

## Six Hours of Exploratory Improvisation

Creativity is seen as a fundamental human capacity which also seems to be very sensitive in escaping scientifically controlled conditions. During the last decades, musical improvisation has become a more and more interesting channel for studying the cognitive neuroscience of creativity. Jazz improvisation especially has shown itself to be a rewarding field of study, since professional jazz musicians are able to create novel ideas flexibly under different controlled circumstances and in relatively short time-scales (see, e.g., Limb & Brown, 2008; McPherson & Limb, 2013; Donnay et al., 2014; McPherson et al., 2014; Pinho et al., 2014; McPherson et al., 2016; Alves Da Mota et al., 2020). Here I can bring something different to the subject: a musician's perspective on an improvisation lasting for hours and based on different aesthetics than in most current music genres.

On 6 February 2017, I improvised for six hours without a break on eight different kanteles (for 5 hours and 47 minutes on seven Finnish kanteles and one Latvian kokle, to be specific) in the Black Box

hall of the Musiikkitalo, Helsinki Music Centre. There were EEG caps on me and three listeners, and the data was recorded for about two hours from the beginning of the event (a somewhat shorter period for the listeners than for me). The performance was recorded and videotaped in its entirety, and the three listeners were videotaped during their EEG measurement. The event was organized by the Sibelius Academy Folk Music Department of the University of Arts, Helsinki, and was co-funded by the Jenny and Antti Wihuri Foundation. Students of psychology and cognitive science from the University of Helsinki worked on the EEG measurements under the supervision of Research Director Mari Tervaniemi, PhD (Psychology) from the Cognitive Brain Research Unit. Some equipment came from the Arts Equal project at the University of Arts, Helsinki, and some from the Cicero Learning network at the University of Helsinki. The technical expertise was in the hands of laboratory engineer Tommi Makkonen from the Cognitive Brain Research Unit, the University of Helsinki. My deepest gratitude to all who contributed to the event (Image 1).

*Image 1.*



This kind of live situation differs from the brain research conducted in laboratory conditions in almost all aspects and brings along new challenges. Although the live situation in some respects is more genuine, there are other distracting factors such as the physical movements, changes in lighting, and elements and details outside of music registered by eyes and ears. All these will have their effects on the reactions of the brain, and they can't be removed from the data. McPherson and Limb (2013), for example, discuss whether it is possible to scientifically research creativity without destroying its essence. In addition, it is important to consider how the activity of various brain areas will change depending on the playing technique on each instrument, the aesthetics and the type of the improvisation, the rules on which the improvisation is conducted etc. For example, in several creativity studies, the musical improvisation is done on keyboard by using only the right hand (Bengtsson et al., 2007; Limb & Brown, 2008; Donnay et al., 2014; Pinho et al., 2014; Alves Da Mota et al., 2020). Whether the results of such studies can be combined with a totally different way of music making, like the one addressed in this article, is worth considering.

In her welcome, Mari Tervaniemi noted that even though the available equipment for making measurements is excellent, the tools for analysing the data containing the previously mentioned distractions are still under development. Thus, the aim of the project from the brain researchers' perspective was to develop and examine the process of the research, with the focus on how brain mechanisms which regulate data processing, creativity and attentiveness or alertness, will work in a

live music situation and in what way they will alternate with the listeners and the musician. In 2015, the Brain and Music group at the University of Helsinki performed a somewhat similar EEG measurement on professional singers in a concert situation, and the brain images were projected for the concert audience (<https://www.helsinki.fi/fi/uutiset/koulutus-kasvatus-ja-oppiminen/muusikon-aivot-yleison-ihailtavina>).

From the musical perspective, my starting point for the six-hour improvisation was to test and experience the reactions of my mind and body to this way of making music in a time scale that was stretched close to the limits of my capacity. I was also curious whether, or to what extent, I might be able to experience the traditional immersion in music in front of an audience. Would the structure and the character of the process change during such a long period and the ongoing improvising? Would the state of mind and the transformed states of consciousness vary and for what reasons? Which factors would lead the mind to give up control and let thoughts progress freely? What would be the relation of the musical elements and automatized finger movements stored in my long-term memory through the years of practise with the consciously invented and unconsciously produced music? In what way would the perceptual feedback (sensed from the audience or my own emotions regarding the produced music) influence the progress of the improvisation?



**Image 2.**

*Photo: Jorma  
Airola*



Since the genre of music now under study is specific and probably unknown to many, I will first give some basic information about the historical background and the essence of the music tradition. The acoustical properties of the instrument and the playing technique have a profound influence on the musical outcome, and they are, to some degree, addressed in the text. In the analysis, I have used the recordings and post-performance notes which reveal the phases of control, unintentional outcomes, control-free progression and even the moments of oblivion. The appendix contains a summary of the

whole event in a time code, the periodization of time between instruments, audience feedback (in Finnish) and the video recording. The main questions in my study are: What is happening in the consciousness preceding and during the state of the so-called quiet exaltation? What are the elements or components needed to be able to achieve this kind of mental state? What is the meaning – the importance – of this music to its producer? Was I able to achieve the state of quiet exaltation during the six-hour improvisation?

## The Quiet Exaltation

The Finnish kantele, an ancient zither instrument that is part of the Baltic psaltery family, is nowadays a large and diverse set of instruments with different structures, shapes, playing techniques and strings, ranging from 5 up to 40. From them, the traditional Finnish Karelian kantele, an inseparable part of the ancient runosong culture, was used in this six-hour event. Early twentieth-century documents give us detailed facts about the instruments, the playing technique, the tuning method, the scales, and the traditional kantele players who could still be found at that time mainly in isolated Karelian villages (Väisänen, A. O. (Ed.), 2002 [1928]; Kastinen et al., 2013; Malvinen, 1997:26, 61–69; Malvinen, 1996: 43–48; Wartainen 1987 [1923]: 82–91, 100–101, 111). In addition, there are also some documents from the nineteenth century (see, e.g., the Archives' collections of the Finnish Literary Society; Kastinen 2009; Gottlund 1828; Relander. 1917: 19–20) – short music transcriptions with only a little (or no)

additional information about the instruments or the players – and a few fragments or short mentions, connected with the kantele tradition, in the eighteenth-century documents (Acerbi 1983: 83–84; Porthan 1983 [1766–68]: 82–83; Ganander 1984 [1789]: 102–105; Ganander 1786; Laitinen 2010: 23–34).

The documents concerning this particular genre of musical improvising contain intriguing stories about situations in which a musician plays for hours just for himself – introverted, ignoring the environment, and, at the same time, enchanting the people hearing him play (NB: indeed, the documents we have, suggest that the player was always male). The Finnish folk music researcher Armas Otto Väisänen (1890–1969) named this special transaction *hiljainen haltioituminen* – the quiet exaltation (Väisänen 1990 [1943]: 43), while the kantele players themselves were talking about *soittaa omaa mahtia* – playing their own power (~ the inner strength and knowledge) (Raja-Karjala 15.7.1911; Relander. 1917: 19–20; Wartainen 1987 [1923]: 90). In the late nineteenth century, as most of the Karelian people were still under the influence of the ancient runosong culture, they were also illiterate (see, e.g., Siikala 2014: 102; Härkönen 1926: 29, 43; Sjöström 1896: 25; Forsström 1894: 150), and their cultural memory presumably reached back many generations. This brings the prehistoric



**Image 3.** Kantele player Jaakko Kulju (1836–1920). Photographed by A. O. Väisänen in 1917 in Suojärvi, Border Karelia. Photo: [The Finnish Heritage Agency](#) (CC BY 4.0).



perspective along and generates the thought of a possible connection between kantele players of their own power and prehistoric shamanism (Siikala 2002: 242–280). However, that question must be left outside this study.

The problem from the point of view of modern researchers and musicians is that the only documents we have of this way of music making are textual stories. The short phonograph (wax cylinder) recordings from the beginning of the twentieth century and the transcriptions from the nineteenth and early twentieth century are mainly recordings of dance tunes of that time. Väisänen actually mentioned that he finds it impossible to write down this endless and constantly varying music authentically (SKS KIA. A. O. Väisänen arkisto. *Kantelespel i Kalevala och i verkligheten*. 1943). The lack of recordings doesn't dim the piquancy of the subject, though. The information we have of the instruments, the detailed descriptions of the special plucking technique, the scales, the tuning system, and the aesthetics of the music inside the runosong culture, give us tools to learn and understand the deeper essence of this music and make it available and alive for the people of the twenty-first century. Naturally, we won't be able to give an accurate reconstruction of the improvisations of the nineteenth-century or earlier kantele players, but if we take a closer look and understand the function of

this music, that is not necessary or even – as I see it – the goal.

The world in which the old Karelian kantele players lived – the slash-and-burn culture that included hunting and fishing as an important part of one's livelihood – is so far away from our modern society it could as well be a thousand rather than a century and a half or two hundred years away. There is no way the individuals of our time can really understand the everyday life of those people so that we could step into their shoes and know their thoughts – it seems to be quite impossible even between individuals living in the same era. However, in the same manner as each Karelian kantele player of the nineteenth century 'played his own power' in his own individual style, the kantele player of the twenty-first century can do the same. Players of their own power describe their feelings and thoughts through music, and that won't happen if musicians try to copy the music exactly the same way as someone else has performed it.

**Image 4.** *Kantele player and runosinger Timo Lipitsä (1857–1950). Photographed by A. O. Väisänen in 1917 in Suistamo, Koitto, Border Karelia. Photo: [The Finnish Heritage Agency](#) (CC BY 4.0).*





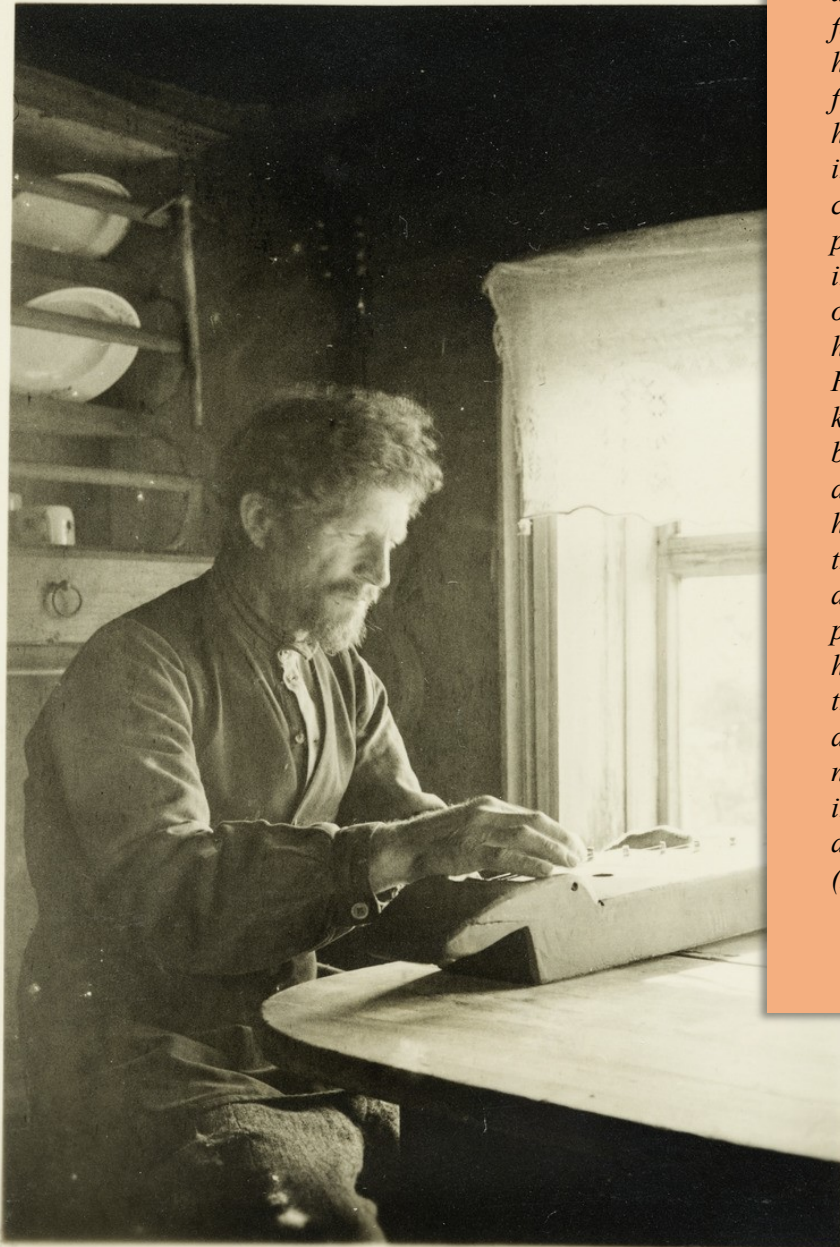
## Where does the music come from?

When playing their own power, the old kantele players didn't much explain the music. Improvising music in that way seemed to be as natural as breathing.

*Paras kanteleensoittaja, mitä koskaan olen kuullut, oli Lahden kylässä Säämjärven rannalla. Jo aikaisemmin olimme hänestä kuulleet. Ja heti kylään tultuamme lähetimme häntä hakemaan. Hän tulikin, mutta vaatimattomasti ei hän sanonut mitään osaavansa. Häneltä olivat sormet äskettäin palettuneet, eikä hän muka sen vuoksi mihinkään kyennyt. Kun me kuitenkin vaadimme häntä soittamaan, soitti hän muutamia tansseja eikä sanonut muuta osaavansa. Me jätimme hänet rauhaan ja arvelimme, että häntä oli turhaan kehuttu. Joku meni sorsia ammuskelemaan, joku puhdisteli pyssyään ja joku kirjoitti muistiinpanoja.*

*Kanteleensoittaja unohtui. Hän istui yksin nurkassa kantele polvillaan, tuijottaen eteensä. Vähitellen rupesi hän soittamaan vienosti, välistä kiihtyen ja lämmeten ja taas aivan hiljaan. Kun me silloin sanoimme semmoista juuri tahtovamme kuulla ja kysyimme, mitä se oli, sanoi hän, ettei se mitään ollut, että hän vain soitti omaa mahtiaan. Sitten annoimme hänen olla rauhassa, puuhailimme kukin omalla tahollamme. Mutta kanteleensoittaja, kun ei kukaan häneltä mitään kysellyt, ja kun sai olla rauhassa, soitteli koko illan, ja me kuuntelimme häntä iloksemme. (From the expedition to Olonetsia in 1882. Relander 1917: 19–20.)*

*[The best kantele player I've ever heard was in the village of Lahti by the lake of Säämjärvi. We had heard of him before, and as soon as we arrived in the village, we sent for him. He did come, but modestly he said he couldn't play anything. He had frozen his fingers recently, and therefore, he claimed, he couldn't play anything. Since we still insisted he play, he played a few dances claiming he knew no more. We left him in peace and thought that he had been praised in vain. One of us went to shoot the ducks, one cleaned his gun, and one was writing his notes. The kantele player was forgotten. He sat alone in his corner, his kantele on his knees, staring in front of him. Gradually he began to play softly, at times warming up and getting more excited, at others so that he was barely audible. On being told that this was precisely what we wished to hear and being asked what was it that he was playing, he replied that it was nothing, that he was simply playing his own power. We, therefore, left him in peace, each going about our business. But the kantele player, no longer asked any questions and being left in peace, played throughout the evening, and we listened to him to our delight.] (Engl. transl. by the author)*



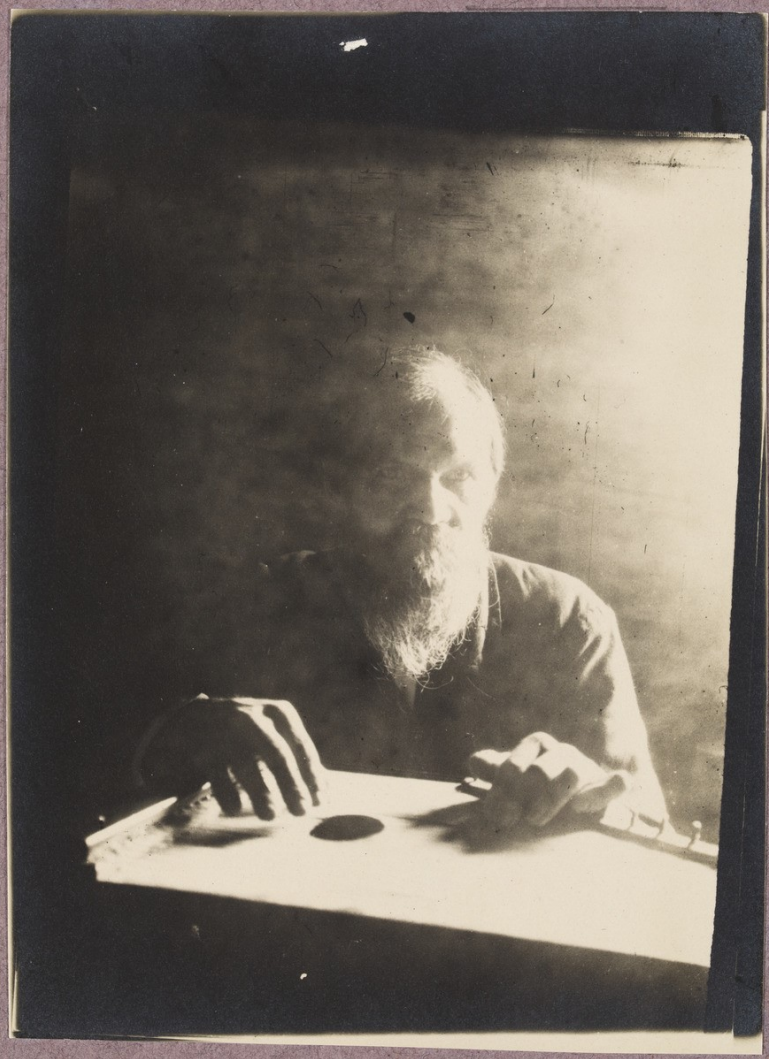
**Image 5.** Kantele player Mikko Mishujev in Kuujärvi, Syrjä, Olonetsia. Photographed by Aino Puosi in 1943–1944. Photo: [The Finnish Heritage Agency](#) (CC BY 4.0).



*Mutta mieltäkiinnittävimpiä hetkiä, mitkä ukon kanssa olen viettänyt, oli tuon kokouksen loputtua kahden kesken pienessä sivuhuoneessa istuessamme. Täällä vastustusten pakisimme elämän syntyjä syviä ja ukko ylimmilleen haltioituneena soitteli vuoroin synkkiä, vuoroin iloisia tunnelmiaan. (Wartiainen 1987 [1923]: 86.)*

*[But the most memorable moments I have spent with the old man were after that meeting when the two of us sat in a small side room. Here, face to face, we talked about the deep topics of life, and the old man played at his highest ecstasy, alternately gloomy or joyful feelings.] (Engl. transl. by the author)*

**Image 6.** Kantele player Iivana Mišukka (1861–1919). Photographed by A. O. Väisänen in the 1910s, in Suistamo, Leppäsyryjä, Border Karelia. Photo: [The Finnish Heritage Agency](#) (CC BY 4.0).



Some musicians of our time have stated that in situations where the musician plays as one entranced, it is actually the instrument which is playing the musician and not the other way round (Rollins 2014; Liu et al. 2012; Titon 1978: 96, 98). I have personally tried to find the music behind the nineteenth-century inscriptions ever since I first found some of the texts in the 1980s, and in my experience the disappearance of self might indeed be one of the key factors. In other words: stopping paying attention to the self. According to psychologist Mihály Csíkszentmihályi, the creator of the concept of flow, ‘the self is the sum of the contents of consciousness and the structure of its goals’. He describes a circular causality where attention/psychic energy is directed by the self, and the contents of consciousness and the goals are the results of different ways of investing attention. ‘Attention shapes the self, and is in turn shaped by it.’ (Csíkszentmihályi 2008 [1990]: 34)

As I feel it, in this area of music – improvising your own power – both the self and the attention should be forgotten. The musician wanders inside her/his thoughts, which can float freely, and doesn’t think about how or what should be played. The automatized playing technique takes care of the instrument and transforms the musician’s inside journey into a musical soundscape. My hypothesis is that, at least at times, the created music is more like the activity of the subconscious than the conscious self. The distinction with the kind of improvisation where the tempo, the pulse and the style is expected to follow certain rules is clear. However, the scale is predetermined by the player due to the nature of the instrument.

**Image 7.** Kantele player Hilppa Vornanen (1849–1920). Photographed by A. O. Väisänen in the 1910s in Korpiselkä, Ristisalmi, Border Karelia. Photo: [The Finnish Heritage Agency](#) (CC BY 4.0).





In his studies, psychologist Daniel Kahneman describes mental life using the metaphor of two agents: the intuitive System 1 (automatic operations) and the effortful System 2 (controlled operations; Kahneman 2011: 19–105). Consistently he demonstrates how we build our reality on illusions, and how our actions and feelings are often guided by events whose existence we are not even aware of.

*We know from studies of priming that unnoticed stimuli in our environment have a substantial influence on our thoughts and actions. These influences fluctuate from moment to moment. — Because you have little direct knowledge of what goes on in your mind, you will never know that you might have made a different judgement or reached a different decision under very slightly different circumstances. (Kahneman, 2011: 225)*

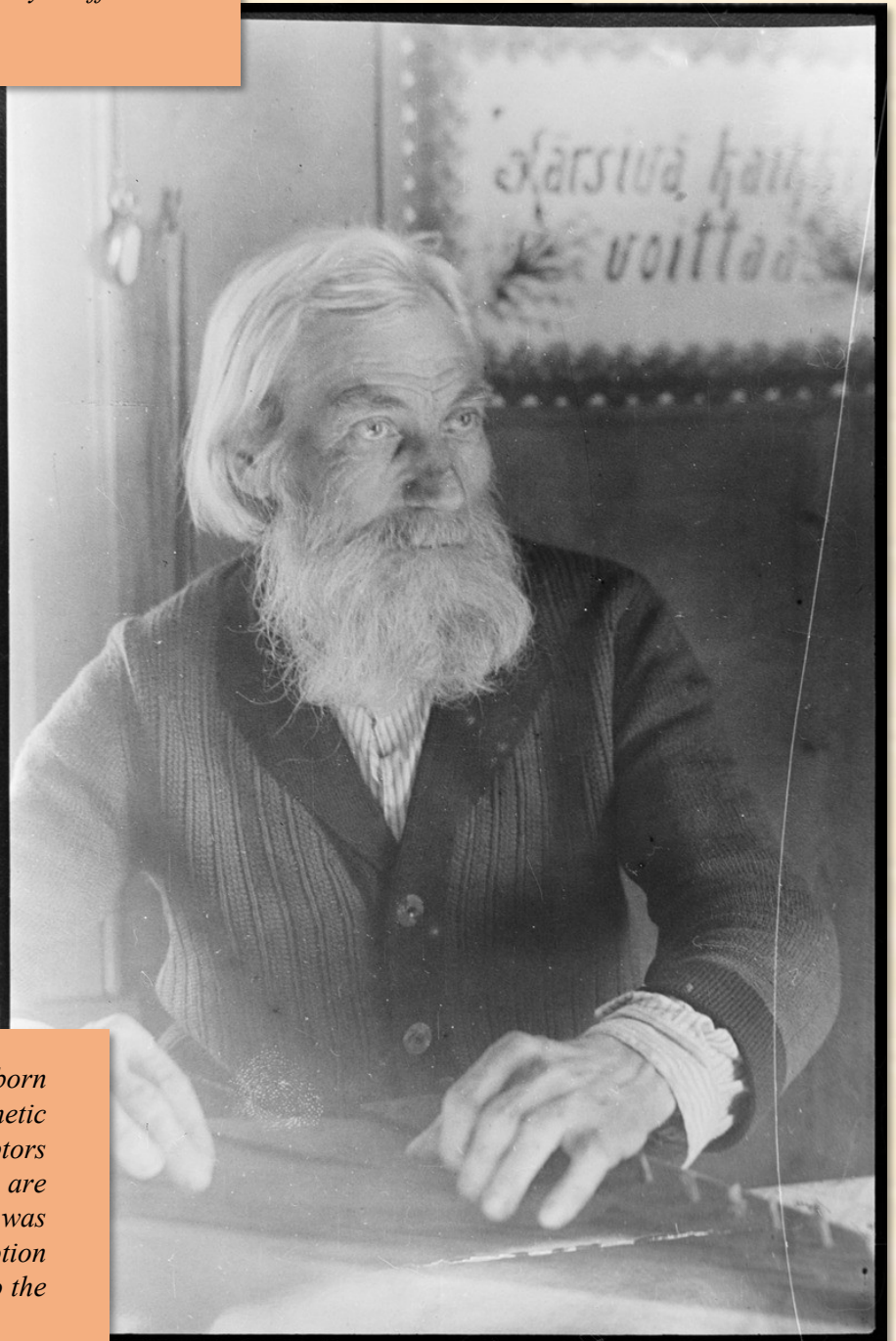
Geneticists, in turn, have shown how even very complex decisions we make can be pre-programmed and dictated by our heredity (Latvala & Silventoinen 2017; Saad et al. 2019). Brain researchers and biologists tell us that to be able to deliver information, the brain requires not only electrical discharges in nerve cells but also actions of chemicals and hormones such as dopamine, cortisol, oxytocin, vasopressin, endorphins, etc. (Ukkola-Vuoti 2017: 136–151). PhD Liisa Ukkola-Vuoti writes:

*Yksilölliset erot tunteissa syntyvät geneettisten tekijöiden aiheuttamista eroista aivoissa. Dopamiinireseptorien määrä on tällainen tekijä, ja erot syntyvät jo yksilönkehityksen aikana. Tutkimuksessa musiikin aikaansaaman tunnetilan huomattiin vaihtelevan geenimuodon mukaan. (Ukkola-Vuoti, 2017: 226)*

*[Individual differences in feelings are born from brain differences caused by genetic factors. The number of dopamine receptors is such a factor, and the differences are already formed during the ontogeny. It was noticed in the study that the emotion generated by music altered according to the allele.] (Engl. transl. by the author)*

So, the scientists in different fields are telling me that my decisions are guided by the unconscious, which is influenced not only by the circumstances here and now, but also by the information and its associations accumulated in my memory during my life; by molecular-level chemical activity; and by my inherited genes. The time scale covers the present, the recent past and history. Thus, it is possible, and actually quite clear, that the music I improvise can be born regardless of my self.

**Image 8.** Kantele player Petri Patronen in Korpiselkä, Yläjärvi (Border Karelia) in the 1920s or 1930s. Photo: [The Finnish Heritage Agency](#) (CC BY 4.0).





## The experimental event of the six-hour improvisation – plans and preparations

The disturbing conflict or paradox in organizing an event like this six-hour performance lies in the fact that as soon as the music is brought on stage, the music will be more or less aimed at the listeners, and the musician no longer plays for him/herself. The original function of the music disappears, and with that the very core of the aesthetics might be lost as well. In some performances, I have sought to change the nature of the event from a conventional concert by playing for a couple of hours in places like art museums where people can come and go as they will, and the music is more like a part of the exhibition. At the six-hour event, the EEG measurement entailed some more pressure, excitement and disturbing thoughts during the process.

*Image 9.*

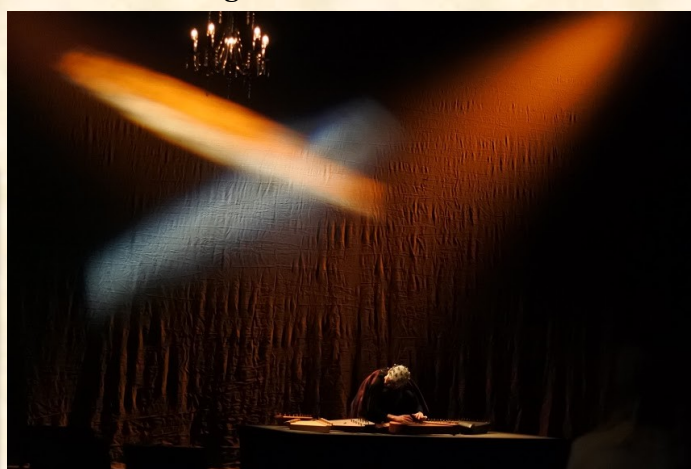


In this case, the elements of a customary concert were coaxed to fade out through several modifications (Image 9). There were carpets and pillows in the middle of the floor for the audience to lie on. The chairs were sparsely placed, not too close to each other, and it was possible to move them. The audience was instructed to leave their shoes outside the concert hall – some wool socks and slippers were available. Needless to say, the mobiles were to be turned off, and people were told not to speak at all while inside. People could come and go to and from the venue as they wished, except for a five-minute period about twenty-five minutes after the beginning when there was a moment of almost complete darkness – at that moment coming or going was not possible. There was a doorkeeper to take care of the silent movements of the door.

The sound system, designed by sound engineer Jon-Patrik Kuhlefelt, was kind of hidden; the small mics were under and between the instruments. The goal

was to get the quality of the amplified sound as close to natural as possible but still filling the entire space. The lighting, by lighting technician Sirje Ruohutula, was warm, dim and cosy, developing slow changes in reflections and in the amount of light (Images 10 and 11). Outside the concert hall there were papers and pens for visitors in case they wanted to share their thoughts on the experience. For me, all these details created circumstances as optimal as possible, despite the previously mentioned paradox. A big thank you goes to the producer of the event, Eeva Hohti.

*Images 10 & 11. Photos: Jorma Airola.*



I was sitting on the floor of a small stage surrounded by the instruments. The instruments were divided into three main groups tuned in different scales, and I was changing my position between the groups according to the development of the music. Playing on the floor has several advantages concerning this musical genre. The floor (preferably wooden) enhances the sound volume through the resonance effect on the otherwise quite quiet instruments. Also, when bent over the instruments, the sound is directed towards the



player, and it is easier to create a kind of private sound bubble and ignore the environment. Furthermore, this arrangement allows me to control several instruments at the same time, which would be impossible if I played them in the traditional way holding the instrument in my lap. Playing on the table would be traditional as well but the floor works out the best for me. It would be possible, naturally, to play just one kantele at a time, as did the nineteenth-century Karelian kantele players, but I am so fascinated by the amazing range of timbres and the variation of distinctive features in the old, self-made instruments which were each unique, that I feel it would be a shame not to bring at least a small fragment of this spectrum to a modern audience.

The question of controlling the time without a watch, of knowing when the six hours would be up and the music should stop, was solved in collaboration with the technicians. At 19:30 a silent film of a Karelian wedding, filmed in 1921, was to start and be projected on the back-wall canvas behind me (acknowledgements to [the Kalevala Society](#) for giving permission; Image 12). I knew that as soon as the film ended there would be approximately 10 minutes left. Just before nine, the lights would go out above my stage and some lights would light up over the entrance for the audience to leave.

As a whole, everything went pretty much as planned. There were some unpredictable and surprising incidents, though, which had their effect on the music. Also, my own reactions and endurance during the six-hour musical performance in front of an audience were something I couldn't know of beforehand and had to simply be experienced. Regarding that, some extra stress was

caused by an accident which took place a couple of weeks before the event. I slipped on an icy road and broke some ribs, which was painful for some time. As the big wheels of different organizations had been set in motion already, a couple of broken ribs was hardly a reason to cancel everything.

What the audience's feelings and thoughts would be was to some extent a question mark for me as well. The way we experience music depends on so many variables of which some are more personal and subjective, some more general, depending on prevailing circumstances. Individual differences in the human auditory system, diverse cultural backgrounds, prevailing mood and alertness, age, education and previous experiences are, for example, obvious variables affecting the subjective experience. The room acoustics being different in different spots, the extra sounds emerging both from the instruments and people, the lighting affecting the visual experience, and the volume and quality of the sound are examples of varying conditions.

As an important psychological factor, the framing effect is interesting and noteworthy, as it influences not only our prior attitudes but alarmingly our memories as well (see, e.g., Kahneman 2011: 363–374). If your friend invites you to attend an event described as 'a six-hour improvisation event which combines cognitive neuroscience and artistic research with an ancient music tradition', your thoughts and attitude would probably be quite different than if the event were described to you as 'a female folk musician is trying to invent music from her own head for six-hours on old, narrow ambitus instruments'. Naturally, the framing effect concerns not only the audience but also me. The way I would frame the unpredictable incidents would affect both the music I am working on and my memories about it.

The preparation time before the event was not optimal from the point of view of the music. The event was to start at 15:00, and I arrived at the approximately 10 minutes left. Just before nine, the lights would go out above my stage and some lights would light up over the entrance for the audience to leave.



*Image 12. Photo: Jorma Airola.*



As a whole, everything went pretty much as planned. There were some unpredictable and surprising incidents, though, which had their effect on the music. Also, my own reactions and endurance during the six-hour musical performance in front of an audience were something I couldn't know of beforehand and had to simply be experienced. Regarding that, some extra stress was caused by an accident which took place a couple of weeks before the event. I slipped on an icy road and broke some ribs, which was painful for some time. As the big wheels of different organizations had been set in motion already, a couple of broken ribs was hardly a reason to cancel everything.

concert venue about five hours earlier. Setting the EEG cap took quite a while. Being interviewed, doing the soundcheck, and building the lighting took time; lots of people were coming and going, and many things rushed forward at the same time – there was no time to properly quiet down and concentrate (Image 13). Usually the preparation and concentration before performing this kind of music mean deep focusing on the tuning at the same time. Some instruments I use are exact replicas of the museum kanteles; some are more or less modified but still based on the old small kantele models. In most of them, the structure is light, which means that they are sensitive to changes in temperature and humidity. The operation of an air conditioner is poison.

This brings along some special demands for the musician; the instruments must be brought to the concert venue early enough that they will have time to adapt to air conditions and the tuning will not change dramatically during the performance. Most probably, the instruments also need to be tuned

more than once, and in the case of this many instruments, it takes time (82 strings to be tuned to resonate with each other). In addition, some of the replicas are more challenging in their tuning technique and thus the tuning takes more time. In the optimal situation there is enough time and peace for tuning, which at the same time will function to help the musician both concentrate and open up to the world of this music and its sounds. Now, this wasn't quite the case. The tuning was done in a bit of haste.

There are quite a few different possibilities in tuning the small kanteles, and even the general pitch can be varied to some extent. I change the tunings and scales from time to time depending on my mood, priorities and the occasion, as is the tradition. The one thing I never do is to use the equal temperament on the museum kantele replicas. The reasoning is pretty straightforward: the equal temperament hadn't been invented during the earliest centuries the kantele was in use among Finnic people, and it wasn't in use by the Karelian people during the late nineteenth or early twentieth century when the tradition was saved. The advantage of not using the equal temperament is that the instrument has more pure thirds and stronger sympathetic vibration. This is essential in an instrument in which the timbre is based on resonance. The challenge is in deciding what kind of compromises to make when you are not able to change any of the tones' pitches while playing.

For this occasion, I had decided to keep the A4 in 442 Hz (which I wouldn't do now). I had planned to use eight instruments and tune seven of them in three basic groups. The eighth instrument and two from the previous groups would occasionally be combined. This resulted in five groups in total with the following tunings (the names of the instruments are just nicknames used on this occasion to separate the instruments from each other).



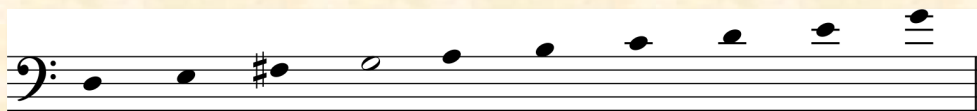
**Image 13.** Students of cognitive science, Jenni Saaristo and Maaria Seppälä from the University of Helsinki, are setting the EEG cap.  
Photo: Jorma Airola.



## Group I: Vaski10 & Korpiselkä

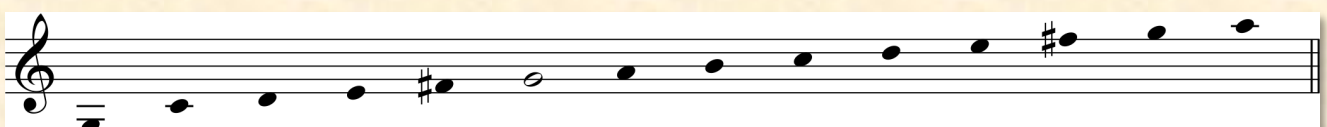
### ① Vaski10

**Image 14.** A 10-string kantele with wooden tuning pegs and bronze strings. Traditional model. Designed and made by Rauno Nieminen in the 1980's. Originally with steel strings but I changed them to explore the timbre. Tuned in G major. The seventh scale degree is not tuned on the high strings which was usual according to the tradition. D3–E3–F#3–G3–A3–B3–C4–D4–E4–G4.



### ② Korpiselkä

**Image 15.** A 14-string kantele with thin steel strings and steel tuning pegs, round end. A replica of a kantele which was bought in 1916 in Korpiselkä for the National Museum of Finland. The model represents the newer version after the hollow kanteles. The replica was made by Rauno Nieminen in 1999. Tuned in G major. G3–C4–D4–E4–F#4–G4–A4–B4–C5–D5–E5–F#5–G5–A5.

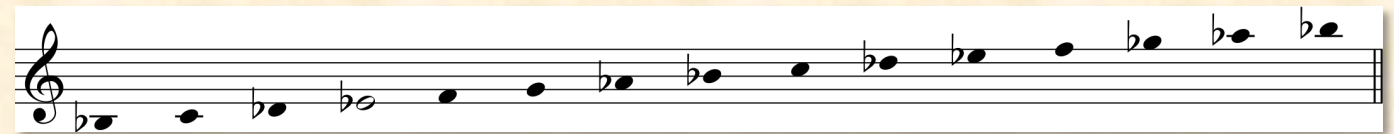




## Group II: Säteri & Shemeikka

### ③ Säteri

**Image 16.** A 15-string kantele with steel strings and steel tuning pegs, round end. A slightly modified version from the previous Korpiselkä kantele. Made by Keijo Säteri 1992. Tuned in Eb Mixolydian; on the higher register Eb Dorian. Bb3–C4–Db4–Eb4–F4–G4–Ab4–Bb4–C5–Db5–Eb5–F5–Gb5–Ab5–Bb5

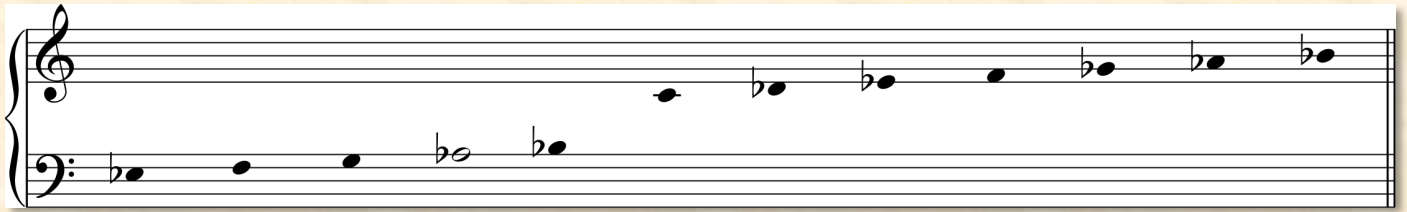


### ④ Shemeikka

**Image 17.** A 12-string hollow kantele with wooden tuning pegs and brass strings. A replica of a kantele which was bought in 1906 for the museum in Perniö, Finland, from the famous runosinger and kantele player Iivana Shemeikka. The model represents the southern type of Finnish hollow kanteles; hollowed out from the top. The replica is made by Rauno Nieminen. Tuned in Ab major on the lower register, accidental Gb4 giving the minor pentachord on the higher register. Eb3–F3–G3–Ab3–Bb3–C4–Db4–Eb4–F4–G4–Ab4–Bb4.



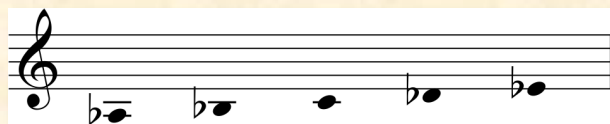




### Group III: Ontrei & Viskoosi & Lovikka

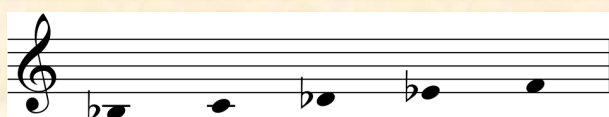
#### ⑤ Ontrei

**Image 18.** A 5-string hollow kantele with wooden tuning pegs and bronze strings. A replica of a kantele which was originally made by the famous runosinger Ontrei Malinen in 1833. The northern model of Finnish hollow kanteles; hollowed out from below. The kantele belongs to the collections of the National Museum of Finland. The replica is made by Rauno Nieminen. Tuned in Ab major. Ab3–Bb3–C4–Db4–Eb4.



#### ⑥ Viskoosi

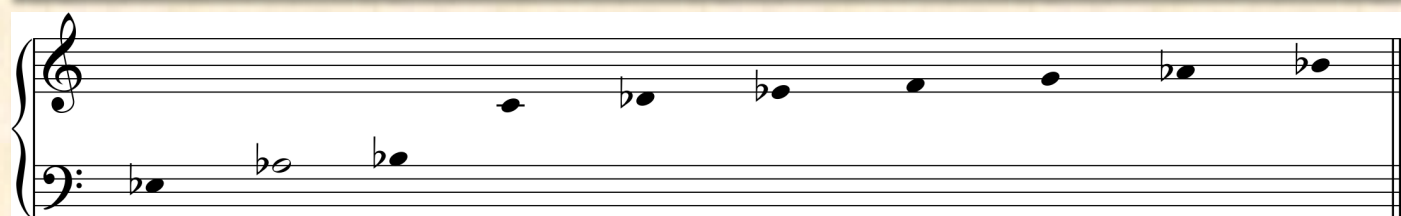
**Image 19.** A 5-string hollow kantele with wooden tuning pegs and viscose strings. The original instrument was made by H. Roponen in 1893 in North Ostrobothnia and is now kept at the Folk Instruments Museum in Kaustinen, Finland. A northern model as well; hollowed out from below. The replica is made by Rauno Nieminen. Here the replica has viscose strings which resemble the sound of horsehair strings but keep their tuning better and thus allow concert usage. Tuned in Bb minor. Bb3–C4–Db4–Eb4–F4.





## ⑦ Lovikka

**Image 20.** A 10-string kantele with steel tuning pegs and a combination of bronze and brass strings. A model designed by Pekka Lovikka, based on traditional models. Originally with steel strings, but I changed them to examine the timbre. Tuned in Ab major. Eb3–Ab3–Bb3–C4–Db4–Eb4–F4–G4–Ab4–Bb4.

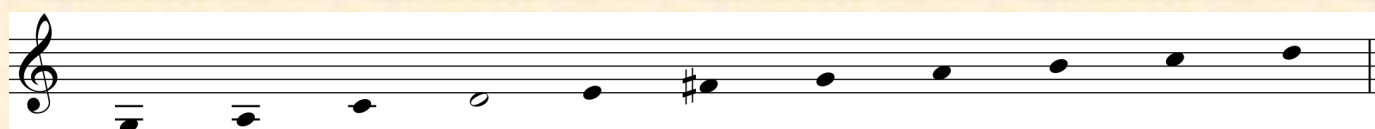


**Group IV:** Ontrei & Vaski10

**Group V:** Kokle & Vaski10

## ⑧ Kokle

**Image 21.** An 11-string Latvian hollow kokle with wooden tuning pegs and steel strings. Kurzeme model, made by Viktors Černoglazovs. Hollowed out from the top. Tuned in D Mixolydian. G3–A3–C4–D4–E4–F#4–G4–A4–B4–C5–D5.





In the following analysis only the first two hours, the EEG measurement period, is addressed in greater detail, although the whole event is transcribed in a time code in the Appendix.

## The first two hours – trying to keep control

In the very beginning, when listening to Mari Tervaniemi talk about the project, and waiting for my turn, I was as far away from the concentrated, peaceful kantele player of her own power as one can be (Image 22). I was panicking – my heart was galloping, and my mind was wondering how on earth I was going to make it through this. Knowing that this severe nervousness would inevitably have a negative influence on my concentration and hence the music didn't help much. I had made some plans for the structure of the first two hours, since I wanted all instruments, diverse timbres and different playing techniques to be part of the EEG measurement. The plan was to start with a three-note lament-like theme played on the 10-string kantele with bronze strings, the Vaski10, and gradually descend from the higher strings to the lower scale.

Wouldn't it have been easier and more honest to start from a clean slate, improvising without prior plans, just listening to the sounds and letting them guide the way? Improvising not only makes musicians free from the shackles of written notes, giving freedom of choice in the space of creativity, but it also brings along a great deal of vulnerability. For that to work out well, there must be confidence both in the situation and in the people around it. In my case the clean slate usually works out best when I am alone, and the music is truly just for me. On the other hand, the ancient scales and themes, the fragments of melodies recorded from people who lived inside the Finnic runosong culture, they are like keys to the forgotten world.

Among the nineteenth-century Karelian people, the hollow kantele held a position of utmost importance and was treated almost like a sacred instrument. In my experience, the old melody fragments have the capability to lead the musician to the paths to find that special atmosphere. The different layers of time seem to become present again. At the same time as the musician can forget the passage of time, (s)he is given the possibility to get the feeling of finding



*Image 22. Mari Tervaniemi explaining the background of the project in the beginning of the event.*

something ancient as a part of her/himself. This is the reason I decided to start with the pre-planned lament-like fragment. I was hoping it would tune my mind into the atmosphere I was looking for.

So, the lights were dimmed, and I started to play, forcing my mind to concentrate on the sounds despite my throbbing heart. The three notes came alive and started building phrases, variations – sentences telling a story. When talking about musical instruments, in this case the small old kanteles that are played with the old plucking technique, the sound always contains so much more than just the played notes. On these instruments, the strings vibrate for a long time – the bronze or brass strings with their lower tuning even longer than the modern steel strings – and thus, in addition to the plucked tone, there will be the lingering sounds of the previously plucked strings ringing at the same time. According to the old plucking technique, the strings are plucked upwards, and almost never stopped. This, together with the tuning system – the first four harmonics of the harmonic series are used for tuning – strengthens the resonance and makes even those strings which haven't been touched resonate along.

Thus, including the frequencies born from the resonating air cavity and the body of the instrument, the resulting sound is always much richer in timbre than the sound each string alone would have



created. In addition, the musician is naturally able to change the timbre according to her/his moods by controlling the plucking technique, the touch. This richness and variability of timbres – which in musical acoustics' terminology means changes in the structure of the harmonic series – subsumes such an enormous amount of information in sounds that even a couple of tones is enough to build a never-ending story. Instead of the wide palette of tones, the listener is drawn inside the depths a single note can produce.

At the beginning, my hands were placed on the scale starting from the second scale degree which resulted in the A Dorian scale. Since the sixth scale degree of the Dorian scale wasn't used, the melody was in practise in natural minor. The very first phrase started from the second scale degree of that scale, B3. I started to build up phrases without a pulse and with different lengths. After varying the theme for one and a half minutes, I started to use the tonic as a drone which brought along the first vertical intervals, the major second and the minor third. After about two and a half minutes, the first tone outside the original theme came along, the low fifth scale degree. Then came the octave to the previous, and finally the fourth scale degree, resulting in the pentachord which so often is associated with the runosong culture.

When I reached the fifth above the tonic (on the Dorian scale), I was faced with the first severely problematic issue of the tuning – the fifth, E4, was out of tune. It seems to be too high, which is a puzzling surprise since usually the fifths may be shorter than pure but never wider. Either the tuning had changed already, or I had made a mistake while tuning in haste. I bet the latter, although the first option is possible as well, since the pitch in the other 10-string kantele, the Lovikka with bronze and brass strings, had notably risen during the first 50 minutes, as explained later. I find it probable that my lack of concentration while tuning resulted in this error. I tried to affect the pitch and minimize the problem with playing technique. Especially in the bronze and brass string kanteles in which the string tension is lower than in the more modern steel string kanteles, the pitch will rise at first as the tension of the string rises in the beginning of the pluck. The stronger the pluck, and the lower the tension, the greater the initial rise. In the Vaski10 the initial rise varies between 10 and 20 cents.

Basically, the human auditory system seems to be quite adaptable, learning to accept different scales and tunings after a while, depending on the context. Most of us have learned to accept the 12-tone equal temperament as the correct scale despite its badly mistuned thirds (see, e.g., Duffin 2008; Campbell–Greated 1987: 176–182) – not to mention all those scales of other cultures which don't use equal temperament, and whose scales may sound alien to our Western ears until we learn to listen to them. Facing the situation, I decided to accept the fifth but at the same time tried to affect it by changing the plucking place on the string and the plucking strength. At times it seemed to help, at least to some extent.

Furthermore, there is a beat in the sound as an elementary part of the sound of the old model small kanteles. The beat is a result of the way the string is attached around the metal bar at the other end. The string goes straight from the metal bar over the soundboard to the tuning pegs, and there is no bridge or extra pin the string would rest upon after its knotted termination. Hence, and because of the quality of the knot, two slightly different vibrating lengths appear on the string, depending on the direction of the string vibration (horizontal or vertical). As the two slightly different frequencies sum up, they create the beat in the sound, the distinctive character belonging to the sound quality of the old small kanteles. (Karjalainen et al. 1993) The beat not only makes the tuning more challenging but also slightly corrects the tuning problems.

After a while, I started to utilize the effect of changing the tonic by changing the position of my hands on the strings. The initial plan was to descend gradually on the scale and, moving both hands one step lower, made the minor pentachord change into major. Together with the adaptation of the auditory system, these actions worked well enough, and after a while the problem with the E4 didn't seem to be such an issue anymore. However, things like this tend to create feelings of uncertainty in front of an audience, and thus they will affect the way I play and what kind of decisions I will make.

There was another disturbing occurrence which should not have been possible and was totally out of my control. After about 11 minutes in, someone opened the side door of the stage with a noise, and then shut it with a slam. There was a doorkeeper at



the door the audience used, but this door was not available for the audience. It must have been a staff member of the university, someone who didn't know of the event. I can remember the feeling of annoyance, puzzled thoughts, and then raising the volume of the music and trying to forget the whole thing.

Memory is a strange thing. It defines the person we are, as Daniel Kahneman writes: 'Memories are all we get to keep from our experience of living, and the only perspective that we can adopt as we think about our lives is therefore that of the remembering self' (Kahneman 2011:381). But the remembering self is untruthful. Memory is selective and not to be seen as the provider of objective facts. I am fully aware that fallacies and biases, like the framing effect, will inevitably affect my thinking and my memories of the event as well. Therefore, I am striving for a more objective view by studying the video and audio recordings and comparing them to the notes I wrote soon after the event. At this point, the incorruptible EEG data would prove priceless, providing there were tools for reliable analysis.

According to the original plan, the lighting was to proceed in 20-minute sequences from dim to brighter, with varying and soft colour reflections on the back-wall canvas, and then back to dim and almost complete darkness. I had thought that the bronze string kantele I started with should cover the first 20-minute sequence and when the lights came back after the darkness, I would start adding the brighter sounds of the steel string kantele. I wrote down a remark sometime after the event: 'I was not able to get the 10-stringer to carry the entire 20-minute period as I had planned, and, therefore, I took the Korpiselkä 14-stringer along already during the 5-minute period of darkness'.

Later I learned that for some technical reasons the lighting technician had had to change the plan and lengthen the period of darkness. So, my internal clock was calculating right; 20 minutes had passed by the time I was ready to take the second instrument along. This is shown on the recorded audio as well, calming down and returning to the initial theme a little over 19 minutes in. Then searching (as I was forcing myself to continue with the 10-stringer despite the desire to move forward), searching, and about 23 minutes from the beginning, the first tones of the Korpiselkä kantele come along. Again, these kinds of things influence how I think about the music and, therefore, affect

the decisions I make during ongoing improvisation.

I made a short transcription of the beginning of the Vaski10 & Korpiselkä combination, starting at 00:23:07 on the video, since it shows some details about processing the rhythm (Image 23). At first, it is not obvious that the pulse is going to be in triple meter. The first tone is barely audible. The right hand is playing the Korpiselkä kantele and is using only one tone in the beginning. Then it starts to make an accompaniment pattern in duple meter; at first in 2/4 although the melody, played by the left hand on the Vaski10, goes in 3/4; then one bar in 5/8 (defined by the melody line on the left hand) and finally the accompaniment becomes established as a repetitive pattern in 6/8. The tempo becomes gradually faster. In my thinking, the left hand on the melody line doesn't slavishly follow the right hand's accompaniment patterns; only the beats of the pulse are relevant. The hands are independent and partly communicating. As the music develops further, the rhythmic variations and some melodic communication between the instruments come along.

After the Vaski10 & Korpiselkä period, the left hand also moves on the Korpiselkä kantele; the solo is essentially based on the old plucking technique. The music is improvised but it is based on those elements that are stored in my memory through years of practise and automatized finger movements: rhythmic and melodic variations in fast tempo, and inside the soundscape, the different registers are highlighted varyingly with dynamic changes. After about six minutes, the left hand moves back on the Vaski10, and a short ending consists of tranquil phrases where the melody is highlighted on the Korpiselkä kantele and the role of the Vaski10 is more like an accompaniment.

The period in the Group II starts at 00:34:29 on the video. At first there are fewer than three minutes of muted sounds on the Säteri kantele. In the muted sounds, only about the first five harmonics will be present (Figure 1; Kastinen 2000: 54–55). In this playing technique, the string is gently stopped by its end either by the knot at the metal bar or by the tuning peg at the same time as the string is plucked. After the muted sounds, the normal plucking technique starts with the combination of the Säteri (the left hand) and the Shemeikka (the right hand) where the hands and instruments are communicating with each other. After only a minute and a half, the left hand moves on the Shemeikka,



## Image 23.

00:23:07

Korpiselkä

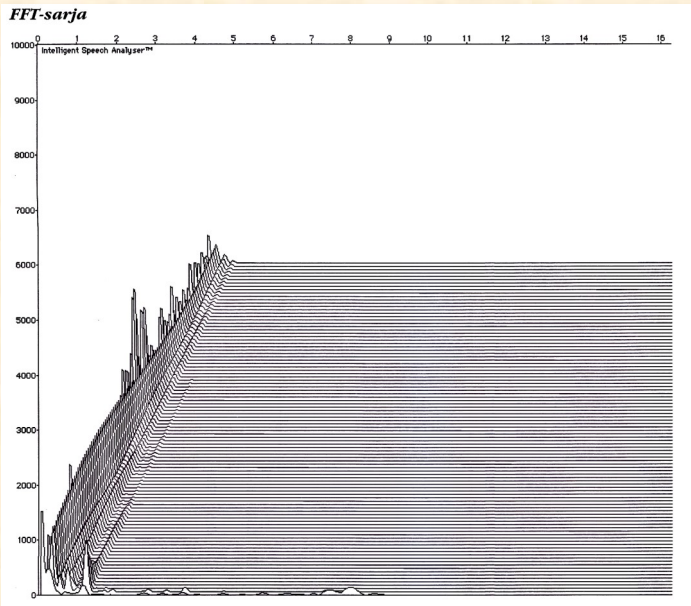
Vaski10

and the solo on it lasts for three minutes and 23 seconds. Then again both instruments are played together for about two and a half minutes, and in the end the Säteri alone for less than three minutes. The

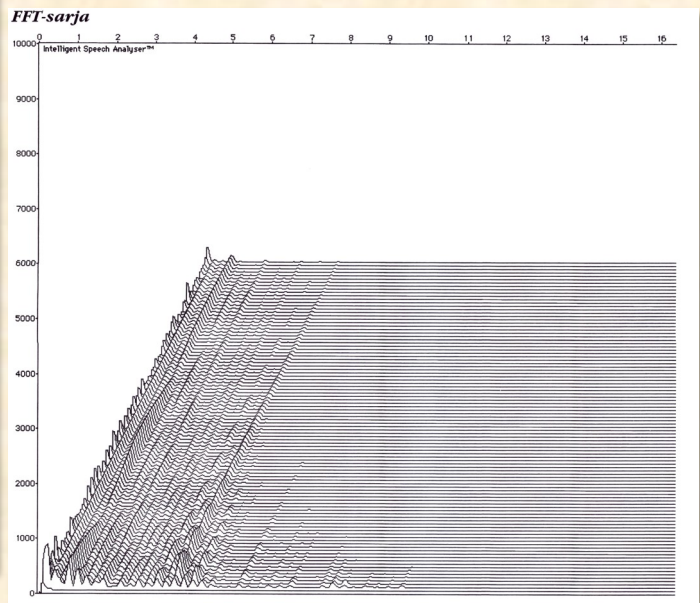
short periods together with a couple of small rhythmic stumbling and touch errors on the vibrating string, reveal some level of nervousness. However, there are interesting moments, for



**Figure 1.** A FFT image of the tone A3 played as a muted sound on the Säteri; only about first five harmonics will emerge. (Kastinen 2000: 55)

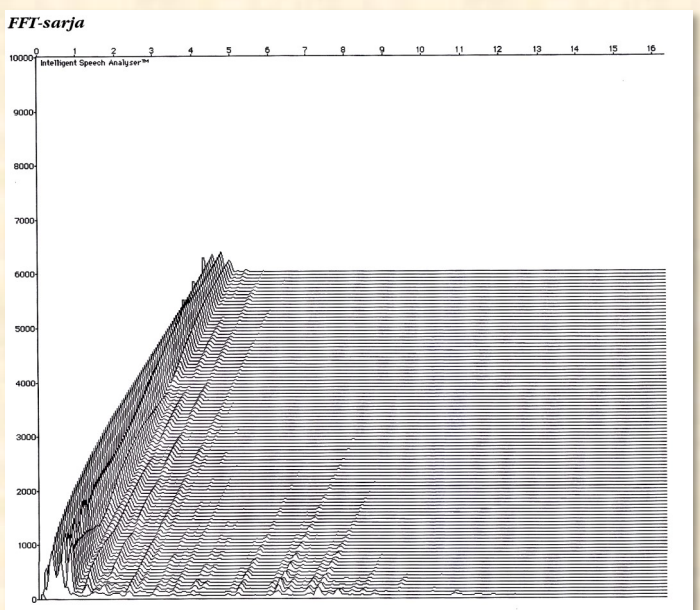


**Figure 2.** A FFT image of the tone A3 plucked close to its knotted termination on the Säteri kantele. The third harmonic is strongest in amplitude. (Kastinen 2000: 36–38)



example, when the distinctively different timbre of the different registers in the Shemeikka emerges as the high strings are highlighted (from 00:40:35 forward), and in the end where the beat in the sound is produced by swinging the instrument against the floor (from 00:43:33 forward).

**Figure 3.** A FFT image of the tone A3 plucked from a quarter of it which is one of (or close to) its natural plucking points. When a string is plucked from the node of a partial that partial and its multiples will not lit at all. (Kastinen 2000: 45)



The period in the Group III starts at 00:47:53. Since I put my hands on the Ontrei at the beginning, it seems that I had thought of starting with it; then, a change of plan – the right hand moves on the Viskoosi and the music starts, and after a moment the left hand comes along as well. At first, I use the traditional plucking technique and after less than a minute move the other hand on the other instrument. There is a theme which is familiar to me, and I am improvising according to it on the Viskoosi & Ontrei and the Ontrei & Lovikka combinations; two vertical fourths alternating in pulse on the Ontrei as an accompaniment and the melody line built on the two other kanteles. I can remember not being satisfied with the Lovikka sound – I wasn't able to find its resonance and build up the melody in the way I had hoped, and thus its part was shortened. After that there is less than a three-minute period when I play the Ontrei and Viskoosi with a bow, and in the end, a little over five and a half minute solo on the Ontrei, which is played with the old plucking technique, melodic and rhythmic variations with ornaments and different interval combinations including the changes in tempo and dynamics.

At 01:04:11 starts the period of the Group IV,

which is used only once and lasts only for one minute and 55 seconds. It combines the Ontrei from the Group III with the Vaski10 from the Group I. The combination was preplanned; to receive a different scale I combined the Ab3 from the Ontrei with the B3, C4, D4, E4 and G4 in the Vaski10. After building up the melodic phrases for less than two minutes, I seem to listen to the silence for a while and then decide to move to the Group II. There is an interesting beat in the sound on the third Ab3–C4, which is repeated four times and the beat



is especially clear on the last time at 01:05:43. On the last time, my hands are moved clearly closer to the ends of the strings.

Changing the plucking point on a string makes changes in the harmonic structure of the tone and thus changes the timbre. In contrast to plucking the string from its middle point or from a quarter of it (Figure 3), for example, when plucking the string close to its end there will be lots of high harmonics present (Figure 2). The previously mentioned beat may result from a slight difference between the frequencies of the high harmonics of the two tones. Furthermore, according to previously conducted acoustic research on the Säteri kantele, it was noticed that the third harmonic (and most of the higher harmonics) had a strong beat in contrast to the first and second harmonics which were stable when plucking the string close to its end (Figure 2). Surprisingly, the third harmonic was also the strongest in amplitude. (Kastinen 2000: 36–38) However, the research results obtained from the Säteri kantele cannot be unreservedly linked to the Vaskil0 or the Ontrei, which are quite different instruments in several respects.

At 01:06:38, the second period starts in the Group II. The episodes are longer this time than in the previous period in this group, which probably indicates a somewhat deeper concentration in the music. At first there is almost a six-minute solo on the Säteri, then almost a five-and-a-half-minute episode on the Säteri and Shemeikka together, and then almost a seven-minute solo on the Shemeikka. This solo proceeds into the ending episode which uses both instruments and lasts about one and a half minutes. The solo on the Säteri consists of different hand positions for the old plucking technique, rhythmic variations and different timbres. The left and right hands are working together to weave a soundscape in which there is communication between different registers. Also, harmonics and muted sounds are added. The elements of this episode are from my long-term memory.

The combination of the Säteri and the Shemeikka starts with subtle exploring. After some minutes, a decision seems to be made and a pulse emerges; the right hand plays mostly in 6/8 on the Shemeikka and the left hand builds up the melody line on the Säteri kantele varying between duple and triple metres. The tempo slows down at the end of the episode. The same happens on the Shemeikka solo: searching at first, then finding a pulse and playing

with the rhythms. There are variations, combinations between 5 and 6 beat bars, changes in tempo and intensity, and communication between different registers. The transition back to the combination of the two instruments happens imperceptibly, and after a short while the tempo slows down, and the end is left open.

After this period, I move back to the Group III and start to play the Lovikka kantele. My goal was to find the timbre I couldn't find the first time. I start on the Lydian scale and the plan was to change the scale later by moving the hand position on the lower strings. Playing felt difficult, and after less than four minutes of searching, a string suddenly broke. Unlike in other bronze and brass string kanteles of mine, the Lovikka kantele has metal tuning pegs, and the higher strings have a tendency to break relative easily compared with the kanteles with wooden tuning pegs. I believe the instrument reacted strongly to the air conditioning and that was the reason the string broke. According to the recording, its tuning had risen about 10–15 cents – the Ontrei and the Viskoosi 5-stringer in the same group, hadn't risen quite as much. Another string broke on the same instrument about three hours later. The sudden, sharp sound was a shock. It really scared me, and I would love to see the EEG curves at that point!

If a string breaks during a performance, one must just try to find a way to continue without it. The challenge is that the breaking of a string will cause a drop in the overall tension, and that means a drop in pitch especially in the strings close to the broken one – the strings will be more or less out of tune. My solution in this situation was to test the tuning with musical phrases, move the broken string aside with one hand, and continue playing on the lower strings which were further away from the broken one. I also tested the combination with the Ontrei kantele to see if it might improve the situation. Nevertheless, I was not satisfied with the outcome, and the Lovikka part ended before it had even started properly.

After the broken string period I change my sitting position to the Group I and start a solo on the Korpiselkä at 01:39:16. I start on the D Mixolydian scale on the high strings, then move the other hand on the lower strings for a while. As nothing interesting emerges, the hand comes back up, and after a while both hands are moved down on the G major scale on which the old plucking technique is



used. I can remember the frustration at some point close to the end of the EEG measurement period – a feeling of disappointment as I have lost my way and can't get back inside. Listening to the music, this episode is probably the phase. After that comes two approximately five-minute episodes on the Vaski10 during which I am searching for a way back inside the music. In both, the old plucking technique is used. The first one contains melodic phrases and rhythmic variation with automatized finger movements in G major. The other one is in triple metre and eventually there emerges a varied, familiar-sounding theme and a chord progression I–VII–VII–I in A Dorian. When the second episode on the Vaski10 is over, I sit quietly for about 20 seconds, concentrating and pulling myself together. This may also be the moment when I am telling myself to stop worrying and to start to enjoy. I move to the Group II and play about a minute and a half on the Säteri with a bow, and then harmonics

and muted sounds for about six minutes. My EEG measurement stops at 02:00:05 on the video, about 20 seconds from the beginning of the harmonics.

During the EEG measurement period there are times when the improvising seems to progress effortlessly, and then there are times I seem to abandon the theme or a musical idea after quite a short while. It seems evident that in those moments I am unable to get inside the music for it to start progressing on its own. This is a typical challenge I face when bringing this music onto a stage, and this has a lot to do with the previously mentioned paradox. The relatively short periods on individual instruments and in each instrument group after the first 33 minutes also reflect nervousness. In addition, there is a clear need to keep control, to be the one who is making the decisions. The show is going on.

## The middle part with losing the sense of time, and the end part controlled by the film

During the first period in the Group V (02:06:22–02:39:13), I start to find the way back inside the music, and within the next period in the Group II (02:39:59–03:14:19) the high-order part of the brain doesn't seem to be in control anymore. Both periods last a little more than half an hour, and the episodes with each instrument inside the groups are longer than before as well. The music contains new elements and feels fresh and concentrated. There are many fewer playing technique errors or stumbles with the rhythm. As before, different playing techniques are used to create different timbres and character; there are rhythmic and melodic variations and changes in tempo and intensity. At times, there is a clear melody line with accompaniment, sometimes independent melodies crossing or elements from different registers communicating. At times, there may be just a sound field. Between 03:00:17–03:08:34 there is a theme, resembling the traditional melodies, which progresses easily on its own, without planning.

At 03:14:49, I start a new period on the Group III, clearly determined to concentrate better on the five string kanteles which had been given less attention earlier due to the problems with the Lovikka kantele in the same group. They are played for a little over 18 minutes: a 10-and-a-half-minute solo on the

Ontrei, a little over two minutes on Viskoosi and then both instruments together for a little less than six minutes. The episode seems to progress effortlessly. After that, I decide to give the Lovikka a try despite its broken string and the changed tuning due to that. At first, I am trying out the tuning with tranquil phrases, and after about two minutes it is played together with the Viskoosi for almost four minutes. I am changing the plucking position on the strings during playing to affect the harmonics and the initial rise in the pitch. The outcome is not completely impossible. There is some noise – presumably someone is leaving – and I wait for a while at 03:37:43. Then I start again with the Lovikka and the Viskoosi with some new vertical intervals, and this time the outcome is impossible. The chosen strings are badly out of tune compared with each other, and after about two minutes I stop.

At this point, feeling cold, I take the shawl on my shoulders, and I move to the Group I and start a solo on the Korpiselkä. The previous events have cut my concentration and it shows in the beginning of this period. The plucking technique after the harmonics is based on elements in my long-term memory, and the tense and nervous rhythm seems to reflect my state of mind. It takes about nine minutes for me to

find the concentration again. There are short periods of combining the Vaski10 with the Korpiselkä and in the end a five-minute solo on the Vaski10. At the end, I sit quietly for a while and gather my thoughts. In total this period in the Group I lasted for 20 minutes and was not a very successful one.

I start a new period on the Group II at 04:02:15 by playing the Shemeikka with the bow and adding the plucked tones above. This was the only time I managed to use the bow during the event to achieve the outcome I wanted. The eight-minute period follows in which the Säteri is combined with the Shemeikka with the plucking technique. This period seems to come effortlessly as well. It seems not to be planned or dictated. Then comes a little over a 10-minute-episode on the Säteri with a beat achieved by swinging the instrument, about a four-minute period of harmonics containing some high ones outside the scale and muted sounds as well, and the old plucking technique. Someone clears his throat at 04:24:41 and it seems to make me stop the harmonics and muted sounds and move into the plucking technique.

While I'm playing the Säteri with the old plucking technique, the film starts at 04:25:14. I can remember being surprised – I hadn't thought the time would be so advanced already. The successful periods after the first two hours made me lose the sense of time. The same thing happened during the film, although it seems that I am following it almost

constantly. After the film stopped, I was convinced that only the first part of it had been shown, and that the lighting engineer had not noticed that there should still be another half. Tiredness may also be part of the reason I didn't realize the second part of the film had started.

During the film, I play a little over a six-minute episode in the Group II, a little less than nine minutes in the Group III, a little over 28 minutes in the Group I, about 25 and a half in the Group II, and after playing the kokle about five minutes in the Group V, the film ends. The short period in the Group III resulted from another break of a string in the Lovikka at 04:39:36. Every now and then I glance the film and seem to adjust the music accordingly, and thus it is the film which is affecting the music during its presence – which doesn't seem to be a bad thing.

After the film had ended, I was puzzled for a while: what should I do? How would I get the information for the technician to continue with the second part of the film? The darkness above my stage came about at 05:43:30 on the video. I continued to play for four minutes, and after stopping I looked at the audience as they stayed quiet and still. Then I looked up at the technicians, but both were bent down at their tables. The light above the entrance door was on, and thus I concluded it must be time to stop. When I entered the backstage room, it was six minutes to nine.

## The other people

As stated earlier, the quiet exaltation excludes contact with other people present from the player's mind. I have found this aim almost impossible to achieve in a concert situation – or in any other situation at all. As soon as a person enters a space, it will be affected, and it seems unfeasible for me to ignore it. Thus, I find it impossible to bring the quiet exaltation in its original meaning on the stage. Performing old tradition improvisation in front of other people is always some kind of show for me, and it differs substantially from the situation when I am truly alone with my instruments.

Nevertheless, during the six-hour event there were episodes when I was able to immerse myself inside the music and the presence of other people wasn't overly distracting or affecting the musical outcome.

In addition, there are clear moments when the external sounds affect my decisions during the improvisation. For example, at 02:14:10, 03:27:50 and 03:37:30 on the video, the chair bumps and subsequent footsteps result in a pause in the music. At 04:14:18 registering the sound of the chair pulls me away from my own thoughts and results in a change on the musical continuum. At 04:24:41 someone clears his throat and that makes me stop, perhaps unconsciously, the period of harmonics and muted sounds. At the early stage of the EEG measurement, starting at 00:12:11 on the video, the opening and closing of the side door of the stage annoyed me, because it felt deliberate or like an act of aloofness. As a result, I raised the volume of the music.



Perhaps one of the most fundamental differences between the performances of the old tradition kantele improvisation and most of the current musical genres is the attitude towards communal experience. In my opinion, in quiet exaltation each individual reflects the music against her/his personal life history, past events, thoughts, all that identity is constructed from. The experience is deeply personal and thus indivisible. This concerns both the musician and the listeners. Instead of being shared, the experience is more like a private journey inside oneself. This was also reflected in the audience feedback.

I received 19 written pieces of feedback, of which 14 were from women and 5 from men. Most (13) were over 50 years old, five were between 27 and 33 and one didn't note her age. Seven were present over two hours but less than three, five were present from one and a half to one and three-quarters of an hour, five for about an hour, one for 45 minutes and one for five minutes. Almost everyone commented on experiencing the music as relaxing and restful. Some mentioned experiencing visual images of nature and personal memories. Some had felt sleepy, perhaps even fallen into a light sleep, and afterwards feeling refreshed. Some mentioned calmness and timelessness, one used the words hypnotic and a trance-like state. Those who may have experienced negative feelings didn't give any feedback.

All feedback is in the Appendix 4 but only in Finnish. As an example, two of them will be translated here. The first is from a 68-year-old woman (No. 17) who attended the event in two periods: from 15:30 to 17:20 and 18:00 to 18:45. She wrote:

*'Palasin lapsuuteni niitylle siskon kanssa tanssimaan kukkaseppele hiuksissa. Maailma on tässä. Ei ole mitään huolia. Kaikki on selvää ja täydellistä.'*

*['I returned to the meadow of my childhood with my sister, to dance with a flower wreath in the hair. This is where the world is. There are no worries. It is all clear and perfect.']*

Another one is extremely touching, coming from a 58-year-old woman (No. 11) who was present from 17:00 to 19:10. This feedback alone made the event worth organizing:

*'Tullessani olin ahdistunut ja mieli oli sekava. Töissä on meneillään yt:t ja kaksi työtoveriani irtisanottiin. Itse olen odottanut koko päivän puhelinsoittoa – jota ei vielä tullut. Tulin surullisena ja lukossa. Soiton aikana mieli keveni, rautapanta keuhkojen ympärillä suli. Soitto toi mielikuvia, se oli kuin nousevia pisaroita se oli kulunut puu, jossa jo syyt näkyivät, se oli ilmaa ja keveyttä. Lävitseni kulki tuttuus kuin sukupolvet olisivat tervehtineet minua. Ajantaju katosi. Nämä kaksi tuntia sulautuivat ajattomuudeksi jossa saatoin leijua. Kevenin ja hengitys alkoi kulkea. Soitto kohtasi jotakin minussa, sähköä, aivoja kutitti iloiset soinnut. Olin kuin "kirkossa" jossa on läsnä epätila joka ei muistuta mitään aiemman kokemaani. Irtoisin hyvällä tavalla murheesta. poistuinkin keveämmällä mielellä. Kiitos.'*

*['When I came in, I was anxious and my mind was confused. There are co-determination negotiations going on at work and two of my co-workers were laid off. Personally, I've been waiting all day for a phone call — which hasn't come yet. I came in sad and locked. During the playing, the mind lightened, the iron band around the lungs melted. The music brought evocative images, it was like rising drops, it was a worn tree where the wood fibre was already visible, it was air and lightness. Familiarity passed through me as if generations had greeted me. The sense of time disappeared. These two hours merged into timelessness where I was able to float. I became lighter and breathing began to flow. The music met something in me, electricity, my brain being tickled by joyful chords. I was like 'in a church' where an un-space that bears no resemblance to anything I've experienced before is present. I detached from the grief in a good way. I left with a lighter mind. Thank you.'](Engl. transl. by the author)*

## Conclusions and Discussion

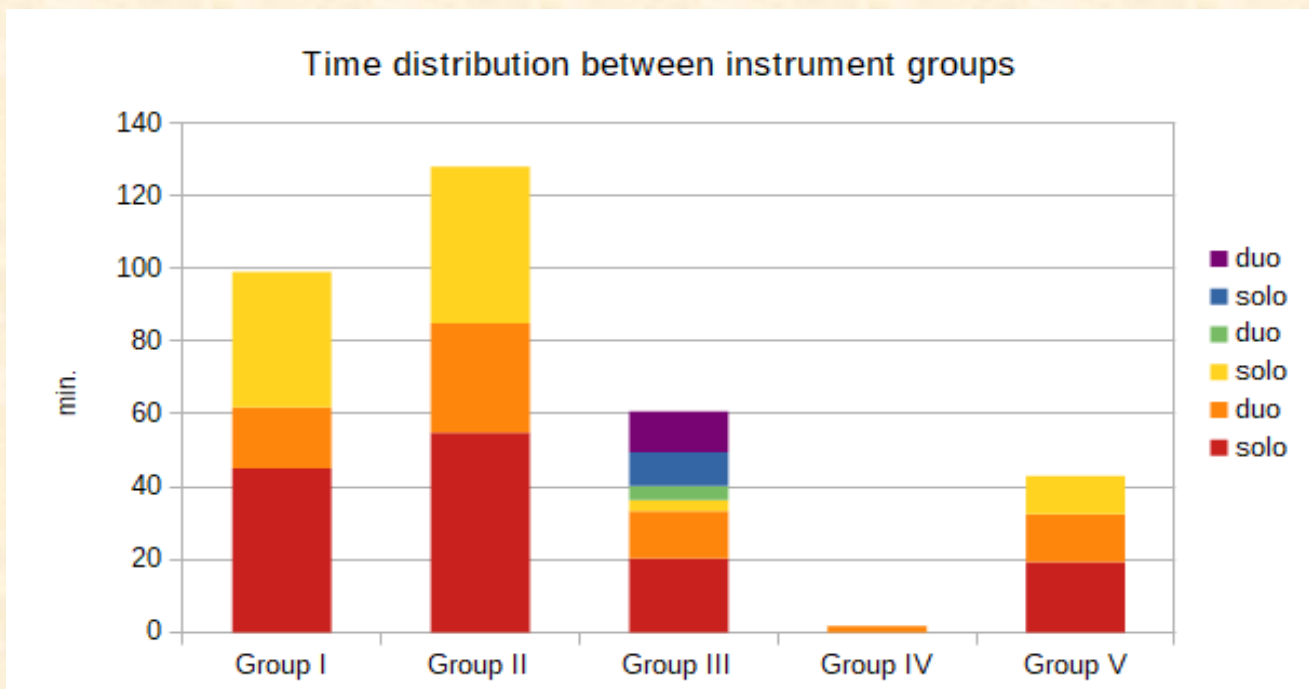
Organizing the six-hour event was one of the most challenging tasks I have faced during decades of studying the ancient kantele improvisation tradition. As part of the old runosong culture where Karelian people were mainly illiterate, still earning their living by hunting, fishing and slash-and-burn cultivation during the nineteenth century, the ancient kantele tradition could be seen as an intriguing phenomenon lost forever. However, the recorded details give us the possibility to find at least some portion of the musical tradition behind the decades and centuries. My intention is not to present myself as a continuator of tradition. I see myself more like an explorer trying to delve into her roots. In this light, the six-hour event is a study of modern improvisation which aims to reach the aesthetics of the ancient tradition.

Roughly defined, the music of the event can be separated into three parts: the first part including the EEG measurement; the middle part when I managed to immerse myself in timeless, introverted improvisation; and the third part where the music was more or less influenced by the silent film.

There were eight instruments involved, and they were used in five different groups. Calculating the time used in each group and instrument gives the following statistics (Figures 4, 5 and 6). Between the groups the order from the most used to the less used is: Group II (Säteri & Shemeikka) 02:08:09 – Group I (Vaski10 & Korpiselkä) 01:39:05 – Group III (Ontrei & Viskoosi & Lovikka) 01:00:45 – Group V (Vaski10 & Kokle) 00:43:01 – Group IV (Vaski10 & Ontrei) 00:01:55.

Between the instruments, the order from the most used to the least used is: Vaski10 01:27:27 – Säteri 01:25:00 – Shemeikka 01:13:10 – Korpiselkä 00:54:04 – Ontrei 00:46:27 – Kokle 00:32:32 – Lovikka 00:24:21 – Viskoosi 00:19:57. Solos as well as duos have been included in the participation rate of each instrument. In Figure 5 these statistics are shown as a pie chart where the instruments belonging in the same group are beside each other (excluding Group IV), and in Figure 6 as a bar chart where they are in order from the most used to the least used.

**Figure 4.**



That the Säteri kantele is among the most used instruments is not a surprise because it has been one of my favourite instruments ever since I received it, but the Vaski10 being the most used and the Shemeikka the third most, that is somewhat

surprising to me. I have had lots of problems in finding usable bronze or brass string material for the Shemeikka in order to receive the resonance and sound quality well enough. Here the combination with the Säteri worked well, and that resulted in



Figure 5.

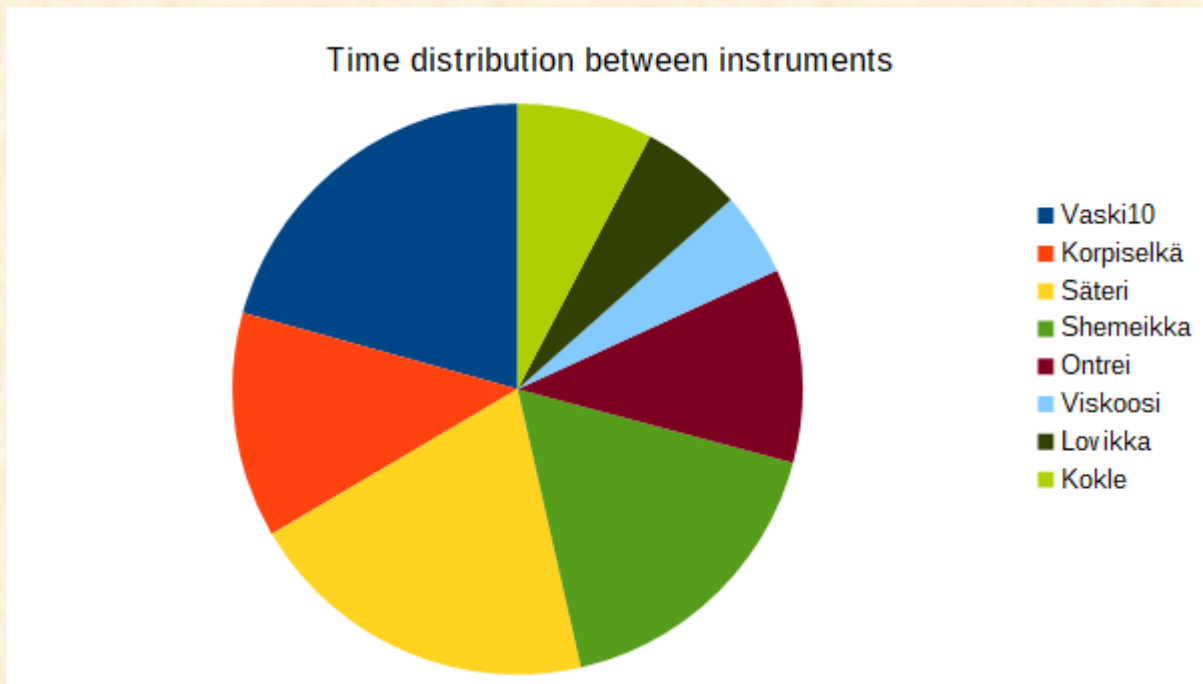
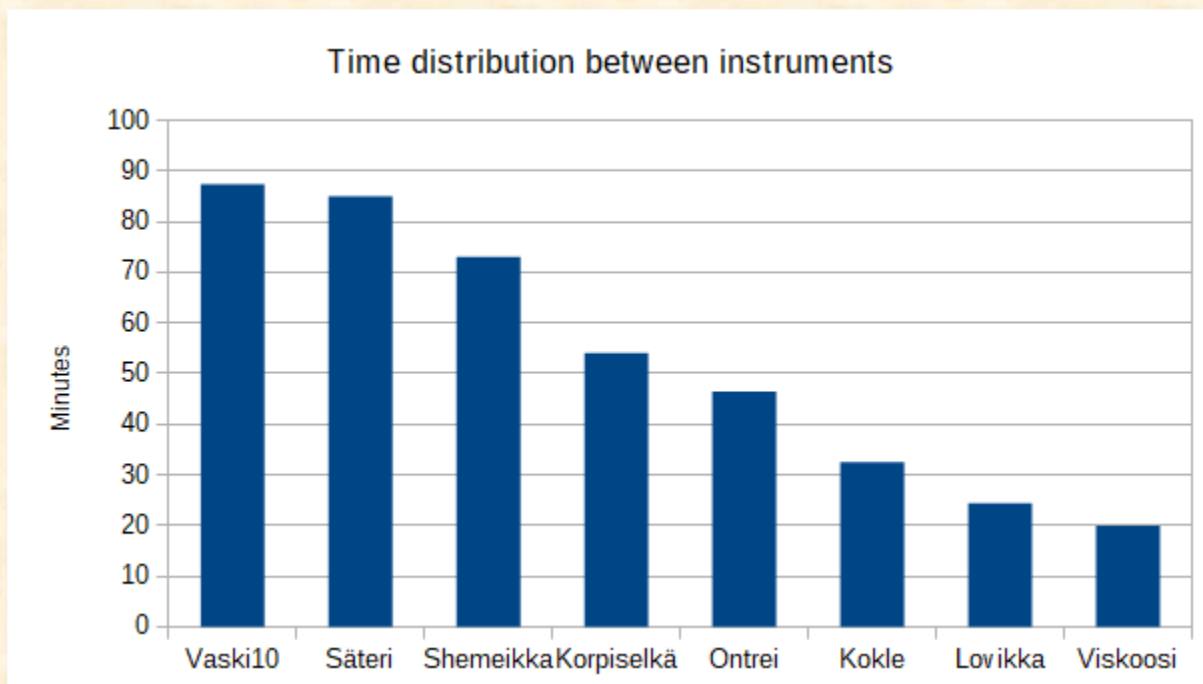


Figure 6.



their being the group I spent most time with. The Vaski10 being the most used is due to its participation in several groups. I couldn't make the Korpiselkä kantele work out in the way I had expected, and the breakage of strings in Lovikka naturally caused the diminution of its role. Ontrei has been my favourite five-string kantele and thus its biggest role in Group III was to be expected.

As for the music, it can be said that the problem with not being able to ignore the environment – the audience and the EEG measurement – was strongly

present during the first two hours, and my search for the quiet exaltation, or the mood of playing one's own power, was effectively escaping the conditions where it was supposed to be measured. I was performing a task, and a clear need can be seen for trying to be the one who is in control of the musical outcome – improvising according to a plan. This resulted in frustration by the end of the EEG measurement period, and only after that do there appear to be episodes when I was able to let go of control.

During the whole event, there were several external stimuli affecting the music and my decisions. The problems with the tuning induced me to change the direction, character or length of the current episode or make changes in the playing technique. Obviously, the sudden breakage of the string caused a total turnaround in the ongoing episode and affected both the future music in Group III and my attitude towards it. The feelings of uncertainty or excitement affected the playing technique which in turn caused errors in the touch, rhythm processing and quality of the sound. As a result, the concentration on the music itself during those moments was deficient, which prevented the free creativity from emerging. Sometimes the sounds of the audience caused me to make changes in the music consciously or unconsciously.

The little over an hour period in Groups V and II from 02:06:22 to 03:08:34 on the video perhaps represents the closest possible state of mind to quiet exaltation that I was able to achieve. The period includes both the old plucking technique and phases with clear separation between the melody and the accompaniment. Compared with the technique where the one hand is playing the melody and the other is taking care of the accompaniment, the old plucking technique has a significant effect on the nature of the music. The effect isn't good or bad, better or worse, but rather in the sense of the structure of the music and the aesthetics. With the old plucking technique, the music shifts away from thinking of harmony or chords towards a stream of endless melodic and rhythmic variations, timbres, sounds, intervals, harmonics – towards, or perhaps back to, a different layer of musical time.

It would be intriguing to know whether that might be shown in brain activity. In addition, as a right-handed person, I would be curious to know whether the use of the old plucking technique would show special activity on either of the cerebral hemisphere when both hands are working together interleaved, and the fingers of both hands alternate on the scale – a technique not found in very many musical instruments in the world. As I see it, both hands are equal, as important, and they build up the soundscape working as one – like an octopus (little fingers are not in use). Sometimes the fingers of the left hand can take the lead, at times right, but all the time their work is interwoven.

There are brain research results suggesting that among right-handed musicians who begun training at a young age, the asymmetry between right and left hemispheres is less than among nonmusicians, and that musicians in general have an increased communication between the right and left frontal lobes. According to one study, among string players the right hemisphere's sensory cortex is relatively enlarged in the region that represents the fingers of the left hand, suggesting that specialized use of them affects the development of certain areas of the brain. (Falk 2000: 206–207) In addition, different areas in the right and left hemispheres react in different ways, whether the activity is connected to listening, playing or reading music; playing and reading the score at the same time; listening to music and reading the score at the same time; playing a memorized piece of music; improvising; singing with words or without; addressing harmony, melody, rhythm or timbre; bringing forth various physical movements by various parts of the body; or producing different emotions; or whether the action is carried out by musicians or nonmusicians, etc. (Brown et al. 2006; Brust 2003; Falk 2000: 201–209; Sergent et al. 1992; Morley 2013: 180–181.) And, as Brust (2003) notes, the psychological whole of the musical experience is something much more than the sum of separate transactions and individual processes in different parts of the brain.

It is difficult to make any direct hypothesis from the previous results in relation to the old plucking technique since the technique doesn't incorporate specialized tasks for either of the hands. However, the difference between producing either improvised or composed music is relevant here. According to Limb and Brown (2008), their research results from jazz-musicians suggests that those regions of the lateral prefrontal cortex which are thought to be connected with conscious self-monitoring and focused attention are deactivated during improvisation, in contrast to during the playing of a memorized song. In the absence of conscious control, spontaneous, unplanned associations, sudden insights, and random, unfiltered or unconscious thoughts and sensations are allowed to emerge. Their study also suggests a possible connection between the altered state of mind during musical improvisation and the physiological change responsible for altered states of consciousness such as hypnosis, meditation or daydreaming – even REM sleep. (Limb & Brown 2008.)



Similar results were reported by Liu et al. (2012) in their fMRI study of freestyle rap. Their study suggests that the significant increases in the activity of the medial prefrontal cortex (MPFC) and decreases in the dorsolateral prefrontal cortex (DLPFC) reflect a state where conscious volitional control is absent and internally motivated, stimulus-independent behaviours are enabled. The deliberate, top-down attentional processes may be attenuated during improvisation, and this state of defocused attention enables the generation of novel, unexpected associations. Interestingly, they also point out that the previously mentioned experience of not being the one who is actually creating the music while improvising, might be connected to the decreased activity of DLPFC and the increased activity of the MPFC.

There are also studies with opposite results. For example, Bengtsson et al. (2007) reported activity in several prefrontal regions, including the DLPFC, during the improvisation, and they suggest that one central role of the DLPFC is to supervise the action: 'to maintain and execute an overall plan for the improvisation through top-down influences on the activity'. The discrepant results between different studies are possibly caused by differences in the methods (Beaty 2015). For example, Bengtsson et al. (2007) studied professional concert pianists who were expected to memorize the improvisations they made, whereas Limb & Brown (2008) studied professional jazz-musicians who were asked to memorize an original jazz composition and in contrast improvise freely on the chord structure of the composition. The study by Liu et al. (2012) resembled the latter in the way that the participants were asked to improvise freestyle rap on an 8-bar musical background and then perform a well-rehearsed set of lyrics on the same background.

These conflicting results are interesting since to some extent they seem to reflect the differences I find relevant between the concepts of flow and quiet exaltation: the differences between ways of improvising when the focus, the goal and the way the improvisation is constructed change. According to Mihály Csíkszentmihályi – the creator of the concept of flow and one of the authors in the study by Bengtsson et al. (2007) – in flow 'there are clear goals every step of the way' and 'there is immediate feedback to one's actions' (Csíkszentmihályi 2008: P.S. 10). This would require selective attention, planning, monitoring in working memory and

auditory-motor integration – the elements activating the DLPFC and controlling the creative process as Bengtsson et al. (2007) stated. I suggest that in quiet exaltation cognitive control is decreased, the down-top oriented process allows spontaneous thoughts to emerge, and the sub-conscious is given more influence.

Playing one's own power contains improvisation that can be constructed in several ways depending on the situation; it can be introverted like the quiet exaltation, it can be externally stimulated like in the previous story of Iivana Shemeikka, or it can be internally motivated but directed to other people. In the runosong tradition, the metric rules and codifying the information inside the patterns and formulas of the runosong serve as tools for remembering and preserving information inside an oral culture. I have come to the conclusion that respectively the old plucking technique serves as a tool for preserving the important musical elements in the long-term memory. As the playing technique becomes automatized, and there is no longer a need to think about your fingers, about what to play and how, the route into the subconscious becomes available.

While the first two hours of the six-hour event were a more or less controlled improvisation based mainly on elements preserved in my long-term memory, and the middle part contained the episodes of my presumably altered state of mind with unconscious elements and losing the sense of time, the third part with the silent film could be described as an externally stimulated improvisation. Now and then I seem to glance at the film to customize the music accordingly and then continue to play – often eyes closed (Image 24). Thus, in addition to the external stimuli, the music during the film also contains the phases of uncontrolled free improvisation.

Interestingly, sight didn't seem to play a significant role in the process of playing the kantele among the traditional players. The loss of sight only seems to have strengthened the importance of music, and those musicians who were not blind didn't follow the strings of the instrument or the fingers, but they were 'staring into the distance' (Tenhunen 2013: 53–55; Warttinen 1923: 111, 126). Even in some old runosongs collected from Ingria and the Karelian Isthmus the only one who is able to make the kantele music alive is the blind musician (see, e.g., SKVR IV:2, 2020, 2021; V:1, 127, 129, 141, 158;



XIII:1, 307, 312, 314, 338). In my own experience *Image 24.*

playing with closed eyes helps one concentrate, and the focus of processing the music changes. Thus, diminishing the role of sight could be seen as a factor in helping the mind give up control, to move outside of conscious awareness.

Another, obvious factor is the ability to relax: a silent environment, an easy playing position, and no need to think about the actual technical process of playing, are essential. A calm atmosphere, with no contacts with other people, is also needed to be able to become introverted when playing. The old plucking technique – automatized finger movements stored in the long-term memory through years of practice – can play a part both in consciously invented and unconsciously born music; I can concentrate in creating new music by using the technique or I can let the thoughts float freely and allow the automatized finger movements produce the outcome. Sometimes the latter option brings out solutions the conscious self-monitoring mind wouldn't have been able to create.

According to the old texts, the kantele instrument held the utmost important position in the runosong culture; its mythical birth and the power its music had on all creation were central topics inside the



tradition (Kuusi et al. 1977: 46–49; Laitinen 2010: 77–99; Siikala 1994: 15–38). Many of the known runosingers of the nineteenth century were also known as skilful kantele players and they treated their instrument with great seriousness. Thus, the importance of the music can be seen as something much deeper than the function of the dance tunes collected in the early twentieth century. To the musician of our time, improvising one's own power can mean pursuing peace of mind, awakening creativity, questing to understand ancient music culture or searching for a connection with one's own roots.

*Image 25.* Kantele player Jaakko Kulju (1836–1920). Photographed by A. O. Väisänen in Suojärvi (Border Karelia) in 1917. Photo: [The Finnish Heritage Agency](#) (CC BY 4.0).





## References

- Acerbi, Giuseppe (1983) *Matka halki Suomen v. 1799*. Suom. Hannes Korpi-Anttila. 2. painos. Helsinki: WSOY, 83—84.
- Alves Da Mota, Patricia & Fernandes, Henrique M. & Stark, Eloise & Cabral, Joana & Heggli, Ole Adrian & Sousa, Nuno & Kringelbach, Morten L. & Vuust, Peter (2020) "The dynamics of the improvising brain: a study of musical creativity using jazz improvisation". <https://www.biorxiv.org/content/10.1101/2020.01.29.924415v1> (read Dec 26, 2020)
- Beaty, Roger E (2015) "The neuroscience of musical improvisation". *Neuroscience & Biobehavioral Reviews*, 51, 108–117. <http://dx.doi.org/10.1016/j.neubiorev.2015.01.004> (read Dec 26, 2020)
- Bengtsson, Sara L. & Csikszentmihalyi, Mihály & Ullén, Fredrik (2007) "Cortical regions involved in the generation of musical structures during improvisation in pianists". *Journal of Cognitive Neuroscience*, Volume 19, Issue 5, May 2007, 830–842. [Journal of Cognitive Neuroscience](#) (read Dec 26, 2020)
- Brown, Steven & Martinez, Michael J. & Parsons, Lawrence M. (2006) "Music and language side by side in the brain: a PET study of the generation of melodies and sentences". *European Journal of Neuroscience* 23, 2791–2803. <https://doi.org/10.1111/j.1460-9568.2006.04785.x> (read Dec 26, 2020)
- Brust, John C. M. (2003) "Music and the Neurologist: A Historical Perspective". *The Cognitive Neuroscience of Music*. Ed. By Isabelle Peretz and Robert J. Zatorre. Oxford: Oxford University Press, 181–191.
- Campbell, Murray & Greated, Clive (1987) *The Musician's Guide to Acoustics*. New York: Schirmer Books, 176–182.
- Csikszentmihályi, Mihály 2008 [1990] *Flow: The Psychology of Optimal Experience*. New York: Harper Perennial.
- Donnay, Gabriel F. & Rankin, Summer K. & Lopez-Gonzalez, Monica & Jiradejvong, Patpong & Limb, Charles J. (2014) "Neural Substrates of Interactive Musical Improvisation: An fMRI Study of 'Trading Fours' in Jazz". <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0088665> (read Dec 26, 2020)
- Duffin, Ross W. (2007) *How Equal Temperament Ruined Harmony (and Why You Should Care)*. New York / London: W. W. Norton & Company.
- Falk, Dean (2000) "Hominid Brain Evolution and the Origins of Music". *The Origins of Music*. Ed. by Nils L. Wallin, Björn Merker, Steven Brown. United States of America: The MIT Press, 197–216.
- Forsström, O. A. (1894) *Kuvia Raja-Karjalasta*. Helsinki: Suomalaisen Kirjallisuuden Seura, 150.
- Ganander, Christfrid (1786) *Runo=Kirja*. Wasa: Georg Wilhelm Londicerildå, esipuhe. <https://digi.kansalliskirjasto.fi/teos/binding/1985278?term=Ganander&page=5> (read Dec 26, 2020)
- Ganander, Christfrid (1984 [1789]) *Mythologia Fennica*. 4. painos. Helsinki: Suomalaisen Kirjallisuuden Seura, 102—105.
- Gottlund, Carl Axel (1831) *Otawa eli suomalaisia huvituksia. I osa*. Nuottiliite. Tukholma: C. A. Gottlund. <https://digi.kansalliskirjasto.fi/teos/binding/1907995?page=702> (read Dec 26, 2020)
- Härkönen, Iivo (1926) *Runolaularia*. Helsinki: Kustannusosakeyhtiö Otava, 29, 46.
- Kahneman, Daniel (2012) *Thinking, Fast and Slow*. UK: Penguin Books.

Karjalainen, Matti & Backman, Juha & Pölkki, Jyrki (1993) "Analysis, Modeling, and Real-time Sound Synthesis of the Kantele, A Traditional Finnish String Instrument". *Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP'93)*, vol. 2. Minneapolis, Minnesota, USA, 229-232.

Kastinen, Arja (2000) *Erään 15-kielisen kanteleen akustisesta tutkimuksesta*. Sibeliuss-Akatemian kansanmusiikin osaston julkaisuja 5. Taiteelliseen musiikin tohtorin tutkintoon kuuluva tutkielma. Helsinki: Sibelius-Akatemia.

Kastinen, Arja (2009) *Taivas auki. Itäisen Suomen ja Karjalan kanteleista 1800-luvun käsikirjoituksissa*. Pöytyä: Temps Oy.

Kastinen, Arja & Nieminen, Rauno & Tenhunen, Anna-Liisa (2013) *Kizavirzi karjalaisesta kanteleperinteestä 1900-luvun alussa*. Pöytyä: Temps Oy.

Kuusi, Matti & Bosley, Keith & Branch, Michael (1977) *Finnish Folk Poetry. Epic*. Helsinki: Finnish Literature Society (SKS), 46–49.

Laitinen, Heikki (2010) "Väinämöisesä ja kanteleesta". \_Kantele\_. Toim. Risto Blomster. Helsinki: Suomalaisen Kirjallisuuden Seura, 23–74.

Laitinen, Heikki (2010) "Runolaularien kantele". *Kantele*. Toim. Risto Blomster. Helsinki: Suomalaisen Kirjallisuuden Seura, 77–99.

Latvala, Antti & Silventoinen, Karri (2017) "Geenit ja kasvu ympäristö psykologisten piirteiden taustalla". *Kiehtovat geenit. Mihin geenitietoa käytetään?* Maarit Jokela & Mirkka Oja-Leikas & Meri Rova (toim.). Helsinki: Duodecim, 143–148.

Limb, Charles J. & Braun, Allen R. (2008) "Neural Substrates of Spontaneous Musical Performance: An fMRI Study of Jazz Improvisation". <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2244806/> (read Dec 26, 2020)

Liu, Siyuan & Chow, Ho Ming & Xu, Yisheng & Erkkinen, Michael G. & Swett, Katherine E. & Eagle, Michael W. & Rizik-Baer, Daniel A & Braun, Allen R. (2012) "Neural Correlates of Lyrical Improvisation: An fMRI Study of Freestyle Rap". <https://www.nature.com/articles/srep00834> (read Dec 26, 2020)

Malviniemi, Rauno (1996) *Iro-neidon pojat. Vornasten suvun runonlaulariat ja kanteleensoittajat*. Helsinki: Vornasen sukuseura, 43–48.

Malviniemi, Rauno (1997) *Tapion tuvilla. Shemeikkain runonlaulariat ja kanteleensoittajat*. Kuopio: Shemeikka Sukuseura, 26, 61–69.

McPherson, Malinda & Limb, Charles J. (2013) "Difficulties in the neuroscience of creativity: jazz improvisation and the scientific method". [https://www.academia.edu/20441231/Difficulties\\_in\\_the\\_neuroscience\\_of\\_creativity\\_jazz\\_improvisation\\_and\\_the\\_scientific\\_method](https://www.academia.edu/20441231/Difficulties_in_the_neuroscience_of_creativity_jazz_improvisation_and_the_scientific_method) (read Dec 26, 2020)

McPherson, Malinda J. & Lopez-Gonzalez, Monica & Rankin, Summer K. & Limb, Charles J. (2014) "The Role of Emotion in Musical Improvisation: An Analysis of Structural Features". <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0105144> (read Dec 26, 2020)

McPherson, Malinda J. & Barrett, Frederick S. & Lopez-Gonzalez, Monica & Jiradejvong, Patpong & Limb, Charles J. (2016) "Emotional Intent Modulates The Neural Substrates Of Creativity: An fMRI Study of Emotionally Targeted Improvisation in Jazz Musicians". <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4698722/> (read Dec 26, 2020)

Morley, Iain (2013) *The Prehistory of Music. Human Evolution, Archaeology, and the Origins of*



*Musicality*. Oxford: University Press, 180–181.

Pinho, Ana Luísa & de Manzano, Örjan & Fransson, Peter & Eriksson, Helene & Ullén, Fredrik (2014) "Connecting to Create: Expertise in Musical Improvisation Is Associated with Increased Functional Connectivity between Premotor and Prefrontal Areas". *Journal of Neuroscience* 30 April 2014, 34 (18) 6156-6163. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4004805/> (read Dec 26, 2020)

Porthan, Henrik Gabriel (1983 [1766–68]) *Suomalaisesta runoudesta*. Kääntänyt ja johdannon kirjoittanut Iiro Kajanto. Suomalaisen Kirjallisuuden Seuran toimituksia 389. Helsinki: Suomalaisen Kirjallisuuden Seura, 82–83.

Raja-Karjala 15.7.1911. "Laulun, runon ja soiton synty ja kehitys Raja-Karjalassa". <https://digi.kansalliskirjasto.fi/sanomalehti/binding/1283064?page=1> (read Dec 26, 2020)

Relander, O. (1917) *O. A. Hainari. Muistelmia*. Kansanvalistusseuran toimituksia 175. Helsinki: Kansanvalistusseura, 19–20.

Rollins, Sonny (2014) "You Can't Think And Play At The Same Time". NPR music interviews, May 3, 2014. <https://www.npr.org/2014/05/03/309047616/sonny-rollins-you-cant-think-and-play-at-the-same-time?t=1601806071498>. (read Dec 26, 2020)

Saad, Gad & Sejean, Richard & Greengross, Gil & Cherkas, Lynn (2019) "Are identical twins more similar in their decision making styles than their fraternal counterparts?" *Journal of Business Research*, April 18, 2019. <https://www.sciencedirect.com/science/article/abs/pii/S0148296319302322> (read Dec 26, 2020)

Sergent, J & Zuck, E & Terriah, S & MacDonald, B (199) "Distributed neural network underlying musical sight-reading and keyboard performance". *Science* 257: 106–109.

Siikala, Anna-Leena (1994) "Transformations of the Kalevala Epic". *Songs Beyond The Kalevala. Transformations of Oral Poetry*. Anna-Leena Siikala & Sinikka Vakimo (Ed.) Studia Fennica Folkloristica 2. Helsinki: SKS, 15–38.

Siikala, Anna-Leena (2002) *Mythic Images and Shamanism. A Perspective on Kalevala Poetry*. Helsinki: Academia Scientiarum Fennica, 242–280.

Siikala, Anna-Leena (2014) *Itämerensuomalaisten mytologia*. Suomalaisen Kirjallisuuden Seuran Toimituksia 1388 / Tiede. Helsinki: SKS.

Sjöström, Juhani (1896) *Korpien povessa. Kuvauksia itäisestä Karjalasta*. Helsinki: Kustannusosakeyhtiö Otava, 25.

SKVR IV:2, 2018, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028; V:1, 127, 129, 141, 142, 152, 158, 1344; XIII:1, 307, 312, 314, 317, 322, 325, 326, 327, 328, 330, 336, 338. [skvr.fi](http://skvr.fi)

Tenhunen, Anna-Liisa (2013) "Henkilökuvat". *Kizavirzi karjalaisesta kanteleperinteestä 1900-luvun alussa*. Arja Kastinen & Rauno Nieminen & Anna-Liisa Tenhunen. Pöytyä: Temps Oy, 5–112.

Titon, Jeff Todd (1978) "Everyday I Have the Blues: Improvisation and Daily Life". *Southern Folklore Quarterly* Vol 41 no 1, 1978: 96, 98. [https://www.academia.edu/6136430/Every\\_Day\\_I\\_Have\\_the\\_Blues\\_Improvisation\\_and\\_Daily\\_Life\\_1978](https://www.academia.edu/6136430/Every_Day_I_Have_the_Blues_Improvisation_and_Daily_Life_1978) (read Dec 26, 2020)

Ukkola-Vuoti, Liisa (2017) *Musikaaliset geenit – hyvinvointia musiikista*. Helsinki: Kustantamo S&S, 136–151.

Väisänen, A. O. (1990 [1943]) "Laulu ja soitto kansanelämässä". *Hiljainen haltioituminen. A. O. Väisäsen tutkielmia kansanmusiikista*. Suomalaisen Kirjallisuuden Seuran Toimituksia 527. Toim. Pekkilä, Erkki. Helsinki: SKS, 42–46.

Väisänen, A. O. (Ed.) (2002 [1928]) *Kantele- ja jouhikkosävelmiä. Suomen Kansan Sävelmiä V. 2.* uudistettu painos. Suomalaisen Kirjallisuuden Seuran Toimituksia 863. Helsinki: Suomalaisen Kirjallisuuden Seura.

Wartiainen, Eliel (1987 [1923]) *Shemeikka*. Porvoo: WSOY: 82–91, 100–101, 111.

The Archives' collections of the Finnish Literary Society:

SKS KIA. A. O. Väisänen arkisto. Kantelespel i Kalevala och i verkligheten. Käsikirjoitus on suomeksi (the manuscript is in Finnish). 1943.

SKS KRA. Borenius, Axel August 414. 1877.

SKS KRA. Hällström, Karl Adolf 162. 1877—80.

SKS KRA. Launis, Armas 785–805. 1905.

SKS KRA. A. O. Väisänen. A. Hällström. Sävel-keräelmä Laatokan Karjalasta v. 1895 I.

SKS KRA. Väisänen, A. O. Kotelo 12 vihkot 7, 8 ja 9. 1916.

SKS KRA. A. O. Väisänen. Raja-Karjala, vihko 2. 1917.

Appendix 1. The video recording of the improvisation

Appendix 2. The music in a time code

Appendix 3. The periodization of time between instruments

Appendix 4. Audience feedback (in Finnish)

Appendixes are available at: <https://www.researchcatalogue.net/view/1089971/1089972>