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INTRA-SPEAKER STRESS VARIATION IN RUSSIAN: A CORPUS-DRIVEN STUDY OF RUSSIAN POETRY

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Russian lexical stress exhibits both inter-speaker variation, defined by the speaker's regional affiliation, social status, age, etc., as well as intra-speaker variation. The latter is difficult to capture due to the need for large corpora of spoken text produced by one speaker. These are lacking, but can be replaced with poetic corpora. We use automatic analysis of poetic texts by 10 poets, drawn from the Russian National Corpus, in order to find word forms that can have stress variation. The number of such forms for an individual speaker ranges between 30 and 200 words, distributed among different parts of speech. We propose a quantitative measure of overall stress variability independent of the corpus size and show that there is a tendency for this variability to diminish over time, at least in poetic texts.

Keywords: corpus-driven research, intra-speaker variation, lexical stress, poetic language, variation in phonology

ВНУТРИИДИОЛЕКТНАЯ ВАРИАТИВНОСТЬ УДАРЕНИЯ В РУССКОМ ЯЗЫКЕ: КОРПУСНОЕ ИССЛЕДОВАНИЕ НА МАТЕРИАЛЕ РУССКОЙ ПОЭЗИИ

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Русское ударение обнаруживает вариативность не только у разных носителей, различающихся между собой по региональной принадлежности, социальному статусу, возрасту и т. д., но и внутри одного идиолекта. Вариативность второго рода трудно исследовать, поскольку для этого необходимы большие устные корпуса текстов от одного носителя. Их, однако, можно заменить поэтическими корпусами. В статье мы автоматически анализируем тексты десяти поэтов, взятые из Национального корпуса русского языка, чтобы найти словоформы с акцентной вариативностью. Число таких форм у одного носителя лежит в интервале от 30 до 200 словоформ разных частей речи. В статье предлагается количественная мера для оценки общей вариативности ударения, не зависящая от размера корпуса; её сравнение для разных авторов показывает, что вариативность снижается со временем, по меньшей мере в поэтических текстах.

Ключевые слова: вариативность в фонологии, внутриидиолектная вариативность, корпусное исследование, словесное ударение, язык поэзии

1. Introduction

Word stress in Russian is generally assumed to be stored lexically and to be driven by morphology (Zalizniak 1985; Knyazev and Pozharitskaya 2012), with some default rules also present in phonology (Lavitskaya and Kabak 2014). This means that in each cell of a given word's paradigm the stress is fixed on a certain syllable, depending on the properties of the word's morphemes. Nevertheless, there exists a substantial amount of variation even within Standard Russian as well as across different regional varieties. Such variation is reflected in Russian pronouncing dictionaries, and some of the words with variable stress tend to become especially prominent among the

Russian public. For example, consider the controversy concerning the pronunciation of the word ˈ*zvonit* or *zvo*ˈ*nit* 'he / she / it calls' where initial stress is heavily stigmatized. Despite this fact, many aspects of stress variation in Russian remain, to the best of our knowledge, understudied, research in this field being rather scarce. It is especially true of intra-speaker variation, as opposed to inter-speaker variation (for the delimitation of these types, cf. Honeybone 2011). Whereas stylistic, regional and chronological inter-speaker variation has received some scholarly attention (Lagerberg 2011; Lehfeldt 2014), intra-speaker variation has not.

Approaching the problem of intra-speaker stress variation, we can take at least two paths of its examination. One is to analyze it through recourse to experimental methods. Such a study focusing on intra-speaker variation was reported by Knyazev, Kukhto, and Piperski (2015) and by Kukhto and Piperski (2016). Speakers of Russian were requested to read out loud sentences containing the word forms *prodal* 'he sold' and *obnjal* 'he hugged'. It was found that the position of stress in such verbal forms is at least partially determined by the stress of the immediately following direct object, making initial stress ˈ*prodal* in sequences like *prodal* ˈ*daču* 'he sold a cottage' more likely than in sequences like *prodal bra*ˈ*slet* 'he sold a bracelet', and the other way round with *pro*ˈ*dal*. That is to say, regarding the results of this experiment, lexical stress shows a tendency to adhere to the Principle of Rhythmic Alternation (see Schlüter 2015), thus exhibiting a general preference for the alternation of stressed and unstressed syllables.

A drawback of this type of experimental study is that it only allows us to examine variation within a limited set of words, primarily because of the restricted resources in terms of speakers' patience (with lexical stress there is an additional problem, namely the speakers' tendency to guess the purpose of the experiment at some point, which renders further investigation useless). Another limitation is that an approach of this type cannot give us any information about real-time—as opposed to apparent-time—change, unless a series of experiments is performed repeatedly over a number of years. Therefore, a corpus study may better help to observe the full scale of variation.

At first sight, spoken corpora appear to be an effective solution. However, most of them are better suited for analyzing inter-speaker variation rather that intra-speaker variation, since large corpora of text produced by one and the same speaker (and annotated for lexical stress with reasonable quality) remain a desideratum. Yet, there is one straw to be grasped, and that is poetic corpora.

Russian syllabotonic poetry has been heavily reliant on lexical stress since the mid-18th century (Gasparov 2000). As shown by Kolmogorov and Prokhorov (1968), a fundamental principle of Russian classical poetry is that the lexical stresses of polysyllabic words can only occupy strong metrical positions, which, in reverse, makes poetry a valuable resource for studying the stress in such words. One might object that stress in poetic texts does not directly reflect the stress in prose; however, the role of poetic license in Russian is often exaggerated. It is true that stress in poetic texts often deviates from the norms of Modern Standard Russian, but such deviations are not random and rarely bend actual stresses simply to fit the meter. To quote Bulakhovskij (1952: 22), "there is a wide-spread wrong opinion that requires some comments. Many people believe that poets freely distort stress patterns in order to fit the rhythm. However, no cultivated poet ever allows himself more variation than is actually present in the standard language of his time".[1] Further evidence for the non-existence of arbitrary poetic license can be found in Gorbachevich (1989: 77–8).

2. Data

In the present paper we analyze intra-speaker variation in the texts of 10 Russian poets: Alexander Pushkin (1799–1837), Nikolay Yazykov (1803–1846), Mikhail Lermontov (1814–1841), Apollon Maykov (1821–1897), Vyacheslav Ivanov (1866–1949), Mikhail Kuzmin (1872–1936), Nikolay Gumilev (1886–1921), Aleksandr Tvardovsky (1910–1971), Konstantin Simonov (1915–1979), and David Samoylov (1920–1990).[2] For these poets, we considered all texts from the poetic subcorpus of the Russian National Corpus (RNC) that are marked as purely syllabotonic, i.e. trochaic, iambic, dactylic, amphibrachic or anapaestic (this decision was made to facilitate the judgments about stress placement and, indeed, to make them possible). The size of the corpus for each poet is given in Table 1:

Table 1. Corpora sizes for 10 poets

Poet	Texts	Tokens	Word types
Pushkin	855	182,014	35,377
Yazykov	354	59,008	15,904
Lermontov	441	125,883	23,122
Maykov	553	107,696	26,196
Ivanov	1,025	103,357	28,717
Kuzmin	553	57,745	17,860
Gumilev	446	57,390	17,245
Tvardovsky	306	101,448	21,272
Simonov	204	51,332	14,505
Samoylov	751	58,179	18,907

Using the stress annotation provided by the RNC, we generated full lists of word forms that occur with varying stress placement, e.g., *glu'boko* and *glubo'ko* 'deeply', in texts by the same poet. This means the study we conducted was corpus-driven rather than corpus-based, because this method of analysis relies heavily on the automatic processing of digitized texts and would be impossible to implement manually. However, the results still had to be filtered manually, since there are many homographic but not homophonous forms (such as *'bedy* 'troubles (NOM/ACC.PL)' or *be'dy* 'of the trouble (GEN. SG)'), as well as some mistakes in the RNC markup. For some word forms, it is difficult

1 «Особых замечаний требует один широко распространенный предрассудок. Многие думают, будто поэты по требованию ритма разрешают себе вольное обращение с ударением, доходящее иногда до искажений. На самом деле ни один культурный поэт никогда не позволял себе и не позволяет колебаний больших, чем те, которые реально существуют в литературном употреблении его времени» (Bulakhovskij 1952: 22).

2 These authors were chosen to ensure balance with respect to chronology and corpus size.

to make a clear distinction between stress variation and polysemy / homography of different words or different forms of the same word. For instance, this is the case with ˈ*devica* and *de*ˈ*vica* 'maid', where there are subtle differences in meaning, or in the case of short forms of adjectives used attributively and predicatively (ˈ*mračna noč* 'gloomy night' vs. *noč mrač*ˈ*na* 'the night is gloomy', cf. Kuleva 2008: 10). In each case a separate decision had to be made based on the judgments of the authors of the present paper (both trained linguists and speakers of Modern Standard Russian).

It should be noted that we make the simplifying assumption that a speaker is not subject to language change throughout their life. We adhere to the apparent-time hypothesis in its strict form (Milroy & Gordon 2003: 35–7), claiming that an individual's language remains stable after being acquired in childhood. This simplification is necessary because some word forms with variable stress are attested only a small number of times, and we cannot be certain whether they actually reflect intra-speaker variation or whether they have undergone intra-speaker change over time.

The distribution of word forms with variable stress across different parts of speech for the 10 poets is shown in Table 2[3]:

Table 2. Word forms with variable stress according to part of speech

Poet	Nouns	Adjectives	Adverbs	Verbs	Numerals	Total
Pushkin	65 (35%)	38 (20%)	8 (4%)	74 (40%)	2 (1%)	187
Yazykov	14 (34%)	18 (44%)	4 (10%)	5 (12%)	0 (0%)	41
Lermontov	50 (41%)	27 (22%)	8 (7%)	36 (30%)	0 (0%)	120
Maykov	52 (39%)	22 (16%)	13 (10%)	48 (36%)	0 (0%)	135
Ivanov	68 (57%)	25 (20%)	3 (2%)	26 (21%)	0 (0%)	122
Kuzmin	14 (22%)	13 (21%)	12 (19%)	24 (38%)	0 (0%)	63
Gumilev	22 (36%)	17 (28%)	6 (10%)	16 (26%)	0 (0%)	61
Tvardovsky	13 (30%)	5 (12%)	10 (23%)	15 (35%)	0 (0%)	43
Simonov	8 (27%)	6 (20%)	7 (23%)	9 (30%)	0 (0%)	30
Samoylov	6 (40%)	4 (27%)	3 (20%)	2 (13%)	0 (0%)	15

As an example, below is a full list of forms with variable stress attested in the corpus of syllabotonic poetry by Aleksandr Tvardovsky, grouped by parts of speech, and their frequencies:

Nouns:		
ˈ*vësnu* × 1	*ve*ˈ*snu* × 2	'spring (ACC.SG)'
*vo*ˈ*rota* × 5	*voro*ˈ*ta* × 3	'gate'
ˈ*kladbišče* × 3	*klad*ˈ*bišce* × 1	'graveyard'

3 It must be noted that we deal with word forms rather than lemmas, since it is often the case that some forms of a word exhibit variation, while others do not. This implies that some variation remains unnoticed. For instance, if a speaker has variation in the word form ˈ*stenax* ~ *ste*ˈ*nax* 'wall (LOC.PL)', it is likely to also exist in DAT.PL and INS.PL; however, these case forms may be unattested.

Nouns:		
'krovi × 4	*kro'vi* × 1	‘blood (GEN.SG)’
'mosta × 4	*mo'sta* × 15	‘bridge (GEN.SG)’
'nuždy × 6	*nu'ždy* × 9	‘need (GEN.SG)’
'okon × 1	*o'kon* × 2	‘window (GEN.PL)’
'poldni × 1	*pol'dni* × 1	‘noon (NOM.PL)’
'polnoči × 2	*pol'noči* × 1	‘midnight (GEN.SG)’
'stenax × 1	*ste'nax* × 2	‘wall (LOC.PL)’
'sudeb × 5	*su'deb* × 2	‘fate (GEN.PL)’
'utra × 1	*u'tra* × 13	‘morning (GEN.SG)’
'hody × 2	*ho'dy* × 1	‘pathway (NOM.PL)’

Adjectives:		
'blizki × 2	*bli'zki* × 1	‘close (PL)’
'bosye × 1	*bo'sye* × 1	‘barefoot (PL)’
'davnišnjaja × 1	*da'vnišnjaja* × 1	‘bygone (F.SG)’
'suhi × 2	*su'hi* × 1	‘dry (PL)’
'ščastliv × 10	*šča'stliv* × 1	‘happy (M.SG)’

Adverbs:		
vy'soko × 4	*vyso'ko* × 8	‘high’
glu'boko × 6	*glubo'ko* × 6	‘deep’
da'lëko × 23	*dale'ko* × 12	‘faraway’
'zadolgo × 1	*za'dolgo* × 1	‘long before’
izda'lëka × 3	*izdale'ka* × 17	‘from afar’
'mel’kom × 1	*mel’'kom* × 1	‘swiftly’
'navek × 1	*na'vek* × 14	‘forever’
'naverx × 1	*na'verx* × 1	‘upwards’
'poverx × 1	*po'verx* × 1	‘on top of’
'totčas × 13	*tot'čas* × 11	‘immediately’

Verbs:		
'valit × 1	*va'lit* × 3	‘make fall (3SG.PRES)’
'vzjalsja × 3	*vzjal'sja* × 1	‘undertake (M.SG.PST)’
'drožit × 1	*dro'žit* × 6	‘tremble (3SG.PRES)’
za'lilsja × 1	*zalil'sja* × 1	‘burst into (M.SG.PST)’
'minulo × 3	*mi'nulo* × 2	‘pass (N.SG.PST)’
ne'obžitoj × 1	*neob'žitoj* × 1	‘not render habitable (NEG.PTCP.PASS.PST)’
'obžitoj × 1	*ob'žitoj* × 1	‘render habitable (PTCP.PASS.PST)’
'obnjal × 2	*ob'njal* × 2	‘hug (M.SG.PST)’
'podnjav × 2	*po'dnjav* × 2	‘raise (GER.PFV)’
po'dnjalsja × 8	*podnjal'sja* × 1	‘raise oneself (M.SG.PST)’

Verbs:		
ro'dilsja × 8	*rodil'sja* × 1	'be born (M.SG.PST)'
so'brala × 2	*sobra'la* × 1	'gather (F.SG.PST)'
so'bralsja × 7	*sobra'lsja* × 2	'set out (M.SG.PST)'
u'dalsja × 2	*uda'lsja* × 1	'succeed (M.SG.PST)'
u'përšis' × 2	*uper'šis'* × 1	'lean against (GER.PFV)'

A look at Tables 1 and 2 alone does not make it possible to compare the amount of variation among individual poets. It is clear that the count of tokens with variable stress depends heavily on the corpus size and the frequency distribution of words within it. A larger corpus is likely to provide more opportunities for a token with variation to surface and for variation to come to light. Type-to-token ratio (TTR) also plays a role, since a corpus with a low TTR includes only a small number of types, which brings down the number of types with variation, even though it is more likely to be attested for each of them. Alternatively, a corpus with a high TTR contains many words, but these appear only a few times each, which means variation is also likely not to surface. For this reason, we need to reduce the counts to find an interpretable measure of variation that is independent of corpus size.

3. Model

In this section, we present a simplified model of our data. Let us assume that there are two types of words—those with variable and those with invariable stress. Let us further assume that any word with variable stress has two possible stresses, one of them surfacing with a probability of 0.25, the other with a probability of 0.75.[4] The probability of variation being attested (a_n) then depends on the number of occurrences of a word in a corpus (n). It is equal to $1 - (0.25^n + 0.75^n)$, where n is the number of its attestations and 0.25^n and 0.75^n are the probabilities of an underlyingly variable word to surface in one of its two forms at all times. For instance, an underlyingly variable word occurring only once cannot exhibit any variation ($a_1 = 0$), an underlyingly variable word occurring twice will exhibit variation with a probability of $a_2 = 0.375$, an underlyingly variable word occurring three times will exhibit variation with a probability of $a_3 = 0.562$, etc.

Let us make an additional assumption that a word w belongs to the class of underlyingly variable words with a probability of v, and to the class of underlyingly invariable words with a probability of $1 - v$. Thus, the probability of a word occurring $f(w)$ times to exhibit variation is equal to $v \times a_{f(w)}$, and the expected number of words with stress variation in the corpus equals $\sum v \times a_{f(w)}$ over all w's.

4 1:3 (0.25:0.75) is the average distribution of the two variants for words with variable stress that were attested at least 5 times in the corpus of a single author. A more elaborate model might take into account that different words have different frequencies of variant forms, e.g., by looking at these frequencies in the decade immediately following the poet's birth, but it remains to be tested whether such a model would fit the data better.

This logic can easily be reversed. Once we know the number of words K with stress variation in the corpus of a poet, we can estimate the value of v so that it would yield the same expected count of words with variation: $\hat{v} = K / \sum a_{f(w)}$. This value seems to be a good estimate of how much intra-speaker variation a given speaker has. However, it is still not robust against corpus size. This can be seen in Table 3, where $\hat{v}$ was calculated for 10 sizes of subcorpora of Pushkin's texts, ranging from 10% to 100% of the total amount of texts available (for each subcorpus size from 10% to 90%, a random selection of texts was taken 20 times, and the mean value of $\hat{v}$ for these 20 trials is provided):

Table 3. The value of $\hat{v}$ in the subcorpora of Pushkin's texts of different sizes

	10%	20%	30%	40%	50%
$\hat{v}$	0.0135	0.0152	0.0162	0.0168	0.0172
	60%	70%	80%	90%	100%
$\hat{v}$	0.0177	0.0185	0.0188	0.0191	0.0194

As can clearly be seen, the estimated variability is higher in larger corpora. This might be due to the fact that larger corpora contain a larger amount of infrequent word forms, where the speakers are less certain about the stress. In order to embed this in our model and render the measure of variability more robust, let us make one more assumption: the probability of having variable stress is not equal to v for all words, but also depends on the rank of the word in the frequency list. The higher the word is in the frequency list, the less variability one would expect, and vice versa.

Let us suppose that the probability that a word belongs to the class of underlyingly variable words is not v, but $v \times r^s(w)$, where $r(w)$ is the rank of the word on the frequency list ($r(w) = 1$ for the most frequent word, etc.), and s is a constant. If s equals 0, it brings us to our starting point (the probability of a word being underlyingly variable is always equal to v); however, if s is a small fraction above zero, it makes less frequent words more variable.

After testing all possible values of s between 0 and 0.30 with a step of 0.001 on the Pushkin and Tvardovsky corpora, we arrived at the conclusion that $s = 0.20$ makes the estimation of v least dependent on corpus size (namely, the standard deviation of the mean estimated values of v for the 10%-samples, 20%-samples, ..., 90%-samples, as well as for the entire corpus is smallest when compared to these values). This makes the final version of our model look as follows:

A word w with the rank $r(w)$ on the frequency list attested n times has underlyingly variable stress (= two variant forms distributed as 1:3) with probability $p = v \times r^{0.2}(w)$.[5] If it has underlyingly variable stress, it surfaces with different stresses with probability $a_n = 1 - (0.25^n + 0.75^n)$. Thus, a word is likely to be attested with variable stress with a probability $P = v \times r^{0.2}(w) \times a_n$. A sum of P's for all words

[5] Strictly speaking, we should not allow this value to exceed 1, making it $p = \min(v \times r^{0.2}(w), 1)$. However, this is not necessary in practice, since v is usually small and $r(w)$ is not greater than 40,000 for any of our corpora.

($\sum P = \sum v \times r^{0.2}(w) \times a_n$) yields an expected number of words with variation K. Once we know the value of K, we can obtain an estimate of v:

$$\hat{v} = \sum (r^{0.2}(w) \times a_n) / K$$

$\hat{v}$ then reflects how much intra-speaker variability a speaker has.

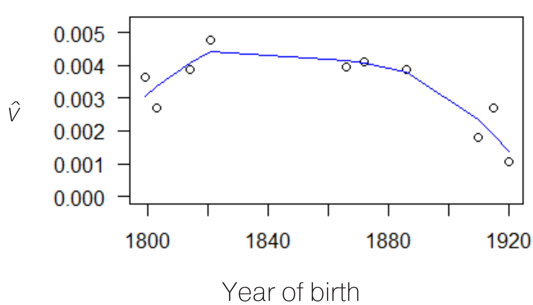
The values of $\hat{v}$ for the 10 poets studied are quoted in Table 4:

Table 4. Estimates of stress variability for the 10 studied poets

Poet	$\hat{v}$
Pushkin	0.00363
Yazykov	0.00268
Lermontov	0.00387
Maykov	0.00475
Ivanov	0.00394
Kuzmin	0.00412
Gumilev	0.00387
Tvardovsky	0.00180
Simonov	0.00270
Samoylov	0.00106

It must be noted that there are some simplifications inherent to our model. For instance, it does not take into account the fact that there are non-syllabic, monosyllabic and clitic words that cannot have any stress variation at all. Nonetheless, these words are generally in the top part of the frequency list, which means that the model correctly assigns them a smaller probability of variation simply because their r (w) is smaller.

Anyway, the value of $\hat{v}$ is a good estimator of how much variation a speaker has, and these values can be compared across speakers, in spite of differences in corpus size. The comparison of poets listed in Table 4 shows that the amount of variation was generally higher in the 19th century and gradually diminished later in the 20th century. This is visualized in Graph 1, where the estimated values of $\hat{v}$ are plotted against the birth years of individual poets (a LOWESS curve is added to the plot to make it more illustrative):



Graph 1. Poets' year of birth and $\hat{v}$

The conclusion we have arrived at using our apparent-time model can be compared to parallel measurements of inter-speaker variation within chronological layers. For these, we created four corpora with texts from four decades (1801–1810, 1851–1860, 1901–1910, 1951–1960), each comprising a random selection of poems totaling up to 100,000 word forms from all poets active during a given decade. Their analysis employing the same methods as above also shows that the rate of variation tends to diminish in bulk towards the middle of the 20th century. The results are presented in Table 5.

Table 5. Stress variation in real time by decades

Decade	Word types	Words forms with variable stress	$\hat{v}$
1801–1810	26,099	187	0.00552
1851–1860	26,215	89	0.00266
1901–1910	27,100	106	0.00299
1951–1960	29,729	59	0.00175

In terms of interpretation, these results can likely be explained by the fact that the norms of Standard Russian were becoming more rigid towards the 20th century. However, even rigid norms turn out not to be powerful enough to dispose of stress variation as a whole.

4. Conclusions

In our paper, we discussed variation in Russian stress. It manifests itself not only as inter-speaker variation depending on regional variety, social status, age, etc., but also as intra-speaker variation, which is difficult to capture. Using the evidence of Russian poetry from the 19th and 20th century in order to study intra-speaker variation, we propose a quantitative measure of overall stress variability independent of corpus size and show that there is a tendency for variation to diminish over time. To provide further support for these findings, we are planning to enlarge the analyzed corpus in future studies.

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