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## **Performance of Musical Scale in Traditional Vocal Homophony: Lithuanian Examples**

Rytis Ambrazevičius<sup>1</sup>

Lithuanian Academy of Music and Theatre (Vilnius)

Kaunas University of Technology (Kaunas)

### **Abstract**

Acoustical measurements of pitches in a dozen songs exemplifying the Lithuanian traditional vocal homophony were carried out. Several phenomena were revealed. First, the entire scales experience gradual transposition (rise) from the beginning to the end of the song performances. Second, the transposition is supplemented with the gradual shrinking of the musical scales (the intervals become narrower). Third, the intonations of the scale degrees are dynamic, i.e. they depend on the musical (both melodic and harmonic) contexts. Fourth, the versions of musical scales work as certain markers for the idiolects (further studies could show if this might be extrapolated to the realm of dialects). All these insights raise issues about the perceptual qualities of the musical scales and their manifestations in the performance.

### **Keywords**

Musical scale, vocal performance, homophony, Lithuanian traditional singing, acoustical measurements, pitch perception.

### *Issue of musical scale*

Before we proceed to the elaboration of the methods and techniques of the acoustical measurements, and the analysis of their results, let's discuss the concept of the 'musical scale'. Most probably, this concept seems to be entirely transparent to us. Yet, upon closer inspection we encounter several obstacles.

For example, Snyder defines musical scale as "subset of the elements of a tuning system" (2000: 135) whereas Dowling and Harwood apply the term "modal scale" for the highest (or 'deepest', see Figure 1) layer of the tonal hierarchy: in the modal scale, "the pitches of a tuning system are hierarchically organized with a tonal center" (Dowling and Harwood 1986: 113–114). Briefly, the term 'scale' is assigned to different layers of hierarchical structures; confusion over the other terms occurs as well (Figure 1).

One can find more definitions of musical scale (including the encyclopedic ones) but with these two typical examples I would like to pay attention to the more or less pronounced discrepancies be-

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<sup>1</sup> rytisam@delfi.lt

tween the approaches to the concept. As for the current study, I will be interested mostly in the intervallic relations in the sound systems under investigation, with some excursions to the hierarchical structures of the systems. Thus the problem of definition is solved for the current case. This problem, however, appears to be negligible compared to the problems of acoustical-perceptual nature.

МЭС	Hall	Snyder	Dowling & Harwood
1991	2002	2000	1986

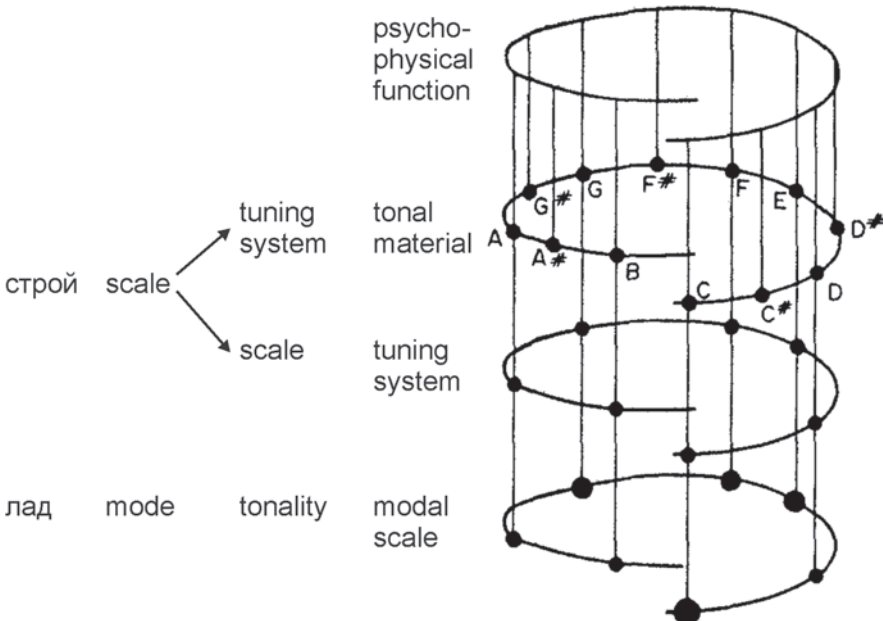


Figure 1. Perceptual levels of musical scales (based on Dowling and Harwood 1986: 114).

At first glance, it seems that it's enough to pick out occurrences of every scale degree in the analyzed sound recording (i.e. single occurrence for every degree), to measure pitch of every sound-scale degree (suitable computer software is applied), to calculate the intervals between the sounds – as simple arithmetic differences between pitches – and then to discuss their deviations from the twelve-tone equal temperament (further 12TET). However, this simple procedure works only in the case of stable tuning, i.e. first and foremost for the majority of musical instruments. This was the basic technique for the traditional ethnomusicological tonometry, starting from the time of Stumpf and Hornbostel. Yet, the stability of musical scale is sometimes only seeming, even for the 'fixed' tunings of musical

instruments. Remember, for instance, various flutes whose pitches depend slightly or even considerably on the force of blowing, or fiddles where the intonations of all pitches except those produced by open strings are variable.

For vocal performance, true free or flexible intonation is typical. One can state even more strongly: acoustically stable intonation is actually impossible in this case. The sounds (i.e. degrees) of a musical scale are intoned slightly sharper or flatter at every turn. This is the case of categorical or so-called ‘zonal’ (e.g. Гартызов 1980) scale: the pitch category is represented by the ‘zone’ of pitches instead of a single pitch.

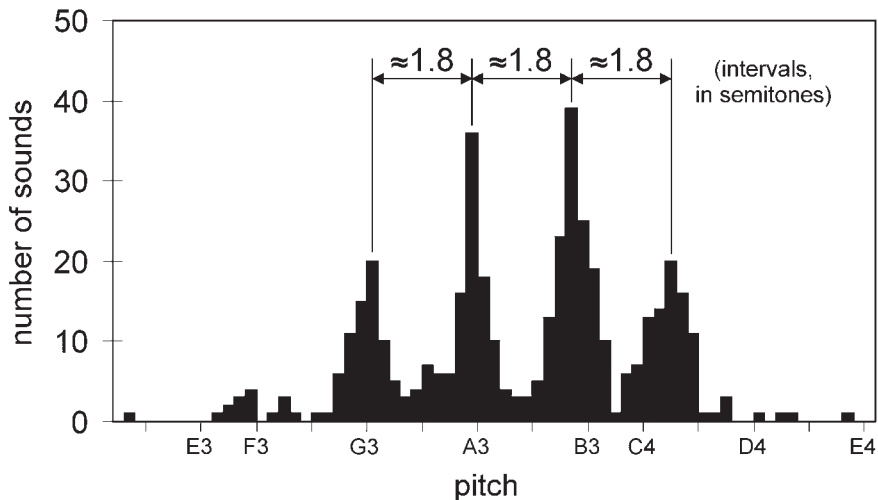
The image shows a musical score for a Lithuanian sutartinė. It consists of four staves of music in 2/4 time, with a tempo marking of quarter note = 72. The lyrics are written below the notes. The first staff starts with a tempo marking and a dynamic marking (>). The second staff has an asterisk (\*) at the end, indicating the start of a second voice. The third and fourth staves continue the melody. The lyrics are: Mi — na, mi — na, mi — na — gau — — čio ly — lio, mi — na — gė — la ly — lio. Su — jo — ja, su — jo — ja, su — jo — ja sve — te — liai, su — jo — ja sve — te — liai. U-ū!

Figure 2. Original transcription of *sutartinė Myna, myna, minagaučio lylio* (Slaviūnas 1958: 657; N. 428a).<sup>2</sup>

Here I provide my beloved example belonging to the Lithuanian traditional polyphony – not homophony (Figures 2, 3). The essence of the discussed phenomenon remains the same. This is the

<sup>2</sup> This *sutartinė* is performed canonically by three women. The first singer performs the entire depicted melody while the second one enters at the moment marked with asterisk and also sings the entire melody (and the same lyrics) from the beginning to the end. Successively, the third singer enters with the delay in regard to the second singer, the first singer enters with new lyrics and with the delay in regard to the third singer, and so on. *Ū-ū!* After the final barline marks the final whoop after all strophes are performed. *Mina, mina, minagaučio lylio, minagėla lylio* (actually performed with long tensey: *Myna, myna...*) are refrain-type words with hardly identifiable or lost meaning. *Sujoja sveteliai* are translated as ‘Guests (diminutive form) came riding’.

Lithuanian *sutartinė* (type of *Schwebungsdiaphonie*) *Myna, myna, mynagaučio lylio*. For instance, the scale degree indicated nominally as B3 is intoned in the range between B3-80 cents and B3-60 cents in 13 occurrences (in the analyzed sound recording), between B3-60 cents and B3-40 cents in 23 occurrences, between B3-40 cents and B3-20 cents in 39 occurrences, between B3-20 cents and B3 in 25 occurrences, and so on (Figure 3). Thus the intonations in the range of B3-40 cents – B3-20 cents prevail, yet many flatter and sharper occurrences are registered as well. Consequently, the objectivized acoustic representation of the scale seems to be roughly two-dimensional: it contains sequence of ‘standard’ (central) pitches and the zone-widths around them. Perhaps, the first dimension is usually more relevant. However, the second dimension can provide some important information about the hierarchy of the scale. Refer to the discussed example of *sutartinė*. The intonations of sounds ~A3 and ~B3 are the most stable, whereas the intonations of sounds ~G3 and ~C#3 are quite flexible and the intonations of other (marginal) sounds are even more flexible. This leads to a presumption that the sounds ~A3 and ~B3 form tonal nucleus (or play the role of tonal anchors).<sup>3</sup>



**Figure 3.** Histogram of pitches in *sutartinė Myna, myna, mynagaučio lylio* (see Figure 2; all pitches in all parts; Ambrazevičius, Wiśniewska 2009: 48).<sup>4</sup>

However, to be precise, certain questions about the technique of calculation of musical scales still remain. Which measure of central

<sup>3</sup> Concerning the peculiar intervals in *sutartinės* and the resulting problems of transcription, see Ambrazevičius and Wiśniewska 2009, etc.

<sup>4</sup> For the measurements, the digitized version (Račiūnaitė-Vyčiniienė 1998: N. 4) of the old recording (from 1930s) was used.

tendency – arithmetic average, mode, or median – should be considered as the most adequate for the evaluation of central pitches? Then, simple logic tells us that, probably, longer notes have more weight in the perception of scale. Additionally, very short (i.e. ornamental) pitches are perceived quite faintly and ambiguously (Zwicker and Fastl 2007: 187; Ambrazevičius and Budrys 2012: 61). Thus when defining the central pitches of the musical scales, most probably, all occurrences should be weighed according to their durations and very short notes should be omitted from the consideration. How weighed? How short notes?

If even we imagine that we know answers to these questions (actually, we can not know; we can only roughly presume), at least one important problem remains. This is the phenomenon of so-called dynamic musical scales, meaning that intonation depends more or less on the (melodic and harmonic) musical context. This dependence can be expressed by so-called ‘performance rules’: in addition to random pitch fluctuations (‘performance noise’), certain systematic pitch deviations can be revealed and objectivized. Of course, this holds true not only for pitch domain, but also for domains of intensity, time, and timbre (e.g., Friberg, Bresin, and Sundberg 2006). For instance, when studying certain dialects of the Lithuanian traditional monophonic singing we discovered that the rules of ‘leading tone’ and ‘ascending and descending sequences’ do manifest: first, a scale degree next to an anchor tone tends to ‘gravitate’ to the anchor tone if the two tones are found in a pattern of strong interaction; second, the pitches in the ascending sequences tend to be raised, whereas those in the descending sequences tend to be lowered (Ambrazevičius and Wiśniewska 2008: 25–27).

Consequently, it is natural to reckon that the dynamic intonation can be influenced by hierarchical structure of the scale degrees. This structure, in turn, can alternate from the beginning to the end of a tune:

“It is important that, in traditional folk song, there is no tight tie between the [modal] function and its carrier. A sound [i.e. scale degree – *R. A.*] plays some ‘role’ in the certain point of the tune only; this sound may carry a different modal charge [...] in other points of the tune” (Енговатова and Ефименкова 2008: 10).

The relatively short discussion above shows that the issue of musical scale is far from trivial. This is frequently reflected in the necessity to make multiple decisions in the techniques of measurements and generalizations of musical scales.

*Introductory notes on Lithuanian traditional vocal homophony*



Figure 4. The ethnographic regions of Lithuania and the location of the samples.  
The shading palette depicts the spoken dialects.

Briefly, monophony (heterophony), polyphony, and homophony are / were characteristic of various Lithuanian singing dialects. Monophony in ensemble performance is traditionally attributed almost exclusively to Dzūkija and Suvalkija (Southeastern and Southwestern Lithuania; see Figure 4). Monophony was also registered in so-called Lithuania Minor<sup>5</sup>, yet after the WWII only some traces of autochthonic traditional music could be found in this region, as the music vanished with the Lithuanian autochthons. Polyphony, containing counterpointal polyrhythmic singing – a type of *Schwebungsdiaphonie* – among other stylistic variants, was documented in the northwestern part of Aukštaitija, yet it had also vanished in the middle of the 20th century and was finally substituted by homophony. Thus nowadays homophony is the prevailing style in different Lithuanian regions. Usually one singer performs the leading part while the rest of a group add the lower ‘background’, making mostly dyads of thirds,

<sup>5</sup> Western part of Lithuania and East Prussia (present day Königsberg / Kaliningrad district) that was part of Germany for several centuries.

fourths, or fifths with the leading part, according to the functional harmony. Sometimes the third, still lower part is added as well, but usually it can be considered merely as stable or heterophonic variant of the second part. Both 'high' and 'low' male singing is common. It means, in the case of mixed (male and female) ensembles, male singers add either interval of third (fourth, fifth,..) or tenth (eleventh, twelfth,..) below the leading female voice. The homophonic multipart singing in Žemaitija and Aukštaitija are considered to be of relatively early origin, mostly featuring major-like mode. The homophonic style in Dzūkija is thought to be of later origin, dating from the turn of nineteenth and twentieth centuries or somewhat earlier. Both major-like and minor-like modes are common.

These are the basics of the singing styles in Lithuanian tradition. Of course, more nuances could be discussed in a comprehensive description.

### *Samples*

The current study does not aim to generalize different phenomena in a big corpus of Lithuanian traditional vocal homophony. This pilot-type research rather strives to compare two typical idiolects of homophony from the viewpoint of musical scale. The first sample comes from Šeduva folklore group; this small town is situated in the Western part of Aukštaitija, Radviliškis Dst. (see the locations in Figure 4). For the second sample, a group of singers from Mištūnai village (Šalčininkai Dst.; Dzūkija region) was chosen. Both groups comprise female singers. Both samples represent major-like homophony and each of them contains five songs recorded in the turn of the last two decades of the twentieth century.<sup>6</sup>

Examples of two song transcriptions are presented in Figures 5 and 6. Other songs in the two samples actually follow the same structural schemes and combination rules for vocal parts (differing slightly for the two dialects).

The 'schematic transcription' means that only basic features of the tunes are depicted, and variations in the melostrophes are generalized. The peculiar scale qualities (their differences from the 12TET) are also neglected: thereafter we will see that the corresponding

<sup>6</sup> Recordings: (Šeduva) orphan song *Auga kiemi dagilis* (Četkauskaitė 2007: CD 3, N. 7), song to welcome the bridegroom *Oi brolio brolužėlio* (Vyčinienė 2002: N. 3), song sung on the wedding eve at the bride's home *Kad aš kelutį keliavo* (Vyčinienė 2002: N. 1), ploughing song *Tėtėrvins subilda* (Četkauskaitė 2007: CD 1, N. 7), song of leaving for the wedding ceremony *Oi sesutėla, ko verki* (Četkauskaitė 2007: CD 2, N. 16); (Mištūnai; all songs from Ambrazevičius 1999) love song *Arškėtėli garbuonėli* (N. 20), song to welcome the bridegroom *Kad šeriau žirgelį* (N. 13), oat harvesting song *Lėkė sakalėlis* (N. 8), emigrants' song *Oi tu sakalėli* (N. 19), and (wedding) guests mocking song *Tai kieno gražus kaimas* (N. 1).

diacritic or other markings would make no sense or they would be too complicated since the scales change noticeably from the beginnings to the ends of songs. The tonalities are normalized: the tunes are transposed so that the tonics are equalized to G4.

$\text{♩} = 100$

Au - ga kie - mi da - gi - liš, au - ga kie - mi ža - lia - se,  
kie - mi kie - me - li, tē - ve - lia dva - rē(li).

Figure 5. Schematic transcription of *Auga kiemi dagilis*.<sup>7</sup>

$\text{♩} = 68$

Arš - kē-tē - li, gar-buo-nē - li, ne-sto-vēk prie ke - lio, ne-sto-vēk prie ke(l)io.

Figure 6. Schematic transcription of *Arškētēli garbuonēli*.<sup>8</sup>

Additionally, to exemplify the influence of the musical context on the intonation of certain scale degrees, two more songs from Aukštaitija<sup>9</sup> are employed (Figures 7 and 8). These songs belong to a particular singing subdialect found in the southern or southwestern part of Aukštaitija, characteristic for the somewhat statistically ‘stubborn’ leading voice anchored to the fifth scale degree and thus a relatively more important backing voice, especially in forming various relations with the leading voice.

$\text{♩} = 96$

U - žug - de ma-ni ma-čiu-te, U - žug - de ma-ni se-nu-te,  
an di-džiū var - gu, an(t)rū-pes-tē - liū, an gai - liū, a - ša-ry, ry.

Figure 7. Schematic transcription of *Užugde mani mačiute*.<sup>10</sup>

<sup>7</sup> Translation of the first strophe: ‘A green goldfinch grew in the yard, in the father’s manor’.

<sup>8</sup> Translation of the first strophe: ‘Curly eglantine, don’t stand at the road’.

<sup>9</sup> Recordings: (Skuoliai, Ukmergė Dst.) song of the newlyweds’ visit to the bride’s parents *Užugde mani mačiute* (Četkauskaitė 1998: CD 3, N. 4), (Kamėnai, Kėdainiai Dst.) haymaking song *Oi Dieve mano* (Četkauskaitė 1998: CD 1, N. 19).

<sup>10</sup> Translation of the first strophe: ‘Old mother raised me, for heavy hardships, for



♩ = 68

Oi Die - ve ma - no, Die - vu - li(au) ma - no, kai per  
 šiuos me - te - lius var - ge - ly bu - vau, vau.

Figure 8. Schematic transcription of *Oi Dieve mano*.<sup>11</sup>

There is a tendency to perform the second scale degree in unison (see the syllables *ma-ni* in the beginning of the second measure, Figure 7; etc.) in contrast to the prevailing tendency in other dialects and subdialects to add the low fifth degree, thus making the interval of fifth between the voices (*da-gi-lis* in the beginning of the second measure, Figure 5; etc.). There is also a specific feature of the leading voice to ‘throw’ the voice from the third scale degree to tonic in the endings of phrases except of the end of a strophe (*-te* in the end of the second measure, Figure 7; and more similar occurrences in Figures 7 and 8).

### *Pitch measurements*

For pitch measurements, Praat<sup>12</sup> software was applied. Two cases were encountered.

In the first case, the two voices were clearly separated in the recorded tracks: in one track of the stereo recording one of the voices dominated while the other was in the background (i.e. one voice was significantly more intense). Just the opposite was characteristic of the second stereo track. Praat draws an intonogram for the dominating voice quite successfully. In other words, the technique used for pitch measurements in monophonic performance can be applied. This means that a quasi-stationary segment of the intonogram of a sufficiently long tone can be chosen for the measurement of the pitch average for this tone.

What ‘sufficiently long’ means needs a separate, thorough discussion. Here I will make a couple of short remarks only. The adequate shortest duration for pitch measurements, if it is bound to the phenomena of pitch perception (such as producing and perceiving musical scales in vocal performance), depends on pitch jnd<sup>13</sup>. The

troubles, for plaintive tears’.

<sup>11</sup> Translation of the first strophe: ‘Oh my God, my dear God, when this year I was in a hardship’.

<sup>12</sup> [www.fon.hum.uva.nl/praat/](http://www.fon.hum.uva.nl/praat/)

<sup>13</sup> Just noticeable difference, difference limen.

better the precision needed, the longer the durations (to some degree) should be considered. If, say, one is satisfied with precision of some 10 cents, durations longer than 50-100 ms should be measured.<sup>14</sup> However, we made interpersonal divergences of 10 cents in the measurements of a vocal performance even for some durations of 400 ms (Ambrazevičius and Budrys 2012: 61). It is mostly because the intonograms of pitches are far from stable in the real vocal performance; the short pitches usually do not even contain quasi-stable segments.

Thus briefly, the quasi-stable sequences of intonograms as long as possible are preferred for pitch measurements. Therefore short ornamental notes are usually excluded from consideration, i.e. mostly the structural notes are taken into account. I usually did not measure short ornamental notes in the current study since first, as was discussed above, perception and measurements of such notes are far from precise, and second (and consequently) their role in the determination of the musical scale is actually negligible.<sup>15</sup>

The ‘monophonic option’ is preferable because of significant savings of time resources: one can measure pitch quickly and directly from intonograms. This option was applied in the case of songs *Užugde mani mačiute* and *Oi Dieve mano*. Unfortunately, the voices of multipart singing tend to be blended in stereo tracks<sup>16</sup> and the discussed technique does not work. Reliable automatic transcription (tracing of the intonograms) is possible for monophonic performance (or for technically ‘monophonic’ performance, as in our case) only. Thus usually the procedure of pitch evaluation in multipart singing is more complicated and more time consuming. This was the typical case in the current study.

As in the study of monophonic singing, relatively stationary segment (for both or all voices) is considered. It is comfortable to start with the narrow-band spectrogram to identify such segments: the spectrogram shows distinctly the undulating lines of harmonics. Then spectrum of the selected segment is obtained and sets of harmonics of the individual voices are identified in the spectrum. Certain outstanding harmonics are chosen and their frequencies are measured. Logarithmic relationship of frequency and pitch is applied and the pitches are calculated.

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<sup>14</sup> According to Zwicker and Fastl (2007: 187), pitch jnd for stable pure tones with frequencies of several hundreds of Hz and durations of 50-100 ms is around 10 cents.

<sup>15</sup> See Ambrazevičius 2005–2006: 66–67; 2013: 89–90 for more detail on the pitch measurements in the case of monophonic performance.

<sup>16</sup> ‘Unfortunately’ for the measurements, but, of course, not necessarily for the joy of listening.

### Gradual transposition: general remarks

Let us start the study from pitch measurements of the song *Auga kiemi dagilis* (Figure 5). Pitch tracks of the first two melostrophes of this song are presented in Figure 9. Each structural note is represented by a corresponding marker-dot. In the legend, ‘mstr1’ and ‘mstr2’ mean, respectively, the first and the second melostrophes, ‘v1’ and ‘v2’ stand for the first (upper, leading) and the second (lower, background) voices, and ‘rep’ means repeat of the second half of the tune. For the better comprehension, the pitch tracks are chunked into four segments each containing two measures. Lyrics of the first melostrophe are appended below the tracks.

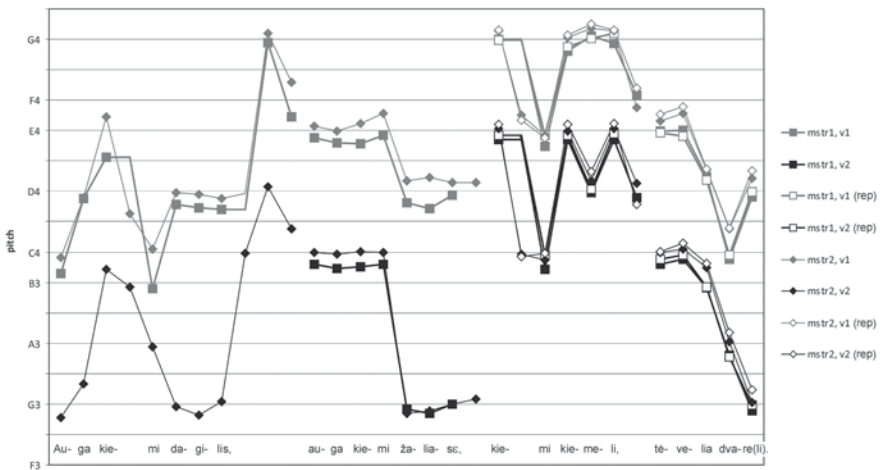


Figure 9. Pitch tracks of the first two melostrophes of *Auga kiemi dagilis*.

Acoustic instability of the scale degrees (their intersonic variation) is clearly visualized. Follow, for instance, the evolution of the first scale degree (tonic) in the first melostrophe: notes 1-5-12-...-15-22-27-28-(rep.)22-27-28. Importantly, not only are the pitch fluctuations in the occurrences (‘performance noise’) observed, but they are supplemented with a gradual rise of pitch towards the ends of the melostrophes (Figure 9). The gradual rise becomes even more evident if we compare the melostrophes: the pitch tracks of the second melostrophe lie noticeably higher than those of the first melostrophe.

To explore the phenomenon of gradual transposition more thoroughly, let’s measure the pitches of several characteristic dyads in all melostrophes of *Auga kiemi dagilis*. Let’s choose the first dyads in all measures: *Au-* (‘note 1’), *da-* (6), *au-* (12), *ža-* (16), *kie-* (20), *-me-* (24), *tè-* (27), *-re-* (31) (Figures 5 and 9). Figure 10 shows the development of pitches from the beginning to the end of the song. The pitch tracks are supplemented with marks pointing to the dyads.

For example, (5-)3 means that this is the pitch track for the third scale degree which occurs in the dyads 5-3 (i.e. composed of the fifth and third degrees). Roman numerals denote pitches below tonic and Arabic numerals denote tonic and higher pitches.

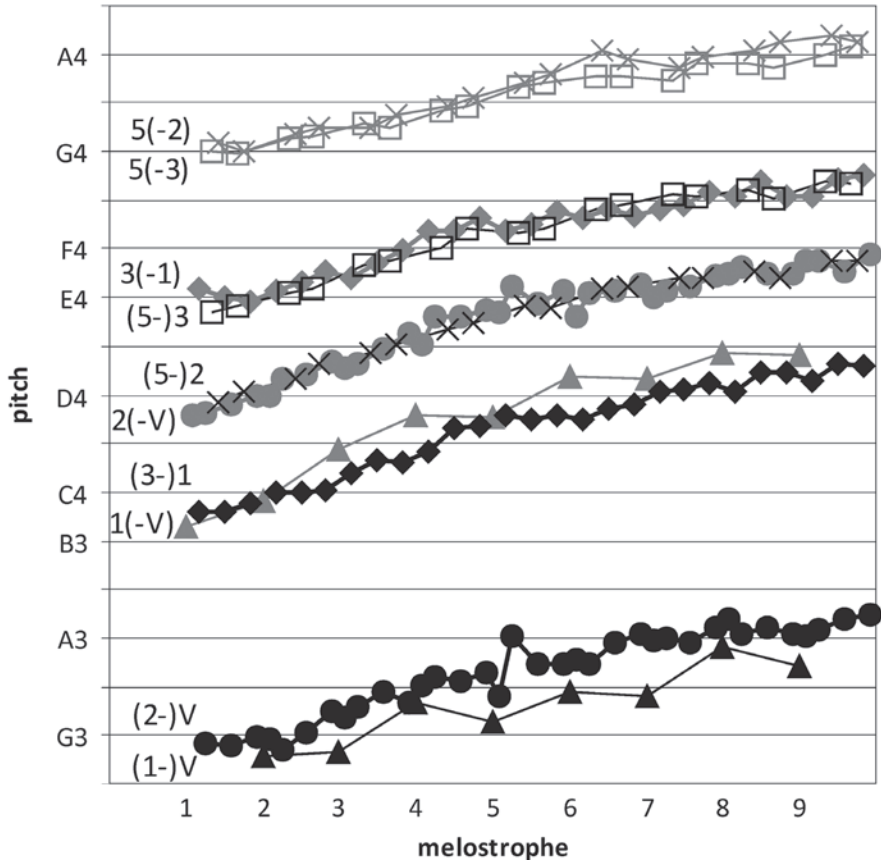


Figure 10. Transposition of dyads in *Auga kiemi dagilis*.

At this moment, it is enough to predicate that, first, the tonality rises in 2-3 semitones; second, this rise differs slightly for the particular dyads, and third, the rise slows down towards the end of the song. The tonality rise, however, is not always that prominent. For instance, it equals roughly a quartertone for *Užugde mani mačiute* (5 melostrophes) and *Oi Dieve mano* (8 melostrophes). Let's then examine more songs to make more reliable statements. Figures 11 and 12 pool results for *Šeduva* and *Mištūnai* samples (each consisting of five songs). The graphs show the transpositions from the first to the last melostrophes for the pitches of analyzed dyads (crosses).

The diamonds mark medians of the values. For instance, consider the song *Oi sesutėla, ko verki* (Figure 11). The minimum value is 0.96, the maximum value is 2.25, and the median equals 1.43. This means that one of two pitches in certain dyad of *Oi sesutėla, ko verki* experiences rise of 0.96 semitone from the first to the last melostrophe, and this is minimum rise for this song. Another pitch rises 2.25 semitones, and this is the maximum rise for this song. The median for all such rises is 1.43. One could conclude that even the converse process – lowering towards the end of a song – could be observed in some cases. However, the tendency of rising transposition is obviously overwhelming, as well as the rough correlation of the rise to the duration of song. Some exceptions (such as *Oi brolio brolužėlio*, Figure 11, and *Ėkė sakatėlis*, Figure 12) could need more attention. One can speculate that particular physiological and psychological circumstances were at work, but the possibility of the influence of certain musical features should not be excluded.

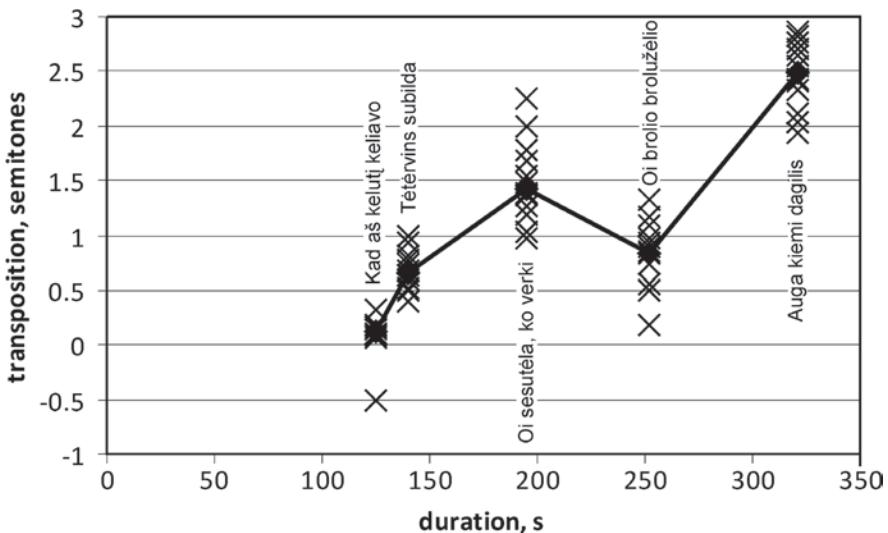


Figure 11. Dependence of transposition on the duration of song; Šeduva sample. Crosses: transposition of pitches of various dyads. Diamonds: medians of the transposition.

### *Gradual transposition: evolution of intervals*

Closer inspection of the gradual transposition in *Auga kiemi dagilis* reveals that the evolution of scale degrees in the course of performance slightly differs. The tonic experiences the steepest rise while the higher degrees transpose progressively to a lesser extent (Figure 10). The lower fifth degree, again, rises slightly less than the

tonic. These differences in the transposition appear especially apparent if observe the change of intervals in the vocal dyads (Figure 13). The width of the nominal major third 3-1 drops from a ‘very wide major third’ (even closer to a fourth) to a ‘narrow major third’ (narrower by some 20-30 cents compared to the 12TET-equivalent).

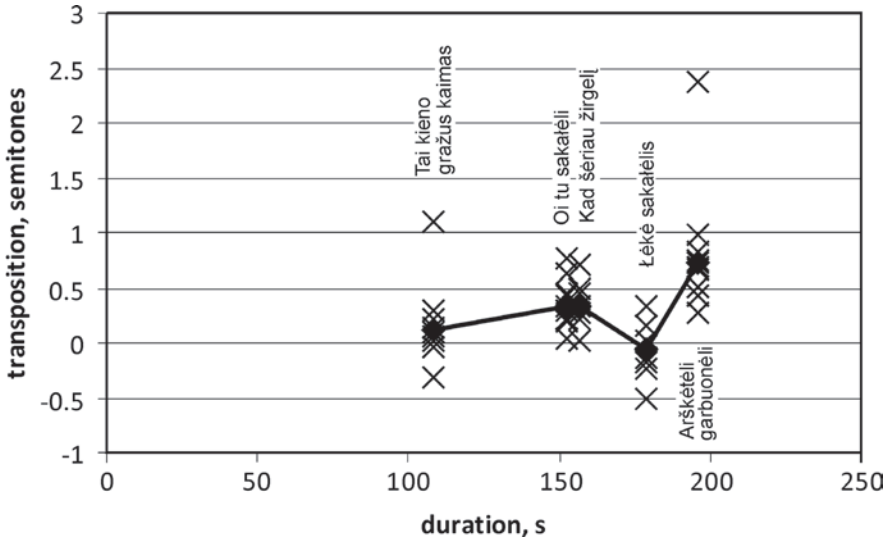


Figure 12. The same as in Figure 11; for Mištūnai sample.

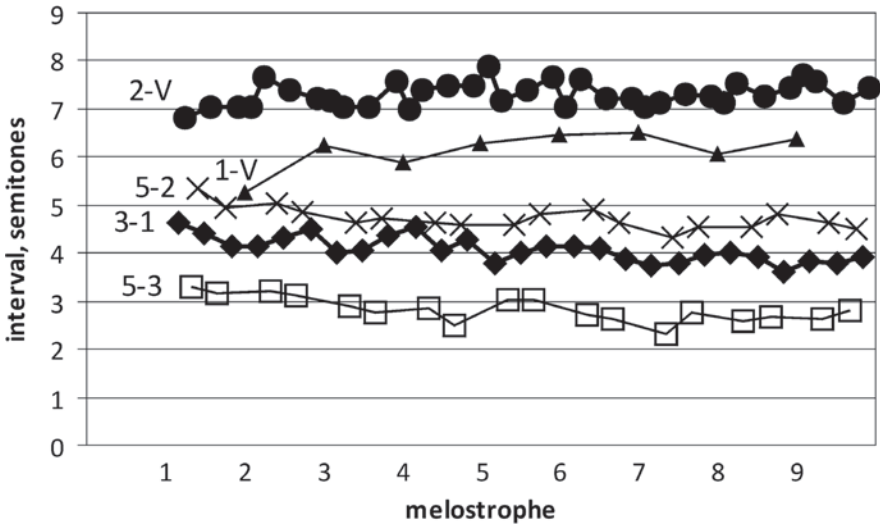


Figure 13. Evolution of dyadic intervals in *Auga kiemi dagilis*.

The same holds for the nominal pure fourth 5-2, which appears to be slightly stretched in the first melostrophe, but soon drops below the tempered equivalent and further narrows progressively to roughly midpoint between pure fourth and major third. Similarly, the nominal minor third 5-3 transforms from a ‘wide minor third’ to something in between the minor third and major second. On the contrary, a slight stretch of the intervals containing the lower fifth degree (1-V and 2-V) is generally observed.

These transformations suggest several important issues regarding perception and performance of the musical scale. First, the harmonic intervals formed by the voices deviate significantly from their 12TET-equivalents. Actually this is not surprising in the case of traditional vocal performance. Second, which is probably more interesting, the harmonic intervals undergo considerable gradual change from the beginning to the end of the song. This leads to the third insight: the intonation of harmonic intervals and, consequently, the intervals in musical scale are only roughly fixed. The system of intervals manifests as certain rough perceptual scheme, which is flexibly shaped in the course of performance. Fourth, one can try to speculate the reasons for the discussed evolution. It seems that they result from interplay of certain physiological and psychological phenomena. Perhaps the general rise can be collated to the tendency of gradual timbral brightening. It goes together with the preferred stretch for musical scales.<sup>17</sup> However, the stretch is generally available for the lower scale degrees only. For the upper scale degrees, the phenomenon of stretch is restricted as these rising degrees occur gradually in the upper part of a vocal range not comfortable for voice production. Thus the upper limit of a vocal range ‘pushes’ the high pitches down and so the intervals squeeze.

Figures 14 and 15 pool results for Šeduva and Mištūnai samples. Quasi-stable segments of the occurrences of certain dyads were cut from the recordings of the first melostrophes of all ten songs. Then LTAS<sup>18</sup> spectra for each set of the segments were composed and averaged pitches of the dyads were obtained. For example, the corresponding segments of the dyads 5-3 were left in the recording of the first melostrophe of *Arškėtėli garbuonėli* (Figure 6): *-tė-* (first measure), *-vėk* (third measure), *-lio* (fourth measure), and *-vėk* (fifth measure). Then the averaged pitches of the third and fifth degrees were calculated from the LTAS. This technique of averaging weights automatically longer and more intense occurrences.

<sup>17</sup> Refer to the phenomenon of ‘outspreading’ (‘unfolding’) scales (rus. *раскрывающиеся лады*; Алексеев 1976: 48–58); this phenomenon can be registered in the Lithuanian tradition as well. This could be attributed to attempts for gradual psychophysiological mastering of a wider vocal range.

<sup>18</sup> Long-Term Average Spectrum.

The same procedure was carried out with the last melostrophes. Then the pitches were normalized to the tonics of the analyzed melostrophes. Finally, deviations of the pitches of scale degrees from their counterparts in the twelve-tone equal temperament were calculated. The fourth scale degree is not shown for Šeduva sample (Figure 14) since it is faintly presented in the analyzed songs: at best, it appears in transitional notes only (as in *Auga kiemi dagilis*, Figure 5).<sup>19</sup>

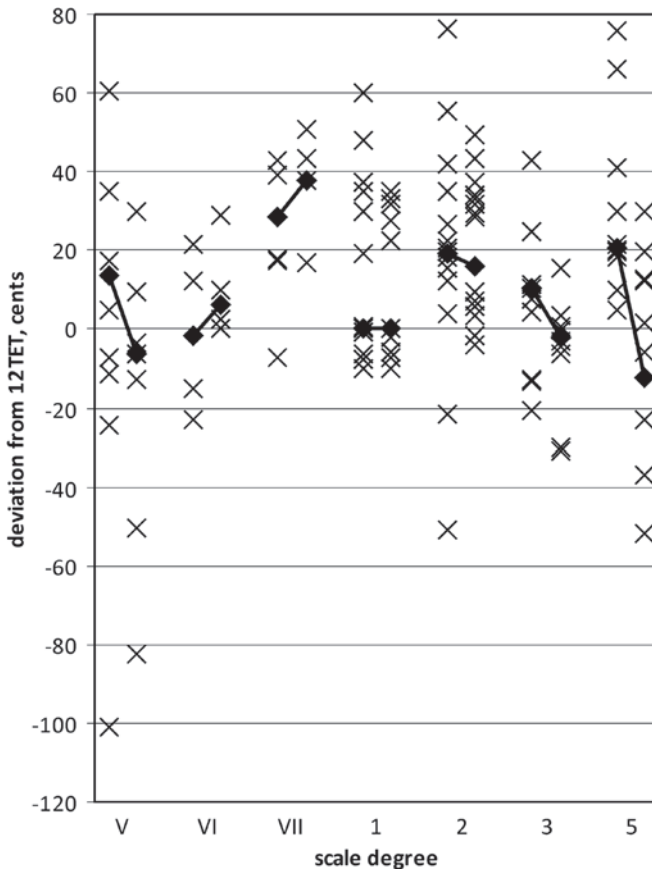


Figure 14. Pitch deviations of scale degrees from 12TET; Šeduva sample. Crosses: pitches of various dyads. Diamonds: medians of the pitches. Transposition is depicted: the values on the left stand for the beginnings of the songs whereas the values on the right show the endings.

<sup>19</sup> Statistical inference about the difference between two populations means (i.e. the corresponding intonations in the first and the last melostrophes) gives fairly low one-tail p-values for the following scale degrees: V (.096), VI (.082), VII (.060), 3 (<.001), 5 (<.001) (Šeduva sample; Figure 14); 3 (.005), 5 (<.001), and 6 (.002) (Mištūnai sample, Figure 15). The few remaining scale degrees (2 in Šeduva sample, 2 and 4 in Mištūnai sample) show p-values larger than .1 which means that, for these degrees and based on the samples of limited size, the tendencies of the changes discussed are either not that strong or ambiguous.



Generally, results confirm the insights gained for one single song, *Auga kiemi dagilis*: the normalized pitches of scale degrees above tonic tend to drop during the course of performance (degrees 2, 3, and 5 in Figure 14, and degrees 2-6 in Figure 15) and those below tonic tend to rise (degrees VI and VII in Figure 14). This means narrowing of the intervals between the certain scale degrees and tonics, i.e. shrinking of the scales. An exception is made for the lower fifth scale degree (V in Figure 14). Probably this reflects the above-mentioned tendency to ‘unfold’.

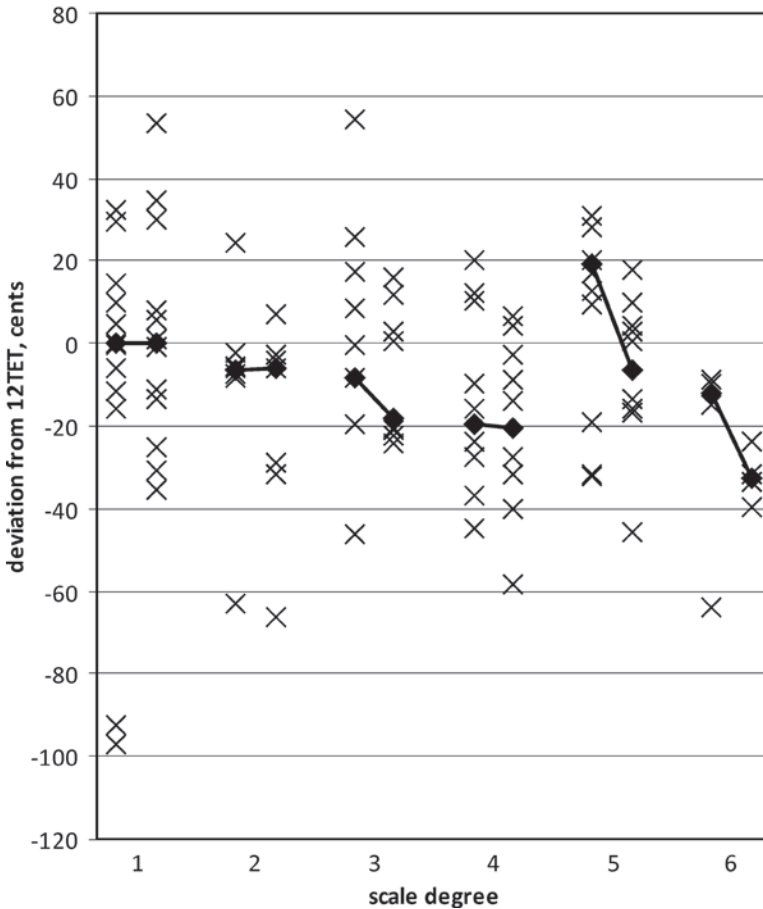


Figure 15. The same as in Figure 14; for Mištūnai sample.

Thus the tendencies of the temporal scale to shrink are essentially the same for both Šeduva and Mištūnai samples. However, the actual intervals differ quite significantly. Let's start from the fact that the tunes in both samples are based on the frame (or nucleus) of two

main tonal anchors: tonic and fifth degree<sup>20</sup>. In both samples, the singers start from slightly stretched fifth (the fifth is some 20 cents sharper compared to its counterpart in 12TET) and this might be attributed to the common psychological preference to stretch intervals (e.g. Dowling and Harwood 1986: 101–104). When approaching the ends of the songs, the fifth degree becomes even flatter than the 12TET-fifth, but still similarly for both Šeduva and Mištūnai samples. However, the rest of the scale degrees (i.e. not belonging to the frame of two anchors) show relevant differences in pitch for the two samples. Briefly, the pitches tend to be sharper in the context of 12TET, for Šeduva sample, but flatter for Mištūnai sample (consider, for instance, the second and third scale degrees).

To generalize, the Šeduva singers apply a ‘bright’ version of major-like scale whereas the ‘dark’ version of major-like scale is characteristic of Mištūnai sample.

### *The role of musical context*

Figure 10 shows that certain scale degrees are systematically intoned sharper or flatter depending on the dyads they belong to. For example, there is a slight tendency to intone the fifth degree sharper in the dyad 5-2 and flatter in the dyad 5-3. The deviations of intonations of tonic in the dyads 3-1 and 1-V are much larger; the same can be stated for the lower fifth degree (i.e. sub-fourth) in the dyads 2-V and 1-V. In some cases, these deviations even approach a semitone (!) Now, I will not speculate on the reasons for every single scale degree, but most probably some generalizations could be inferred concerning the phenomenon. First, the vertical (harmonic) context could be at work: the tendencies to intone certain dyadic intervals wider or narrower could result in the corresponding tendencies of intonation of scale degrees.<sup>21</sup> Second, there could be also some impact of more extensive musical context including the horizontal component. Third, it is also possible that the vocal parts (or the singers corresponding to the vocal parts) have slightly different ‘versions’ or even ‘models’ of the scale to be applied. (The case of tonic in *Auga kiemi dagilis* is meant: the tonic is performed by the leading voice in the dyad 1-V and by the backing voice in the dyad 3-1.)

The slightly different scalar ‘versions’ of the vocal parts are partially obtained in the songs *Užugde mani mačiute* and *Oi Dieve mano* (Figures 7, 8, 16, and 17). As has already been mentioned,

<sup>20</sup> Or, if based on more refined interpretation, the lower and upper tonics (Харлап 1972: 247).

<sup>21</sup> Actually this corresponds to the ‘harmonic intonation’ rule in Friberg, Bresin and Sundberg 2006: 151, with a difference in target intervals, which generally but not necessarily have to be natural in our case.

the sound recordings of these songs can be conveniently analyzed in ‘monophonic mode’ as the two voices dominate in the two different stereo channels. Thus even the deviations in unisons can easily be registered.

Quite unexpectedly, the voices deviate noticeably within the unisons, the deviations reaching even some 50 cents. This is especially distinct in the intonation of tonic: the leading voice makes tonic higher (compared to the backing voice) in *Užugde mani mačiute* whereas the opposite can be stated for *Oi Dieve mano*. The nucleus of the mode is the same for both songs, and it is based on the anchors of tonic and the fifth degree. The nucleus performed by the leading voice shifts compared to the tonic performed by the backing voice (Figures 16 and 17). Therefore one can expect that the whole scale is transposed slightly, resulting in a mismatch between voices, but probably this is only partly true because other scale degrees do not fit the simple scheme of transposition.

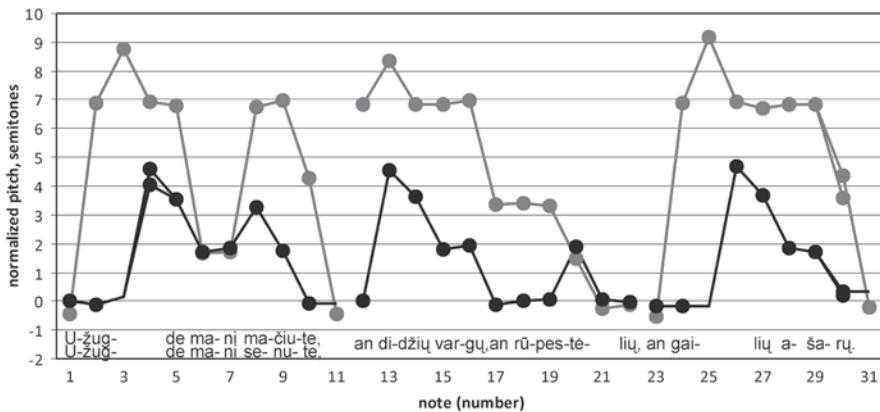


Figure 16. Generalized pitch tracks of *Užugde mani mačiute*. Medians of the pitches normalized to the median of tonic of the lower voice are presented. Lyrics of the first strophe are appended.

Besides the tonic, the third scale degree experiences the largest changes of intonation in the course of performance. Refer to *-te* (note 10), *an rū-pes-* (notes 17-19), and *-rų* (note 30) in Figure 16: the deviations range to a semitone. A closer inspection of the transcription (Figure 7) reveals that the sharper versions occur for the mentioned ‘throws’ of voices (notes 10 and 30, *Prima Volta*), i.e. for the relatively short notes (roughly 100 ms<sup>22</sup>). The flatter versions occur for relatively long structural notes (17-19 and final 30). The case of the note 30 is especially distinct: for the first time, it is a short note, and when repeated it becomes a long *finalis*, performed significantly low-

<sup>22</sup> Large part of the quaver is used for the *glissando*.

er. Most probably this means that the flatter version is, in a sense, the ‘true’ version, as it is actually not influenced by physiological issues and perceptual ambiguity of short pitches.<sup>23</sup>

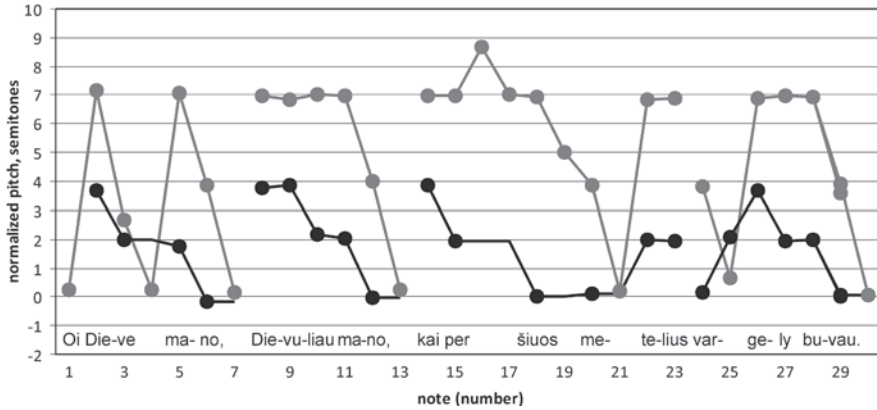


Figure 17. Generalized pitch tracks of *Oi Dieve mano*. Medians of the pitches normalized to the median of tonic of the lower voice are presented. Lyrics of the first strophe are appended.

Similar phenomenon of diverging sharp and flat versions of the third scale degree resulting from the differences in durations can be envisaged in *Oi Dieve mano* (Figure 17) as well. Yet the divergences are faint compared to the case of *Užugde mani mačiute* (see, for instance, the versions of note 29 in Figure 17). Possibly this could be attributed to slow tempo of *Oi Dieve mano*: the slower tempo increases the durations of the short ‘thrown’ notes and thus allows to perform them more precisely or more closer in pitch to the prolonged notes.

Intonation of the third scale degree in the backing voice part of *Užugde mani mačiute* generally confirms the presumption about the flat version of this degree as the ‘true’ or ‘main’ one. Additionally, noticeable divergences in the occurrences of the flat version should be stressed. For instance, note 8 is extremely flat, making nearly a minor third with tonic, although generally (from the traditional viewpoint) the tune is considered to be major-like. Other occurrences of the third scale degree (such as notes 5, 14, and 27) are clearly sharper and similar to each other; nevertheless they are still flatter than a major third. The discussed divergences point to the influence of melodic context on the pitch performance.<sup>24</sup> Specifically, the third scale

<sup>23</sup> Precision of short vocal pitches is limited both because of the physiological limitations of vocal production and because of already mentioned limitations to perceive the produced pitches precisely enough.

<sup>24</sup> The harmonic context is not responsible for the changes in intonation of the backing voice, in this case, since the dyads are the same (5-3) and the intonations of the leading voice (making the fifth degree) are quite stable.

degree is intoned differently in the sequences 4-3-2 (scale degrees) and 2-3-2.

A very short generalization of the musical scales in *Užugde mani mačiute* and *Oi Dieve mano* could be as follows: although, from the traditional ethnomusicological viewpoint, they are considered as major-like scales, actually they follow some ‘sweet-and-sour’ scheme with roughly neutral third scale degree. Additionally, this static scheme manifests dynamically, i.e. (besides of the performance noise) the intonations change systematically, in dependence on the musical context.

### *Discussion*

Detailed analysis of several vocal performances representing Lithuanian traditional homophony reveals how complicated phenomena of musical scales are and how the actual performances differ from the simplified theoretical presuppositions. Just to remind ourselves, the common ethnomusicological attitude would tell us that we are dealing with simple major-like scales or even a major scale in the classical sense. Acoustical measurements provide data which let us try to reconstruct the original emic schemata and processes. First of all, this emic basis seems to be far from simplified theory because of significant deviations from 12TET, leading to certain doubts concerning the major-like quality. Possibly, the scales could be considered in the wider and flexible context of major-minor continuum or something similar. However, this is not the end of the story. One can expect that these microtonal deviations could be expressed in some unsophisticated way, such as a static set of peculiar intervals between the scale degrees. Maybe this might work for rough estimations, yet then the substantial properties of the scales would be overlooked and lost. These important properties include different levels of scalar dynamics: possible transposition (mostly rise) of the entire scale plus different rates of the transposition for different scale degrees, plus systematic effects of musical context on the intonation. These dynamic qualities of musical scale come from physiology and perception of singing. Interplay of these qualities result in peculiar outcomes such as shrinking scales in the course of performance of entire song or seeming ‘chromaticisms’ appearing in various musical contexts.

For analysis this interplay needs more sophisticated and multifaceted (or, generally, even multidimensional) techniques of measurement, evaluation, and visual presentation. A single static set of deviations in cents marked at the sequenced scale degrees is not enough.

To make things both more complicated and more trivial, we should make clear that phenomenologically, for the performers, the musical scale of a single given song under discussion is probably

unvaried from the beginning to the end of the song.<sup>25</sup> By the way, contemporary ethnomusicologist listeners usually also do not notice the slight tonality changes and changes of the intervals, unless asked to concentrate on the considered phenomena or unless they are possessors of absolute pitch. This is because the changes are slow and gradual. If we compare occurrences at distant moments of the performance, the changes become perceivable more easily. More importantly, the seeming stability of the scales supports the attitude that we are not dealing with changing scales (one scale transforming into other) but rather with a single scale embodying an intrinsic feature of change.

Finally, it is worth mentioning again that the explored properties of the musical scales could serve as idiosyncratic markers for different vocal idiolects (and possibly dialects), the markers of which also manifest as bundles of colors for a contemporary outside listener.

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<sup>25</sup> To be precise, performers of vocal tradition usually have no idea about the construct of musical scale. But let us imagine that they have learned somehow about the construct and we asked them to describe the certain cases of the scales in performances.

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### Ритис Амбразевичиус

## ИЗВОЂЕЊЕ МУЗИЧКЕ ЛЕСТВИЦЕ У ТРАДИЦИОНАЛНОЈ ВОКАЛНОЈ ХОМОФОНИЈИ: ПРИМЕРИ ИЗ ЛИТВАНИЈЕ

### (Резиме)

Текст разматра питање музичке скале: одступања / раскорак / противречност између приступа концепту лествице и проблеме акустичко-перцептуалне природе у вези с њима (углавном флексибилна интонација и резултирајућа „правила извођења”). Представљене су основе литванске традиционалне вокалне хомофоније. Оформљена су два узорка, од којих сваки садржи по пет снимака извођења песама. Један узорак литванске традиционалне вокалне

хомофоније потиче из Аукштайтије (источног дијалекта), а други из Дзукије (југоисточног дијалекта). Још две укључене песме су на специфичном аукштайтијском поддијалекту.

Реч је о техникама и проблемима акустичких мерења тонских висина. Спроведена су тонска мерења висина у десетинама песама. Након генерализовања / сумирања резултата, откривено је неколико феномена. Прво, читаве лествице су у процесу постепене (узлазне) транспозиције од почетка до краја извођења песме. Друго, транспозиција је допуњена поступним сажимањем музичких скала: интервали постају ужи како горњи ступњеве скале досежу поступно до горњег дела вокалног амбитуса, који није удобан за продукцију гласа. Треће, интонације ступњева скале су динамичне, тј. зависе од музичког (и мелодијског и хармонског) контекста. На пример, у неким случајевима, интонација ступњева скале зависи од тога у којој се вокалној дијади дати ступањ појављује. Други пример: интонација трећег ступња може значајно зависити и од мелодијског обрасца којем припада и од трајања тонске висине (што првенствено значи разлику између структурног и кратког орнаменталног тона). За ухо слушаоца са Запада, то украшава мелодију специфичним смењивањем „слатко-киселе” дурско-молске тоналности. Четврто, верзије музичких скала функционишу као маркери идиолеката – конкретно, реч је о *свейлим* и *џамним* верзијама скала налик дурској. Идеја таквих верзија може се, евентуално, извести у домену дијалеката. Сви ови увиди отварају питања перцептивних својстава музичких скала и њихових манифестација у извођењу.

Музичке скале привлаче пажњу етномузиколога од самог настанка компаративне музикологије. Та пажња је вероватно најчешће усмеравана ка специфичним „егзотичним” скалама због њихове концепције и интервала потпуно другачијих од оних у западној уметничкој музици. У том погледу, западне традиционалне музичке културе су разматране генерално као више или мање сродне њиховим „развијеним парњацима” у високој култури (макар у погледу конститутивних интервала), отуда и као не толико интересантне за истраживаче.

Појавио се и одређени број студија који пориче преовлађујући став. Актуелно истраживање продужава овај алтернативни ток и илуструје питања музичких скала путем феномена које налазимо у литванској традиционалној вокалној хомофонији.

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