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ASSIBILATION TYPOLOGY AND VARIATION IN SIBILANT SYSTEMS

Dissertation Summary
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The dissertation discusses variation and change in sibilant systems in five language families spoken in Russia.

1. Structure and contents

The dissertation consists of the Introduction, Chapters 1-5, Discussion, Bibliography, and the Appendices (the list of languages, glosses, details of the experiment from Chapter 2, the database, details of the language sample).

In this dissertation, I provide the first attempt at a typology of assibilation based on 53 languages and dialects from five language families spoken in Russia: Uralic, Indo-European, Chukchi-Kamchatkan, Northwest Caucasian, and Turkic (Chapter 3). Both synchronic alternations or free variation and reconstructed diachronic shifts are taken into account. The typology is supplemented with a theoretical overview of the classifications and mechanisms of phonetic change (Chapter 1).

The change in the structure of phonetic variation is viewed here as the driving force of assibilation. In one of the chapters, I analyse variation in sibilants (Chapter 2). In two other chapters, I focus on variation in segments that undergo assibilation. The attention to variation and variability allows me to explain changes that have not been studied before or whose triggers and conditions were not understood. This is, first of all, assibilation of labiodentals (Chapter 4) and lateral fricatives (Chapter 5). The detailed analysis of these and other types of changes allows me to claim that variation, facilitated by articulatory and acoustic factors, can either widen or narrow its scope under the influence of the phonological system. This becomes a crucial factor of sound change.

2. Aims of the study

The primary goal of this study was to provide a typology of assibilation in the languages of Russia. The secondary goal was to create a database of assibilation and sibilant inventories (The Sound Change in Sibilants Database, SCSD), which could be further expanded with new language families, individual languages, and language

varieties. The database was created by G. Moroz and I. Sieber on Github. Its current version is available at <https://agricolamz.github.io/scsd>. SCSD allows to search for synchronic and diachronic sound alternations and changes in the 53 languages or Russia that were included in the present study.

3. Theoretical and practical significance of the study

The study of sound change has a long history, yet many aspects of the phenomenon are still not understood. Over the last decade, two opposing approaches to sound change have formed in the field: one that is more speaker-oriented (articulation, distinctiveness in the system, e.g. Martinet) and the other one that is more listener-oriented (acoustics and perception, e.g. Ohala). New typological data that could potentially verify or falsify these two approaches and their postulates are now sought for.

The second important aspect of this dissertation is the attention to the acoustics of fricatives and affricates. This attention also determines the practical value of my results: they can be used in speech science, especially in speech recognition.

Despite the fact that multiple factors and parameters of the variation in fricatives have been found and described, to the best of my knowledge, there have to this day been no attempts to measure the degree of such variability and quantify it. This highly relevant—both theoretically and practically—problem is also addressed in the present study.

Nowadays, linguistic typology is not solely concerned with the current state of the languages of the world. There have been recent active developments in the typology of sound change, which allows to measure its cross-linguistic variability. This dissertation is one of the first studies in Russian that focusses on this topic. The overview chapter could be used as a base for a future course on sound change for linguists; as of today, such a course is lacking in the linguistic education in Russia. On top of that, the assessment, documentation, and mapping of the chosen parameters of variation for all of the languages spoken in a certain area is valuable for areal linguistics.

4. Basic terminology

Sibilants (e.g. *s, z, ʃ, ʒ, dʒ*) is a class of fricatives and affricates unified by their common articulatory and acoustic properties [Ladefoged, Maddieson 1996: 138; 150], acquisition¹ [Kolpovskaya, Spirova 1968; Sadovnikova 1995], perception and categorisation [Nartey 1982: 13]. Sibilants are alveolar and post-alveolar obstruents to the exclusion of laterals (*l ʟ*); dental (*θ*) and palatal (*j ç*) segments are also not considered sibilants. I will assume the following basic definition of sibilants in what follows:

Sibilants are fricatives and affricates that are articulated in the dental-alveolar and postalveolar region, with the teeth set close downstream from the constriction, and are acoustically characterised by the noise of high intensity in the upper sections of the spectrum.

Despite the fact that the subsystem of sibilants can be singled out in any consonantal inventory according to a set of parameters, studies of languages with multiple sibilants have shown that within a given language it is very difficult to determine the acoustic invariants for each of the sibilants, see [Newman et al. 2001; Haley et al. 2010]. The reason for that is the exceptional variability of sibilants and especially of the alveolar sibilant. Cross-linguistic variation in sibilants is also quite substantial [Gordon et al. 2002; Nartey 1982]. It is partially due to physiology [Ladefoged, Maddieson 1996: 146; Chodroff 2017: 110], partially to sociolinguistic parameters [Fuchs, Toda 2010; Linguistics 2017]; a significant part of this variation is due to linguistic factors, such as the influence of the local vocalic context [Hughes, Halle 1956; Lindblad 1980], position within a syllable [Silbert, de Jong 2008], the type of pronunciation [Maniwa et al. 2009].

For the purposes of this study, assibilation is any process that leads to a change of a non-sibilant segment to a sibilant. A substantial proportion of assibilation can also be viewed as palatalization, but unlike palatalization (in most approaches), instance

¹ For written mistakes in standard and non-standard speakers see also [Sieber 2017a].

of assibilation include the change from non-sibilants to dental-alveolar sibilants, changes of the palatal glide, and changes into a sibilant without a typically palatalising context.

By languages of Russia, I will mean in what follows such idioms that are mostly spoken inside Russia (the distribution data are taken from the encyclopaedia “Yazyki mira”) and whose speakers do not have an independent national state outside of the Russian Federation. This study includes 53 languages and varieties where a synchronic alternation or a diachronic change of a non-sibilant into a sibilant take place or have been reconstructed. A description of one of the dialects of a language served as a primary source of data for that language. If another dialect of the same language was found to have additional instances of assibilation, that idiom was separately included into the study. Thus, the list comprises 20 idioms of the Uralic family, 2 Indo-European idioms, 7 Chukchi-Kamchatkan idioms, 8 Northwest Caucasian idioms, and 16 Turkic idioms.

5. The typology of assibilation

161 cases of assibilation were identified in the languages of the study. Among them, there are 124 diachronic changes (9 being deep reconstructions on language group level) and 37 synchronic alternations (10 having a morphological character), and also a couple of cases of synchronic variation.

There is no taxonomy of sound change that is based on the properties of the underlying processes. What is more, the task of coming up with such a taxonomy is highly complicated if at all attainable (see Chapter 1). The most informative typology for the purposes of the present study appears to be one that is based on the properties of the initial segment undergoing assibilation, since changes of segments from one place and manner of articulation tend to be similar. Inside each of the groups of consonants according to their place and manner of articulation, I decided to single out two subtypes on the basis of the place of articulation of the resulting segment: “hushing” assibilation, i.e. changes to a post-alveolar sibilant (and also to

a hissing-hushing sibilant) and “hissing” assibilation, i.e. changes to an alveolar sibilant. Synchronic and diachronic processes were counted separately.

5.1. Types of assibilation

I. ASSIBILATION OF CORONAL PLOSIVES AND VELAR CONSONANTS

1) “Hushing” assibilation

- a. Full palatalization under the influence of the context
- b. Full palatalization of palatalised consonants
- c. Full palatalization of labialised consonants
- d. Affricatisation of coronal plosives

2) “Hissing” assibilation

- a. “Hissing palatalization” of velar consonants
- b. Spirantisation of coronal plosives

II. ASSIBILATION OF CORONAL LATERALS

1) “Hushing” assibilation

2) “Hissing” assibilation

III. ASSIBILATION OF LABIAL FRICATIVES

“Hissing” assibilation

IV. ASSIBILATION OF VIBRANTS

1) “Hushing” assibilation

2) “Hissing” assibilation

V. ASSIBILATION OF THE PALATAL GLIDE

1) “Hushing” assibilation

2) “Hissing” assibilation

5.2. The frequency of different types of change

The variety of diachronic changes is greater than that of synchronic processes. Only in language reconstruction are there cases of vibrant assibilation and labialised consonants assibilation, as well as the change of velar consonants into hissing sibilants. This lack of certain reconstructed types of assibilation in the synchrony

suggests that descriptions of modern languages pay little attention to the variability in the realisation of segments if that variability does not impact on their distinctive properties.

Among the most widespread types of assibilation in the sample one finds:

- 1) Full palatalization of coronal and velar consonants under the influence of the context, namely front vowels, palatal and bilabial glides, and laryngeal consonants.
- 2) Full palatalization of consonants that have the additional articulation of palatalization independent of their position.
- 3) Strengthening of the palatal glide.

Among the rarest types of assibilation in the sample one finds:

- 1) The change of velar consonants into alveolars under the influence of the palatalising context (Proto-Slavic).
- 2) Affricatisation of coronal plosives without a palatalising context (Koryak, Selkup; both cases are disputable).
- 3) Spirantisation of plosives without a palatalising context (Itelmen, Kerek; both cases are disputable).

The assibilation of labio-dental consonants is also rare (Udmurt, Itelmen). On the contrary, there are many reconstructed cases of assibilation of labialised consonants (Northwest Caucasian).

The assibilation of lateral consonants, contrary to what has been reported in the literature, is found quite frequently in various language families.

6. Variation and its causes

Among the aforementioned types of assibilation, two attracted my special attention, namely the change of labiodental fricatives into alveolar sibilants and the assibilation of coronal laterals. These unusual changes have not been discussed in the previous literature, yet the analysis of their causes and properties can shed some light onto the mechanisms of assibilation and sound change in general.

6.1. Assibilation of labiodental consonants and the structure of the inventory

The change of labial consonants into sibilants and, in particular, of labiodental fricatives into sibilants is a rare occasion in the languages of the world. There has been some discussion of the change of labials into post-alveolar sibilants in some languages, for instance Tswana and Romanian (1), in the literature. The most conclusive interpretation is that a sequence of changes took place in these cases, none of which affected the labial consonant itself [Bateman 2007].

- (1) $f > \epsilon / _i$ ‘pl.’ (Moldovan Romanian) [Bateman 2007]
kartoff ‘potato, sg.’ – kartog ‘potato, pl.’

On the contrary, the perceptive similarity of v and z when the labiodental consonant is actually an obstruent is in some circumstances quite substantial, enough to give rise to the actual change of the labiodental into a sibilant. Such cases, to my mind, are found in Udmurt and Itelmen (2–3).

- (2) $v > z / \#__$ (Beserman Udmurt)
Standard Udmurt yeme – Beserman zeme ‘help’ [Teplyashina 1970: 160–161]
- (3) $*v > z \sim \emptyset / C__$ (Itelmen) [Mudrak 2000: 14]
Proto-Chukchi-Kamchatkan $*\text{ʔaj}\underline{v}$ a ‘morning, tomorrow, east’ >
Itelmen $\text{ʔa}\underline{z}$ osk ‘tomorrow’

The expansion of the variability of the labiodental consonant in the direction of fricativisation, lower sonority, and greater intensity leads to a greater number of obstruent realisations and the occurrence of perceptually ambiguous segments. The fact that it was exactly this tendency that was characteristic of Itelmen and Beserman Udmurt is mirrored by other phenomena in these two languages, namely alternations between the labiodental and more obstruent-like consonants and the general shift of the phonetic systems towards a greater reliance on consonants in comparison to related idioms.

6.2. Assibilation of coronal laterals and the articulatory factor

Lateral consonants are characterised by certain invariant properties of their spectrum [Nartey 1982: 74; Ladefoged, Maddieson 1996; Gordon et al. 2002], however, these consonants are generally characterised by a high degree of cross-linguistic variation [Gordon et al. 2002: 141]. I believe that the articulatory properties of laterals predispose them to high variability. As a result, in some languages laterals can have—either across the board, or conditionally, or sporadically—realisations with a high degree of sibilant noise.² Under certain conditions, a reanalysis of such assibilated realisation as the more normative ones can happen and, as a result, their spread to all of the positions where the lateral is found, i.e. a sound change.

Such changes, which lead to the assibilation of a lateral consonant (4–6), were identified in the present study.

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|--------------------------|-------------------------|----------------------|
| (1) *l > s | (Sakha) | [SIGTYa 2002: 661] |
| (2) l > tʃ / _...tʃ | (Koryak) | [Murav'eva 1979: 43] |
| (3) *l ^w > *ʃ | (Common West Caucasian) | [Chirikba 1996: 177] |

6.3. Variation in sibilants and the structure of the inventory

Although multiple factors and parameters of the variation in sibilants and alveolar sibilants in particular have been found and described, to the best of my knowledge, there have been no prior attempts to measure the degree of such variability and quantify it. Without doing so, we can neither compare its degree in different phonetic contexts, nor assess the role of various related factors. This is especially important for the alveolar sibilant, which is the most frequent sibilant in the languages of the world and, presumably, the most variable one. Together with G. Moroz, I made an attempt at such an investigation [Sieber, Moroz 2019a].³ Our materials were field

² More on the assibilation of laterals in Chukchi in [Sieber 2018c, 2019b].

³ The idea of this study was put forward by I. Sieber. The methodology was developed by both authors. The analysed recordings were made by the investigators as well as their colleagues. The automatic post-processing was implemented in Praat [Boersma, Weenink 2018], while the visualisation, mapping, and principle component analysis were implemented in R [R Core Team

recordings of words with the alveolar sibilant pronounced in isolation in Anguema Chukchi (1 sibilant), Bzhedug Adyghe (31 sibilants), Standard Russian (9 sibilants), Dzhuen Nanai (3 sibilants), and Beserman Udmurt (8 sibilants).

Various acoustic and statistic parameters reflect the high variability of sibilants. These are spectral centre of gravity, standard deviation, skewness, as well as the location of the first peak and slope. These parameters measured in Hertz and the psycho-acoustical Bark scale, reflect both the variability in the frequency of the noise and the variation in the form of the envelope, i.e. the prominence of the peak of energy. The principal component analysis (PCA), one of the methods of dimensionality reduction, allowed is to compare the variability of pronunciations across multiple parameters simultaneously. PCA made it possible to place all of the measurements in a two-dimensional space preserving most of the observed variability. The model with variables encoded in Barks turned out to be the most informative one. In that new space reflecting the variability across pronunciations, we determined the centroid for each language and measured the distance between all of the pronunciations and the centroid. The mean and standard deviation of the distance between the observed values and the centroid make it possible to quantify the variability of pronunciations in each language and compare languages among each other.

Of the five idioms under investigation, the greatest degree of variability was demonstrated by Nanai and Chukchi⁴ and the smallest degree by Adyghe. Thus, the variability in the pronunciations of *s* was greater in those systems where there are few sibilants, and smaller in those where there are many. These results indicate that the structure of the phonological inventory and its subsystems, particularly the number of sibilants, influences the degree of articulatory and acoustical variation of certain segments. Nevertheless, this question calls for further investigation on a broader span of data.

2018] and packages «ggplot2» [Wickham 2009] and «lingtypology» [Moroz 2017] by G. Moroz.

⁴ On the variability of the alveolar sibilant in gender and geographical varieties see [Sieber 2018c, 2019b]; on the interference in the Russian language of Chukchi speakers see [Sieber 2018a].

7. Main conclusions

A consonant can acquire sibilant properties in different ways. Similar strategies are found in languages with different inventories and related to each other only if distantly. Some parallels between diachronic changes and synchronic variability have been noted a number of times.⁵ It is worth noting that even such a significant change in the quality of a sound as its transition into the class of sibilants is found among cases of synchronic variability.

The phonetic property of “being a sibilant” is not binary from the acoustic and, probably, the articulatory point of view. It constitutes a continuum, where the extremes, the most typical cases, as well as the middle ground can be singled out. The high variability of sibilants blurs the borders between them and paves way to further spread of the system.

The high variability of other segments, non-sibilants, can be due to their internal articulatory and acoustic properties or tendencies active in the system at a given time. These tendencies can impact other segments and features, which should be considered together. In the case of lateral fricatives one can say that their place and manner of articulation are very close to those of corresponding sibilants, and that the articulatory variability, which is at times characterised by the shift towards assibilation, is a natural consequence of the similarity of the two articulations, i.e. a certain universal property of voiceless obstruent laterals. This universality results in the frequency of positional, phonologised, and morphophonologised alternations with laterals and sibilants.

The case of labiodental consonants is different in its nature. The perceptual similarity of *v* and *z* is only observed when *v* has enough noisy realisations, which is not the case with a sonorant *v* and, indeed, *w*, which have a lesser degree of constriction. When the articulatory variation of *v* drifts from approximant to fricative realisations, some of its realisations become perceptually close to the dental sibilant

⁵ More on this and the connection between variation and the system on the basis of some languages of the sample see also [Sieber 2018b].

[Sieber 2017b]. Thus, to reject the convoluted argumentation appealing to the structure of the inventory, following Ohala, means to leave unanswered the very important question of why a certain change takes place in a certain language at a certain time but not in other cases. The expansion of the variability of a segment appears to be always part of a broader context, other systematic phenomena in the phonetics of a language.

In the words of John Ohala, large-scale changes go back to “micro-changes” created by the hearer, who misinterprets the speech signal. It seems that for a sufficient amount of perceptually ambiguous realisations that would facilitate the change, the variation of articulation has to develop in a particular direction first. The impetus to the expansion or shrinking of variability, overcoming the tendency of the system to preserve its stability (homoeostasis), is in the end what gives rise to the change.

We cannot be sure that the search for the “prime mover” of sound change will ever be successful. Yet it is necessary to study the mechanisms of alternations and changes in order to establish the most significant events that lead to the eventual reorganisation of the whole system. The beginning of the expansion of acoustic variability is, to my mind, one of such crucial events.

8. Author’s publications on the topic of the dissertation

As a part of the present study, three papers were published in journals from the Additional List of Eligible Journals for Allocation of Academic Bonuses and Research Productivity Assessment at HSE.

1) Sieber I. A., Moroz G.A. (2019a) Issledovanie akustičeskoj variativnosti *s* metodom glavnyx komponent [Study of the acoustic variation of *s* using PCA] // Vestnik Novosibirskogo gosudarstvennogo universiteta. Serija «Lingvistika i mežkul'turnaja kommunikacija». №1. P. 49–64.

2) Sieber I. A. (2018b) Variativnost' i zvukovye izmenenija: o slučajax assimiljativnoj labializacii glasnyx [Variation and sound change: on cases of assimilative vowel labialisation] // Acta Linguistica Petropolitana. Trudy instituta

lingvističeskix issledovanij. V. XIV. № II. P. 243–270.

3) Sieber I. A. (2018a) Fonetičeskaja interferencija v ruskoj reči čukčej (konsonantizm) [Chukchi-Russian fonetic interference (consonants)] // Tomskij žurnal lingvističeskix i antropologičeskix issledovanij. № 1. P. 9–19.

Certain aspects of the study are represented in other publications by the author:

4) Sieber I. A. (2019b) Segmentnaja fonetika. Konsonantizm (amguèmskij govor) [Segmental phonetics. Consonantal system. (Amguema dialect)] // Grammatičeskij očerk čukotskogo jazyka. Èlektronnyj resurs. (www.chuklang.ru).

5) Sieber I. A. (2018c) O konsonantizme amguèmskogo govora čukotskogo jazyka [On consonantal system of Amguema Chukchi] // Malye jazyki v bol'soj lingvistike. Sbornik trudov konferencii 2017. M.: Buki Vedi. P. 70–76.

6) Sieber I. A. (2017b) Preodolevšie sonornost': perexod /v/>/z/ i drugie javlenija načala slova v besermjanskom udmurtskom [Overcoming sonority: /v/>/z/ and other initial shifts in Beserman Udmurt] // Vestnik Moskovskogo universiteta. Serija 9: Filologija. № 2. P. 140–149.

7) Sieber I. A. (2017a) Svistjašie i šipjašie v pis'mennoj reči škol'nikov: k tipologii ošibok [Sibilants in students' written speech: the typology of spelling mistakes] // Russkaja slovesnost' (Škol'naja pressa), № 1. P. 93–99.

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