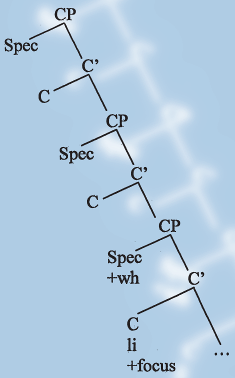

Potsdam Linguistic Investigations
Potsdamer Linguistische Untersuchungen
Recherches Linguistiques à Potsdam

Edited by / Herausgegeben von / Edité par
Peter Kosta
Gerda Haßler
Lilia Schürcks
Nadine Thielemann

Peter Kosta / Lilia Schürcks (eds.)

Formalization of Grammar in Slavic Languages

PETER LANG
Internationaler Verlag der Wissenschaften

This book assembles the contributions of the Eighth European Conference on Formal Description of Slavic Languages (FDSL VIII) which took place from 2nd to 5th December 2009 at the University of Potsdam. The concern was to bring together excellent experienced but also young scholars who work in the field of formal description of Slavic languages. Besides that two workshops on typology of Slavic languages and on the structure of DP/NP in Slavic were organized.

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Contributions of the Eighth International Conference on Formal Description of Slavic Languages – FDSL VIII 2009

University of Potsdam, December 2–5, 2009

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Editorial

The series *Potsdam Linguistic Investigations – Potsdamer linguistische Untersuchungen – Recherches linguistiques à Potsdam* presents cutting-edge fundamental linguistics research carried out at the University of Potsdam. Its major goal is to publish collection of articles, conference proceedings and monographs on contemporary issues in the fields of Slavic languages and literature, Romance studies, English and American studies, German studies and general linguistics. A special focus of study is the formal, functional and cognitive description of language. The following areas of linguistics will seek to develop their own profile: phonology, morphology, syntax (with special attention to generative syntax), semantics, pragmatics (discourse analysis, speech act theory), sociolinguistics and language contact.

We do not set any theoretical, methodological or geographical boundaries. The series will serve greatly as a forum for young scholars as well as other researchers working in various linguistic fields and frameworks in Potsdam or elsewhere. The indication of Potsdam stands for the crucial importance and outstanding quality of linguistics research at the University of Potsdam. On the other hand, researchers from other Universities with proven excellence of their work are most welcome to publish their doctoral dissertations, habilitation monographs or conference proceedings in this series. The languages of publication are German, English and French.

Editorial

Die Reihe *Potsdam Linguistic Investigations – Potsdamer linguistische Untersuchungen – Recherches linguistiques à Potsdam* ist eine Plattform für linguistische Forschungen an der Universität Potsdam. Sie publiziert Sammelbände und Monographien zu aktuellen Fragen der zeitgenössischen internationalen Linguistik aus den Disziplinen Slavistik, Romanistik, Anglistik/Amerikanistik, Germanistik und Allgemeine Linguistik. Ein besonderer Schwerpunkt liegt in der formalen, funktionalen und kognitiven Sprachbeschreibung. Darin bilden vor allem die Bereiche Phonologie, Morphologie, Syntax (unter besonderer Berücksichtigung der generativen Syntax), Semantik, Pragmatik (Diskursanalyse, Sprechhandlungstheorie, Geschlechterforschung), Soziolinguistik und Sprachkontakt ihre eigenen Profile.

Wir wollen keine theoretischen, methodischen oder lokalen Grenzen setzen. Deshalb richtet sich die Reihe sowohl an Nachwuchswissenschaftler als auch an Kollegen in Potsdam und außerhalb Potsdams, die in verschiedenen Richtungen, Modellen und theoretischen Ansätzen der modernen Linguistik arbeiten. Der Hinweis auf den Standort Potsdam soll zum einen die herausragende Bedeutung der linguistischen Forschung an dieser Universität signalisieren. Andererseits bedeutet die Nennung nicht, dass ausschließlich Forschungsergebnisse (einschließlich Dissertationen, Habilitationen und Konferenzsammelbände) veröffentlicht werden, die von Linguistinnen und Linguisten an der Universität Potsdam stammen. Die drei Publikationssprachen sind Deutsch, Englisch und Französisch.

Editorial

La serie « *Potsdam Linguistic Investigations – Potsdamer linguistische Untersuchungen – Recherches linguistiques à Potsdam* » représente une plate-forme d'études linguistiques à l'université de Potsdam. Elle publie des recueils et des monographies sur les questions actuelles de la linguistique contemporaine internationale dans les domaines des études des langues slaves et romanes, anglaise et américaine, des langues germaniques et de la linguistique générale. Un point principal de recherche est posé sur la description formelle, fonctionnelle et cognitive des ces langues. Dans ces domaines, on met l'accent sur les profils de la phonologie, morphologie, syntaxe (en tenant compte de la syntaxe générative), sémantique, pragmatique (l'analyse du discours, la théorie des actes de la parole, la recherche sur le genre), la sociolinguistique où la linguistique de contact.

Nous ne voulons pas poser des limites dans la théorie, la méthode et le lieu de recherche. C'est pourquoi la série invite les jeunes chercheurs ainsi que les collègues de Potsdam et des autres universités qui travaillent dans les secteurs de la linguistique moderne. Le titre de la série veut démontrer d'un coté l'excellente qualité de la recherche linguistique à Potsdam sans toutefois exclure les autres. Cela veut dire que nous acceptons et nous invitons les linguistes de Potsdam et de l'extérieur (inclus les thèses de doctorat et d'habilitation et les actes de colloques). Les trois langues de publication sont : l'allemand, l'anglais et le français.

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Preface

The University of Potsdam was – after 1997, 2001 and 2005 – from 2 to 5 December 2009 already for the fourth time the host of one of the most internationally renowned Slavic linguistic conferences. The *8th European Conference on Formal Description of Slavic languages* has gathered more than 100 participants from 25 countries in Europe, Israel, Asia and the USA.

We are most delighted to present the contributions of the Conference Formal Description of Slavic Languages (FDSL VIII) in this issue. After the formal linguistics has experienced an enormous boom in recent decades worldwide, it is now the Slavic languages which shift more and more into the focus of the formal language description. The current conference, hosted by the University of Potsdam and the Institute for Slavic Studies, provided participants the opportunity to talk about the latest state of research on formalization of grammars and thus to develop new joint projects. The program included a total of 75 lectures in three sections. During the three-day events, more than 100 participants from various parts of the world took part in this international venue. They devoted interesting models and methods of the so-called Principles-Parameters framework and other formal frameworks. The focus has been put on the accuracy of this theory in the field of phonology, morphology, machine translation, semantics and syntax of Slavic and other languages. The participating scientists were here to include also relevant directions of the computational and corpus linguistics.

Among the highlights of the meeting, five panels with keynote speakers from the U.S., Italy, Norway and France and two workshops on language typology and the structure of DP/NP in Slavic languages were conducted.

In addition to the traditional three sections on three mornings the organizers of the FDSL VIII conference decided to conduct two workshops, which took place on the two afternoons in succession. The first workshop "Perspectives of Language Typology: Slavic and Standard Average European" was organized by Anton Zimmerling and Peter Kosta. The basic idea of this workshop was to check out whether Slavic languages as a group of closely related Indo-European idioms constitute a separate (sub)-type and to establish the position of Slavic languages within the construct known as 'Standard Average European'. Thus, typologically valid descriptions of Slavic languages may contribute to verifying or reconsidering this construct.

The second workshop "The Structure of NP/DP and its Implications for QP" was organized by Lilia Schürcks and was dedicated to the following goals: 1) to inspire discussions whether the DP projection exists in articleless languages, 2) to address recent approaches in the area of the structure of determiner phrases, quantificational phrases, and the linking element D, and 3) to establish and to evaluate the role of cross-linguistic variation.

While most articles from the three sections and from the first workshop on language typology are published in this volume, the contributions of the second workshop will be published in a special issue under the title “The Structure of NP and Beyond” in the series Studies in Generative Grammar (eds. Lilia Schürcks, Anastasia Giannakidou, Urtzi Etxeberria, and Peter Kosta,) in de Gruyter Verlag Berlin New York (to appear).

We would like to thank the German Research Foundation (DFG) and the University Society Potsdam for the generous financial aid! Finally, we would like to thank the many helpers in the organization and implementation of FDSL VIII Conference warmly. Without their selfless efforts, the conference would not have become what it is. We would finally like to thank the two bands Jazzmissia and Phoenixband and the theater group AP Chekhov for their musical and professional performance. Last but not least, it was Monika Kruschinski, our secretary and ‘good ghost’ of the institute, whom we owe a warm thank you for her effective support before, during and after the conference.

The Editors Potsdam, April 2011

I.

Phonetics & Phonology

Structure of syllables in Czech

Aleš Bičan

In the following paper we will describe the syllable in present standard Czech. In particular, we will focus on syllable-initial and syllable-final consonantal combinations and the way their structure can be predicted from the model called *distributional unit*, originally developed by JAN MULDER (1968, 1989). The same model was used by EL-SHAKFEH (1987) for English, and it was applied on other languages, too. Something similar to the tree schemes we present for Czech at the end of this paper was offered for English e.g. by WHORF (1940; reproduced in GOLDSMITH 2009) and FUDGE (1969). They, however, used a different theoretical background.

1. Preliminaries

Every description must be based upon a certain theoretical framework. We have chosen to follow the theory of functional phonology originally conceived by the Prague School and NIKOLAI TRUBETZKOY (1939), later developed by ANDRÉ Martinet and his school (MARTINET 1991, AKAMATSU 1992) and further expanded and formalized by Jan Mulder and his followers (MULDER 1968, 1989, EL-SHAKFEH 1987).

Functional phonology views phonemes as unordered bundles of distinctive features. Phonemes enter into mutual paradigmatic and syntagmatic relations, oppositions and contrasts, respectively. Oppositions are valid if there is some relevant paradigmatic difference between two or more phonological entities. Similarly, contrasts are valid if there is some relevant syntagmatic difference between phonological entities. However, both oppositions and contrasts may become invalid if some differences become irrelevant, i.e. if they are canceled under clearly defined circumstances. In that case we speak about neutralization of an opposition and about neutralization of a contrast. The outcome of the former are archiphonemes; of the latter archi-positions. We will return to archi-positions below.

In Czech, neutralization of voicing is operative. It means that the phonological difference between voiceless and voiced consonants is canceled and not valid in some contexts. In effect, the realizational voicing of consonants is predictable from the context they appear in. And as wholly predictable features cannot be part of phonological representation, it follows that phonological entities occurring in the context of neutralization of voicing cannot be either voiceless or voiced. Consequently, they cannot be identified with either voiceless or voiced phonemes, and the notion 'archiphoneme' has to be introduced. Archiphonemes may be viewed as phonemes in a subsystem representing two or more phonemes of the overall system.

There is not enough space discuss all subtleties of the Czech phonematic systems, so we will resort to mention just a handful of necessary points and direct the readers elsewhere for details (BIČAN 2008). The overall system of Czech consonants is given in the table (1). The table does not contain so-called affricates [ʦ] and [ʧ], because these are analyzed as corresponding to combinations of two consonants /Ts/ and /Tš/ (the capital letters standing for archiphonemes). There are good reasons for it. For one thing, their structure reflects that of attested combinations /Ps/, /Pš/, /Ks/ and /Kš/ (cf. *psát* "to write", *pšenice* "wheat", *xylofon* "xylophone", *kšiltovka* "peaked cap"), which fact makes the subsequent phonotactic analysis simpler.

(1)

	occlusive		*fricative*		*nasal*
	voiceless	*voiced*	*voiceless*	*voiced*	
labial	p	b	f	v	m
alveolar	t	d	s	z	n
palatal	ť	ď	š	ž	ň
velar	k	g	x	h	

Phonemes outside the system of proportions: /j/ 'approximant', /ř/ 'spirant'.

The system of archiphonemes resulting from the neutralization of voicing is in the next table (2). They occur in the contexts summarized in the formulas in (3) (i.e. in these contexts the voicing of consonants is wholly predictable).[1]

(2)

	occlusive	*constrictive*	*nasal*
labial	P	F	m
alveolar	T	S	n
palatal	Ť	Š	n
velar	K	X	

1 _ = the context, $C_{\text{v-less}}$ = any voiceless Consonant, $C_{\text{v-ed}}$ = any voiced C, # = end of word. Examples for (3a): /Stan/ [stan] *stan* "tent", /FStāT/ [fsta▯t] *vstát* "to get up", /Křťin/ [kř̥c▯n] *křtin* "christening part (gen. pl.)". Examples for (3b): /Kdo/ [▯do] *kdo* "who", /FSbuďiT/ [vzbu▯▯t] *vzbudit* "to get up", /XřbeT/ [▯ṛb▯t] *hřbet* "spine" but /svjeT/ [svj▯t] *svět* "world" and /zvjeT/ [zvj▯t] *zvěd* "spy". Examples for (3c): /ploT/ [plot] *plod* "fruit", /pePř/ [p▯př̥] *pepř* "pepper". The stipulation "before pause" is necessary, because if the form is followed by a word beginning with a voiced consonant, the archiphoneme will likewise be realized as voiced, cf. /ploT#bil/ *plod byl* "the fruit was" realized as [plodb▯l].

(3)

(a) $\_C_{\text{v-less}}$, $\_\check{r}C_{\text{v-less}}$ → archiphoneme always realized as voiceless

(b) $\_C_{\text{v-ed}}$, $\_\check{r}C_{\text{v-ed}}$ except for /v/ → archiphoneme always realized as voiced

(c) _#, _ř# → archiphoneme always realized voiceless before pause

The vowels of Czech are the following ones; we do not give here any table, because the constituency of vowels as to their distinctive features is not immediately relevant for our paper. Short vowels: /i/, /e/, /a/, /u/, /o/; long vowels: /ī/, /ē/, /ā/, /ū/, /ō/; diphthongal vowels: /ë/, /ä/, /ö/. It should be noted that diphthongal vowels are here viewed as single phonemes (there are again good reasons for it, see BIČAN 2008); they are realized as [ɛu̯], [au̯] and [ou̯], respectively. Vowels are phonemes only occurring in the syllable nucleus whereas consonants are phonemes occurring only in syllable margins, i.e. in non-nuclear contexts. In addition, Czech has a third class of phonemes, so-called semiconsonants. Semiconsonants are phonemes that can occur both in the nuclear as non-nuclear context. Czech has two such phonemes: /r/ and /l/, cf. /prST/ *prst* "finger" × /prase/ *prase* "pig". For the sake of simplicity, we will include /r/ and /l/ under the term 'vowels' if they occur in the nuclear context, and under the term 'consonant' if they occur in the non-nuclear context.

2. Distributional unit

Now that we have the phonemes of Czech, we can turn our attention to the main topic of our discussion, which is the structure of syllables in Czech. However, because the space allotted to this paper is limited, we cannot describe the exact procedure and the way we have arrived at our model. For that see BIČAN (ms.).

Distributional unit is meant to be a model of phonotactic distribution of phonemes. That is to say, in this particular case, it is meant to be a model for syllables in Czech, as it accounts for the distribution and combinations of phonemes within syllables in this language. It is defined as a bundle of positions. A position may be viewed as a syntagmatic slot where a phoneme can occur and where it can be replaced here by other phonemes. A position can also be empty. The set of phonemes capable of occurring in a given position forms a paradigmatic position class.

One of the positions is nuclear and it is that upon which other positions are functionally dependent. This position can never be empty, because phonemes occurring there function as identity elements of syllables without which they could not be well-formed.

The distributional unit in Czech has ten positions. One of them is nuclear. Five positions are pre-nuclear, that is, they appear before the nuclear position. Four positions are post-nuclear. The five pre-nuclear positions correspond to the maximum number of consonants capable of occurring at the beginning of a syllable in Czech. Similarly, the four post-nuclear positions correspond to the maximum number of consonants capable of occurring at the end of a syllable. This is deduced from the forms /FSkvjeT/ [fskvjɛt] *vzkvět* “prosperity” and /borŠTŠ/ [borʃʧ] *boršč* “borsch”. The way they are mapped onto the distributional unit is shown in (4).

(4)

F	S	k	v	j	e				
↓	↓	↓	↓	↓	↓				
pre2	**pre1**	**e3**	**e2**	**e1**	**n**	**i1**	**i2**	**i3**	**i4**
					↑	↑	↑	↑	↑
					o	r	Š	T	Š

It must be stressed right away that the notion ‘position’ used here differs from traditional conceptions which generally view it as a place of possible occurrence of an object relative to another object. In the case of distributional unit, however, positions are not viewed as relative placements but as absolute and constant ones. This is to say that the number of positions in the distributional unit is given once and for all, and what actually changes is only the way positions are filled with phonemes or whether they are empty. This can be conveniently illustrated on the syllables /ta/, /va/ and /ma/. The phonemes /t/, /v/ and /m/ occur in different positions, even though they are the first phonemes of those syllables. It is because their phonotactic properties are different: They show dissimilar ways of how they combine with other phonemes, e.g. as to how many consonants can precede or follow them. The reason why it is so will hopefully become obvious in the due course. See (5) for the way they are mapped onto the distributional unit. The zeros represent positions not filled with a phoneme.

(5)

pre2	**pre1**	**e3**	**e2**	**e1**	**n**	**i1**	**i2**	**i3**	**i4**	**syllable**
∅	∅	t	∅	∅	a	∅	∅	∅	∅	*ta*
∅	∅	∅	v	∅	a	∅	∅	∅	∅	*va*
∅	∅	∅	∅	m	a	∅	∅	∅	∅	*ma*

Every position may be filled with a phoneme from a certain class. These classes together with the structure of the distributional unit represent an underlying model for the phonotactic structure of Czech, that is, for all syllables in Czech. The model is given in the table (6). The positions marked with ‘e’ are *explosive* positions or pre-nuclear positions. The positions marked as ‘pre1’ and ‘pre2’ are so-called *pre-explosive* positions; they are filled with a phoneme only if at least of the previous pre-nuclear positions has already been filled with a phonemes. Otherwise, they are empty. The positions marked with ‘i’ are *implosive* or post-nuclear positions. Finally, ‘n’ stands for the *nuclear* position.

The capital /M/ given in the positions ‘e2’ and ‘pre2’ is the nasal archiphoneme. It is a result of neutralization of the place of articulation for nasals, as that becomes irrelevant in certain contexts. Let us say it in other words. The only nasal that can occur before a consonant or semiconsonant in the pre-nuclear context is the bilabial nasal. However, as the nasal is *always* bilabial in this situation, it is obvious the bilabialness cannot be a distinctive feature here, because it is wholly predictable from the given context. Consequently, the nasal archiphoneme /M/ must be introduced.

(6)

<table>
<tr><th>pre2</th><th>pre1</th><th>e3</th><th>e2</th><th>e1</th><th>n</th><th>i1</th><th>i2</th><th>i3</th><th>i4</th></tr>
<tr><td rowspan="5">P T K
F S Š
X
r l j M
∅</td><td rowspan="5">T
S Š
ř
∅</td><td rowspan="3">k g x
h
t d
s z š ž
∅</td><td rowspan="3">v
M
∅</td><td colspan="2">r l</td><td rowspan="5">m n ň
r l j
∅</td><td rowspan="2">P T K
Š
∅</td><td rowspan="2">T S
ř
∅</td><td rowspan="4">K T Ť
Š
∅</td></tr>
<tr><td rowspan="3">m n ň
r l
j ř
∅</td><td rowspan="4">i e a
o u
ī ē ā
ō ū
ë ä ö</td></tr>
<tr><td colspan="2" rowspan="2">F X</td></tr>
<tr><td colspan="2">p b f</td></tr>
<tr><td colspan="3">ť ď</td><td colspan="3">m n ň</td></tr>
</table>

The figure is a result of our previous analysis, but as already mentioned, we will not explain in detail how we arrived at it, because it would lengthen our paper considerably. Moreover, we have done it elsewhere (BIČAN forthcoming and BIČAN ms.). Yet the basic principle of the model can be summarized as follows: a phoneme belongs to a certain position if and only if it possesses phonotactic properties of the position in question.

Let us demonstrate it on the position which is labeled as ‘e3’. It is the third pre-nuclear position. It can be occupied by velars /k/, /g/, /x/, /h/, alveolars /t/, /d/, /s/, /z/ and by palatal fricatives /š/ and /ž/. They belong to this position because they all share the same distributional characteristics. Or at least the potential for them, as they need not always be actually manifested, for instance, in the case of /g/ which has rather limited distribution due to historical reason. Two major distributional characteristics are summarized in (7)[2].

2 Examples for (7a) are: /FTkāT/ *vtkát* “to weave into”, /FSxo-/ *vzchopit se* “to brace up”, /FShū-/ *vzhůru* “upward”, /jSte/ *jste* “you are (pl.)”, /FSdāT/ *vzdát (se)* “to give up”, /XTse/ *chce* “(he) wants”, /FzīT/ *vzít* “to take”, /rTše-/ *rčení* “saying”, /lži/ *lži* “lies”. Examples for (7b): /kvjeT/ *květ* “flower”, /gla-/ *glazura* “glaze”, /xvjeT/ *chvět (se)* “to tremble”, /hvjeST/ *hvězd* “star (gen. pl.)”, /tMňe/ *tmě* “dark (loc. sg.)”, /dvje/ *dvě* “two”, /svjeT/ *svět* “world”, /zMra-/ *zmrazit* “to freeze”, /šrām/ *šrám* “wound”, /žlu-/ *žlutý* “yellow”. Examples for (7c): /FSkvjeT/ *vzkvět* “properity” or /PŠtroS/ *pštros* “ostrich”.

(7)

(a) In the pre-nuclear context, the phonemes /k/, /g/, /x/, /h/, /t/, /d/, /s/, /z/, /š/ and /ž/ can be *preceded* by one or two phonemes belonging to the positions ‘pre1’ and ‘pre2’ and by *no others*.[3]

(b) In the pre-nuclear context, the mentioned phonemes can be *followed* by one or two phonemes from the positions ‘e2’ and ‘e1’ and *no other*.

(c) The properties (a) and (b) can be realized at the same time.

In other words, the membership of these phonemes in the position ‘e3’ reflects two facts. First, it holds that at the beginning of a syllable, all of these consonants can appear right next to a vowel and can be, at the same time, preceded by one or two other consonants. Second, it holds that at the beginning of the syllable, one or two other consonants can appear between of any of these consonants and the vowel.

A similar reasoning lies behind all other positions. Once again: a phoneme belongs to some position if and only if it exhibits properties of that position. Positions are thus representations of phonotactic properties of phonemes. It is possible that some phoneme belongs to more than one position. In that case its distributional properties are the sum of the properties of the individual positions. For example, the semiconsonants /r/ and /l/ belong to four positions and therefore they have properties of all these positions.

3. Archi-positions

We should now explain why several phonemes in the table (6) extend over two or more positions. It is because they occur in a so-called archi-position. An archi-position is a position is a subsystem representing two or more positions in the overall system. Its purpose is to account for special distribution of some phonemes. It is a result of neutralization of a certain syntagmatic contrast. Its practicability can be demonstrated on the palatal occlusives /ť/ and /ď/. They have distributional properties summarized in (8). Examples demonstrating them are: /Křťin/ *křtin* “christening party (gen. pl.)”, /lSťi-/ *lstivý* “deceitful”, /MSťī/ *mstí (se)* “(he) avenges”, /FSďe-/ *vzdělaný* “educated”, /MSďe/ *mzdě* “salary (dat. sg.)”.

(8)

(a) In the pre-nuclear context, the phonemes /ť/ and /ď/ can be preceded by up to two phonemes belonging to the positions ‘pre1’ and ‘pre2’ and by no others.

3 This is important to realize, because it really holds that these phonemes cannot be preceded by any other consonant or consonantal combination.

(b) In the pre-nuclear context, the mentioned phonemes must be immediately followed by a vowel, never by a consonant or semiconsonant.

If these properties are taken into account, we have to conclude that the difference between the positions ‘e1’, ‘e2’ and ‘e3’ is in fact canceled. They no longer serve the purpose they were established for. For instance, the position ‘e1’ has been established to account for the fact that some phonemes occurring right next to a vowel can be preceded by up to four consonants. All phonemes belonging to the position ‘e1’ share this capacity. However, as (8) shows, the phonemes /ť/ and /ď/ are never capable of this. They can be preceded only by one or two consonants, and hence the position ‘e1’ is actually of no use for them. And so are the positions ‘e2’ and ‘e3’. Yet /ť/ and /ď/ have still to be assigned to some position, and for that reason, an archi-position has to be postulated.

During the course of the analysis we have found necessary to postulate four archi-positions for phonemes with special distribution. First of all, there is the already mentioned archi-position for /ť/ and /ď/; we label it ‘E3’ as it results from neutralization of *three* explosive positions. Then there is another explosive archi-position ‘E2’ where the phonemes /p/, /b/ and /f/ can occur. For the implosive/post-nuclear context, we have postulated two archi-positions: ‘I2’ for the archiphonemes /F/ and /X/ and ‘I3’ for the phonemes /m/, /n/, /ň/. These nasals occur here in forms like /jilm/ *jilm* “elm”, /fajn/ *fajn* “fine” or /Tšerň/ *čern* “blackness”; they cannot be followed by any other phoneme in that case. Finally, there is an archi-position we have marked as ‘N’; it is where the semiconsonants /r/ and /l/ occur if they are syllabic. Simply said, syllabic /r/ and /l/ can never be preceded by /m/, /n/, /ň/, /r/, /l/, /j/ or /ř/, i.e. by any phoneme belonging to the position ‘e1’. In fact, the only nasal they can be preceded with is /M/ which, it is to be remembered, is an archiphoneme whose place of articulation is predictable from the context (actually, it is always realized as bilabial nasal).

To conclude this section, we give here the table (9) where several examples of syllable in Czech are given. They are all derivable from the distributional unit as given in the table (6). In the next section we will outline how this is achieved.

(9)

<table>
<tr><th>pre2</th><th>pre1</th><th>e3</th><th>e2</th><th>e1</th><th>n</th><th>i1</th><th>i2</th><th>i3</th><th>i4</th><th>word</th></tr>
<tr><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>a</td><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>a</td></tr>
<tr><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>n</td><td>a</td><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>na</td></tr>
<tr><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>u</td><td>∅</td><td>Š</td><td>∅</td><td>∅</td><td>už</td></tr>
<tr><td>F</td><td>S</td><td>k</td><td>v</td><td>j</td><td>e</td><td>∅</td><td>T</td><td>∅</td><td>∅</td><td>vzkvět</td></tr>
<tr><td>∅</td><td>∅</td><td colspan="2">b</td><td>∅</td><td>o</td><td>r</td><td>Š</td><td>T</td><td>Š</td><td>boršč</td></tr>
<tr><td>K</td><td>ř</td><td>t</td><td>∅</td><td>∅</td><td>u</td><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>křtu</td></tr>
<tr><td>K</td><td>ř</td><td colspan="3">ť</td><td>i</td><td>n</td><td>∅</td><td>∅</td><td>∅</td><td>křtin</td></tr>
<tr><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>n</td><td>e</td><td>∅</td><td colspan="2">X</td><td>Ť</td><td>nechť</td></tr>
<tr><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>j</td><td>i</td><td>l</td><td colspan="3">m</td><td>jilm</td></tr>
<tr><td>r</td><td>∅</td><td>t</td><td>∅</td><td>∅</td><td>i</td><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>rty</td></tr>
<tr><td>P</td><td>S</td><td>t</td><td>∅</td><td>r</td><td>u</td><td>∅</td><td colspan="2">X</td><td>∅</td><td>pstruh</td></tr>
<tr><td>∅</td><td>∅</td><td>∅</td><td>v</td><td>∅</td><td>o</td><td>j</td><td>∅</td><td>S</td><td>K</td><td>vojsk</td></tr>
<tr><td>∅</td><td>∅</td><td colspan="2">p</td><td>∅</td><td>o</td><td>m</td><td>∅</td><td>S</td><td>T</td><td>pomst</td></tr>
<tr><td>T</td><td>ř</td><td colspan="2">p</td><td>∅</td><td>i</td><td>∅</td><td>T</td><td>∅</td><td>∅</td><td>třpyt</td></tr>
<tr><td>∅</td><td>∅</td><td>h</td><td>v</td><td>j</td><td>e</td><td>∅</td><td>∅</td><td>S</td><td>T</td><td>hvězd</td></tr>
<tr><td>l</td><td>S</td><td>t</td><td>∅</td><td>n</td><td>ī</td><td>∅</td><td>∅</td><td>∅</td><td>∅</td><td>lstný</td></tr>
<tr><td>K</td><td>∅</td><td>š</td><td>∅</td><td>∅</td><td>i</td><td>l</td><td>T</td><td>∅</td><td>∅</td><td>kšilt</td></tr>
<tr><td>X</td><td>∅</td><td colspan="3">ť</td><td>ī</td><td>∅</td><td>T</td><td>∅</td><td>∅</td><td>chtít</td></tr>
<tr><td>∅</td><td>∅</td><td>s</td><td>M</td><td colspan="2">r</td><td>∅</td><td>∅</td><td>Š</td><td>Ť</td><td>smršť</td></tr>
<tr><td>∅</td><td>S</td><td>p</td><td>∅</td><td colspan="2">l</td><td>ň</td><td>∅</td><td>∅</td><td>∅</td><td>splň!</td></tr>
<tr><td>T</td><td>Š</td><td>t</td><td>v</td><td colspan="2">r</td><td>∅</td><td>T</td><td>∅</td><td>∅</td><td>čtvrt</td></tr>
</table>

4. Structure of consonantal combinations

Now that we have the distributional unit, we can redraw it to a graphical representation in the schemes (10) and (11) for the pre-nuclear and post-nuclear contexts. They are given at the end of this paper.

The distributional unit may be viewed as a series of points where a choice can be made. The points are the ten positions. At each of these points you can choose from a limited set of phonemes which have previously been recognized as belonging to the respective position (see (6) for the sets). In other words, the distributional unit is a series of points where, at each of these points, you can choose one phoneme which will appear there. It is also possible to leave the position empty. In fact, all positions except for the nuclear position and archipositions can be empty. The distributional unit can be likened above to an onion with positions being like its peels clustered around the nucleus. The nuclear position is the central and essential part of the distributional unit to which non-nuclear positions are "glued" one by one according to their degree of peripherality. When deriving the structure of syllables, we thus start from the nuclear position which is filled with a certain vowel. To this vowel several phonemes may be added, either before or after it or both. A vowel may be preceded by up to five phonemes and followed by up to four phonemes. We go through the paths as indicated in the schemes. Most paths are branching which means there are several directions to take. Every path has several points at which we choose one phoneme from a certain class or leave that point empty.

Let us start with the pre-nuclear context first, with the scheme (10). Once the nuclear position is filled with a vowel, there are two possibilities how it can be expanded; this is indicated by the first branching of the scheme (viewed from the top to bottom). Of course, the vowel may be not be expanded at all, because onset-less and code-less syllables are possible in Czech (cf. *a* "and"). First, a vowel can be preceded by a phoneme from the position 'e1', i.e. by /m/, /n/, /ň/, /r/, /l/, /ř/ or /j/[4], though the position can also be empty, as is indicated by the next branching. Second, it may be expanded by /ť/ or /ď/ from the archi-position 'E3' in which case some steps are skipped, as these phonemes can in turn be preceded only the phonemes from the positions 'pre1' and 'pre2'. We will return to them. Note that archi-positions are never empty[5] and thus there is no subordinate branching for them like in the case of other positions for which there is always a possibility to remain empty.

So the position 'e1' is either filled with a phoneme or left empty. The subsequent branching of the scheme may look a little bit complicated, but it is not. In fact, our next step is either to fill the position 'e2' with a phoneme or leave it empty or to fill the archi-position 'E2' with a phoneme in which case we again skip some steps and get right next to the position 'pre1'. The archi-position 'E2' can be filled with /p/, /b/ or /f/. These phonemes exhibit special combinability: they cannot combine with the phonemes from the positions 'e2' and 'e3' and are thus mutually exclusive with them. The position 'e2' can be filled with /v/ or /M/ or it can, of course, be left empty. At this point we encounter a restriction on the occurrence of a phoneme in 'e2', which explains the complicated branching: although the phonemes /v/ and /M/ belong to this position, the latter can occur there only if the position 'e1' is non-empty (or in case /r/ or /l/ occurs in 'N'). Simply said, /M/ cannot occur before a vowel because it is a product of neutralization of the opposition between /m/, /n/ and /ň/ before a consonant or a semiconsonant.

It is now obvious that if the position 'e1' is filled with a phoneme and so is 'e2', we get a combination of two phonemes. However, it should be noted that not all combinations are attested: /Mm/ and /Mj/ are not, though the latter occurs marginally in a surname *Mjachký*. Similarly unattested are combinations /bm/,

4 However, not all vowels may be expanded by these phonemes: for instance, the combination /ňē/ is not possible.

5 Archi-positions were established for phonemes with special distribution; an empty archi-position would be thus useless.

/bn/, /bň/ or /pm/ in which case phonemes from the archi-position ‘E2’ are combined with those of ‘e1’.

With the position ‘e2’ filled with a phoneme or left empty, we step up to another position, the position ‘e3’, which may be filled with /t/, /d/, /s/, /z/, /š/, /ž/, /k/, /g/, /x/ or /h/ or again left empty. If the positions ‘e2’ and ‘e1’ are also filled with a phoneme, we get a pre-nuclear combination of three consonants. Or we can get a combination of two consonants if either ‘e3’ and ‘e2’, or ‘e3’ and ‘e1’, or ‘E2’ and ‘e1’ are filled with a phoneme. Again, there are, however, restrictions as to which combinations are attested and possible. Some combinations are missing by an accident, i.e. no structural rule can be introduced to explain their non-occurrence, whereas other combinations are structurally impossible. We can, for instance, mention a constraint of the co-occurrence of the consonants /ř/ and /š/ or /ž/: these phonemes cannot occur in one and the same combination: although pre-nuclear /sř-/, /zř-/ are attested, similar combinations /šř-/ or /žř/ are not. Likewise, pre-nuclear /Stř-/, /Sdř-/ are attested but not /Štř-/ or /Šdř-/, i.e. the impossibility of the palatal fricatives to co-occur with /ř/ is not limited to the immediate adjacency, but applies to combinations as wholes.

Once we have gone through the positions ‘e1’, ‘e2’ and ‘e3’ or through ‘e1’ and the archi-position ‘E2’ instead of ‘e2’ and ‘e3’ or just though ‘E3’, we get at a junction where all the paths unite and continue together toward the positions ‘pre1’ and ‘pre2’. They may be viewed as expansions because there is one important condition under which they are filled with a phoneme. They may be filled with a phoneme *only if* at least of the positions ‘e1’, ‘e2’, ‘e3’ and/or their archi-positions ‘E2’ and ‘E3’ have already been filled with a phoneme. In other words, they are never filled with a phoneme if the positions ‘e1’, ‘e2’ and ‘e3’ are all empty. That is why they are expansions: they expand the pre-nuclear phonemes or their combinations.

The position ‘pre1’ can be occupied by /T/, /S/, /Š/ or /ř/ and the position ‘pre2’ by /P/, /T/, /K/, /F/, /S/, /Š/, /X/, /r/, /l/, /j/ or /M/. These positions represent contexts for neutralization of voicing. What is more, we can see that both positions can be filled with /T/, /S/ and /Š/ but it holds that these archiphonemes occur in ‘pre2’ only if the position ‘pre1’ is already filled; otherwise they belong to ‘pre1’, cf. /FSkaS/ *vzkaz* “message” (/S/ in ‘pre1’) × /STkāT/ *stkát* “to weave together” (/S/ in ‘pre2’ because /T/ is in ‘pre1’). There are additional restrictions as to which the mentioned phonemes may occur in the positions ‘pre1’ and ‘pre2’ but we cannot deal with them here. Some of these constraints are directly derivable from the structure of the distributional unit. Particularly interesting is the occurrence of /ř/ in ‘pre1’. This phoneme can also occur in the position ‘e1’. It means that it has phonotactic properties similar to two classes of phonemes: on the one hand, to “sonants” /r/, /l/, /m/, /n/, /ň/ and /j/ (cf. /PŠtroS/ *pštros* × /PStřeň/ *pstřeň* (a kind of mushroom)), and on the other, to /T/, /S/ and /Š/ (cf. /KŠťiTse/ *kštice* "fell (of hair)" × /Křťini/ *křtiny* "christening party"). Also noteworthy is the occurrence of /r/, /l/, /j/ and /M/: if they occur there, they form so-called side-syllables (*pobočné slabiky*), cf. /rTi/ *rty* "lips", /lStnī/ *lstný* "deceitful".

With the two pre-explosive positions we have exhausted pre-nuclear context, and by having filled each particular position with a phoneme or by leaving it empty, we have generated one possible pre-nuclear consonantal combination. We might have either left all the pre-nuclear position empty, in which case there is of course no consonantal combination, or filled exactly one position with a phoneme, in which case the nuclear vowel is preceded by one phoneme. Or we could have filled two, three, four or five positions in which case we have gotten a combination of two, three, four or five consonants. In our database we have compiled there are nearly 400 pre-nuclear consonantal combinations each of which is attested in at least one Czech word (cf. BIČAN forthcoming). All of these combinations are describable with the scheme (10). Similarly, the database lists over 80 post-nuclear consonantal combinations which are describable with the help of the scheme (11) to which we now get.

Once the nuclear position has been filled with a vowel, it may be expanded by a phoneme from the post-nuclear position 'i1', i.e. by /m/, /n/, /ň/, /r/, /l/ or /ř/, though that position may also be left empty. It is noteworthy that the members of the position 'i1' are the same phonemes that belong to the position 'e1' except for /ř/, which belongs to the post-nuclear position 'i3'.

The branching after this first post-nuclear position might again look complicated at the first sight. We have three possibilities. Having gone through the position 'i1', we can, first, step to the position 'i2', second, to the archi-position 'I2', or third, to the archi-position 'I3'. However, only if the position 'i1' is filled with a phoneme (i.e. not empty), the third step is feasible. This is simply to say that the archi-position 'I3', where /m/, /n/ and /ň/ occur, is filled with a phoneme only if the position 'i1' is filled with a phoneme. On the other hand, the first two steps are not dependent on 'i1' being filled or not. If we choose the path of 'i2', we can fill it with /P/, /T/, /K/ or /Š/ or we can leave it empty. We then proceed to 'i3'. If we choose the path of the archi-position 'I2', we skip the positions 'i2' and 'i3' and get right to the last post-nuclear position 'i4'. By various ways these positions are filled with a phoneme we get particular post-nuclear consonantal combinations attested in Czech.

The archi-position 'I2' has been introduced for the archiphonemes /F/ and /X/. It reflects the fact that these archiphonemes are mutually exclusive to the phonemes belonging to 'i2' and 'i3' and never combine with them. It is most obvious in the case of /ř/ which never combines with /F/ and /X/ in the post-nuclear context. In fact, it always combine with an occlusive, cf. /pePř/ *pepř* "pepper", /-Tř/ from *dovnitř* "inside", /buřT/ *buřt* "sausage". In addition, it holds that /F/ and /X/ can, in the post-nuclear context, be preceded by one phoneme from ‘i1’ or one phoneme from ‘i4’. Interesting is the fact that they are not capable of both at the same time, i.e. they are either preceded or followed by a phoneme. Cf. /harF/ *harf* “harp (gen. pl.)” × /naFT/ *naft* “petrol (gen. pl.)”.

The position ‘i3’ can be occupied by the phonemes /T/, /S/ or /ř/. We have already seen that the position ‘i2’ could be filled with /T/. The conditions for its occurrence in ‘i3’ are similar as those of /T/, /S/ and /Š/ in the pre-nuclear positions ‘pre1’ and ‘pre2’: /T/ occurs in ‘i3’ only if the position ‘i2’ has already been filled with a phoneme, which means that it cannot thus be mapped onto that position. The archiphoneme can also belong to the position ‘i4’, but once again this is conditioned by whether the position ‘i3’ has already been filled with a phoneme or not. If it was not, it belongs to ‘i3’, but if it was, it must belong to ‘i4’. Cf. /peTS/ *pec* “oven” (/T/ in ‘i2’) × /kumŠT/ *kumšt* “art” (/T/ in ‘i3’) × /teKST/ *text* “text” (/T/ in ‘i4’).

The last post-nuclear position ‘i4’ can be filled with /K/, /T/, /Š/ or /Ť/ or it left empty. The circumstances allowing the occurrence of /T/ here have already been mentioned. In fact, the only phoneme belonging to the position ‘i4’ not dependent on whether the previous positions have been filled with a phoneme or not is /Ť/[6]. It is because the remaining two archiphonemes /K/ and /Š/ belong primarily to the position ‘i2’. They can appear in the position ‘i4’ only if one of the previous positions has been already filled with a phoneme, in particular if either the position ‘i2’ or ‘i3’ or the archi-position ‘I2’ has been filled with a phoneme. Cf. /teKST/ *text* “text” (/K/ in ‘i2’) × /vojSK/ *vojsk* “army (gen. pl.)” (/K/ in ‘i4’).

By filling the position ‘i4’ with a phoneme or leaving it empty, we have exhausted all possibilities for the post-nuclear context. As we already gone through the scheme (10) for the pre-nuclear context and as we have already filled the nuclear position with a vowel, we get a full-fledged syllable. That is to say, the trees (10) and (11) are models for all well-formed syllables in present standard Czech.[7] It should be mentioned that there are several restrictions as to which phonemes can combine with which in particular contexts, but these restrictions could not have been incorporated into the trees in (10) and (11) without making it a little clumsy and less clear. They are well mapped, though.

5. Conclusion

The distributional unit as we described here for Czech is a model of the phonotactics of Czech, that is to say, it is a model from which statements about the distribution of phonemes and their combinations can be derived. In short, it is a

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6 From this follows that if /Ť/ occurs, it is always the last consonant of a syllable.

7 There is one exception, though: the syllables containing syllabic /r/ and /l/. They would require a separate scheme for the pre-nuclear context involving the archi-position ‘N’, but we have not discussed it here for the lack of space.

model for all well-formed syllables in Czech. Two particular types of statements can be derived from the model as given in (6) and their tree-like visualizations in (10) and (11). It is widely acknowledged that any phonotactic description should be able to account for both statements (cf. GOLDSMITH 2009).

First, our model is capable of describing all consonantal combinations in Czech that are attested in Czech. In our database we have nearly 400 pre-nuclear consonantal combinations and over 80 post-nuclear combinations (see BIČAN forthcoming) are they are derivable from the distributional unit. Consequently, any attested syllable in Czech is describable with these models.

Second, our model is capable of calculating (predicting) consonantal combinations which are not actually attested in the data, but which are still structurally possible. That is to say, combinations which are not used in any phonological form of Czech words but which have a structure that they could function as such, should there ever appear a word containing them. For example, there is a combination /dvj/ occurring in the word *dvě* but a structurally similar combination /tvj/ is not attested. However, there is no reason why Czech could not have a word which would begin with the combination /tvj/. There are other combinations of this kind, and the distributional unit is capable of predicting them.

We claim that all those consonantal combinations (and in turn syllables) that are derivable from our model are well-formed in the Czech phonological system. This is not to say that each and every syllable our model predicts is well-formed. There are additional restrictions to be considered, some of them mentioned in our paper, others not discussed to the lack of space. What we claim is this: a combination that cannot be derived from the distributional unit is not well-formed in Czech. So far we have not been able to refute this hypothesis.

References

AKAMATSU, T. (1992) *Essentials of Functional Phonology*. Peeters: Louvain-La-Neuve.

BIČAN, A. (2008) *Phonematics of Czech: An axiomatic-functionalist view*. Masaryk University. Unpublished PhDr. thesis, available online: <http://www.phil.muni.cz/linguistica/art/bican/bic-rigo.pdf>.

BIČAN, A. forthcoming. Distribution and combinations of the Czech consonants. *Zeitschrift für Slawistik*.

BIČAN, A. ms. Distributional unit: hypothesis and testing. Manuscript available online: <http://www.phil.muni.cz/af/files/bican-du-12-04-10.pdf>.

EL-SHAKFEH, F. (1987) *The phonematics, phonotactics and para-phonotactics of southern Standard British English*. University of St. Andrews. Unpublished PhD. thesis, available online via the EThOS service: <http://ethos.bl.uk>.

FUDGE, E. C. (1969) Syllables. *Journal of Linguistics* 5.253–86.

GOLDSMITH, J. (2009) The syllable. Manuscript, to be published in the second volume of *The Handbook of Phonological Theory*. Available online <http://hum.uchicago.edu/~jagoldsm//Papers/syllables.pdf>

MARTINET, A. (1991) *Élements de linguistique générale*. Paris: Armand Colin.

MULDER, J. (1968) *Sets and Relations in Phonology*. Oxford: Clarendon Press.
MULDER, J. (1989) *Foundations of Axiomatic Linguistics*. Berlin – New York: Mouton de Gruyter.
WHORF, B. L. (1940) Linguistics as an exact science. *Technology Review* 41.80-3.
TRUBETZKOY, N. S. (1939) *Grundzüge der Phonologie*. Prague: Jednota Československých matematiku a fysiků.

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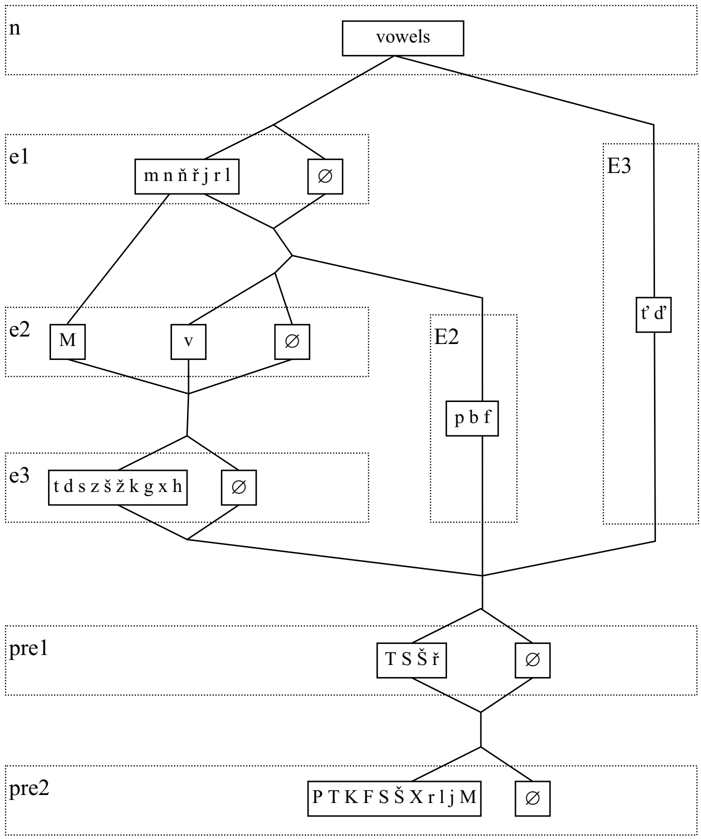
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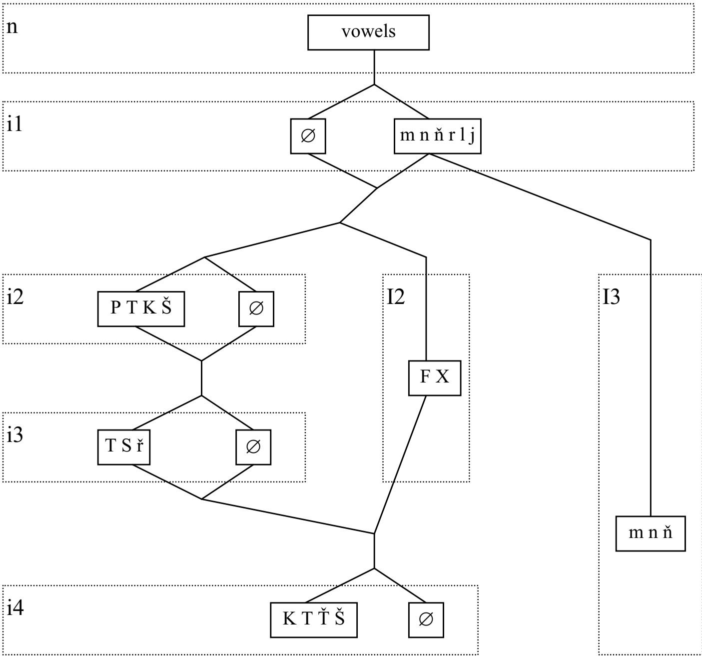
vowels
e1
m n ň ř j r l
∅
E3
e2
M
v
∅
E2
ť ď
p b f
e3
t d s z š ž k g x h
∅
pre1
T S Š ř
∅
pre2
P T K F S Š X r l j M
∅

(10)



(11)

Merger of the place contrast in the posterior sibilants in Croatian

Małgorzata E. Ćavar

Abstract

The paper investigates the reasons behind the merger of the place contrast in posterior sibilants in Croatian, i.e. of /č/ and /ć/, and on the other hand, of /dž/ and /đ/.[1] It is argued that systemic factors such as inventory density are not a sufficient trigger for merger. On the other hand, acoustic variation in the realization of the categories may lead to merger. This approach is formalized in terms of Functional Phonology (BOERSMA 1998).

1. Introduction

Whereas prescriptive grammars of standard Croatian list two series of posterior affricates including post-alveolar /č, dž/ on the one hand, and prepalatal (alveopalatal) /ć, đ/ on the other hand, see (1), it is clear that in every-day speech of the substantial proportion of speakers the contrast between post-alveolars and prepalatals simply does not exist.

(1) Standard Croatian coronal inventory

	affricates	affricates	fricatives	sonorants
	voiceless	voiced		
post-alveolar	č	dž	š/ž	
prepalatal/palatal	ć	đ	-	lj (IPA ʎ), nj (IPA ɲ)

In this paper the reasons for the merger are scrutinized. One potential area of explanation refers to the density of inventories (Dispersion Theory, cf. LILJENKRANTZ & LINDBLOM 1972, FLEMMING 1995/2002, PADGETT 2001, PADGETT & TABAIN 2005, PAGETT & ZYGIS 2007, CAVAR 2004, etc). In the inventories with a high number of contrasts, the same perceptual space is by necessity shared by a bigger number of phonemes and particular sounds are perceptually closer (thus more prone to misperception and merger) than in the systems with a smaller amount of contrasts. This approach alone, however, is not sufficient to explain the tendency to merger in Croatian, as it becomes clear when we compare the

1 Throughout the paper, the Croatian orthographic symbols are used instead of IPA. Whereas Croatian/ć/ and /đ/ are clearly IPA alveopalatal affricates /tɕ/ and /dʑ/ respectively, the classification of /č/ and /dž/ is problematic even without considering the variation discussed in the paper, the symbols used in literature ranging between IPA /tʃ/ and /dʒ/ over less-specific American symbols /tš/ and /dž/ to IPA retroflex symbols /tʂ/ and /dʐ/. Since the goal of the paper is the discussion of the category internal phonetic variation, the orthographic symbols are used as least qualifying.

Croatian sibilant system with the inventory of sibilants in Polish (section 2). In section 3, we will look at the possibility of the systemic avoidance of palatal and prepalatal consonants as the driving force of merger. Then, in section 4, another, traditional explanation of the merger in the standard Croatian will be discussed. The merger might be connected with the dialectal background of the speakers (cf. ŠKARIĆ 2009), in particular, the fact that in some Croatian dialects the contrast does not exist and this simplified system is transferred to the standard. It is clear that the regional dialectal realizations of the respective sibilants have decisive impact on the realizations of the contrast in the standard pronunciation. The assumption made here is that speakers with the different dialectal background learn the standard to some extent as if it were a foreign language, using the same strategies as in the acquisition of a second language. In section 5, the predictions of this assumption are tested in a formal analysis coined in terms of Functional OT (BOERSMA 1995, ESCUDERO 2005).

2. Perceptual density as a trigger of merger

One can look at the phonological processes in language from the functional perspective (PASSY 1891, MARTINET 1955), that is, assume that in language two contradictory drives are present to reach some sort of equilibrium between the needs of the participants in communication: the sequence of speech sounds has to be maximally easy to produce for speakers, and the same sequence of sounds must be maximally easy to perceive and interpret for listeners. These two drives lead potentially to contradictory processes in languages. For example, sounds such as retroflexes, which are perceptually very distinct, with very distinct patterns of acoustic cues, and thus optimal from the perspective of the listener, involve also more complex articulatory side, that is, they are sub-optimal from the perspective of the speaker. And the other way round, sounds which are produced with less difficulty, such as palatoalveolars, which are produced with a less extreme displacement of the tongue from the neutral position and with less complex combination of gestures than retroflexes, they are optimal from the point of view of the speaker but also, since e.g. the formant transition values are less distinct, they are also less attractive for the listener. If some two sounds are not perceptually distinct enough, the two categories will merge. Modelling of vowel inventories were done first by LILJENKRANTZ & LINDBLOM (1972), modelling of the development of sibilant inventories were shown later by BOERSMA & HAMANN (2007), and for obstruent systems by BOERSMA & HAMANN (2010). BOERSMA & HAMANN (2007) have demonstrated that – given idealized conditions with one perceptual dimension of the center of gravity – systems with two sibilant categories will always end up in the simulation with the unmarked articulatorily-perceptually balanced /s-ʃ/ system, as in English. In their model, a system with three sibilants will develop into a Polish-like system with retroflex-like /ʂ/, a prepalatal /ɕ/ and dental /s/, with respective spectral means of roughly

3500Hz, 5500Hz and 7500Hz, relatively equally dispersed in the perceptual space. After reaching this state, the inventory will not develop any further, having reached the optimal dispersion between the members of the contrast. Interestingly, in their simulations, /s/ and /s^j/, sounds which are relatively close perceptually, instead of merging, they develop in a three-way system into a more distinct contrast between dental /s/ and prepalatal /ɕ/, yielding an optimal and stable system as in Polish (2007:25). This is what actually happened in the history of the Polish language (KLEMENSIEWICZ 1985, cf. PADGETT & ZYGIS 2007 and references therein). The question arises why the Polish three-way sibilant system turns out stable whereas in Croatian affricates tend to merge to one post-alveolar place of articulation.

3. On the track of the alternative explanation: Systemic avoidance of palatal consonants

One answer might point to the obvious lack of the distinction between retroflex and prepalatal fricatives in the Croatian system. Whereas the Polish system is completely symmetric between fricatives and affricates, in Croatian this symmetry does not exist, as shown in (2).

(2) Standard Croatian versus standard Polish

	Croatian	Polish[2]
post-alveolar affricates	č/dž	cz (= Cro. Č)/dż (=Cro. dž)
post-alveolar fricatives	š/ž	sz(=Cro.š)/ż (=Cro.)ž
prepalatal affricates	ć/đ	ć/ dź (=Cro. đ)
prepalatal fricatives	–	ś/ź
sonorants	lj/nj/j	– /ń (= Cro. nj) /j

One might stipulate that Croatian is in the process of elimination of the (pre)palatal sounds, although this does not seem convincing in the light of the fact that Croatian has more ‘soft’ palatal sounds in the class of sonorants than Polish. Consequently, one should rather exclude some systemic removal of a particular contrast as a driving force of the merger.

4. On the track of the alternative explanation: variation in realization

One striking difference between Polish and Croatian is the amount of variation in the realization of the sibilant segments in the standard versions of the language. In Polish impressively there is very little variation in the phonetic realization of sibilants depending on the regional background of the speaker. The realizations that are deviating from the norm are not considered standard and are either simply absent from or stigmatized in the media and public discourse.

---

2 Polish orthographic convention is used.

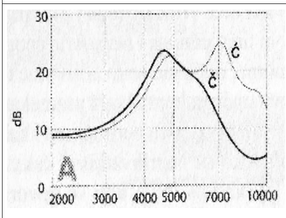
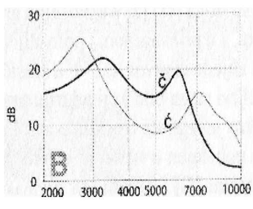
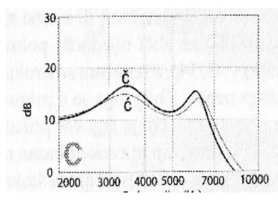
4.1. Polish

I am not aware of studies that would directly target the question of the regional phonetic variation in sibilants in standard Polish but ĆAVAR & HAMANN (2003) recorded for the purpose of their analysis three speakers of Polish from geographically (and dialectally) very distinct areas, i.e. Warsaw, Czestochowa, and Szczecin, and found them homogenous.

4.2. Croatian

For Croatian, the variation in the realization and the tendency to the merger of the two affricate series is discussed in ŠKARIĆ (2009). He distinguishes three registers of standard Croatian which differ in the realization of the contrast: (a) the classical pronunciation with the clear distinction, which supposedly is no longer in common use, (b) the received pronunciation as spoken in the media by trained speakers such as actors and radio presenters, where the realization is somewhere between the classical and the merger, (c) and the accepted pronunciation which merges the two series, that is spoken by everybody else. Below the spectra from ŠKARIĆ (2009) are reproduced. The method on how the spectra were produced, is not described, thus, one cannot rely on the absolute frequency ranges, however, one can compare the rough shape of the envelope and the relative concentration of energy. Thus, the classical type has two distinct shapes of the envelope: /č/ has one peak between 4 and 5 kHz, /ć/ has the concentration of energy slightly above /č/ with two peaks, one overlapping with the peak in č, and the other at around 7 kHz. In the received pronunciation both series have two peaks, the peaks located relatively close to the peaks of the other series, with /č/ slightly more compact in the middle ranges and /ć/ slightly more diffuse. In the accepted pronunciation, the two series do not differ in realization.

(3) Spectra of the two fricative series from Škarić 2009:75

<table>
<tr><td>a. classical type</td><td>b. received pronunciation</td><td>c. accepted type</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

ŠKARIĆ (2009) assumes that in the general use, all speakers assume the accepted type of articulation, irrespective of the dialectal background.

HAMANN & CAVAR (in progress) have also investigated the realization of sibilants in standard Croatian: 18 educated speakers (university students or young faculty members) have been recorded, each speaker has produced 30 realizations of /ć, đ, dž/ and 35 of /č/. In this study we found an overwhelming intra- and inter-speaker variation in the realization of affricates, contrary to the claim in ŠKARIĆ (2009). No overall results are available at the moment, so for the purpose of this current paper four representative speakers have been selected impressionistically, and for each speaker two realizations of each voiceless affricate were chosen for the analysis[3]. For each sound, 5 FFT slices were created with the help of Praat (BOERSMA & WEENINK 2009). The slices were taken at 5 ms intervals. The spectral peaks were read off the FFT slices directly. Then the mean values for the peaks in 5 slices were recorded.

4.3. Results of the acoustic analysis of Croatian sibilants

Each of the selected speakers represented a different type of realization of the contrast between hard and soft affricates. Speaker A produced two very distinct categories, with soft series peaks at 4 and a much weaker at 8-9 kHz and, on the other hand, the hard series peaks at 3 and a weak one 6-7 kHz. The second speaker, speaker B, showed a huge intra-speaker variation in the realizations. The realizations of the soft series tend though to have two peaks at 4 and 6 kHz, and the hard series had the first peak only slightly lower at approximately 3.5 kHz and the second peak between 6-7 kHz, that is, more-less overlapping with the soft series. Speaker C displayed a complete merger of the two categories, both series realized with a broad energy plateau between 4 and 6 kHz. The result of the merger is realized as a segment acoustically between the soft and hard series. Finally, speaker D also merges the two categories, yet the resulting sound is realized differently than for speaker C, i.e. it sounds "softer" with the two peaks located at 5 and (a weak one) at 8 kHz. The peak location is summarized for the four speakers in (4).

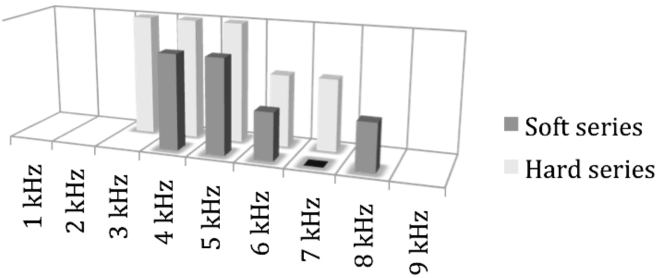
(4) Location of the first and second peak for the analyzed speakers

a. in the four speakers

	soft series	hard series
Speaker A:	4 & 8-9 kHz	3 & 6-7 kHz
Speaker B:	4 & 6 kHz	3,5 & 6-7 kHz
Speaker C:	4 & 6 kHz	
Speaker D:	5 & 8 kHz	

3 Voiced affricates were neglected in the study. It seems that their realizations are not necessarily parallel to the realizations of voiceless affricates.

b. First (higher balks) and second peak (lower balks) across the four speakers



As displayed in (4b), if the first peak is located between 4 and 5 kHz, the sound might be a realization of both hard and soft series. Both series may be realized with the concentration of energy around 6 kHz.

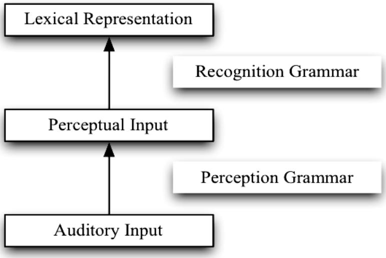
4.4. Discussion

If such realizations appear all in an official context of the university-internal interaction, listeners must face a difficulty deciding what phoneme they actually hear on a particular occasion. Since the contrast between the hard and soft series of affricates does not have a high functional load in Croatian, it seems plausible that on the basis of the acoustic information listeners can only roughly identify the category, i.e. narrow the identification to posterior sibilants, and the actual decision about what they have heard is made on the lexical level.

5. Formal functional analysis

Functional Optimality Theory (Functional OT) is an approach using the standard OT mechanisms (PRINCE & SMOLENSKY 1993, MCCARTHY & PRINCE 1986/1996, MCCARTHY 2002), assuming the evaluation of plausible candidates by ranked constraints and the elimination of the suboptimal candidate representations violating the constraints which are highest ranked. Functional OT differs from the classical OT with respect to the assumption of the articulatory and auditory grounding of constraints and structures, as well as with respect to the overall model of the phonological grammar: phonology is in this approach a bidirectional model for both production and perception. In the perception grammar, we have three levels of representation (BOERSMA 1998, ESCUDERO 2005): the non-discrete auditory input is "run through" the perception grammar with ranked constraints, which produces discrete perceptual input, the phonological representation. The perceptual input, in turn, is subject to the evaluation by the recognition grammar with its ranked constraints, bringing the listener to the lexical representation, see (5).

(5) Perception grammar in Functional Optimality Theory (based on ESCUDERO 2005:43)



Under this approach, a child acquiring a language first has to learn the categories and the constraint rankings of the language, using two strategies: discovering the sound categories from the distribution and repeating patterns in the acoustic signal, and then the fine-tuning of the system, adjusting the category boundaries, using the gradually built lexical knowledge (Gradual Learning Algorithm: BOERSMA & HAYES 2001, ESCUDERO & BOERSMA 2003). For L2 learning, it is assumed that the same strategies, i.e. both distribution- and lexicon-driven learning are used (ESCUDERO 2005), with the assumption of the Full Transfer Hypothesis (SCHWARZ & SPROUSE 1996) and Full Copying Hypothesis for language perception (ESCUDERO & BOERSMA 2004).

My proposal to the Croatian data is that standard Croatian is learned as a second dialect (D2), i.e. similarly like a second language, the only difference being the full access to lexical representations transferred from the first dialect (D1) already at the onset of the learning. Thus, the starting point for the learner of the standard dialect is the firm knowledge about the membership of some acoustic event in a given phonological category. Then, the learner of the second dialect will fine-tune the phonetic boundaries of the categories, i.e. the learner will adjust the respective ranking of the perception grammar constraints to encompass maximal number of phonetic events into the appropriate categories. In the following, the two scenarios for learning standard Croatian are discussed.

5.1. Speakers with the contrast in their native dialect

Speakers with a clear distinction between soft and hard posterior affricates in their D1, like e.g. speaker A in section 4.3, will produce the typical /č/ with the fist peak at 3 kHz and the typical /ć/ with the first peak at 4 kHz[4]. Their D1 per-

4 For the sake of clarity of exposition the concentration of energy in the higher frequency ranges are neglected. In reality, the concentration of energy in higher frequencies may influence the perception of the energy distribution in the lower area (e.g. BLADDON 1986).

ception might look as in (6) and (7), where the constraint against categorizing the input signal with the concentration of energy at 3 kHz as /ć/ must be higher ranked than the constraint against categorizing such a signal as /č/, because the signal with the peak at 3 kHz is more likely to be the realization of /č/ than /ć/. The input signal with the peak at 3 kHz will be interpreted as /č/ and this information is then passed over to the recognition grammar that interprets the signal as a part of the realization of some lexical entry.

(6)

Peak 1=3kHz	3 kHz not ć	4 kHz not č	4 kHz not ć	3 kHz not č
ć	*!			
□ č				*

On the other hand, the input with the peak at 4 kHz, given the same ranking, will be interpreted as /ć/, because, crucially, the constraint "4 kHz not č" is ranked higher than "4 kHz not ć".

(7)

Peak 1=4 kHz	3 kHz not ć	4 kHz not č	4 kHz not ć	3 kHz not č
□ ć			*	
č		*!		

At this point, if the user of this grammar is confronted with the data of the standard, where the lexical item containing /č/ might be realized with the first peak at 4 kHz, the mechanism of the Gradual Learning Algorithm (lexical-driven learning) would cause the re-ranking of the perception grammar constraints and broadening of the boundaries of category /č/.

(8) Listeners confronted with standard Croatian data

a. before re-ranking

Peak 1=4kHz intended as č	4 kHz not č	4 kHz not ć
□ č	*!	
□ ć		*

b. after re-ranking

Peak 1=4kHz intended as č	4 kHz not ć	4 kHz not č
☞č		*
ć	*!	

Under normal circumstances in the first and second language acquisition the re-ranking of constraints would result in the permanent change in the category boundaries. In standard Croatian, however, the user of the grammar will be confronted with as many realizations of /č/ with the peak at 4 kHz as with the peak at 3 kHz, driving an endless re-ranking of the constraints. One way out would be the modification of the lexical representation in that the two categories merge. This, however, does not happen because the standard Croatian system with two categories is firmly coded by written grammars and taught at schools. The solution for the listener is the strategy as in the perception in noisy conditions: the rough identification in terms of a voiceless posterior sibilant is made by the perception grammar and the final decision is handed over to the recognition grammar, compare the tableau in (9). Recognition grammar evaluates the fitting of candidate lexical entries into semantic context. In the example below, it is more likely that the input /plač'e/ (with non-distinct realization of the sibilant) that appears in the context of lexeme 'spend' is the realization of //plaće// meaning 'salaries' (candidate b) rather than of lexeme //hlače// meaning 'trousers' (candidate c) or 's/he cries' (candidate a), as illustrated in (9)[5].

(9)

/plač'e/ Context='spend'	*LEX plače 'cry'/'spend'	FAITH	*LEX hlače 'trousers'/ 'spend'	*LEX plaće 'salaries'/ 'spend'
(a) //plače// 'cry'	*!			
(b) //plaće// 'salaries'				*
(c) //hlače// 'trousers'		*!		

To sum up, the number of the perceptual categories for the speakers with the first dialect background of two separate categories does not have to permanently change when acquiring standard Croatian as a second dialect: listeners will continue perceiving two separate categories.

5.2. Speakers with no contrast in their native dialect

For the speakers who have just one posterior sibilant category in their native dialect D1, when faced with standard D2 inputs, the task is potentially to split/redistribute the native category into two separate categories. This corresponds to ESCUDERO's (2005) SUBSET scenario in the learning of a foreign language. Escudero gives an example of Spanish native speakers with just one high front vowel category (/i/) learning Dutch with its two categories in the same perceptual space (/i/ and /ɪ/). It might be achieved through the interaction of recognition grammar with the distribution-driven learning of categories (category boundaries) and it should result in the change in the underlying representa-

5 Additionally, in Croatian the agreement of morphosyntactic features of words will play a role in the recognition. This aspect has not been taken into account.

tion of words. For example, minimal pairs differing only in the presence of /i/ versus /ɪ/ will have for the learners in the early stages of learning Dutch the same underlying representation, and only later two separate underlying representations will develop. However, in the case of second dialect learning, when learners have clear underlying representations for all lexical items, the first step will consist in "stretching" the native D1 category to encompass all kinds of input from the standard D2, see tableau (10a). For comparison, the perception of an input with a typical for D1 frequency peak at 4 kHz is shown in (10b).

(10) a. Perception of the D2 input

Peak 1=3 kHz	PERCEIVE	3 kHz not č'	5 kHz not č'	4 kHz not č'
☞ č'		*		
--	*!			

b. Perception of the D1 input

Peak 1=4kHz	PERCEIVE	3kHz not č'	5kHz not č'	4 kHz not č'
☞ č'				*

For the language user with D1 with no posterior sibilant contrast (just one category typically realized with the first peak in the spectrum at around 4 kHz) no changes in the perception grammar, or more precisely, in the ranking of perceptual constraints are necessary in the process of D2 learning. In other words, no re-ranking of constraints is necessary in order to perceive D2 sibilant with a slightly different energy distribution in the spectrum as a member of the D1 category. This is because of the relatively higher ranking of constraint PERCEIVE (cf. BOERSMA 1998: 163; ESCUDERO 2005:72 ff): even if the input has some properties beyond the normal category borders, we want to categorize it. Thus, in the lack of other, better-fitted categories, the input with the first peak of energy at 3 kHz will be categorized as a member of a category whose members usually have the energy peak in D1 at 4 kHz. Listeners will categorize inputs from D2 with the peaks anywhere between 3 and 5 kHz as the member of their D1 category, and this without any change in grammar, only with more variation in the input.

The question arises whether the listener under this scenario can develop two separate categories. This seems unlikely because of the inconsistency of the input, as demonstrated in section 4.3. The fact that they do not develop two separate categories in their perception of D2 is also not very problematic from the point of view of communication because of the low semantic load of /č/-/ć/ (and /dž/-/đ/) contrast in Croatian. The low type (and token) frequency of the contrast hinders the distribution-driven learning mechanism; consequently, no changes in grammar for D2 speakers are expected.

5.3. Standard as L1

Whereas for the speakers of standard Croatian using it as their second, non-native dialect, the exposure to the varied input does not trigger change in either constraint ranking of perceptual grammar or in the modification of the inventory of categories, the situation for a native speaker of standard Croatian as their D1/L1 is slightly different. On the basis of the acoustically inconsistent input, they cannot in a natural way develop two separate categories. The process of merger might be, however, slowed down or temporarily halted by sociolinguistic factors represented by the normative tendencies and language policies. Yet, if these are rendered less important, the natural consequence of the acoustic variation is the complete merger of the two categories.

6. Conclusions

In this paper the reasons for the merger of posterior sibilant categories in Croatian are scrutinized; in particular, the question of acoustic variation versus structural factors – such as the density of perceptual space – are discussed. It is quite unquestionable that the category density of sibilants is higher in standard Croatian than for other European languages, which in itself might be a factor leading to merger of the contrasting categories. However, structural factors obviously are not sufficient to trigger merger, which can be concluded from the comparison of Croatian and Polish systems. The difference between Polish and Croatian systems is in the absence versus presence of the variation in the realization of the categories. In Croatian, due to varied dialectal background of speakers, the listener is exposed to an immense acoustic variation between different realizations of the same category. Two scenarios have been investigated. For speakers who in their native dialect have two separate categories, no new ranking of relevant perceptual constraints in standard Croatian can be established, and the lexical decisions are made on the basis of semantic information rather than bottom-up perception. On the other hand, for speakers who do not have a sibilant place contrast in their native dialect, no such contrast can be learned from the data of standard Croatian because the data is inconsistent, thus, no change in grammar results either.