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Vowel reduction in Russian classical singing: The case of unstressed /a/ after palatalised consonants

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The paper focuses on variable pretonic vowel reduction /a/→[a~e~i] after palatalised consonants in Russian classical singing, as in /grʲaˈda/ [grʲaˈda~grʲeˈda~grʲiˈda] 'ridge'. Faithful /a/→[a] realisation frequently occurs in classical singing as opposed to spoken standard Russian, where /a/→[i] reduction applies without exception. In this study, I examined how various linguistic and musical factors influence pretonic /a/→[a~e~i] realisation in 17 classical Russian art songs as recorded by 35 professional singers. T-tests were run to assess the effect of phonetic duration, which appeared insignificant in my data. The contribution of other factors was studied by constructing mixed-effects logistic regression models. Three parameters proved to be relevant: the quality of the stressed vowel, the relative pitch of the note bearing the pretonic vowel as opposed to the stressed vowel, and the singer's year of birth. Although faithful /a/→[a] realisation is commonly attributed to orthographic influence, my findings suggest that vowel reduction may be affected by other factors in singing, and it is also subject to high individual variation.

KEYWORDS: Russian, vowel reduction, classical singing, lyric diction, dissimilation, mixed models.

1. Introduction

In classical singing, vowels undergo various types of adjustments, also known as vowel modifications. For example, this happens in the upper register for sopranos, where F_0 frequency is higher than F1, especially in high vowels (Sundberg 1975). A more specific and less studied issue concerns singing in languages with categorical vowel reduction realised as stress-related vowel alternation, e.g. in Russian /ˈvodɨ/ [ˈvo̠dɨ] 'waters' (NOM.PL), / voˈdɨ/ [vaˈdɨ] 'water' (GEN.SG), where stressed [o] alternates with unstressed [a] within the same morpheme. In singing, and in a classical singing style in particular, a conflict arises between the phonetic properties of unstressed vowels, namely their reduced quality and duration, and their inevitable lengthening in musical performance (Sadovnikov 1958: 10, Manukyan 2011: 88-96). In a language with categorical vowel reduction, such as Russian, this raises the question as to whether vowel alternation rules apply to unstressed vowels in singing in a similar way to the spoken language.

Categorical reduction of unstressed vowels in spoken Russian has been widely studied from various phonological and phonetic perspectives (Avanesov 1956; Crosswhite 2000; Padgett 2004; Knyazev 2006; Hermans 2008; Iosad 2012). The two major patterns of vowel reduction in spoken Russian are so-called ‘akanye’ and ‘ikanye’ (Avanesov 1956). ‘Akanye’ refers to /o a/→[a] neutralisation after non-palatalised consonants (henceforth NPC) or word-initially in a pretonic position, e.g. /ˈsada/ [ˈsa̱da] ‘garden’ (GEN.SG), /saˈdɨ/ [sa̱ˈdɨ] ‘gardens’ (NOM.PL) *vs* /ˈvodɨ/ [ˈvo̱dɨ] ‘waters’ (NOM.PL), /voˈdɨ/ [va̱ˈdɨ] ‘water’ (GEN.SG). ‘Ikanye’ covers cases when all vowels except /u/ are realised as [i] in unstressed position after palatalised consonants (henceforth PC) resulting in /i e a o/→[i] neutralisation, e.g. /ˈlʲisɨ/ [ˈlʲi̱sɨ] ‘foxes’, /lʲiˈsa/ [lʲi̱ˈsa] ‘fox’ *vs* /ˈrʲekʲi/ [ˈrʲe̱kʲi] ‘rivers’, /rʲeˈka/ [rʲi̱ˈka] ‘river’ *vs* /ˈgrʲadɨ/ [ˈgrʲa̱dɨ] ‘ridges’, /grʲaˈda/ [grʲi̱ˈda] ‘ridge’.

Crucially, ‘akanye’ equally applies in spoken and sung Russian. To be more precise, unstressed /o a/ after NPC may be realised as [a] or its more closed variant [ə] in spoken Russian, but they tend to be pronounced as fully open [a] in singing – e.g. /xoroˈʃo/ [xəraˈʃo] ‘well’ in spoken Russian *vs* [xaraˈʃo] in singing. However, as shown by Barnes (2002), the choice between [ə] and [a] is gradual in spoken Russian and it trivially depends on vowel duration. The allophonic divergence between [xəraˈʃo] and [xaraˈʃo] is quantitatively predictable and is not unexpected given the lengthening of vowels in classical singing. Therefore, it is not important for the present discussion, cf. Krasovitsky (*this issue*).

At the same time, ‘ikanye’ is more variable in singing. After PC, unstressed /e/ can be faithfully realised as [e] or be reduced to [i] in singing as in /rʲeˈka/ [rʲiˈka~rʲeˈka] ‘river’. Similarly, and crucially for the present paper, unstressed /a/ after PC can be realised as [a], [e] or [i] in singing, as in /grʲaˈda/ [grʲaˈda~grʲeˈda~grʲiˈda] ‘ridge’. In this study, I focus on the realisation of unstressed /a/ after a PC. In Russian orthography, /a/ after most PC corresponds to the letter *я* (*ya* in transliteration).[1] Only after *ч* (*ch*) and *щ* (*shh*), which are always palatalised, is it represented as *a*.

Categorical vowel reduction in Russian classical singing has been discussed in practical manuals as well as in published song transcriptions for non-Russian speaking singers (Sadovnikov 1958; Challis 1989; Piatak & Avrashov 1991; Richter 2000; Fanning 2002; Grayson 2012; Olin 2012). Sketch descriptive observations regarding vowel pronunciation in singing were also made by Shcherba (1957/1939), Reformatskij (1955), and Panov (1963). More modern and systematic studies of vowel reduction patterns in Russian singing have been conducted by Iljinov (2007) and Manukyan (2011).

Remarkably, observations specifically concerning /a/-reduction after PC are quite controversial in the existing literature, which points at considerable variation. As observed by Manukyan (2011: 122), “even presumed authorities on Russian diction can be at odds with one another regarding proper practice of vowel reduction in classical singing”. Still, most authors recognise that, in singing, /a/ after PC is much less commonly realised as [i] and tends to be pronounced as a more open vowel [e] or [ɛ] (e.g. Belov 2004: 23), or as [a].

For example, already in 1939 Shcherba noted that in “the old times” the students at the conservatories had been taught to pronounce /a/ as [e] in /plʲaˈsatʲ/ [plʲeˈsatʲ] ‘dance’, but contemporary singers preferred the most open vowel [plʲaˈsatʲ] (Shcherba 1957/1939: 129). In a classic textbook on singing pronunciation, Sadovnikov (1958: 11) points out that, while in speech unstressed /a/ may be realised as [i^e] (a sound intermediate between [i] and [e] and so represented following Avanesov 1956), in singing such pronunciation would distort the word. Therefore, Sadovnikov suggests that singers opt for a sound that would be intermediate between [a] and [e], which he marks as *я*^{e}. Aleksandr Reformatskij (1955: 194-195) also acknowledges that /a/→[a] after PC is common in singing, but he stresses that this is due to the influence of orthography and should be seen as a false teaching tradition in vocal pedagogy.

In a manual on singing pronunciation, otherwise known as lyric diction, Emily Olin observes that:

> Sometimes native Russians, singing the same piece of music, pronounce the unstressed vowels *e* and *я* differently. Some use pure vowels, others use reduced ə (*shwas*). For a non-native speaker, determining which to choose is confusing and the help of a Russian coach is essential. (Olin 2012: 12)

The present study seeks to determine factors influencing the realisation of pretonic /a/ after PC in Russian classical singing. The paper is organised as follows. In section 2, I discuss the data and the annotation procedure. Section 3 focuses on the factors potentially influencing vowel reduction that I considered in this study. Section 4 presents the results of a statistical analysis. Section 5 concludes the paper.

2. Data sampling and annotation

2.1. Sampling

The study is based on 17 art songs, or *romansy*, written by Russian composers of the 19th century (M. Glinka, P. Bulakhov, A. Dargomyzhsky,

P. Tchaikovsky, N. Rimsky-Korsakov, S. Rachmaninoff). All songs contain words with unstressed /a/ in lyrics (see Appendix 1). Unlike operatic arias, which were studied by Iljinov (2007) and Manukyan (2011), art songs impose minimal restrictions on the voice type or gender of the singer. This allowed me to compare various recordings of the same song made by a larger number of singers than for an operatic aria. The recordings analyzed in this study were performed by 35 singers (17 women and 18 men, of various voice types), all accomplished professionals, well-known in Russia and native speakers of Russian, born between 1872 and 1977 (see Appendix 2).

In order to simplify the comparison with spoken Russian, which is commonly described as having different patterns of vowel reduction in pretonic position as opposed to other positions (Crosswhite 2000, Knyazev 2006), only instances of immediately pretonic unstressed /a/ after PC were analyzed in this study. As a result, a total of 195 tokens of pretonic /a/ were collected.

2.2. Vowel categories

All the recordings collected for this study contained orchestral or piano accompaniment, which largely affects the signal, and acoustic analysis based on formant extraction proved largely inaccurate for such data. Therefore, I had to adopt an annotation procedure based on perceptual analysis.

First of all, I annotated all the recordings myself based on my own perception as a native speaker of Russian. Used five labels included [a], [a^{e}] (intermediate between [a] and [e]), [e], [i^{e}] (intermediate between [e] and [i]) and [i] for underlying /a/. It was not always easy to choose between [a] and [a^{e}] in some cases, and [e], [i^{e}] and [i] in other cases, since these variants are perceptually and acoustically quite close to each other. Therefore, I grouped the first two sound types [a] and [a^{e}] into an [A] category, and the latter three sound types into an [E] category. The [A] category predominantly contains [a]: there are 89 instances of [a] *vs* 11 tentatively labelled as [a^{e}] in my data. Remarkably, the [e] variant is predominant in the other category (61 [e] *vs* 21 [i^{e}] *vs* 13 [i]), which is why I decided to represent it as [E], rather than [I]. It also means that, even when the singers choose to reduce the vowel, it is not the speech pattern of ‘ikanye’ (with [i]) that they follow. They rather compromise between the speech [i] and the orthographic *ya* (*я*) and pronounce [e] following the strategy known as ‘ekanye’ in Russian dialectology (Kasatkin 2005: 42). In total, there were 100 instances of [A] and 95 instances of [E] in my data.

Later, for an independent cross-check of the chosen category labels, a sample of 16 tokens balanced for the performers' sex and the expected vowel category [A] or [E] were then annotated by three experts in Russian phonetics, all native speakers of Russian. They listened to 16 short fragments containing two syllables – pretonic and stressed syllable – and were asked to label the vowels in the pretonic syllable by choosing from the five variants [a], [a^e], [e], [i^e] and [i]. There was a slight disagreement regarding [e] *vs* [i^e] *vs* [i] labelling in their answers, but crucially, the degree of agreement within the two [A] *vs* [E] categories was 100%. Hence, their results strongly confirmed my own labelling.

3. Factors influencing vowel reduction

First of all, I considered the ABSOLUTE PHONETIC DURATION of the /a/-bearing note as the most straightforward musical predictor. The assumption here is that duration negatively correlates with qualitative reduction, i.e. the longer the note, the less likely the reduction to [e] or [i] in singing, see Manukyan (2011: 133-135).

Apart from phonetic duration, I investigated various categorical linguistic and musical predictors. My general assumption was that in singing, similarly to spoken Russian (Knyazev & Pozharitskaya 2011: 160), the prosodic nucleus of the word comprising the pretonic vowel and the stressed syllable is a salient phonological domain. Hence, the factors considered in this paper largely pertain to the various relationships between a pretonic vowel and the stressed vowel in text and in melodic structure.

I also tested the QUALITY OF THE CONSONANT FOLLOWING PRETONIC /a/ (palatalised *vs* non-palatalised) and the QUALITY OF THE STRESSED VOWEL (/a o u i e ɨ/) as the two linguistic factors known to influence vowel reduction patterns in Russian dialects (Kasatkin 2005; Pozharitskaya 2005).

Musical structure may impose prominence (Manukyan 2011) on certain syllables of the lyrics, even if they are unstressed in linguistic structure. My general hypothesis was that more musically prominent positions, such as those listed below, should disfavour vowel reduction.

The most obvious parameter is the METRICAL POSITION of the /a/-bearing note (accented or unaccented, i.e. falling onto the strong beat in the musical metre or not). However, in my data the /a/-bearing note was invariably weak, hence this factor was irrelevant. This, however, suggests that all composers might have taken into account the linguistically unstressed nature of /a/ when composing the melodies and aligning the text to them.

Furthermore, I looked at the POSITION of the /a/-bearing note IN

A MUSICAL PHRASE, which could be at the beginning of the phrase, i.e. after a pause, or in the mid position, i.e. surrounded by other notes. Since I only looked at pretonic /a/, no cases of phrase-final /a/ were observed in the data. The beginning of the musical phrase, i.e. following a pause, was interpreted as being more prominent than the medial position, since it is perceptually more salient.

I also considered the RELATIVE LENGTH of the /a/-bearing note as opposed to the following note bearing the stressed vowel (pretonic /a/-bearing note is shorter *vs* the same). If the pretonic vowel bearing note was of the same length as the stressed vowel bearing note, e.g. both are quavers (8^{th}) or crotchets (4^{th}), then the assumption was that the pretonic note was more prominent. On the contrary, if the pretonic vowel bearing note was shorter than the stressed vowel bearing note, e.g. in a sequence of a quaver (8^{th}) and a crotchet (4^{th}), the pretonic note was less prominent. No cases of the pretonic vowel bearing note being longer than the stressed vowel bearing note were attested.

The last musical parameter was the RELATIVE PITCH of the /a/-bearing note as opposed to the following note bearing the stressed vowel (higher *vs* the same *vs* lower). I hypothesised that the direction of melody from the pretonic vowel bearing note to the stressed one may affect the singers' choice of reduction pattern. I expected that if the two notes were of the same pitch, the pretonic vowel would be in a more prominent position than if they made up an ascending or descending interval.

To illustrate how a given piece of music was annotated for linguistic and musical parameters in this study, let us look at the beginning of Sergei Rachmaninoff's song "Zdes' xorosho".

Figure 1. Sergei Rachmaninoff, "Zdes' xorosho".

In Figure 1, the word *взгляни* /vzglʲaˈnʲi/ 'look' has a pretonic /a/. The following consonant /nʲ/ is palatalised, and the stressed vowel is /i/. The /a/-bearing $C^{\#}_5$ note is at the beginning of the musical phrase, and is shorter and lower than the E_5 crotchet bearing the stressed syllable.

Now consider the following line from Pyotr Tchaikovsky's song "Den' li carit".

Figure 2. Pyotr Tchaikovsky, "Den' li carit".

In Figure 2, we focus on the word *святого* /sv^{j}aˈtovo/ 'saint' (GEN.SG). The following consonant /t/ is non-palatalised, and the stressed vowel is /o/. The /a/-bearing $G^{\#}_4$ quaver is in the middle of the musical phrase, it is shorter and higher than the following $D^{\#}_4$ crotchet.

Furthermore, vocal pieces were interpreted by individuals having their personal preferences and presumably following a certain style particular to a given period. While inspecting the data, I noticed that singers from older generations, i.e. born before 1930, produced more reduced vowels of the [E]-type than their younger colleagues, who preferred more open [A] variants, cf. also Shcherba's (1939) observation as cited in section 1. Therefore, in statistic tests I took into account the singer's YEAR OF BIRTH.[2] I also tested GENDER as a factor, although I did not expect it to influence vowel reduction. Finally, I modelled individual variation in the singers' vowel reduction preferences as a random effect, see section 4.2.

It could also be true that certain WORDS favour or disfavour vowel reduction, see Manukyan's (2011: 149) observation that pretonic /e/ is more commonly reduced in personal pronouns *meˈnya* (1SG.ACC) and *teˈbya* (2SG.ACC). I modelled specific words as another random effect in this study, see section 4.2.

After formulating my hypotheses, I manually annotated all the recordings for the predictors and their values.

4. Results

4.1. Vowel duration

The only strictly phonetic factor in this study was the duration of the /a/-bearing note. In order to control for other factors, I decided to test the influence of duration on vowel reduction for each single word token as pronounced by different singers. I took word tokens with no less than eight recordings and no less than four instances of each response value [A]/[E], i.e. with more or less symmetric data sets for [A] and [E]. Only three items met these two requirements – *tyaˈnulis’* (*тянулись*) from Glinka’s song “Ya pomnyu chudnoe mgnovenje”, *glyaˈzhu* (*гляжу*) from Tchaikovsky’s song “Net, tol’ko tot, kto znal”, and *vzglyaˈni* (*взгляни*) from Rachmaninoff’s “Zdes’ xorosho”, see Appendix 1. The data on the duration of the /a/-bearing note for each word are represented in Table 1, all sets in the columns are sorted in ascending order. Since these words come from different songs, they were pronounced by non-identical groups of singers. For example, I only have Anna Netrebko’s recording of Rachmaninoff’s song with *vzglyaˈni* but not the two others.

tyaˈnulis’		*glyaˈzhu*		*vzglyaˈni*	
[A]	[E]	[A]	[E]	[A]	[E]
0.177	0.175	0.279	0.457	0.118	0.157
0.336	0.185	0.398	0.5	0.244	0.35
0.357	0.189	0.437	0.547	0.273	0.406
0.433	0.221	0.452	0.574	0.287	0.652
	0.264	0.641	0.593	0.305	
		0.682			
		0.692			
		0.763			

Table 1. The effect of duration on /a/ realisation (in seconds).

To investigate the potential effect of duration on the response value, t-tests were run separately for each word in RStudio (version 1.1.383). No significant difference between [A] and [E] durations was found in all the three cases: $t(3.55) = 2.12$, $p = 0.11$ for *tyaˈnulis’*, $t(9.06) = 0.13$, $p = 0.90$ for *glyaˈzhu*, $t(3.65) = 1.36$, $p = 0.252$ for *vzglyaˈni*; nor was it found when the data from the three sets were calculated together: $t(28.43) = 0.42$, $p = 0.6757$.

4.2. Other factors

This study was based on the assumption that in vocal pieces, various linguistic, musical and social parameters may influence vowel reduction. However, the data sample collected to model this potentially complex interaction was not balanced. There were as many as 13 data points for *glyaˈzhu*, but only 3 for *nayaˈvu* in my data, see Appendix 1.

Similarly, there were only three singers, i.e. Dmitri Hvorostovsky, Sergei Lemeshev and Irina Arkhipova, who had 15 or more data points in my sample, while most singers (23 out of 35) provided five or fewer data points; see Appendix 2.

In order to estimate the contribution of multiple factors on the binary [A]/[E] response value in an unbalanced sample, I constructed generalised mixed-effects logistic regression models using *glmer* function of *lme4* package in RStudio (see Manning 2007). The baseline model included all linguistic and musical factors together with the singer's year of birth and gender as fixed predictors, while individual singers and word tokens were modelled as introducing random variation. After constructing the overfitted model, I gradually excluded the factors which turned out to be insignificant, and compared the new models based on the Akaike information criterion (AIC).

The level of individual variation among the singers and the word tokens proved to be very high in the data (the variance values are 7.62 and 2.94 respectively). Therefore, both random factors needed to be present in the model; cf. also Manukyan's (2011: 143) observation that in art songs, vowel reduction is strongly influenced by the personal preferences of the artists. The two most divergent artists in my sample were Ivan Kozlovsky, who strongly preferred reduced [E], and Anna Netrebko, who left the vowel unreduced, i.e. [A], see Appendix 2.

Among the fixed predictors, the quality of the following consonant, the position of the unstressed /a/-bearing note in the musical phrase and the singer's gender did not influence vowel choice in this sample. On the other hand, the contributions of the quality of the stressed vowel, the relative pitch of the /a/-bearing note and the singer's year of birth were highly significant. These three parameters are discussed in sections 4.2.1 to 4.2.3 below.

4.2.1. Stressed vowel

The quality of the stressed vowel turned out to be a strong predictor of the response value. A dissimilation pattern was discovered, which is not attested in standard spoken Russian. Non-high stressed vowels, i.e. /e o a/, favour pretonic /a/→[E], whereas high vowels, i.e. /i ɨ u/ favour pretonic /a/→[A]. As shown in Table 2, this pattern is not entirely consistent across all the vowels, since the proportions of [A] and [E] are roughly the same for /u/. However, when the stressed vowel is represented as a binary category (high *vs* non-high), the summed values are highly significant, X^2 $(1, N = 195) = 24.59$, $p < .001$, see Table 3.

STRESSED VOWEL	[A]	[E]
i	33	10
ɨ	21	5
u	12	13
e	21	32
o	4	20
a	9	15

Table 2. Stressed vowels and pretonic vowels (number of tokens).

STRESSED VOWEL	[A]	[E]
high	66	28
non-high	34	67

Table 3. High *vs* non-high stressed vowels and pretonic vowels (number of tokens).

Dissimilatory patterns of vowel reduction have also been attested in Russian dialects (Kasatkin 2005; Pozharitskaya 2005). More specifically, pretonic vowel dissimilation after PC triggered by high *vs* non-high stressed vowels has been documented in Southern Russian dialects spoken around the river Don, cf. hence this pattern is called *Donskoy* type of vowel dissimilation (Kasatkin 2005: 46; Pozharitskaya 2005: 60-61). However, the Donskoy type is not exactly identical to the pattern discovered in classical singing.

First of all, the reduced pretonic vowel occurring before non-high stressed vowels surfaces as [i] in the dialect, cf. /rʲaˈdɨ/ [rʲaˈdɨ] 'rows' *vs* /rʲaˈdok/ [rʲiˈdok] 'a small row' (Pozharitskaya 2005: 61), but it tends to be realised as [e], rather than [i] in singing. Second, vowel dissimilation is obligatory in the dialect, whereas it is highly variable in singing. Finally, in the Donskoy type, vowel dissimilation affects not only pretonic /a/, but also pretonic /e/, cf. /sʲeˈdɨje/ [sʲaˈdɨje] 'grey-haired' (NOM.PL), /sʲeˈduju/ [sʲaˈduju] 'grey-haired' (ACC.SG.F) with pretonic /e/ realised as [a] before high vowels /y, u/ *vs* /sʲeˈdoj/ [sʲiˈdoj] 'grey-haired' (NOM.SG.M), /sʲeˈdaja/ [sʲiˈdaja] 'grey-haired' (NOM.SG.F) with /e/ realised as [i] before non-high vowels /o, a/ (Pozharitskaya 2005: 61). In classical singing, pretonic /e/ after PC can be realised as [e] or [i], but never as [a]. Therefore, to our knowledge, the dissimilatory pattern attested in singing has no direct parallels in Russian dialects.

As noted by Pozharitskaya (2005: 48-49), dissimilatory reduction can be interpreted as quantitative dissimilation, since high vowels are inherently shorter than non-high vowels, cf. also Maddieson (1997). Therefore, vowel dissimilation ensures that the prosodic nucleus of the word, i.e. its pretonic and stressed syllable, is more or less quantitatively stable.

In my view, the quantitative explanation does not hold for singing. In singing, the duration of vowels is dictated by musical structure, hence it is unlikely that the inherent duration of high *vs* non-high vowels may directly influence pretonic vowel dissimilation. At the same time, high vowels are known to be less sonorous than non-high vowels (Parker 2002: 236). In singing, melodic lines should be produced with equal sonority, and I would tentatively suggest that height dissimilation is a tool for balancing vowel sonority. When the stressed vowel is more open and sonorous, the preceding one becomes less open and less sonorous, and vice versa. Apparently, this mechanism only applies where variation is possible, as is the case for /a/-reduction after PC.

4.2.2. Relative pitch of the /a/-bearing note

The relative pitch of the /a/-bearing note also proved to influence pretonic vowel reduction. In a descending melody, i.e. when the pretonic note is higher than the stressed note, reduction occurs more often, but in an ascending melody it is less common, X^2 (2, N = 195) = 16.52, $p < .001$. However, the preference for unreduced vowels is stronger when the /a/-bearing note has the same pitch as the stressed note.

Relative pitch (pretonic /a/-bearing note *vs* stressed note)	[A]	[E]
higher	14	37
same	22	11
lower	64	47

Table 4. Relative pitch of the /a/-bearing note (number of tokens).

Therefore, lower or same pitch corresponds to lower pretonic vowel quality. This result does not support my original hypothesis, namely that ascending and descending intervals between pretonic and stressed vowels would pattern differently as opposed to same pitch as the latter position is more prominent for the pretonic vowel. On the contrary, these data suggest that the difference in the pretonic and stressed vowel height is aligned in singing with the corresponding difference in their pitch height. This finding corresponds at least indirectly to the well-known generalisation that higher vowels have intrinsically higher F_0 than lower vowels in spoken languages (Maddieson 1997).

4.2.3. Year of birth

The last significant factor was the singer's year of birth. My original hypothesis was that singers from older generations would prefer more reduced vowels. This proved to be generally true as long as the year of birth is modelled as a binary feature with a cut-off point at 1925, which is the mean between 1872 and 1977, X^2 (1, N = 195) = 17.04, p < .001, see Table 5. The regression model which included the singer's year of birth as a binary predictor performed better than the model without it (AIC = 202.8 for the former, AIC = 208.2 for the latter).

YEAR OF BIRTH	[A]	[E]
Singers born before 1925	24	42
Singers born in 1925 and later	76	53

Table 5. Year of birth as a binary factor (number of tokens).

However, if we cut the timeline into four parts, it appears that the preference for [E] may be particularly strong for singers born between 1900 and 1924, see Figure 3 and Appendix 2.

Figure 3. Year of birth (number of tokens).

In Figure 3, the data sets are divided into four groups according the singer's year of birth. Still, this figure needs to be treated with caution. First of all, the numbers of singers and data points were unequal in each group – there were 7 singers providing 21 data points born in 1872-1898, 19 singers with 45 data points born in 1899-1924, 13 singers with 83 data points born in 1930-1959, and 6 singers with 46 data points born in 1960-1977 in my sample. Hence, the four sets are not balanced.

Furthermore, individual singers provided different numbers of data points, and individual variation proved to be quite strong in the data. The dominance of [E] in the second period can be due to the individual contribution of Ivan Kozlovsky and Sergei Lemeshev, who provided many data points for this period (17 out of 45): were are 9 instances of [E] out of 10 for Ivan Kozlovsky, and 12 instances of [E] out of 17 for Sergei Lemeshev in my data (see also Appendix 2). In general, it remains unclear whether the variation across individual singers can be better explained by their personal preferences or any changes in the singing style and/or pronunciation tradition.

Obviously, dividing the singers into smaller groups based on their year of birth makes the resulting distribution more sensitive to individual variation; therefore, in this study I modelled the year of birth as a binary predictor.

4.3. General results

The resulting logistic mixed effects regression model included stressed vowel quality, relative pitch and the singer's year of birth as fixed effects. Individual singers and word items were modelled as random effects. The model revealed huge variation across individual speakers and individual words. However, some consistent patterns were also observed in the data.

The most significant predictor was the quality of the stressed vowel. Immediately pretonic /a/ dissimilated with the stressed vowel in height: the reduced [E] variant was more likely to appear before stressed non-high vowels /a e o/ ($\beta = 2.92$, $z = 2.75$, $p < .01$). As argued in 4.2.1, this may be a specific tool for balancing vowel sonority in the melodic line.

The second factor was the pitch of the /a/-bearing note as opposed to the stressed note. A higher pitch in the pretonic note favoured a higher vowel in the pretonic note, whereas lower and same pitch correlated with an unreduced lower vowel ($\beta = -2.45$, $z = -2$, $p < .05$ for reduced [E] and the lower pitch and $\beta = -3.55$, $z = -2.21$, $p < .05$ for reduced [E] and the same pitch). This may suggest that the pretonic vowel height tends to harmonise with its relative pitch as opposed to the stressed vowel.

Finally, the singer's year of birth appeared to predict a vowel reduction pattern in that singers from older generations had more reduction than their younger colleagues; in other words, the younger generation had a negative effect on vowel reduction ($\beta = -3.26$, $z = -2.15$, $p < .05$). However, this parameter is not uncontroversial since it may be influenced by the singer's personal preferences. It also remains unclear whether this tendency may be linked to any process of change in spoken Russian.

5. Discussion and conclusions

This paper discussed the realisation of pretonic /a/ after PC in Russian classical singing, a phenomenon which has been reported variably in the literature. In this study, I explored the influence of various linguistic and musical parameters on vowel reduction in Russian art songs, using logistic mixed effects regression modelling.

Most importantly, my data suggested that pretonic /a/ tends to dissimilate with the stressed vowel in height. The reduced vowel, most commonly realised as [e] in my sample, was more likely to appear before non-high stressed vowels /a e o/, but pretonic /a/ tended to be realised faithfully before high stressed vowels /i ɨ u/. Secondly, vowel reduction was influenced by the musical structure. Reduction was more common in cases in which the note of the pretonic vowel was higher than the note of the stressed vowel, so pretonic vowel height tends to be aligned with difference in pitch between the two notes. Finally, singers born in 1925 and later were more inclined to faithfully pronounce pretonic /a/ as [a], although individual variation was also quite strong in my data.

A word of caution should be added since this study is based on a specific genre, namely art songs. According to Manukyan (2011: 142-143), different stylistic considerations apply in art songs as opposed to operatic arias. Arias are more inclined toward unreduced, i.e. faithful, realisation of unstressed vowels, whereas art songs are more inconsistent and more subject to the personal preferences of the performers. Hence, the results of the present study may not hold for the whole body of Russian classical vocal music.

Still, these findings generally support Shcherba's (1957/1939) observation, first published in 1939, that contemporary singers opted for unreduced [A] vowel, whereas previously conservatory students had been taught to pronounce [E]. However, my data suggest that at first, even older singers pronounced [A] in many cases and that the shift in preference from [E] to [A] may have occurred later, since the singers born after 1925 could not begin their careers until 1950. The discrepancy between Shcherba's account and my own points to the fact this shift in the vowel reduction pattern is a very complex gradual phenomenon, and only larger samples may help to pin down its exact chronology. To study this process further, one would have to explore the recordings of younger singers born after 1977.

It also remains to be seen what factors influence the realisation of unstressed /a/ in positions other than pretonic, as well as the realisation of unstressed /e/ after PC. I would suggest that vowel dissimilation may also explain why pretonic /e/ is predominantly reduced to [i] before stressed /a/ in oblique pronominal forms *menya* (1SG.ACC) and *tebya* (2SG.ACC), as noted by Manukyan (2011: 149).

In general, faithful /a/→[a] realisation after PC in singing is commonly linked to the influence of orthography in the literature, since /a/ after PC is represented by specific letters *я* or *а* (Reformatskij 1955; Iljinov 2007; Manukyan 2011). However, my findings suggest that the orthographic influence, although not improbable, interacts with more subtle linguistic and musical factors, since the reduction of /a/ after PC may be sensitive to vowel and pitch height. Moreover, orthographic influence cannot explain why /o/→[a] ('akanye') reduction after NPC always applies in singing, as mentioned in the introduction, while /a/→[i] ('ikanye') reduction after PC is realised with much complex variation, as demonstrated in this study. Although these two types of reduction are usually treated as parallel patterns of categorical change in spoken Russian (Crosswhite 2000; Knyazev 2006; Iosad 2012), the divergent realisation of these patterns in classical singing suggests that they may be of a different phonological nature in Russian.

A possible explanation of this fact could be that 'akanye' is a lexical process in Russian, while 'ikanye' is a postlexical one. The evidence for such a distinction comes from the fact that the former pattern has exceptions in spoken language, and hence is non-automatic, e.g. in the pronunciation of some loanwords: *boa* [boˈa], *radio* [ˈradʲio], *poet* [poˈet] or [paˈet] depending on the speech style (Knyazev & Pozharitskaya 2011: 70), as well as some foreign personal names, e.g. *Coco Chanel* [koˈko ʃaˈnelʲ]. On the other hand, /a/→[i] change has no exceptions and, presumably, is less recognizable for speakers. Just as intonation, a postlexical phenomenon, is suppressed by the melody in singing, postlexical /a/→[i] reduction may be blocked by inherently prolonged duration of vowels, as already observed by Sadovnikov (1958: 11). Still, as shown in section 4.1, vowel duration as such does not predict the concrete phonetic realisation of /a/→[a~e~i] in classical singing.

Abbreviations

ACC = accusative; AIC = Akaike information criterion; GEN = genitive; F = feminine; M = masculine; NOM = nominative; NPC = non-palatalised consonants; PL = plural; PC = palatalised consonants; SG = singular.

Notes

[1] Hereafter, I transliterate the Russian orthography in the names of art songs and specific words following the Russian national standard of romanisation of Cyrillic letters GOST 7.79-2000 System B (<transliteration.ru/gost-7-79-2000/>) with minor modifications. In this paper, Cyrillic letters *ы*, *э* and *ь* are represented as *y*, *e* and *’* respectively. Where needed, stress is marked by a raised vertical line ˈ following IPA rules. When referring to Russian singers and composers with familiar spellings, I use the transliteration of their names as adopted in English Wikipedia. Well-known Russian scholars, e.g. Lev Shcherba, are spelled following the tradition already adopted in the literature.

[2] Another way to capture time difference would be to consider the year when a given recording was made. However, I did not have this information for many recordings so I could not use this parameter.

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Appendix 1. Art songs and words

Composer	Art song	Word	[A]	[E]	Total
Petr Bulakhov (1822-1885)	"Ne probuzhdaj vospominan'ya"	*svyashchennyj*	5	3	8
		svyatym 1	1	3	4
		svyatym 2	2	1	3
Alexander Dargomyzhsky (1813-1869)	"Nochnoj zefir"	*javis'*	6	3	9
Mikhail Glinka (1804-1857)	"V krovi gorit ogon' zhelan'ya"	*bezmyatezhnyj*	2	4	6
	"Ya pomnu chudnoe mgnoven'e"	*javilas' 1*	8	1	9
		javilas' 2	7	2	9
		tyanulis'	4	5	9
	"Somnen'e"	*shchastlivyj*	6	0	6
Sergei Rachmaninoff (1873-1943)	"V molchanji nochi tajnoj"	*opjanenji*	9	1	10
	"Ja byl u nej"	*klyalas'*	1	2	3
	"Utro"	*ryady*	6	0	6
	"Zdes' xorosho"	*vzlglyani*	6	4	10
Nikolai Rimsky-Korsakov (1844-1908)	"Redeet oblakov…"	*gryada*	3	6	9
Pyotr Tchaikovsky (1840-1893)	"Den' li tsarit"	*svyatogo*	2	8	10
	"Kolybel'naya"	*vzyala 1*	2	4	6
		vzyala 2	3	3	6
	"Net, tol'ko tot, kto znal…"	*glyazhu*	8	5	13
	"Serenada"	*bezmyatezhnym*	1	6	7
		svyatoj 1	1	6	7
		svyatoj 2	1	6	7
	"Sred' shumnogo bala"	*glyadeli*	2	11	13
	"Zabyt' tak skoro"	*glyadela*	2	7	9
	"Zachem"	*najavu*	0	3	3

Appendix 2. Singers

Singer	Y. of birth	Gender	Voice type	[A]	[E]	Total
Abdrazakov, Ildar	1976	m	Bass	1	0	1
Antonova, Elizaveta	1904	f	Contralto	0	1	1
Arkhipova, Irina	1925	f	Mezzo-soprano	8	7	15
Atlantov, Vladimir	1939	m	Tenor	5	0	5
Borodina, Olga	1963	f	Mezzo-soprano	3	3	6
Chaliapin, Feodor	1873	m	Bass	1	0	1
Dolukhanova, Zara	1918	f	Mezzo-soprano	3	4	7
Gedda, Nikolai	1925	m	Tenor	3	3	6
Hvorostovsky, Dmitri	1962	m	Baritone	11	7	18
Ivanova, Viktoriya	1924	f	Soprano	0	1	1
Kazarnovskaya, Lyubov	1956	f	Soprano	3	7	10
Kosits, Nina	1892	f	Mezzo-soprano	5	0	5
Kovaleva, Galina	1932	f	Soprano	4	0	4
Kozlovsky, Ivan	1900	m	Tenor	1	9	10
Leiferkus, Sergei	1946	m	Baritone	3	1	4
Lemeshev, Sergei	1902	m	Tenor	5	12	17
Maksakova, Maria	1902	f	Mezzo-soprano	0	1	1
Marusin, Yurij	1945	m	Tenor	4	0	4
Migaj, Sergej	1888	m	Baritone	0	1	1
Milashkina, Tamara	1934	f	Soprano	3	6	9
Nesterenko, Yevgeny	1938	m	Bass	4	2	6
Netrebko, Anna	1971	f	Soprano	9	0	9
Nezhdanova, Antonina	1873	f	Soprano	3	1	4
Obraztsova, Elena	1939	f	Mezzo-soprano	3	2	5
Obukhova, Nadezhda	1886	f	Mezzo-soprano	0	3	3
Ots, Georg	1920	m	Baritone	2	2	4
Pluzhnikov, Konstantin	1941	m	Tenor	4	0	4
Preobrazhenskaya, Sofia	1904	f	Mezzo-soprano	1	2	3
Reizen, Mark	1895	m	Bass	4	1	5
Shtoda, Daniil	1977	m	Tenor	1	1	2
Shtokolov, Boris	1930	m	Bass	2	0	2
Sinyavskaya, Tamara	1943	f	Mezzo-soprano	1	5	6

Sobinov, Leonid	1872	m	Tenor	0	2	2
Vinogradov, Georgi	1908	m	Tenor	0	1	1
Vishnevskaya, Galina	1926	f	Soprano	4	9	13