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Consonantal Structures in Phonetics and Phonology: Cases from Slavic languages*

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Abstract

The purpose of this study is to present and compare two different approaches (a phonetic approach and a phonological one) for the speech sound systems of natural languages. To this end, this study investigates natural speech sound systems with the consonantal systems of four Slavic languages, Russian, Polish, Czech and Serbian and Croatian, on the basis of phonetic and phonological approaches. In the phonetic approach, the consonant inventories of the four Slavic languages are analyzed with the theory of maximal and sufficient dispersion and the size principle, together with a frequency-based statistical approach. Segmental universals are discussed regarding sound types such as obstruents and sonorants. From the phonetic approach, it is shown that Slavic consonant systems are very unusual in terms of natural languages. Palatalized sounds in Russian and affricates and fricatives in Russian and Polish support that the Slavic consonantal system is far removed from the general aspect of human languages. On the other hand, with the phonological approach, four of the five feature-based principles proposed by Clements are employed to reveal the universals of the languages. They are Feature Economy, Marked Feature Avoidance, Robustness and Phonological enhancement. What we have seen is that some unsolved problems from the phonetic approach are explained by phonological accounts. The fact that Russian has plenty of segments represented by [+palatal] may not be unusual with respect to a feature-based approach. In addition, while the phonetic approach claims that Slavic languages (in particular, Russian and Polish) have different consonantal systems from the general aspect of natural languages because of the marked segments, the phonological approach accounts for the universals of these languages in the light of Robustness and Feature Economy. In short, what we get from phonetic accounts are language universals, found by frequency-based statistical approach while what we get from phonological accounts, using a feature-based approach, are linguistic universals.

Keywords: consonantal systems of Slavic languages, phonetic universals for Slavic consonants, distinctive features, feature economy, marked feature avoidance robustness, phonological enhancement

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1. Introduction

There are two different approaches for explaining the speech sound systems of natural languages. One is a phonetic approach, and the other is phonological. As for the former, it is said that sound systems are structured by seeking points of contact in trade-offs between the 'ease of articulation" by which similar sounds or simple sounds are preferred which are easier to pronounce (articulatory economy) and 'perceptual salience" by which very different sounds or complex sounds are preferred to provide listeners perceptional saliency (maximum or sufficient acoustic distance). As for the latter, it is claimed that languages tend to organize their sound structures according to feature-based principles such as feature economy. This paper compares two claims regarding the research of natural speech sound systems with the consonantal systems of four Slavic languages; Russian, Polish, Czech and Serbian and Croatian.

2. Consonantal Systems

Russian, Polish, Czech and Serbian and Croatian have different consonantal system inventories. The (standard) systems of four languages are shown in Tables 1-3.

Table 1. The Russian consonantal system (after Yanushevskaya and Bunčić).

	Bilabial	Labiodental	Dental	Post-alveolar	Palatal	Velar
Plosive	P b pʲ bʲ		t d tʲ dʲ			k g kʲ
Affricate			ʦ	ʧ		
Fricative		f v fʲ vʲ	s z sʲ zʲ	ʃ ʒ ʃː		x xʲ
Nasal	m mʲ		n nʲ			
Trill			r rʲ			
Approximant					j	
Lateral Approximant			l lʲ			

Table 2. The Polish consonantal system (after Jassem).

	Bilabial	Labio-dental	(Post-) dental	Alveolar	Alveolar-palatal	Palatal	Velar
Plosive	p b		t d			c ɟ	k g
Affricate			ʦ ʣ	ʧ ʤ	ʨ ʥ		
Fricative		f v	s z	ʃ ʒ	ɕ ʑ		x
Nasal	m		n		ɲ		ŋ
Lateral			l				
Flap/Trill				r			
		Front			Back		
Approximant		j(j̃)			w(w̃)		

Table 3. The Czech (in Bohemia and Moravia) consonantal system (after Šimáčková *et al.*).

	Bilabial	Labio-dental	Alveolar	Post-alveolar	Palatal	Velar	Glottal
Plosive	p b		t d		c ɟ	k (g)	
Affricate			ʦ (ʣ)	ʧ (ʤ)			
Fricative		f v	s z	ʃ ʒ		x	ɦ
Nasal	m		n		ɲ		
Trill			r				
Approximant					j		
Lateral approximant			l				

Table 4. The Serbian and Croatian consonantal system (after Landau *et al.* 1995; 2009).

	Bilabial	Labio-dental	Dental	Alveolar	Post-alveolar	Palatal	Velar
Plosive	p b		t d				k g
Affricate				ʦ	ʧ ʤ	ʨ ʥ	
Fricative		f		s z	ʃ ʒ		X
Nasal	m			n		ɲ	
Trill				r			
Approximant		ʋ				j	
Lateral approximant				l		ʎ	

3. The Phonetic Approach to the Consonantal Systems of the Slavic Languages

As mentioned above, phonetic accounts of sound structures are based on a principle of maximal or sufficient dispersion, or contrast (Lindblom 1986; 1992; Lindblom and Maddieson). When this notion comes into phonological theory, the universals of the vowel systems are well accounted for, including major trends in vowel system inventories such as the relationship between the number of vowels and the types of vocalic sounds (i.e. if we know the number of vowels in a system we also can predict what the individual sounds might be) and the symmetry of front-back peripheral vowels. This principle also lets us know systems with a gap (or a hole) at the triangle corners are skewed.

However, whether the principle of dispersion is applicable to the consonantal system or not is controversial. The arguments for and against the principle are well known respectively from Lindblom and Maddieson and Ohala. Ohala has claimed that if the principle for maximizing segmental distance from each other applies to a consonantal system which has seven sounds, we reach an apparent false prediction and get an undesirable set of consonants such as {ɖ k' ts ɬ m r ɻ}.

Lindblom and Maddieson (66f.), who have a different opinion from Ohala, have acknowledged the natures of two different types of sounds. They agree with the fact that it is not likely that consonants position themselves so as to maximize inter-consonantal distance. Instead, they still pertain to the notion of dispersion or contrast saying that 'consonant inventories tend to evolve so as to achieve maximal perceptual distinctiveness at minimum articulatory cost." They propose the following consonantal categories based on the complexity of articulation which relate to perceptual distance.[1]

Table 5. Three consonantal categories based on the complexity of articulation.

Set I	Basic articulations	unmarked consonants commonly appearing in most languages (e.g. /p t k ʔ b d g f s h ʃ m n ŋ l r w j/)
Set II	Elaborated articulations	Manners: Breathy and creaky voice, voiced fricatives, pre-nasalization, pre-/post-aspiration, nasal release, ejectives, implosives, clicks Places: labiodental, palate-alveolar, retroflex, uvular, pharyngeal Modification: palatalization, labialization, pharyngealization, velarization
Set III	Complex articulations	Combinations of two or more from Set II

1 According to Lindblom and Maddieson (71), each set of articulations differ in dimension of articulation, and recruiting additional dimensions from the lower set to the higher set increases perceptual distance.

In Table 5 above, we have three different categories based on the complexity of articulation. According to the size principle, as the size of the inventory becomes bigger, the set of sounds the system takes becomes more complicated. Concrete, smaller inventories tend to fill the system only with the unmarked segments in Set I, and Set II segments can be new members of a larger system approximately at the point where Set I segments reach their level of saturation, and the segments of Set III will come into the bigger system when no more Set II segments are available

3.1 Analysis 1: Consonant Inventory Size

As pointed out in Pandey, one of the main concerns of studies on phonological inventories is a frequency-based statistical generalization regarding the occurrence of segments, and we will see how this manner of research appears in the phonetic approach.

We first consider the size of the consonant inventories of the languages. According to Maddieson (2013), mapping the size of consonant inventories prepares the way to investigate two connected issues. The first concerns how the complexity of different aspects of the sound patterns of the languages is related, and the second issue concerns the hypothesis that there is an overall relationship between the size of a consonant inventory and the kind of consonants it includes, i.e. the size principle. Since the former issue is beyond the scope of this paper, in the following we focus on the second issue.

According to Maddieson (2013), consonant inventories range very wide from a low of 6 consonants (e.g. Rotokas) to a high of 122 (e.g. Xu). However, the more typical size of the common systems of 562 languages of WALS (the World Atlas Language Structures) is around 22. Based on this fact, Maddieson divides consonant inventories into the following five categories, and the inventory size of the four languages are provided in Table 6 below: Russian falls into a large group, Polish is moderately large, Czech moderately large or average and Serbian and Croatian average.

Table 6. Size of consonant inventories (Maddieson 2013)..

Value	Size	No. of languages	Languages
Small	6~14	89	
Moderately small	15~18	122	
Average	19~25	201	Czech(24-27), Serbian and Croatian(25)
Moderately large	26~33	94	Czech(24-27) Polish(31)
Large	34 or more	57	Russian(36)
Total		563	

As mentioned above, the size principle claims that there is a connection between the size of the consonant inventory of a language and the characteristics of the expected candidates for consonants in it. That is, again, the systems with smaller inventories tend to exhibit simpler sounds (or basic articulation) which are easier for a speaker to produce and are salient for a listener to distinguish from other sounds, and consonants which are inherently more complex will be found in larger inventories (Lindblom and Maddieson). The nature of simpler sounds is characterized as the most frequently occurring segments among consonants, or basic sounds with no elaborated articulation, and are thus acquired in early childhood. With the $UPSID_{317}$ data file, Maddieson (1984: 12) reveals a structure consisting of the 20 most frequent sounds under the name of the 'typologically most plausible structure" (but that does not exist in reality) as seen in Table 7 below.

Table 7. Typologically most plausible structures.

	Bilabial	Dental/ Alveolar	Post-alveolar /Palatal	Velar	Glottal
Plosive	p b	t d		k g	ʔ
Affricate			ʧ		
Fricative	f	s	ʃ		h
Nasal	m	n	ɲ	ŋ	
Trill		r			
Approximant	w		J		
Lateral approximant		l			

Comparing the consonantal structures of the four Slavic languages with this system, we easily reach the conclusion that no Slavic language system has the nature of a small size of inventories, but rather they are classified into a 'larger system" because of the following segments.

Table 8. Segments that are not included in small inventories.

Language	Number	Segments
Russian	18	all palatalized consonants (pʲ bʲ tʲ dʲ kʲ gʲ ʧʲ fʲ vʲ sʲ zʲ ʃʲ: xʲ mʲ nʲ rʲ lʲ), ʒ
Polish	8	ɕ ʝ ʒ ɛ ʑ ʤ ʨ ʥ
Czech	4	ɕ ʝ ʒ
SC	4	ʨ ʤ ʒ ʎ

What we can see from the systems of the four languages is that the characteristics of Slavic languages are mainly affricates and palatals. It is these sounds that cause the four languages to fall into the large inventory group regardless of the actual size of consonants, and we see that the system of Russian shows quite distinct aspects from the general structures of human languages.

3.2 Analysis 2: The Segmental Frequency of Sound Types[2]

Frequency-based statistical approaches to consonantal inventories present several facts in regard to the segmental frequency of the four Slavic languages.

3.2.1 The Obstruent-Sonorant Ratio

The first phonetic universal is the ratio of obstruents versus sonorants. It is generally said that languages tend to have 70% obstruents and 30% sonorants. As for this ratio, scholars claim that it relates to the physical characteristics of the regions of the "phonetic space" in which obstruent and sonorant consonants range. The phonetic space for obstruents is larger and richer than that for sonorants (Ohala). The ratio of obstruent to sonorant for the four languages are almost the same as for the general aspect of natural languages.

3.2.2 Frequencies of Slavic Sonorants

1) Nasals

As is well known, nasal sounds are the second most frequently occurring phonetic type in human sound types. As revealed from UPSID, 435 or 96.45% of 451 languages have at least one nasal consonant, and nearly 90% of 451 languages have 2-4 nasals placed at the bilabial, dental/alveolar, palatal, and velar locations.

The four Slavic languages under discussion are very common in their numbers of nasals since they contain from 3 to 4 nasals, and are not very far from the general aspects of natural languages with respect to the quality of the nasals as well, except for the fact that Russian has two

2 Please note that this is discussed in more detail in Heo, written in Korean.

peculiar nasals (m^j n^j) which have palatality as a secondary articulation. Note that /m^j/ occurs in only 10 languages, or 2.22% among the 451 UPSID sample languages, and /n^j/ never occurs in any language but Russian.

2) Liquids

The lateral approximant /l/, together with r-sounds, is classified into the same group of 'liquids" in the sense that they share certain phonetic and phonological similarities (Ladefoged and Maddieson). From the $UPSID_{317}$ survey, it can be said that these sounds are very common in natural languages, so almost all languages in the UPSID sample of 317 languages have at least one liquid; that is, 95.9% of them do. Most languages, that is 72.6%, have more than one liquid (Maddieson 1984: 73f.). Compared with the UPSID survey, three of the Slavic languages under discussion, unlike Polish which has two liquids, have 3 or 4 liquids; thus they present slightly unusual aspects. Note that 41.0 % of the 317 UPSID sample languages have two liquids and 14.5% have three liquids.

3) Approximants

Sounds like /j/ and /w/ are categorized as approximants. Of the world's languages, 85% have the palatal approximant /j/ and 76% the labio-velar approximant /w/ (Ladefoged and Maddieson 322). What is of interest is that none of the four Slavic languages under discussion have /w/ if we consider the Serbian and Croatian /ʋ/ as a fricative /v/. Note that proto languages for modern Slavic languages, PIE, Proto-Balto-Slavic, Early Proto-Slavic and Late Proto-Slavic, have /w/ (Kortlandt; Sussex and Cubberley; Townsend and Janda).

3.2.3 Phonetic Universals for Slavic Obstruents

1) Stops

Among 17 possibilities of the place of articulation for consonants, from Bilabial to Glottal, plosive sounds are produced mainly in four phonetic areas. They are bilabial, dental/alveolar, velar and glottal, as can be seen in Table 6 above, and the first three places are phonetically the most common places for plosives, so that 99% of UPSID languages have plosives at these places. The two languages of Russian and Serbian and Croatian have exactly the same places for the pronunciation of their plosives. However, the other two languages under discussion, Polish and Czech, take the

palatal as the fourth place rather than the glottal for the plosives. Note that out of 451 UPSID sample languages, only 71 or 15.74% have plosives at this place; thus, these two languages are unusual places of articulation for plosives.

2) Fricatives and Affricates

In general, affricates are classified into a stop group, but we consider them together with fricatives in this paper because of the characteristics of these languages. As can be seen in Tables 1-4, the number of fricatives and affricates are unusually large in comparison with those segments of other languages. What is more interesting is that affricates are rarely found in the proto Slavic languages, except for Late Proto-Slavic (Comrie and Corbett 70). The quantity and the quality of the fricatives of the Slavic languages under discussion are another issue that we should pay attention to.

Table 9. Major fricatives in the UPSID and the frequency of fricative series by number of series.

a. Major fricatives in $UPSID_{451}$								
Segment	s	ʃ	f	z	v	X	ʒ	ɣ
No. of language	411	187	180	122	95	94	63	56
%	91.1	41.5	39.9	27.1	21.1	20.8	14.0	12.4
b. Frequency of fricative series by number of series								
No. of fricatives	1	2	3	4	5	6		
No. of languages	37	62	47	37	26	26		
Series	s	s f	f s ʃ	f v s z	?	f v s z ʃ ʒ		

As can be seen in Tables 1-4, Russian has 13 fricatives and more than half of them (palatalized fricatives) are those that are not visible in Table 9 above, and the remaining three languages are less problematic than Russian, but they still contain fricatives such as /tɕ dʑ ɦ/.

4. Phonological Approach to the Consonantal Systems of Slavic Languages

The phonological approach to phonological inventories has mainly been developed by Clements (2003a; 2003b; 2009). He claims that phonological inventories are structured in terms of distinctive features rather than phonetic categories. He presents five principles that constrain the internal structures of a sound system. First, Feature Bounding, by which features bound the number of sounds and the number of contrasts that a language may have. Second, Feature Economy, by which features have a tendency to be combined maximally. Third, Marked Feature Avoidance, by which certain disfavored features are systematically avoided. Fourth, Robustness, by which higher-valued features are made use of before less highly-valued features. Finally, Phonological Enhancement, by which perceptual contrasts are reinforced by introducing marked features. The four principles, apart from the first principle, relate to the universals of natural languages, and we can evaluate whether or not a certain language is high-valued according to each principle.

4.1 Feature Economy

The principle of Feature Economy is based on the fact that speech sounds in a language tend to appear in the same series of categories. It is true that languages prefer to have more than one voiceless plosive or front unrounded vowel rather than only one voiceless plosive or front unrounded vowel. This means that languages tend to have as many as possible sounds (or feature combinations) with the fewest features; thus, features used once in a language tend to be combined repeatedly and regularly with other features to generate new sounds without introducing new features. According to Clements (2009), 'given a system with *S* speech sounds characterized by *F* features, its economy index, *E*, is given by expression" as in (1).

(1) E = S/F

Since the higher the value of E, the higher degree of the economy, either the number of segments S is increased or the number of features is decreased to get a higher degree of economy. Let us now see the measure of economy of the four languages. The nine features in (2a) are commonly used in the four languages, and those which are required in addition in respective languages are given in (2b) below. Note that the consonantal system of Polish and Serbian and Croatian do not require any additional features.

(2)

a. [sonorant], [labial], [coronal], [dorsal], [continuant], [posterior], [voice], [nasal], [strident]

b. Russian: [palatal][3]
Czech: [glottal]

Given these number of features, we can obtain the ranking of the Feature Economy index as can be seen in Table 10.

Table 10. The economy index of the four languages.

Language	DF	Consonants	Economy index
Russian	10	36	3.6
Polish	9	31	3.4
Czech	10	24~27	2.4~2.7
Serbian and Croatian	9	25	2.8

From this data, we can see that Russian is the most economical and the Czech and Serbian and Croatian have a relatively lower degree of economy, and Polish is between them. The higher degree of the economy index of Russian and Polish is due to the feature [palatal] of the second articulation such as /pʲ/ in Russian, and [strident] that characterize the affricates and fricatives in Russian and Polish. The segments corresponding to this category are 17 and 12 respectively, many of which are not included in small inventories as can be seen in Table 10 above. This may contradict to the claim of the phonetic approach above that the consonantal systems of Russian and Polish are very unusual with respect to the universals of natural languages because of these two features. These two features are problematic in terms of phonetic universals, whereas they are the features that make the two languages have a higher degree on the economic index. It is also worthwhile to note that, from the fact that these four languages are daughter languages of the same ancestor languages like Proto-Indo-European and Proto-Slavic, the two languages of Czech and Serbian and Croatian could have had more consonants (in particular, obstruents with respect to the other two languages) to reach a the higher degree on the economy index.

3 We define the feature which generates palatalized sounds as a secondary articulation is simply [palatal].

4.2 Marked Feature Avoidance

Let us now consider the universals of the four languages with respect to the Principle of Marked Feature Avoidance (henceforth, MFA). As mentioned earlier, this is simply that there are certain disfavored features in languages, and that languages have the tendency to avoid such features in taking up new constituting segments. Thus, we can predict that the number of sounds containing marked values is less than the number of sounds containing unmarked values except in some special cases which we will see below in 4.3.

In general, sonorants are more marked than obstruents, affricates are more marked than fricatives and fricatives are more marked than stops, if we define the criterion of markedness in terms of frequency, as many linguists do, including Clements (2009). This means that the universal tendency of the relation between sonorants and obstruents is that the former may occur less than the latter according to the number of the occurrence of each in a language, and the same is true for the relation between affricates and fricatives, and fricatives and stops. Now let us see the frequency of such sound categories.

Table 11. The frequency of such sound categories.

a. Frequency of sonorants and obstruents			
	Sonorants	Obstruents	
Russian	9	27	√
Polish	8	23	√
Czech	7	20	√
Serbian and Crotian	8	17	√
b. Frequency of affricates and fricatives			
	Affricates	Fricatives	
Russian	2	13	√
Polish	6	9	√
Czech	4	8	√
Serbian and Crotian	5	6	√
c. Frequency of fricatives and stops			
	Fricatives	Stops	
Russian	13	12	?
Polish	9	8	?
Czech	8	8	?
Serbian and Croatian	6	6	?

We see that the problem of the four languages is that, as can be seen in Table 11c, the number of the marked value segments (i.e. fricatives) are in excess of or not less than the unmarked value segments (i.e. stops).

Simply, they all have too many fricatives. Note that the average number of fricatives of $UPSID_{451}$ is between 4 and 5, but they have a range from a low of 6 to a high of 13 fricatives. It is the fricatives that make these four languages have a lower degree of universals in terms of MFA. In the case of Russian, the palatalized sounds are more marked than non-palatalized sounds, thus the feature [palatal] also makes this language violate MFA. Again, the features [palatal] as well as [+strident] play important roles in deciding on the universals of the two languages, but this time these two features, unlike the case of Robustness, make the two languages become non-universal languages.

We can see another fact, that Russian and Polish, which have large inventories, have marked segments more than the other two languages, which have smaller inventories. This is what Maddieson (1984) and Clements (2009) mentioned.

(3)

a. A smaller inventory has a greater probability of including a given common segment than a larger one, and a larger inventory has a greater probability of including an unusual segment type than a smaller one (Maddieson 1984: 10).

b. The average number of sounds in languages containing a marked term M is greater than the average number of sounds in languages containing its unmarked counterpart U (Clements 2009: 41).

4.3 Robustness

The next theory Clements (2009) proposes as one of the phonological accounts of the organizing principle for sound structures is Robustness. This principle is firstly based on the fact that phonological structures are not a simple gathering of sounds which are composed of the same or similar features, for example, only stops, but they consist of various types and categories of sounds such as stops, fricatives, nasals in manners and bilabial, alveolar and velar in place of articulation. In relation to this, Clements (2009: 42) claims that 'some contrasts are highly favored in sound systems, others less favored, and still others disfavored." For instance, contrasts between sonorants vs. obstruents, labial vs. coronal vs. dorsal and stop vs. continuant are favored, while the contrasts between aspirated vs. non-aspirated, implosive vs. explosive and glottalized vs. non-glottalized are disfavored across the languages. Based on this fact, he suggests a Robustness scale for consonant features as seen in Table 12, given below.

Table 12. Robustness scale for consonant features and commonest consonant contrasts in UPSID

Robustness scale	Commonest consonant contrast in UPSID	Example[1]	% (UPSID)	Feature(s)
a. [±sonorant] [labial] [coronal] [dorsal]	Dorsal vs. coronal obstruent	K/T	99.6	[dorsal], [coronal]
	Sonorant vs. obstruent	N/T	98.9	[±sonorant]
	Labial vs. coronal obstruent	P/T	98.7	[labial], [coronal]
	Labial vs. dorsal obstruent	P/K	98.7	[labial], [dorsal]
	Labial vs. coronal sonorant	M/N	98.0	[labial], [coronal]
b. [±continuant] [±posterior]	Continuant vs noncontinuant sonorant	J/N	93.8	[±continuant]
	Continuant vs noncontinuant obstruent	S/T	91.6	[±continuant]
	Posterior vs. anterior sonorant	J/L	89.6	[±posterior]
c. [±voiced] [±nasal]	Voiced vs. voiceless obstruent	D/T	83.4	[±voiced]
	Oral vs. nasal noncontinuant sonorant	L/N	80.7	[±nasal]
d. [±posterior]	Posterior vs. anterior obstruent	Tʃ/T	77.6	[±posterior]
[glottal]	Glottal vs. nonglottal consonant	H/T	74.5	[glottal]

On the basis of the Robustness scale, Clements (2009: 48) formulates the Robustness Principle as in (4) below.

(4) Robustness Principle

In any class of sounds in which two features are potentially distinctive, minimal contrasts involving the lower-ranked feature will tend to be present only if minimal contrasts involving the higher-ranked feature are also present.

As Clements points out, this principle addresses "a significant gap in the theory developed so far" (Clements 2009:43). What this principle says is simple; higher-ranked features should be taken before lower-ranked features. Thus, the features in Table 12a (e.g. [±sonorant]) should be present before the other features in Table 12b-d (e.g. [±nasal]). Considering the robustness of the four languages, we see that all the higher-ranked features listed above in Table 12, together with the feature [±strident], which is not included in the robust features, are present in Czech. This means that this language does not violate the Robustness principle. However, the situation is different in the other three languages, where the lower-ranked feature [±strident] is present instead of the higher-ranked feature [glottal]. This means that these languages do not have the glottal segment such as /h/ which is probably favored over other disfavored segments such as /ʦ/

which is [+strident], in their inventories. The segment /h/ occurs in 279 (61.68%) out of 451 UPSID sample languages, whereas /ʦ/ occurs in only 57 (12.64%) languages. That means that the [glottal] feature is higher than [+strident] in the Robustness scale, and thus, the former should be present before the latter, but this is not considered in the phonetic approach.

A word should be mentioned concerning the [palatal] feature used in Russian and [+strident] in Russian and Polish. Recall that it is these two features by which the two languages have a higher degree on the economy index, and by which they have a lower degree of universals in terms of MFA. As for this, the feature-based approach explains this with the interaction of Robustness and Feature Economy. As Clements (2009: 49) mentions, 'as a result of Feature Economy, even though less robust features tend to be less frequent across languages, once they are present in a system they tend to generalize to other sounds." That is [palatal] is a lower-ranked feature and thus it would not easily be present in other consonant systems, but this feature in Russian cross-classifies almost all segments to double the number of segments. The same is almost true for the case of [+strident] in the two languages. We can see why systems which are very unusual from the phonetic point of view, and which exist in natural languages, can be explained from feature-based accounts.

4.4 Phonological Enhancement

As a last interacting principle that, together with the above, organizes the structure of sound systems, let us consider the case of Phonological Enhancement, which is defined as the reinforcement of weak acoustic contrasts by increasing the acoustic difference between their members by introducing marked features (Clements, 2009: 50).

The notion of Phonological Enhancement comes from the fact that, contradictory to the prediction of MFA, there are cases where marked value features are more frequent than unmarked value features. According to Clements (2009), exceptional cases like this can be explained by the principle of Phonological Enhancement. For instance, [+nasal] is a marked value feature in most criteria of sounds. The only exception is the criterion of sonorant non-continuants, where only nasal stops and laterals are available. Among 451 UPSID sample languages, 435 languages have /n/ ([+ nasal]) whereas only 368 languages have /l/ ([-nasal]). As for this fact, Clements claims that [-continuant] is enhanced by the marked value feature [+nasal] to increase the contrast between [+continuant] (such as /ɾ/ or /ɹ/) and [-continuant] in the group of sonorant non-continuants. In the cases of the four languages under discussion, we can find the following increased contrasts by the application of Phonological Enhancement.

(5) Phonological Enhancement in the four languages

a. [+labiodental] enhancing [+continuant] in labial consonants results in increasing the contrast /f, v/ and stops such as /p, b/: Russian, Polish, Czech, Serbian and Croatian

b. [+strident] enhancing [+posterior] in coronal stops results in increasing the contrast /ʃ, ʤ/ and stops such as /t, d/: Russian, Polish, Czech, Serbian and Croatian

c. [+strident] enhancing [+continuant] in coronal obstruents results in increasing the contrast between /s, z/ and (non-continuant) stops such as /t, d/: Russian, Polish, Czech, Serbian and Croatian

d. [+nasal] enhancing [-continuant] in sonorant consonants results in increasing the contrast between /n/ and oral continuants such as /r/: Russian, Polish, Czech, Serbian and Croatian

e. [+posterior] enhancing [coronal] in sonorant continuants results in increasing the contrast between /j/ and non-coronal sonorant continuants such as /w/: Polish, Serbian and Croatian

The above five cases of Phonological Enhancement are illustrated in Clements (2009: 51) as an example of the principle, and the four cases in (5a-d) are present in the four languages. The only controversial case is /j/. Unlike the statement in (5e), the two languages, apart from Polish and Serbian and Croatian, do not have /w/, which is a non-coronal sonorant continuant and thus is supposed to be a prospective segment to be in contrast with /j/ by the application of Phonological Enhancement. Thus, we can assume that Polish and Serbian and Croatian are more universal and the other two languages are less universal. Based on UPSID data, it is true that 226 (or 71.3%) out of 317 UPSID sample languages have both glides /w/ and /j/, and only 47 languages (or 14.8%) have /j/ but no /w/ (Maddieson 1984: 91f).

5. Conclusion

From the phonetic approach we can see that our major Slavic languages have the characteristics of large inventory size with respect to the size principle. They have sounds that are not easily occurring in the smaller size of the consonant inventory. The palatalized sounds of all types of consonants in Russian are very odd in natural languages, and the great

number of affricates and fricatives in Polish may be a typical Slavic consonantal system, but this system is still very unusual with respect to the general aspect of human languages. The other two languages, Czech and Serbian and Croatian, have consonantal systems more or less close to that of being universal.

On the other hand, from the phonological accounts we can understand some problems which are unsolved or unexplained by the phonetic approach. The first and foremost is why certain languages like Russian have many unusual segments, not just one or two that are not easily found in other languages. The feature-based approach accounts for the interaction of the two principles of Robustness and Feature Economy. The second issue concerns Feature Economy, by which we can understand why segments occur in series in a language. This could also be problematic in the theory of maximal dispersion by which one may expect languages will contain very different segments which share no common features at all. Finally, markedness is another point we can think of. The Phonological approach, as well as the phonetic approach, show similar observations in that markedness is discussed in terms of the size of inventories, but as for the question of why some marked features prevail in certain sound categories like fricatives, this is accounted for by the principle of Phonological Enhancement from the feature-based approach.

Works Cited

Clements, George. "Feature Economy in Sound Systems." *Phonology,* vol. 20 (2003a): 287-333.

Clements, George. "Feature Economy as a Phonological Universal." In *Proceedings of the 15th International Congress of Phonetic Sciences, Barcelona, 3-9 August 2003.* Eds. María-Josep Solé, Daniel Recasens and Joaquín Romero. Adelaide: Casual Productions (CD-ROM), 2003b, 287-333.

Clements, George. "The Role of Features in Phonological Inventories." In *Contemporary Views on Architecture and Representations in Phonology.* Eds. Raimy, E. and C. E. Cairns. Cambridge: MIT Press, 2009, 19-68.

Comrie, Bernard and Corbettt Greville (eds.). *The Slavonic Languages.* London: Routledge, 1993.

허용, "현대 슬라브어 자음체계 분석: 러시아어, 폴란드어, 체코어, 세르비아·크로아티아어를 대상으로", 언어와 언어학, vol.83 (2019): 277-300. (Heo, Yong. "An Analysis on the Consonantal Systems of Modern Slavic Languages: Focused on Russian, Polish, Czech and Serbo-Croatian." *Language and Linguistics,* vol. 83 (2019): 277-300.)

Jassem, Wiktor. "Polish." *Journal of the International Phonetic Association,* vol. 33, no. 1 (2003): 103-107.

Kortlandt, Frederik. 'From Proto-Indo-European to Slavic." *Journal of Indo-European Studies,* vol. 22, no. 1 (1994): 91-112.

Ladefoged, Peter and Ian Maddieson. *The Sounds of the World's Languages*. Mladen: Blackwell, 1996.

Landau, Ernestina, Mijo Lončarić, Damir Horga and Ivo Škarić. 'Croatian." *Journal of the International Phonetic Association,* vol. 25, no. 2 (1995): 83-86.

Lindblom, Björn. 'Phonetic Universals in Vowel Systems." In *Experimental Phonology.* Eds. J. Ohala and J. J. Jaeger. Orlando, Florida: Academic Press, 1986, 13-44.

Lindblom, Björn. 'Phonological Units as Adaptive Emergent of Lexical Development." In *Phonological Development. Models, Research, Implications.* Eds. Charles A. Ferguson, Lise Menn and Stoel-Gammon. Timonium: York Press, 1992, 131-163.

Lindblom, Björn and Ian Maddieson. 'Phonetic Universals in Consonant Systems." In *Language, Speech and Mind.* Eds. C. Li and L.M. Hyman. London: Routledge, 1988, 62-78.

Marsico, Egidio, Ian Maddieson, Christophe *Coupé* and Pellegrino François. 'Investigating the Hidden' Structure of Phonological Systems." In *Proceedings of the 30th Annual Meeting of the Berkeley Linguistic Society,* 2005, 256-267.

Maddieson, Ian. *Patterns of Sounds*. Cambridge University Press, 1984.

Maddieson, Ian. 'Consonant Inventories." *The World Atlas of Language Structures Online.* Eds. Matthew S. Dryer and Martin Haspelmath. Leipzig: Max Planck Institute for Evolutionary Anthropology, 2013. Internet: http://wals.info/chapter/1.

Maddieson, Ian and Precoda Kristin. "Updating UPSID." *UCLA Working Papers in Phonetics,* vol. 74 (1990): 104-111.

Ohala, John. J. 'The Origin of Sound Patterns in Vocal Tract Constraints." In *The Production of Speech* . Ed. P.F. MacNeilage. New York: Springer-Verlag, 1983, 189-216.

Pandey, Pramod. 'Phonological Inventories." Talk presented as 'Nagamma Reddy" at the 39th All India Dravidian linguistics Association Conference, Punjabi University, Patiala, 14-16 June, 2011.

Šimáčková, Šárka Podlipský, Jonáš Václav and Kateřina Chládková. 'Czech Spoken in Bohemia and Moravia." *Journal of the International Phonetic Association,* vol. 42, no. 2 (2012): 225-232.

Sussex, Roland and Paul Cubberley. *The Slavic Languages.* Cambridge University Press, 2006.

Townsend, Charles and Laura Janda. 'Common and Comparative Slavic: Phonology and Inflection with Special Attention to Russian, Polish, Czech. Serbo-Croatian, and Bulgarian." Slavica Publishers. Inc. 1996.

Yanushevskaya, Irena and Daniel Bunčić. 'Russian." *Journal of the International Phonetic Association,* vol. 45, no. 2 (2015): 221-228.