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### Commentary on 'Dissonance/roughness and tonality perception in Lithuanian traditional *Schwebungsdiaphonie*'

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Rytis Ambrazevičius' article opens an interesting and by today not much investigated topic: differing notions of *dissonance* and *roughness* in *Schwebungsdiaphonie* musical cultures. This work rises from author's long lasting continuous work on psychoacoustics, as well as from his rich experience both in scientific and in practical approach to traditional music.

When we are speaking about *Sutartines* and, generally, about *Schwebungsdiaphonie*, fascinating phenomenon of „clashes“ of second chords provokes some questions that are connected to the nature of human communication through sound, as well as to questions of the character of traditional culture expressed through its elements, such as the character of *consonance* considered as criterium for „beautiful“ performance and its impact to human life.

One of the questions, connected to the phenomenon of „clashing“ of tones in *Schwebungsdiaphonie*, rises from the fact that there is persistent confronting not only of physical tones, that we can hear, but also of each performer's melody and of their, so to say, vocal and mental „directions“ – confronting *intentions* of each singer embodied in sound, and especially having in mind their effort to resist roughness and keep „clashing“ throughout the performance. As the opposite, in another way of singing – in unison, all the voices in the group follow one single melodic line and, in most cases, tend to be perfectly matched to each other. Thus a completely different goal is gained: a sound space is built following the same line, avoiding any clashing or confronting. The ornaments are performed like there was only one singer, and the special quality is gained through the impression it was only one multiplicized voice, to which everyone is actively contributing. This „getting along“ through sound, opposite to „confronting“, adopting to common sound/tone is imperative in unison singing and shows the character of communication of other kind. It is about different physical and psychical conditions demanded for the performance that probably come from a different kind of feeling of community. I suppose there must be a deeper reason for the different feeling of *beautiful* singing – in vertical (sound roughness) and in linear (sound brightness) listening to music – that points to different characters of human communication.

What it is that makes such a distinction between the two aesthetic principles; what are the other physical conditions of life that these elements of culture have been connected and dependent of?

„Clashing“ of tones and of human attitudes, expressed through sound, as the core of *Schwebungdiaphonie*-cultures, could be opposed to „getting along“ of voices in unison sound structure; so, also the notion of „consonance“ might be expressed in seconds or in unison. The opposite ways of communication and sound building show an interesting field for investigation the character of human communication in general. Seeing this, we would maybe be a step closer to the answer to question of the character of traditional culture(s) in its (their) natural environment(s).

**Commentary on ‘Dissonance/roughness and tonality perception in Lithuanian traditional *Schwebungsdiaphonie*’**

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By using the results of his previous seminal studies as a foundation, Rytis Ambrazevičius clearly demonstrates the specificity of sonorities in traditional Lithuanian *Schwebungsdiaphonie*. He convincingly claims that the sensation of roughness fulfils a similar function in Sutartinės as the sensation of consonance in Western tonal music. This observation provokes us to reconsider the influence of cultural information on the aesthetic evaluation of auditory qualia. From a musical-theoretical point of view, in Western tonal music a dissonant sonority elicits tension which necessitates a resolution – a consonant sonority (Parncutt and Hair, 2011). The ‘reversed’ aesthetic assessment of roughness in Sutartinės suggests that these same auditory qualia trigger tensions differently than in Western tonal music. However, the actual cultural mechanism which causes this sensory/emotional difference remains unknown.

In my opinion both the auditory sensations and their aesthetic evaluation are not equivalent to qualia described as various sensations of stability. While the sensation of roughness depends almost completely on the acoustical property of the tone, the sensation of stability is related to the musical context and its prediction (Huron, 2006). Thus, although both sensory and cognitive representations are important for the creation of tonal expectations (Collins et al., 2014), only the latter necessitates a musical context. It is probably because auditory sensations are not music-specific as studies on animals indicate (McDermott and Hauser, 2004; Watanabe et al., 2005; Sugimoto et al. 2010; Chiandetti and Vallortigara, 2011). In the case of music perception by humans, the sensations which depend on harmonicity necessitate admittedly not only subcortical (Bidelman and Krishnan, 2009) but also the cortical level of processing (as research on people with amusia shows (Cousineau et al., 2012). Yet, it does not mean that these sensations suffice to organize a musical

syntactic pitch structure. Discrimination of pitch categories seems insensitive to small deviations from the intonation standards (Siegel and Siegel, 1977). In contrast, these same deviations can be crucial for sensations of roughness or consonance. This difference suggests that the gradual character of sensory qualia precludes their efficiency as the distinctive features of the basic units of musical syntax.

From this perspective, rather than being a primary cause of tension, dissonance (roughness) in Western tonality contributes to the elicitation of tension as a result of the tradition in which dissonances have been permanently used in culture-specific pitch class contexts. This means that the difference between 'Western' and traditional Lithuanian's aesthetics of roughness can be explained by context-dependent social learning. However, what is associated (contextualized) is the sensory quale (roughness) with the structural quale (stability). If this is true, Sutartinės's statistics (the statistics of pitch classes occurring in particular contexts) are the primary reason for the tension-relaxation patterns specific to Sutartinės. The different degrees of sensations of roughness, in turn, are combined by associative learning with the sensations of tonal stability. Importantly, the associated elements (sensory with structural qualia) belong to the meanings of an 'internal world' (cf. Seifert et al., 2013). As a result, roughness serves in Sutartinės as a means of facilitating the recognition of tonal structure in a cultural-specific way.

**Roughness and ratios of one-step intervals: A Response to 'Dissonance /roughness and tonality perception in Lithuanian traditional *Schwebungsdiaphonie*'**

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Having ranges of less than an octave, the *sutartinės* Rytis Ambrazevičius analyzes are instances of tunings that do not feature registral duplication. All the same, to the extent that they are, as he says, 'equitonic', they can be considered degenerate well-formed. Specifically, in terms of the formulation developed in my commentary on the article by Omigie et al., each interval that spans  $n$  steps is smaller (in cents) than each that spanned  $n+1$  steps (where  $n=0,1,2,3, \dots$ ). Similarly (albeit cast in Western European letter notation, unlike Ambrazevičius's seemingly more appropriate Figure 1), the 52 pieces analyzed in Vida Palubinskienė's recent (2011) study, which comprises items performed by the 5-string *kanklės*, span less than an octave, and all but two are degenerate well-formed.

As analyzed by Ambrazevičius previously (2009, Figures 3 to 7) and consistent with his present report (Figures 1 to 3 and 6), the more instances of a particular degree and the longer its total duration, the smaller the differences in its fundamental frequencies (as assessed in cents). Similarly for intervals between degrees: the differences in cents between pairs of degrees tend to be smaller if the constituent degrees are longer-

lasting and more frequent. Accordingly, it is not surprising that probe-tone values are highest for the central degrees: throughout the experiment, because the central tones are more frequent, last longer, and vary less in their fundamental frequencies, they would tend to be responded to as better fitting the particular excerpt heard in a particular trial.

To remove such artifacts from the analysis of the results, one would have to factor out frequency of occurrence, duration, and even variability of intonation for each degree. In any event, even if much the same results obtained, it seems overreaching, or at least precipitate, to advance Ambrazevičius's analogy whereby the central degrees correspond to the tonic of Western European Common Practice and the peripheral degrees correspond to the subdominant and dominant. In this regard, Matt Hughes's (1977) statistical analysis of pitch classes in Schubert's *Moment Musical in C*, op. 94, no. 1, concluded that the piece's tonal "orientation" was directed not toward C, but toward G.

Arguably, Hughes's finding was an artefact of G being part of both the tonic and dominant triads and the piece being an instance of a widespread, but not necessarily universal, tendency for music to be skewed toward the dominant rather than the subdominant side of a potentially symmetrical framework (see, e.g., Rahn 1983, 173). However, Ambrazevičius's analyses do not clearly point toward a corresponding asymmetry in the *sutartinės*. Accordingly, rather than basing such an analogy on statistical distributions, it would seem more effective to consider how each tone in each of these pieces is related to the piece's other tones, including not only their pitches, onsets, durations, and spectra, but also the ways in which these articulate patterns of rhythm and form.

### **Commentary on 'Dissonance/roughness and tonality perception in Lithuanian traditional *Schwebungsdiaphonie*'**

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This paper is aimed at describing the scale structure in traditional Lithuanian polyphonic music which tends to favor dissonant harmonic intervals to consonant ones. The phenomenon is known as the *Schwebungsdiaphonie* in ethnomusicological literature. In addition, a psychoacoustically relevant issue whether performed intervals of about 1.8 semitones in the female middle voice range are targeted to maximum roughness or to maximum sensory dissonance, is addressed. It is an intriguing paper based on original material, to which I would like to add a few comments.

The most important question from the point of view of music theory seems to be whether the sound material from different voices can be merged into a single scale or

not. On page 14, Ambrazevičius writes that “two simultaneously sounding modi show two trichords displaced by 1.8 semitones and comprised of neutral thirds.” It should be noticed that in one sounding modus only even-numbered scale steps are used and in another modus only odd-numbered steps are used (cf Figures 1 and 6). It may therefore be more plausible to describe the whole sound material in the performance as a polytonal structure where two trichords (“scales”) are harmonically combined, somehow similar to how two major triads in the so-called Petrushka chord by Igor Stravinsky, C major and F# major — a tritone apart — clash when sounded together and create a dissonant chord.

If so, then care must be taken in replicating the probe tone experiment by Krumhansl with the Lithuanian *Schwebungsdiaphonie*, in order to avoid “comparing apples with oranges.” The sound structures in the latter case and in the Western tonal music seem to be fundamentally different in a number of important aspects:

- (1) the Western tonal music in general is in a single tonality at one time while the Lithuanian *Sutartinės* may be polytonal;
- (2) the Western tonal music is based on the octave equivalence while the Lithuanian *Sutartinės* seem not to<sup>1</sup>;
- (3) the Western diatonic scale (as well as the pentatonic scales and some other scales in traditional music) are constructed from two intervals of different sizes, which sometimes has been considered a universal principle in music, while the melodic intervals in the Lithuanian polyphony are pervasively neutral thirds and the harmonic intervals of about 180 cents size only.

When Ambrazevičius writes on page 20 that “[t]he subjects (Group 1) give approximately the same [goodness-of-fit] ratings for the two central pitches” [in the sense of Krumhansl (1990)], I can easily agree that “they feel the “double tonic” constituted of the two most prominent pitches of the intertwining vocal parts.” Moreover, in my opinion, the “double tonic” in its turn gives evidence on the polytonality of the sound structure of *Sutartinės*.

## Author's Response

### **Sutartinės: Perhaps an exemplary material for further study on tonal phenomena from cross-cultural perspective**

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I am really grateful to Jaan Ross, Piotr Podlipniak, Jay Rahn, and Jelena Jovanović for their valuable comments. The reviewers discuss mostly the last and the shortest topic considered in the paper, the tonal hierarchies in *Sutartinės*.

Ross touches really intriguing issues of tonality perception in *Sutartinės*. This polyphonic music is frequently considered as polytonal, indeed (e.g. Boiko 2008: 117-122; Račiūnaitė-Vyčiniene 2000: 76; I should only add that here certain part of *Sutartinės* is meant while some of others are even monophonic). I also refer to the discussed tonal structure as “two simultaneously sounding modi” showing “two trichords displaced by 1.8 semitones and comprised of neutral thirds,” as Ross mentions. This seems to be a simple truth if the structure decomposed into two parts is meant. However, if we mean the actual manifestation of the tonal space in the performance, the question whether we deal with a real polytonal structure remains open. Maybe this could be rather considered as a peculiar realization of “roughened” linear thinking (cf Lippus 1995), i.e. rough sounding “double degrees” composed into intertwining “double melodies” (see Ambrazevičius 2008a: 702–703, for details)? Thus I would not collate this phenomenon with the so-called Petrushka chord, even if some similarity on the surface possibly could be stated.

Ross then shrewdly cautions against the risks “in replicating the probe tone experiment by Krumhansl with the Lithuanian *Schwebungsdiaphonie*.” I agree that the technique should be applied with evaluation of possible risks of misinterpretations. But probably not all points mentioned by Ross pose a problem. For instance, he writes that “the Western tonal music is based on the octave equivalence while the Lithuanian *Sutartinės* seem not to.” Yes, structures of the discussed *Sutartinės* are oligotonic, but how would this prevent from the application of Krumhansl's technique?

I apologize that some details were not revealed in the current paper as they appeared in the previous one (Ambrazevičius & Wiśniewska 2009). So, as Ross writes, “in Figure 6, additional lower (1) and higher (8) notes absent in the scale of the sample are included but their origin remains unclear.” “The tones absent in this portion were made from the original ones by pitch change” (Ambrazevičius & Wiśniewska 2009: 51). The fact that seven successive intervals of 1.8 semitones make 60 cents more than an octave (i.e. 1260 cents) should not bother since, first, the number 1.8 should

be regarded as approximate, second, the notes 1 and 8 are not presented in sequence in the experiment, thus there is no possibility to evaluate their octavic relationship.

In any event, the probe tone technique by Krumhansl could be applied not only for the Western tonal music: there are (although not numerous) applications of the probe technique for different atonal and non-Western musics as well (even Krumhansl 1990: 73–74, 240–270; Oram & Cuddy 1995; see also Budrys & Ambrazevičius 2008). I fully agree with the Podlipniak's comments; the insights presented in the last paragraph of his response are especially inspiring. I would only like to add that, when discussing the stability of scale degrees, I mean the objective acoustical stability of intonations (reciprocal to their standard deviation) in different occurrences. Obviously, this is not the same as the cognitive qualia of stability (incidentally, based on sensations or experiences?). I demonstrated that the perceptual ratings of the scale degrees in the studied case correlate with the acoustical stability. However, the correlation is not expected to be the general case (see the reply to Rahn's comments as well).

Rahn writes: "it is not surprising that probe-tone values are highest for the central degrees: throughout the experiment, because the central tones are more frequent, last longer, and vary less in their fundamental frequencies, they would tend to be responded to as better fitting the particular excerpt heard in a particular trial". Concerning the "not surprising," yes and no. Typically, or, better, statistically, "yes". However, there are also many cases when certain scale degree does not even occur in a tune (or number of the occurrences is small), yet the degree is perceived as weighty enough. For example, refer to the instances of hidden harmonies in homophonic music. Say, if only the leading part which lacks occurrences of tonic is performed, still the (almost) missing tonic is "reconstructed" based on the hidden (i.e. absent in the actual performance) parts characteristic of numerous occurrences of tonic. Some examples of the typical Lithuanian vocal homophony can be found, e.g., in Ambrazevičius 2014. A similar phenomenon of implied harmony in Western tonal music (e.g. Thompson 2009: 105–107) could also be mentioned.

Additionally and generally, the ratings of fitting of the scale degrees in the probe tone experiment do not necessarily correlate to the objective acoustical stability of fundamental frequencies of the degrees. If a certain scale degree "varies less in its fundamental frequency," it will not automatically "tend to be responded to as better fitting the particular excerpt heard in a particular trial". The case of tonic comes first to my mind again. It is typical, at least, for the Lithuanian traditional singing, that tonic is intoned more freely than, for instance, the upper tonal anchor (sometimes called even "upper tonic"), mostly a fifth or fourth above the tonic (Ambrazevičius 2008b: 173). This phenomenon could be probably attributed to certain matters of voice physiology (range, intensity, "comfortable" pitches, etc.; see also Kharlap 1972: 247; Alexeyev 1986: 67; for the different roles of the upper and lower tonics in the genesis of musical scales). Nevertheless, the (lower) tonic is perceived as the weightiest and most important scale degree.

Rahn then suggests "to remove such artifacts from the analysis of the results," i.e. "to factor out frequency of occurrence, duration, and even variability of intonation for

each degree”. This proposal nevertheless may seem to undermine some essential points of the phenomenon of tonal hierarchy. The tonal hierarchies are defined in time only; the temporal sequence of musical events induces the different weights of scale degrees (see, e.g., Snyder 2000: 151–152; Thompson 2009: 111–112; and other textbooks). One could start from the Krumhansl’s experiments and Krumhansl-Schmuckler key-finding algorithm (1990; etc.), then follow to the further discussion on correspondence between the tonal profiles and statistics of scale degrees (Temperley 1999; Huron 2006: 147–153). Of course, the bottom-up element is supplemented with decisions coming from implicit learning, yet the explicit element should not be underestimated, in general. We have done the probe-tone experiment with two groups of listeners, experts in *Sutartinės* and novices (Ambrazevičius & Wiśniewska 2009: 51–52). The results for both groups showed similar tendencies in shaping the tonal profiles (ibid.: 52–53). This means that, in the discussed case, either the top-down element is weak or the top-down and bottom-up elements result in similar outcomes.

When considering T-D-S functions, Rahn moves to the details characteristic of the Western tonal music (such as triads, tonal “orientation,” etc.). In my paper, when discussing the analogy between the tonal domains in *Sutartinės* and T-D-S functions, only basics of designs of the tonal spaces are meant. Specifically, the relation between the central tonal nucleus and the adjacent tonal subspaces in *Sutartinės* seems to be similar to the relation between the main tonality and the adjacent tonalities in the Western tonal music. This could be demonstrated by collation of the corresponding tonal profiles, similarly as in Krumhansl & Kessler 1982: 343–344.

Rahn proposes that the discussed *Sutartinės* scales can be considered degenerate well-formed. This is an interesting point which needs further discussion. Incidentally, we should be careful with the reference to Palubinskienė’s study (2011). Rahn writes, “the 52 pieces analyzed in [the] study, which comprises items performed by the 5-string *kanklės* [Lithuanian type of zither]... all but two are degenerate well-formed.” However, first, there are actually only two instruments with constant tunings. Two musicians (Petras Lapienė and Jonas Plepas; Palubinskienė 2011: 131) used the *kanklės* to play several pieces. Later in the text, scales of vocal performances are presented. Second, both the *kanklės* tunings and scales of vocal performances are listed in diatonic forms which are crude misrepresentations of the actual tunings, although possibly adequate for an initial introduction. Therefore, both actual *kanklės* tunings acquired slightly different diatonic representations for certain pieces (!). Palubinskienė also thinks that all scales in traditional music are based on the natural scale (ibid.: 129–130) what, unfortunately, is hardly observed in reality. Third, there are some discrepancies between the scales in vocal and instrumental *Sutartinės* (Ambrazevičius, Budrys, & Višnevskaja 2015: 287–289). In the current paper, I limit myself with the vocal instances.

The issue touched by Jovanović is probably the most fascinating for me (as presenting the ethnomusicological and cross-cultural perspective), yet the most “mysterious” as well: it is a certain sense that the answers are greatly relevant but somehow locked in

the mist of history, still waiting for resolution. Fortunately, we can at least speculate on some points, based on the available, though quite faint, data.

First, I would not consider the performance of a *Sutartinė* as “confronting intentions of each singer embodied in sound”. I would make an accent not on the confronting but on the producing a common entity. The “clashing” voices should adjust each other very carefully, in pitch, intensity, and timbre. Actually they create kind of homogeneous “rough” melodic contour (see also the reply to Ross’s comments). Singing (or, as performers say, chanting) *Sutartinė* was sort of manifestation of tight community; I have mentioned that “the noun *Sutartinė* derives from the verb *sutarti* which means ‘to agree,’ ‘to be in concord’ (‘to live in concord,’ ‘to sing in concord,’ and so on)”.

Second, there is another satellite topic which is surely awaiting more comprehensive investigation. From our ethnomusicological fieldwork, we know how difficult sometimes is to discuss number of vocal parts with informants. Not rarely they argue that the sing “in one voice” (i.e. in unison), although we hear clearly two or three parts (the notes can be found at the Musical Folklore Archives, Lithuanian Academy of Music and Theatre). This means that the perception of unison has certain cultural dimensions, similarly to the perception of consonance.

Third, different aesthetic principles can coexist. In the Northeastern Lithuania, the polyphonic singing coexisted with monophonic and homophonic singing: as already noted, the continuous tradition of *Sutartinės* vanished in the middle of the 20th century, whereas homophonic singing in this region was popular at least from the middle of the 19th century, not to mention the archaic monophonic singing (Nakienė 2000). Additionally, there were also *Sutartinės* based on harmonic series (supposedly conjunct with the similar music played on wind instruments). There was even a certain period of vanishing vocal *Sutartinės* and emerging homophonic singing. At last, now we are fond of switching between different aesthetic principles, i.e. singing *Sutartinės*, monophonic, and homophonic songs. Probably, this could be attributed to multimusicality; something similar to enjoying both chili roasted pork and desert of vanilla cream afterwards.

I would like to believe that these attractive topics (performative confronting/agreement, emic/etic, and multimusicality in the case of *Schwebungsdiaphonie*, as well as the discussed general tonal phenomena in their cross-cultural perspective) will continue to attract attention of Jovanović, me, and other researchers in future. Hopefully at least some more answers will be found based on the comparative studies of *Schwebungsdiaphonie* in Balkans and Lithuania revealing certain local and universal features of this peculiar musical thinking.

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<sup>i</sup> The sounds of *Sutartinės* tend to be accommodated within a single octave. In Figure 6, additional lower (1) and higher (8) notes absent in the scale of the sample are included but their origin remains unclear. If there are eight steps in the scale and if the difference between all successive steps is 1.8 semitones, the scale encompasses  $7 \times 1.8 = 12.6$  semitones, i.e. 60 cents more than an octave. The issue of possible equivalence between the steps 1 and 8 is unfortunately not discussed in the paper.