowiak and Schwartz (2018) in the context of the second word beginning with /m/ or /j/. However, crossdialectally, /m/ which is claimed to have an activated Closure node, thus being an inherently promoted sonorant, does not preclude voicing in CPP, while /j/, which is inherently more sonorous, and "less likely to undergo promotion" (Wojtkowiak and Schwartz 2018: 140), does not induce voicing in WP. All the above observations clearly point to the fact that the systemic decision as to the division between WP and CPP is made elsewhere. Learners of a particular dialect may well ignore the relative prominence or relative sonority stories and treat them as they should: as phonetic correlates of something more fundamental. They are either correlates of the fact that the preceding word-final obstruent is pronounced as voiced or voiceless (Kohler 1982), in which case the causality is not related to the initial sonorant, but to the final obstruent, or a result of the way in which the boundary – it is the same word boundary in both dialects – is signalled. In other words, the causality may be phonological (cf. relativism) or belong to the interface, in which case, new realism points to a possibility that has not been sufficiently considered so far in theoretical phonology.<sup>12</sup>

#### 3.2. Promoted sonorants do not construct boundaries

There would be no theoretical problem with the representation of the promoted sonorants in WP if they were a mere illustration of the left edge of words at the phonetic level. However, it will be recalled that Wojtkowiak and Schwartz (2018) have not found any significant differences between the sonorant consonants in WP and CPP. The point of introducing the representational distinction between the promoted sonorants in WP and the unpromoted ones in CPP was to place sonorant consonants in line with the vowel initial forms in the two dialects - pre-glottalized in WP, and not pre-glottalized in CPP - and to unify the representational contexts responsible for the dialectal division. In other words, the motivation was phonological. Promotion as a mechanism representing strength is not meant to be a mere description of phonetic correlates corresponding to independently established boundary types. It is the cause, producing the different boundary types in this analysis: "The phonological shape of words, and therefore the boundaries between them, is determined by mechanisms such as absorption and promotion" (Wojtkowiak and Schwartz 2018: 138).

Once the structure of promoted sonorants is assumed to play a phonological role of defining strong boundaries in WP, we may expect that every time we meet that representation, it will behave in a uniform way: a strong word boundary is erected. It can be easily demonstrated that sonorant promotion is an unlikely phonological mechanism constructing word boundaries, or stronger word boundaries. The latter must be somehow represented independently. First of all, word boundaries are needed in CPP as well, if only to cause delaryngealization of final obstruents in that context. In other words, at some level of linguistic representation, which is as yet undefined in OP, both dialects possess a word boundary which acts differently from

<sup>&</sup>lt;sup>12</sup> A notable exception is Keating (1984), emphasizing the need for a complex structure of implementation of phonological [voice].

other types of boundaries, that is, suffix and proclitic boundaries, but rather uniformly across dialects.

Secondly, if word-initial promoted sonorants were a representational means to express the same causality as the diacritic #, the juncture phoneme, or the final empty nucleus, one would expect systematic behaviour of such structures. Namely, each time the promoted sonorant structure is proposed, it should mean that it follows, or in fact constructs a strong word boundary. This cannot be true. For example, it would automatically eliminate the difference between word boundaries and pro-clictic boundaries in Polish and also construct word boundaries inside words. As for the former case, the short pro-clitics in Polish, for example, the preposition od 'from', or the prefix od-, end in a voiced obstruent. When followed by sonorant-initial words, e.g. od Radka 'from Radek', od Jadzi 'from Jadzia' and odrobić make up', odjechać 'go away', the obstruents remain voiced in normal speech. This is expected in CPP, but should not be possible in WP in which Radek and Jadzia must have a promoted initial sonorant defining a strong boundary according to OP. We should expect the same effect as in (8b): the final obstruent in *od* should be part of a defective tree (with missing VO-VT), which should not absorb the promoted /r/ and /j/ from Radek and Jadzia and consequently lead to devoicing.

Promoted sonorant structure is used elsewhere in OP analyses of Polish in ways inconsistent with the analysis of Wojtkowiak and Schwartz (2018). In Schwartz (2016: 59), promoted /r/ is postulated for both Polish dialects inside words like gra 'game' and kra 'ice floe' to distinguish temporal articulatory differences between Polish and English TR clusters. Again, no boundary, or boundary strength distinctions can be even referred to here because it is a word-medial context. Thus, the promoted representation has no phonological consequences, and does not define the difference between Polish dialects. Like in pro-clitics, the structure of promoted sonorants in kra and gra is of no consequence to the laryngeal distinction on the preceding obstruents, though it may express the phonetic fact of a looser articulatory cohesion in TR clusters in Polish as compared to English. But this is a phonetic, or interpretational fact. For reasons given above, it cannot be phonological. Finally, the pre-vocalic gliding in the Wielkopolska variety of Polish, which is part of CPP, is also represented as a promoted glide with activated Closure in (Schwartz 2016: 67), e.g. okno [wokno]'window'. Recall that this is the dialect in which promotion is not expected as it would block the expected presonorant sandhi voicing.

Examples of similar inconsistencies in OP can be multiplied. What is important, however, is to understand the source of these problems, and discern the real import of the analysis and some of its assumptions, once all

the elements of the laryngeal system in new realism click into their correct place. I would like to claim that the explanations are inconsistent because they are derived from phonetic detail translated into phonological hierarchical structure and elevated in status from being effects ("go hand in hand," Wojtkowiak and Schwartz 2018: 123) to being the cause (type 3 circularity). The problems disappear once we assume that the OP trees are not phonological, but phonetic. Then, the question is whether the hierarchical trees express anything that a temporal linear sequence C–N–VO–VT would not, once it is viewed as a result of phonetic interpretation or spellout of phonological representations, where the latter need not even resemble the C–N–VO–VT sequence. In conclusion, the notion of word-boundary and its relative strength still requires a linguistic explanation, but this cannot be achieved as a bottom-up projection of phonetic detail.

All of the above does not mean that the intuitions of Wojtkowiak and Schwartz (2018) are wrong. Their initial hypothesis that sandhi-voicing dialects have weaker boundaries still stands and may still be expressible in OP. What is more, it can be explanatory, and the new realism of OP points to the place to look for the answers. Before we continue, it is important to remind ourselves that the real challenge for new realism and OP is not how to voice obstruents in pre-sonorant sandhi in CPP – this comes for free – but how to devoice them in WP, once we know that the answer is not in the phone-based representation C–N–VO–VT.

## 3.3. New realism and the structure of laryngeal systems

I would like to begin by claiming that the general structure of the sound system that emerges from the analysis in Wojtkowiak and Schwartz (2018) contains elements which are very promising theoretically, but they need clarification. Namely, one can identify truly phonological, clearly phonetic, and obviously implementational (interface) aspects of the laryngeal system of Polish, that, if developed along the scheme in (9) below, can potentially lead to interesting new questions about the interface. This structure emerges as an automatic result of a single linguistic assumption: privativity.

(9)	The structur	e of	laryngeal systems and OP		
	phonology	$\leftarrow$	implementation	$\rightarrow$	phonetics
	privativity		mechanisms of enhance-		phone-based representation
	/C <sup>Lar</sup> vs C <sup>o</sup> /		ment and spell-out		[C-N-VO-VT]

Truly phonological is the new realist assumption that a two-way laryngeal contrast is privative ( $C^{Lar}$  vs  $C^{\circ}$ ). Recall that in laryngeal relativism (Section 4.2 of Part 1) this is the point at which the marking decision can

only be logical, predicting that the so-called voice languages can be either /b<sup>Lar</sup>/ vs /p<sup>o</sup>/ or /p<sup>Lar</sup>/ vs /b<sup>o</sup>/. In laryngeal realism, in general, the decision concerning the actual marking in voice languages is made on the basis of some aspects of phonetic theory, and, consequently, follows from the phonetic signal, thus moving away from logical marking. In traditional realism, the phonetic grounding is based on the VOT continuum and the assumption that full voicing constitutes phonetic displacement from the neutral, short positive VOT, and should be marked  $(/b^{Lar}/ vs /p^o/)$ . On the other hand, in new realism, the decision is made on the basis of a particular interpretation of the Modulation Theory that has led to the opposite conclusions and reversed marking  $(/p^{Lar}/vs/b^{\circ})$ . While the decision concerning privativity is purely linguistic (top-down), the fact that both types of realism rely on the phonetic signal in deciding on the actual phonological representation links these approaches firmly with natural (bottom-up) markedness, which leads to circularity of type 1. Despite this drawback, new realism also has advantages. It fares better than traditional realism in handling pre-sonorant sandhi voicing. It is also fully compatible with the development of the two dialects as proposed in Śmiech (1961) and Andersen (1986). The view that there was, and perhaps still is, a single representation for both CPP and WP, that is, /p<sup>Lar</sup>/ vs /b<sup>o</sup>/ seems more viable diachronically than the relativist proposal, which assumes opposite marking in the two dialects (see Section 4.2 of Part 1).

What the phonological side in OP lacks, however, is first of all a linguistic mechanism responsible for the distribution of |Lar|, and hence delaryngealization, including a new explanation of incomplete neutralization, which would not simply state that obstruents sometimes are, and sometimes are not neutralized in the phonetic representation, see "the choice of allophones" (Wojtkowiak and Schwartz 2018: 140) illustrated in (5) above. Secondly, OP still needs a linguistic representation of the word boundary, which would behave differently from the pro-clitic one, and would not be represented on the initial segments of words, as shown above. One option is that the boundary information is shipped from morpho-syntax to phonology (e.g. Scheer 2011, 2012), in which case we need a phonological object that unambiguously leads to the boundary effects such as delaryngealization of the obstruents in front of it, and is subject to varied phonetic interpretation resulting in different phonetic correlates on the first syllable of the following word. Alternatively, the morpho-syntactic representation is itself in some way taken into account in the phonetic interpretation of phrases. Both options are open to further research.

Like any other privative, monovalent and non-derivational model, new realism in OP relies on implementation statements concerning the phonetic interpretation of the unmarked  $/C^{\circ}/$ . Some principles, e.g. contrast

enhancement, were mentioned in the previous sections, highlighting the role of the context \_(R)V at the phonological and phonetic level. Thus, in general, most of the structure of the laryngeal system in OP in (9) is already in place. All that is required is explicitness as to the status of each of its elements. As for the nature of the implementation, it appears to be a genuine interface mechanism that takes the phonological representation as input and yields (spells-out) the phonetic representation C–N–VO–VT respecting language-specific and universal phonetic conditioning to do with production and perception of speech. Focusing only on the production side of phonetic interpretation, e.g. articulatory planning we may note that this aspect of the interface between phonology and phonetics seems to be connected with the OP mechanisms of absorption, submersion, and promotion.

#### 3.4. Cohesion as interpretation windows?

The different levels of cohesion referred to as absorption, submersion, and promotion constitute another interesting intuition which is assumed to follow from the way the OP trees interact (Schwartz 2016). Their status, however, is also vague, mainly because of the fact that the OP trees conflate the tripartite structure in (9) into one. Recall that Wojtkowiak and Schwartz assume that absorption and promotion are not processes in synchronic grammar and refer vaguely to their diachronic origin and templatic nature (Wojtkowiak and Schwartz 2018: 138). The status of these mechanisms, however, becomes clearer under the scheme in (9), which takes into account the truly phonological new realist assumption concerning the representation of the laryngeal contrast in voice languages. Thus, the effect of absorption in (7c) and its absence in (8b) above can be viewed as an illustration of the phonetic outcome of mechanisms which operate elsewhere. The scheme in (9) restricts possible options. Either the causality of absorption and its absence is interpretational, or it is phonological.

The matter requires further study. It seems, however, that in new realism the distinction between WP and CPP can only be explained by reference to implementational mechanisms, and not to phonology, or phonetics. The phonological conditions seem to be the same in the two dialects. The laryngeal contrast is expressed as  $/p^{Lar}/vs /b^o/$ , the final obstruent is neutralized in the word-final context, and it is expected to be interpreted as voiced when followed by a sonorant-initial word, that is, \_(R)V. At the same time, the absence of following phonetic material leads to FOD: the neutralized /C<sup>o</sup>/ is phonetically interpreted as voiceless in both CPP (7a) and WP (8a). Given that the explanation of the dialectal distinction can only be implementational, one may hypothesize that in WP the domain of phonetic interpretation does not reach beyond the word boundary, while in CPP the boundary is ignored. This is illustrated in (10). (10) Interpretation windows<sup>13</sup> in WP and CPP

a. WP	kət°	<b>'</b> #'	radka
b. CPP	kət°	<b>'</b> #'	radka

The difference lies in the scope of the interpretation window, which may be viewed as following from the treatment of the boundary as visible or invisible for the purposes of articulatory planning. The string /kɔtº/ in WP has to be interpreted as if there was nothing following. This situation is parallel to cycles in phonology, or phases in syntax. The distinction may have indeed developed historically, as suggested by Wojtkowiak and Schwartz (2018), and may have been caused by the mechanisms proposed in Śmiech (1961), which were initially phonetic. That is, first the initial vowels in WP started to be glottalized and introduced devoicing sandhi in that dialect. This was then codified a level higher - as an interpretative mechanism - to systematize the sandhi effects in the pre-sonorant context, not as an arbitrary rule, but as a mechanism of an interpretative cycle. The boundary plays two roles here: it causes delaryngealization of the final consonant in both dialects, and closes the interpretation window in WP. The fact that '#' does not close the interpretation domain in CPP can be viewed as a parametric choice: boundaries do or do not close interpretation cycles.<sup>14</sup>

To conclude, the new realist assumption concerning the privative representation of the laryngeal contrast in Polish directly and logically leads to the architecture of laryngeal systems in (9), which is predicted by any privative model of representation, and the solution to the WP–CPP divide in (10), by pointing to the interface character of the phenomena at hand. As a result, the relative prominence of the first syllable in WP may now be viewed as a phonetic correlate of the left edge of an interpretational domain. This way we get the effect that boundary signals are phonetic correlates of something that is not physically present (cf. Scheer 2011). It should perhaps be added that the most conspicuous correlates of a word boundary are the sandhi patterns themselves, with neutralization of the lexical contrast.

<sup>&</sup>lt;sup>13</sup> The term is not accidental. It refers to similar temporal aspects of phonetic interpretation that are observed at various levels of representation, including the segmental one (e.g. Keating 1990; Cho and Ladefoged 1999).

<sup>&</sup>lt;sup>14</sup> A Reviewer rightly points out that this reference to interpretative windows verges on circularity. Firstly, the three types of circularity listed in (1) refer to phonetically based consequences for the phonological structure. Here, the phonology is the same for both dialects, but subject to different interpretation at the interface. The principles of phonetic implementation in privative models adhering to non-specification require further study, and possibly different methodology. Some evidence for the existence of interpretational windows in Polish comes from the presence of place assimilation across morpheme boundaries in southern Polish (CPP), e.g. *panien-ka* [paŋɛŋka] 'young girl', and its absence in standard varieties (WP), e.g. [paŋɛŋka] (cf. Gussmann 2007: 301).

### 3.5. Some predictions of new laryngeal realism and relativism

It follows from the discussion in this paper that currently there are two viable and competing representation-based proposals concerning the distinction between WP and CPP in pre-sonorant sandhi, that is, new realism (Wojtkowiak and Schwartz 2018), as amended above, and laryngeal relativism (Cyran 2011, 2014). Both stem from a single representational assumption, namely, privativity, which enforces the tripartite structure of the laryngeal systems in (9). However, they differ on how the marking is established, and consequently, make different predictions about the placement of the causes of the dialectal distinction in modern Polish, as well as about the diachronic developments that led to it.

In new realism the marking is natural. It is grounded in phonetic theory and based on the phonetic signal: the presence of voicing is evidence for being unmarked. Both diachronically and synchronically, WP and CPP have the same representation of obstruents, that is,  $/p^{Lar}/vs/b^o/$ , and the dialectal distinction is made between phonology and phonetics, that is, at the interface. It can be concluded that OP, which is in general independent of the privative assumption, but adheres to new realism, still needs to propose some non-phonetic means of representing the word boundary so that the interpretational rules (or windows) can refer to it in WP (10a), and ignore it in CPP (10b).

While the natural marking in new realism involves circularity of type 1, it makes strong predictions about the nature of the interface, e.g. the interpretational windows in (10), but also about the diachronic development of Polish after the loss of jers and consequently the introduction of phenomena such as FOD and sandhi voicing. In this model, there is no need to claim that, at the earlier stages, Polish was a protensity or aspiration system  $[p^h-b]$ . It may have been a voice system like today's [p-b] with the new realist marking  $/p^{Lar}/vs /b^o/$ , which guaranteed pre-sonorant sandhi voicing, once final jers were lost and final obstruents started to be neutralized in final position. This model is also compatible with the phonetically based explanation of the innovation in WP, which led to two interpretative systems in (10), where the difference follows from the interpretation of the word boundary. Given the importance of the boundary, OP needs to clarify what it is.

In relativism (Section 4.2 of Part 1), on the other hand, the marking is logical in Trubetzkoyan sense. It is systemic, or linguistic, and not phonetically-based. The synchronic difference between the dialects is phonological and lies in the opposite representation of the contrast: WP has  $/p^{o}/$  vs  $/b^{Lar}/$  and CPP is  $/p^{Lar}/$  vs  $/b^{o}/$ . Thus the locus of explanation is in the phonological representation of the laryngeal contrast in obstruents and not in the treatment of the boundary at the interface with phonetics. The interpretative windows are not necessary in relativism. The boundary effects observed in

Wojtkowiak and Schwartz (2018) would be viewed as following from the interpretation of the final obstruent as voiceless in WP and voiced in CPP (cf. Kohler 1982). The morpho-syntactic information of the word-boundary is shipped to phonology as the final empty nucleus ( $\emptyset_{\text{FEN}}$ ), where it acts identically in WP and CPP: it causes delaryngealization of the final obstruent and is invisible to phonetic interpretation.

The logical markedness in relativism avoids all the types of circularity in (1), but also spawns a number of questions. One of them concerns the nature of linguistic evidence and how it differs from phonetically observed patterns and phenomena. Consequently, a question arises as to the result of such marking in the absence of overt linguistic evidence pointing to one or the other series of obstruents. Such situation may have been present in Polish before the loss of jers, when there was no FOD, and consequently no sandhi involving word-final obstruents. Unless the role of linguistic evidence in logical marking is clarified, the model predicts that in the absence of linguistic evidence, except that there is a two-way contrast /b/ vs /p/, it is next to impossible to decide, or, it does not matter phonologically which congener is marked. The question now is: how do we know it is a bad thing? It is true that the diachronic development in such a model will have to be more chaotic. We can no longer rely on the automatic voicing sandhi in all dialects of Polish after the loss of jers and the phonetically triggered innovation of WP, as we saw in new realism above.

These questions cannot be addressed in the present paper, but they constitute interesting directions in which research can proceed. Laryngeal relativism constitutes an extreme position on markedness, freeing it completely from obvious phonetic evidence, but also allowing one to formulate new questions that are worth pursuing. One place to look for potential answers are systems, which, like earlier Polish, are in transition and are taking the first steps in the evolution of a new laryngeal system. One example could be Macedonian, in which word-final obstruents undergo FOD, suggesting delaryngealization, while pre-sonorant sandhi shows patterns of contrast maintenance suggesting absence of delaryngealization (Korytowska 2012: 19). A closer typological look at such systems holds out the promise of resolving the problems sketched above.

# 4. Conclusions

The pre-sonorant sandhi patterns in Polish constitute a package of effects which seem to be controlled from different levels of linguistic analysis. The phonetic level (level I in (11) below) contributes to the understanding of some of the sound patterns, for example, the phenomena of assimilation that follow from the fact that WP and CPP are both voice systems, but it has its

limitations which become obvious once a typological variation is taken into account that cannot be generated under the same physical conditions. For example, final obstruent devoicing in Polish may appear to be a phonetically natural phenomenon, but then its absence in Ukrainian and Serbian must be assumed to be controlled outside or above phonetics, enforcing contrast maintenance. Something allows for delaryngealization in the former system, but not in the latter two. A similar problem for phonetic explanation arises in the dialectal distinction between WP and CPP with respect to pre-sonorant sandhi. Only one of these patterns can be phonetically natural under given conditions, and the explanation of the other must assume powers above phonetics, that is, at level II or III in (11). The problem at this point is that, contrary to popular belief, the higher levels are unapproachable directly from phonetics (bottom-up) without falling into some degree of circularity.

Representation-based models of phonology, especially those assuming privativity, offer a top-down view which, instead of excluding the bottomup perspective, defines the meeting point between the sharply distinguished phonology and phonetics. The scheme below does not exclude phonetic explanation or possible phonetic causes of linguistic innovation. However, it points to what status such phonetic patterns should be translated to when they are taken higher. They may either be encoded as interface mechanisms at level II, with no phonological distinctions involved, as in new realism (11a), or in the phonology (level III), as in laryngeal relativism (11b).

(11) Three levels of explanation and pre-sonorant sandhi

<i>Level III</i> phonology	$\begin{array}{ll} Level \ II \\ \leftarrow & \text{interface} & \rightarrow \end{array}$	<i>Level I</i> phonetics
privativity /C <sup>Lar</sup> vs C <sup>o</sup> /	<ul> <li>spell-out mechanisms</li> <li>enhancement</li> <li>articulation planning</li> <li>(interpretation windows)</li> </ul>	<ul> <li>phone-based representation</li> <li>(C-N-VO-VT)</li> <li>coarticulation (assimilations)</li> <li>voice system (d-t)</li> </ul>
a. new realism WP = CPP	WP ≠ CPP	WP = CPP
b. relativism WP ≠ CPP	WP = CPP	WP = CPP

The graph in (11) clearly shows the general problem with the OP model with respect to the analysis of pre-sonorant sandhi in Polish. The problem is that the hierarchical trees in OP conflate the phonetic representation, which should be phone-based and devoid of abstract, hierarchical, prosodic or other linguistic information (level I), with the phonological representation (level III), thus also losing sight of some of the interface (level II). It is this conflation that introduces vagueness concerning the status of delaryngealization, or the status of absorption and promotion discussed above. On the other hand, the privativity assumption in new realism automatically leads to the tripartite model whose predictions are clear and comparable with, e.g. relativism. This architecture points to the locus of explanation of the sandhi patterns in Polish. In new realism, it is placed where the two dialects differ, that is, at the interface. In relativism, on the other hand, the explanation is located in the phonology allowing the interface to be the same in both dialects.<sup>15</sup> Thus, the predictions made by the two assumptions are different, fairly clear and amenable to further theoretical and empirical testing.

Returning to circularity, it is not a yardstick for rating models, but it is a good indication that a particular model is unable to unambiguously separate phonology and phonetics, which in turn leads to various inconsistencies and lowers the explanatory value of a given analysis. Circularity appears to be an inherent property of laryngeal realism due to natural marking. It must be stressed, however, that new realism (van der Hulst 2015; Schwartz 2016; Schwartz et al. 2021), in which voicing is never marked phonologically, makes interesting predictions about the diachronic shifts leading to pre-sonorant sandhi in Polish. As claimed above, circularity can be eliminated if privative marking is by principle logical, as in laryngeal relativism. This extreme view forces us to return to the question: what constitutes linguistic evidence in phonology if not phonetic forms? The sharper the distinction between phonology and phonetics the more obvious it becomes that sound systems need a well-defined interface. One can think of two reasons why interfaces are neglected in modern phonology. Firstly, if the phonological framework is unclear about the division between phonology and phonetics, it cannot identify what belongs to the interface. Secondly, the interface between phonology and phonetics may at times resemble rules, often seemingly or overtly arbitrary, which renders them theoretically unattractive.

<sup>&</sup>lt;sup>15</sup> This may turn out to be a welcome result, given the existence of regressive voicing assimilation in pre-obstruent sandhi context in both dialects, e.g. *brat Basi* [brad baci] 'Barbara's brother'. If interpretation windows block coarticulation, one should expect this assimilation to be absent from WP.

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