

Structural and perceptual correlates of the musical peak experiences

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Tiivistelmä – Abstract <p>The music is capable of moving emotions and of manipulating the feelings in a very sensitive and special way. The extreme manifestation of the ability to arouse the pleasure are the peak experiences. Many studies in the field focused on the structural features of the peak events. Much less attention was devoted to a listener's perception and understanding of these events. In this study, the participants were asked to evaluate peak-inducing events in freely chosen pieces of popular music and to decide which particular musical feature induce their peak experience. Their evaluation was compared with the results of the musicological analysis in order to reveal potential correlations with the actual musical features. Based on 59 instances of the peaks it was found that the variables achieving the statistical significance were melody and harmony which both resulted in the lowest level of agreement between the experimental group and the control group. Further, it was observed that from listener's perspective the melody seem to play an essential role in experiencing the musical peak experiences as 51.47% viewed the melody as the main factor contributing to the peak experience.</p>	
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1 INTRODUCTION

The ability of music to arouse various emotions (or illusions of these emotions) has been taken for granted among the vast majority of people involved in music as the listeners, the performers and the composers. The music is capable of moving emotions and of manipulating the feelings in a very sensitive and efficient way. With the latest technological possibilities of recording and reproducing the sound, the music has become almost a commodity. Another significant factor which contributed to a huge expansion of music quite recently were the new methods of storing and archiving the music as a data. This, hand in hand with the growth of Internet as a mean of data distribution, enormously simplified the process of obtaining the new music. The age of music consumption has reached its climax and the ways or levels in which the music is (omni-)present in the society have changed dramatically. The music serves as a mood regulator, as a stimulant for sportsmen before a match, as an emotional cue in movie scenes, as a psychological tool increasing sales of goods in supermarkets or as an audio scene to our daily transport. Considering these new contextual roles in which music functions, one thing remains stable throughout the ages as well as throughout the particular contexts and it is the ability of music to arouse a pleasure. A pleasure of a very special nature. Moreover, a pleasure which often tends to increase with the growing familiarity and that is something what makes the music even more unique compared to the other creative arts.

When it comes to the strong emotions or peak experiences, these represent an extreme form of the pleasure related to music listening. Indeed, it has been observed that music has a power to trigger an exceptionally great experience often resulting in a profound catharsis and in an altered view on the world. Many musicians have reported the peak experiences to be one of the major reasons they pursue a music career. In a way, these subjective feelings might be regarded as a paramount manifestation of the power of music. It is very difficult to generate the musical experience without

the music itself. Even if we are familiar with a musical piece thoroughly, no matter how hard we try to imagine our favourite musical idea from our beloved song, it appears to be impossible to arouse the same kind of sensation that we get once we can hear the song itself. Ultimately, it is only the actual and sounding music what makes us satisfied and what is processed by a listener's mind are not the notes of a score, but the sounds. The sonic structure as a phenomenal entity is thus crucial to the musical experience. Hence, the link between the specific musical patterns and the musical experience may provide a solid basis to study the music perception. In general terms, this thesis deals with this linkage between the two aforementioned concepts or ideas: the pleasure of listening and the sound and its qualities.

The notion of a potential causative relationship between a certain musical pattern and emotion it induces is by no means a novel approach. The idea to examine and find certain generalizations of how various musical events affect emotion has its origin in the 17th century in so-called *Affektenlehre*, commonly known as “Baroque affect theory”. However, it was only relatively recently that the empirical scientific research of relationship between the musical features and the induced emotions began. Gradually, a body of knowledge about the musical characteristics causative of particular basic emotions like happiness, sadness or anger has been growing. Nowadays, the computer models of music perception are able to identify the overall "mood" of a piece of music with quite remarkable accuracy. Yet these artificial models are applicable only to a very limited repertoire of music which does not contain any emotional ambiguity. This only proves how sophisticated phenomenon the human music perception is and how challenging task it is to try to understand it and to model this kind of processing. As regards the current research of strong experiences with music, this focuses on philosophical, psychological, musicological as well as physiological issues pertaining to peaks.

2 PRIOR RESEARCH ON PEAK EXPERIENCES

The present research review gives an account of studies related to the phenomenon of strong emotions with music sometimes referred to as peak experiences. The brief introduction provides the general information about the framework of this review. The references themselves are grouped with respect to the perspective or methodology they apply.

Peak experience is a concept tightly connected to the psychology. The term has its origin in the psychological theories of human needs conceived by Abraham Maslow (1968). As the concept refers to the intense and highly pleasurable emotional experiences in general, it can be applied to various domains of human activity. As a result of growing interdisciplinarity among the scientific disciplines, gradually, the scientists from the other fields than psychology became interested in this phenomenon. Currently, the scope of research is considerably large and peak experiences are studied from the diverse perspectives. Apart from a great deal of studies analyzing peak experiences as a psychological state, there has been a significant research progress of peaks in relation to music. After the review of groundwork psychological studies describing the nature and the effects of peak experiences at large, follows a summary of current trends of research related to the music utilizing physiological, psycho-acoustical, musicological and philosophical approaches. Included is also an overview of Leonard Meyer's work pertaining to musical expectancies which have been shown to play a major role in the strong emotional responses.

2.1 The nature and effects of peak experiences - the psychological approach

Several studies represent the backbone of fundamental knowledge about the peak experiences. It is to the credit of Maslow who was the first to turn the attention towards and to conceptualize the peak

experiences. Maslow highlighted the significance of these experiences among self-actualized individuals and coined the term itself. Peak experiences can be described as particularly joyous and exciting moments in life accompanied by feelings of euphoria, self-awareness and awe. The first study focused solely on strong experiences triggered by art was conducted by Panzarella (1980). The study revealed essential information about the perception of peaks and about their overall nature and functioning. Although Panzarella reviewed only the intense aesthetic experiences, the author pointed out that the identical characteristics applied to the peak experience in response to any other stimuli. The author carried out a thorough analysis of 103 reports (51 with 5 music, 52 with visual art) and deduced 4 major components of these experiences: renewal ecstasy, motor-sensory ecstasy, withdrawal ecstasy and fusion-emotional ecstasy. Renewal ecstasy factor correlated highly with the visual art stimuli, whereas motor-sensory component was associated with the music. Further, Panzarella described the temporal framework of functioning of peaks as they proceed through the 3 main stages. After the onset of peak, initiated by cognitive awareness of intensified perception and loss of self, comes the second or climaxing stage with continued loss of self and physiological responses, which subsides in the third stage characterized by emotional responses of self-transformation. Besides, Panzarella has concluded that the peak experiences had a long-lasting or even permanent effect on people involved. Among these effects he included: 1.) A more general appreciation of music or visual art experiences, 2.) Altering of self-appreciations, relationships with other people and attitudes towards the life or the world in general, 3.) Enhanced perception of specific artistic features, 4.) Enhanced perception of everyday reality, motivational effects, and rather long-lasting mood effects. All these observations are in accord with Maslow's findings who also attributed the long-lasting characteristics to peak experiences. To date, the most exhaustive account on psychological aspects of peak experiences triggered by music is an ambitious project Strong Experiences with Music – SEM conducted by Gabrielsson (2001). It comprises a collection of over 1000 written reports on peak experiences as remembered and described by participants of

this long-term study. Gabrielsson gathered by means of questionnaires first-hand information about the intense experiences resulting from musical activities. Various personal, existential and even transcendental aspects of peak experiences have been confirmed: changed attitude to music, confirmation of identity or meaning of existence. Gabrielsson classified three factors influencing SEM: 1.) Musical factors, 2.) Personal factors, 3.) Situational factors. This classification supports new theories of music communication which also proposes a model containing the same variables (Kendall and Carterette, 1990). Further, based on the fact that many comments from participants mentioned a relief from pain or grief, increased self-confidence and other positive outcomes of SEM, the author suggested a therapeutic effect of peaks. Above all, the SEM project has deepened the understanding of psychological qualities of strong emotions induced by music as such. The findings are much in line with Panazrella's observations, however their specific systematization is beyond the scope of this paper.

2.2 The biological and physiological correlates of peaks – the physiological approach

In an effort to reveal new facts about the functioning of peaks, some researchers have turned the attention towards the monitoring of biological processes or other physiological responses which often accompany strong emotional excitations.

A unique research utilizing a brain imaging techniques used participant-selected music containing peak moments. Positron emission topography showed that the intensely pleasurable responses increased the activity in the same cerebral areas as more "biologically relevant, survival related stimuli" commonly associated with the food consumption, sex or cocaine consumption (Blood & Zatorre, 2001). Generally, the authors concluded that there is a link between the cognitive

processing of music and mechanisms of mediating motivation, emotion, arousal and reward.

The aim of Rickard's study (2004) was to compare the levels of physiological arousal resulting from "emotional powerful music" (EPM) to physiological responses resulting from other samples of less intense music and visual stimuli (emotionally powerful film scenes). The monitored bodily sensations included skin conductance, heart rate, skin temperature, EMG, and salivary cortisol levels. The participants' subjective feelings of chills were also carefully recorded. It was found out that emotional powerful music elicited remarkably increased skin conductance and chills compared to any other stimuli used in the experiment. This confirms the Maslow's presumption that two easiest ways of getting the peak experiences are through music and sex (1976).

Numerous researchers used "thrills" or "chills" as a parameter for strong emotions in response to music. The bodily reactions like shiver down the spine, lump in a throat or piloerection are objective indicators of a strong emotional excitation and the fact that they are clearly observable and easily measurable makes them a potential powerful measure instrument. Goldstein (1980) conducted the first study utilizing thrills in which he examined neurochemical changes associated with the strong arousal with music. The purpose of his study was to find out whether the chills (and thus, possibly, the intense emotional experiences) are mediated by endorphins. If this was the case, naloxone which is a very effective substance in blocking the release and transmission of endorphins, could decrease the intensity or frequency of chills. This hypothesis was proved to be true only partly since only 3 of 10 participants reported a lower frequency of chills. More relevant were the data regarding the general occurrence of chills which indicated that about 50% of population have experienced chills related to music, however, this number reached 90% for the sample of music students. Moreover, 96% of respondents cited music as their primary stimulus of thrills.

An experiment carried out by Panksepp (1995) involved undergraduate students listening to 18 pieces of music (14 chosen by participants themselves, 4 selected by the researcher) and indicating

the chills. As results revealed, the chills are more likely to be felt by females than by males. Other findings of this study implies that strong arousal usually occurs with a familiar piece of music and that the "sad" music is statistically more effective in inducing chills. Panksepp pointed out that in particular crescendos and passages containing an entrance of a solo instrument tend to induce chills. A recent study by Lewis (2010) also utilized multiple scientific approaches, however, the most noteworthy conclusion was achieved by measuring the brain activities of participants while experiencing peaks. One of the primary questions of this study was to find out whether the occurrence of PPE (Peak emotional experiences) can be detected in the brain. A system of 21 channel EEG was used to trace the cortical impulses. A comparison between the non-peak and peak brain images showed the difference between the activities of hemispheres. The author suggested that people who are more susceptible to peak experiences may process the music using both hemispheres as opposed to casual music listeners' single right-hemisphere processing. This idea is consistent with the assumption of Goldstein (1980) who believed that the brain area involved in the perception of thrills in response to music has a bilateral representation.

2.3 The musical events and peaks - the musicological approach

In comparison with the aforementioned approaches, the scope of research concerned with the strong experiences with music from a musicological perspective is narrow. Only a few studies have addressed the question of analysis of music corresponding to the particular segments of music inducing peaks.

A study by Sloboda (1991) was the first attempt to investigate the potential correlates of musical structural elements and peak experiences. Sloboda aimed to determine whether the listeners are able to identify precise events in the music which evoke thrills and chills. If this was proved to be true, a

further systematic empirical research in this direction could follow. Another purpose of the study was to obtain the relevant generalization of participant-identified musical patterns. In total, 83 participants took part in the experiment and filled the questionnaire inquiring about their strong experiences within the last five years. The participants were asked to select up to three pieces of music which caused a strong response as shiver, tears, goose pimples, lump in the throat, sweating or racing heart. Consequently, they should have specified, with the highest possible accuracy, a location in music triggering this response. The results showed that the majority of the participants can recall peaks and, most importantly, are able to specify with considerable precision which musical events have led to strong emotional response. However, it should be noted that only the musical players provided reliably precise data regarding these events. The shivers down the spine, laughter, lump in the throat and tears were the most frequent physical responses reported. After the musicological analysis, Sloboda derived a list of 10 structural devices to be related to thrills: harmony, descending cycle of fifths to tonic, melodic appoggiaturas, melodic or harmonic sequence, enharmonic change, harmonic or melodic acceleration to cadence, delay of final cadence, new or unprepared harmony, sudden dynamic or textural change, repeated syncopation, and the occurrence of a prominent event earlier than expected. Sloboda's study illuminated for the first time a relationship between the induction of strong emotions and actual structural parameters of music. Similarly to Panksepp's comments on the most effective musical triggers (1995), these observations of musical features also refer to particularly dramatic and intense moments. Altogether, Sloboda opined that these features are based on a violation of expectancy which was postulated by Meyer nearly 50 years ago in his theories of emotion and meaning in music (1956).

Grewe and his colleagues (2007) combined various methods as the name of their study suggests. The three major questions were of particular concern: the frequency of the chill response; possible personality-dependent correlates; and finally - the musical and acoustical features linked to such strong emotional responses. The 38 participants were asked to listen to the pre-selected pieces of

music encompassing various genres as well as to their own music. Several personal factors were correlated with the experience of chills such as a preference for less intensive stimuli and reward dependence. What is worth a note is that the Goldstein's (1980) value of occurrence of chills among the population (53%) was in this study quite closely repeated, for it was revealed that 55% of participants experienced a strong emotion during the experiment. It was also found that the more reactive listeners have generally more serious interest in music and are prone to the more conscientious and attentive listening as opposed to the casual or background listening. The classical music was, once again, the most effective style of music triggering peak experiences. As the most significant musical triggers were reported entry of a voice, both vocal and instrumental, and changes in volume which are all the features previously observed by Sloboda (1991).

In addition to all the foregoing studies utilizing musicological approach, a special remark should be given to the Master's Thesis Musically-induced emotional peaks (2009) by Anthony Prechtl which was highly instrumental and directly inspired the present research project. The thesis has come up with the findings concerning the music-structural features occurring in the peak-inducing passages of popular songs. As revealed by this thesis, shift in the melody, a change in pulse clarity, a repetition of prior lyrics, a change in dynamics, and an addition of background instruments seem to significantly correlate with the peaks.

2.4 Profundity versus peaks - the philosophical approach

The account of academic research activities related to peak experiences with music would not be complete without a brief reference to the philosophical debate of this phenomenon. Reading these studies we might question their relevance as they are often limited to rather speculative attempts to grasp the overall peculiar nature of music. Nevertheless, as a closer look reveals this holistic approach is addressing the questions of universal boundaries of perception of music from a

philosophical point of view and these ideas can be easily extrapolated to the issues of peak experiences. As such they comprise an insightful and intellectual counterpoint to the empirical research. A stimulating discussion pertaining to peak experiences is interleaved with the reflections on the profundity of music. Before continuing, a note about nomenclature is needed. The term "profound" is used in the context of term "peak" and, quite interestingly, although opposites, in the literature both these expressions are in most cases referring to the same quality.

Bennett Reimer's paper published in 1996 in *Journal of Aesthetic Education* and later in his collection of essays (Reimer 2009) is one of those attempts examining issues of profundity of music. In this study author cites heavily from other essays written about the topic but also proposes his own interesting ideas and insight into the nature of profundity. After the introduction he reviews the profound (and/or peak) experiences with music citing mostly Maslow's and Panzarella's groundbreaking studies. Reimer later asks whether a profound musical experience can occur also with music of a culture quite foreign to the person experiencing it. He assumes that it appears to be extremely rare or at least nonexistent in the literature. However, he admits that there are reports of profound experience with music of a genre not usually enjoyed by a person - classical music with a rock enthusiast and a jazz enthusiast, for example. Further, Reimer questions the hypothesis which states that any music at all within a particular musical and cultural system could result in such a response. Contrary to this, he emphasizes the importance of not only musical piece itself but also the quality of its performance as another determining factor. He argues that if a faulty performance within certain tribe rituals is enough to prevent from getting into desired trance as has been observed, then it surely must play a decisive or at least an important role within the western cultural context. Generally, he regards qualities of the music as an essential factor in profound experiences of music regardless the particular cultural context in which the experience takes place. By far the boldest statement of this article is its challenge to focus the current research on questions of profundity-related issues as the findings may become a groundwork of new and valued knowledge:

"I am hopeful that if we encourage research scholarship dealing with higher or highest musical responses we can produce far more knowledge of use to us, and of meaning for us, than we have by our overwhelming concentration on lower or lowest musical responses. Certainly our research literature would become more interesting" (p. 17). On the other hand, the author is openly skeptical about the possibility to find general particular patterns triggering profound experiences as he says: "I do not believe it is possible to describe particular musical features that would always be implicated in profound experiences, because that would require a split in the subject-object duality not capable of being made" (p. 11). Seen this in context with the latest empirical research of peak experiences, it seems less surprising how Lewis (2010) concludes his study reviewed above: "In fact, it might be that the 'scientific method' will never reveal satisfactory answers" (p. 90).

Another intriguing point of view suggests Davies (2002). In short, by a logical reasoning Davies illustrates how the essential cognitive capacities of human are manifested in music and are analogous to those present in the game of chess: "My central thesis is that some music is profound as some chess play is; namely, for what it exemplifies and thereby reveals about the human mind" (p. 355). Of course, it is debatable whether drawing a nice parallel to the game of chess can be of some relevance in terms of scholarly research and potential fruitful development. However, the complexity of certain phenomena somehow resists to be grasped in its entirety as it is no doubt the case with the music. Davies, somewhat inwardly, appears to recognize the fundamental "enigma" of music and in this regard he does not strive to conceptualize any specific theory of musical expressivity. Instead, he reasonably brings into attention the understanding of music as a kind of game which at the same time satisfies and challenges human emotional and intellectual capacities in an ultimate manner. All the more his parallel seems appealing when we think of a great deal of composers who were also keen chess players (likewise, chess players who were fond of music).

2.5 Leonard B. Meyer: The musical expectations

As the review indicates, the scope of research of peak experiences is broad and various concepts have been suggested with a view to systematize or account for some of the major issues. With regard to the musical features inducing strong emotions, there is one general finding which can be drawn from observations and was confirmed by multiple studies. The results of studies conducted by Sloboda (1991), Grewe et al. (2007) and Panksepp (1995) highlighted the violation of expectancy as the common feature of musical events likely to elicit the intense arousal and physiological response. This idea, however, dates back as far as the mid-twentieth century and deserves a more detailed discussion. Leonard Meyer proposed his view of the induction of emotions in his influential work *Emotion and Meaning in Music* (1956). The principal idea of Meyer's understanding of music is that the emotional effect is achieved by the means of increasing and decreasing of the tension. In other words, the musical structures builds the tension which is expected to be consequently resolved by certain conventional patterns. Naturally, there are, theoretically, infinite possibilities of such a gradual rise and subsequent resolution and their precise mechanisms are highly aesthetics dependent and varies among the different musical cultures, ethnic groups as well as periods and genres. In essence, what a listener perceives as a response to music, are these expectations which are based on a listener's familiarity with a particular style of music and violations of these expectations. The composers utilize these processes and delays, for instance, an expected chord resolution or at other times surprises with a striking entrance of percussion or abrupt modulation. As demonstrated by many studies mentioned above, both these devices are largely effective in arousing a strong response. Further, Meyer specifies these aspects of expectancy as he borrows from Gestalt psychology its notions of similarity, continuity, grouping or return which he attribute to perception of music. Meyer has provided somewhat stagnant research of music emotion with a unique and original insight and has earned a lot of respect from the wide musicological

community. We might even argue that Meyer seems to come up with his ideas ahead of his time as it did not stimulate much research right after.

Only recently, apart from the studies covered in this review, has been Meyer's theories tested by other researchers that further indicated the validity of his approach. Steinbeis and colleagues (2006) measured the bodily responses along with the subjective responses related to expected and unexpected harmonic events. The increased heart-rate and electrodermal activity positively correlated with the highly unexpected events as opposed to significantly lower correlation with only slightly unexpected events.

Huron contributed to the discussion about the expectancy in his warmly received book *Sweet Anticipation* (2006). He puts the phenomenon of musical expectations into the wider evolutionary context of human. The author highlights the crucial role of brain's predictions about the continuation of music and hypothesizes that intrinsic reward system might be engaged in this prediction model which only supports the Blood's and Zatorre's actual observations implying the reward-like functioning of music perception (2001).

2.6 Conclusion

All these studies have observed an overall positive nature of the peak experiences. Even though peak experiences can be elicited by diverse stimuli, their nature and psychological characteristics remain identical (Maslow 1968, Panzarella 1980). Further, it can be concluded that these responses are rather rare among the population, but on the other hand entirely common among the musicians (Goldstein 1980). Once they are experienced, they are extremely valued and remembered and often are one of the main reasons why the people continue to pursue their interest in music (Panzarella 1980, Gabrielsson 2001, Grewe et al. 2007). With regard to music, statistically the most frequent genre prone to trigger peaks is the classical music (Maslow 1976, Panzarella 1980, Gabrielsson

2001, Grewe et al. 2007), however, any kind of music is able to induce strong emotion. Various components of strong emotions have been observed at cognitive and physiological level, but their precise functioning remains widely unknown. As far as musical events related to peak experiences are concerned (which is the focus of my own research), the studies indicate that a causative relationship between the structural elements of music and strong response might exist and requires further research (Panksepp 1995, Sloboda 1991, Grewe et al. 2007).

3 RESEARCH PROJECT

3.1 Research project outline

In the centre of this research project was the listener and his peak experience as it is triggered by a musical event. Prior research has somewhat underestimated the listeners' experience and competence. The objective of the project was to reveal some of the new aspects of the issue by inquiring the listeners themselves. The present Master's thesis utilized the musicological approach and the primary goal was to investigate the musical features of peak inducing segments of music such as melody, harmony, rhythm, dynamics and instrumentation. Further, the project strived to get certain insight into the perceptual characteristics of these musical events and how these may differ from the actual musical parameters. So far, the research focused primarily on the question whether the people can identify what segment of music corresponds to the peak experience or, at best, the studies tried to find out which structural features can elicit peaks. This has been proven and confirmed and the ability of the listeners, in particular the musicians, to "pick" the particular event of peak is now acknowledged. The structural features have also been explored and some of the

mechanisms described. The present research project continues in this direction and builds on top of these findings. The aim was to enlarge the knowledge about the peaks not by focusing only on "the surface" – on the event as a whole, but on the inner structure of these events – on "the content". More precisely, how this content is understood and processed by a listener. Is there any hierarchy between a horizontal line – the melody, a vertical line – the harmony, a time division of an event – the rhythm, a timbre – the instrumentation and dynamic nuances – the loudness? Are the listeners aware of this kind of hierarchy at all? If so, are the listeners able to point out more relevant out of these parameters in a particular event? To which feature do the listeners assign the highest importance? These were the questions which were posed and led to the present research design. As regards the five mentioned musical elements, these were used for numerous reasons. They represent the dimensions in which the people have thought of the music for centuries. They are somewhere in the halfway between the music as an actual sonic entity and the music as a mental notion of a composer, a performer or a listener. Even the musical notation has been evolving with respect to these main categories and in order to capture, present and deliver the relationships between them as clearly as possible. Altogether, from a musicological point of view are these dimensions an optimal compromise between the music as a whole and the music as a reduction to the smallest possible units. Any further division might lead to the point where the main unit is closer to the sound rather than to the music and this might naturally result in not operating with the music. To put it another way, the units of the five elements are a niche where "the whole" is equal to and meets "the sum of things". The two primary research questions were as follows:

- 1.* To what extent do the listeners identify structural parameters of emotional peaks and which musical feature is statistically most frequently perceived as dominant in these peak events?
- 2.* What are the perceptual and structural correlates of the peaks? Does listener's perception correspond to the actual musical features? Specifically in which parameters achieve the

listeners highest correlation with the musicological analysis?

The entire research project can be divided into two major consequent parts which are "Data collection" and "Data analysis". The Data collection part consisted of developing of the questionnaires, distribution and collection of questionnaires among the participants. The Data analysis part involved the process of eliminating the unusable data and the analysis of the data which eventually produced the results of the thesis.

3.2 Questionnaire and participants

In order to obtain the samples of peaks as the main input data of this project, a short questionnaire was devised. The desired number of the samples of peak experiences was about fifty. Therefore, the idea was to ask only those most relevant questions, so as not to discourage or bother the potential participants. Altogether, the three questions were retained in the questionnaire.

The first question asked about the piece of music (a song) to which a participant feels emotionally attached and which contains an emotional peak. The participant was requested to provide the name of the artist and the title of the selected piece of music. This selection was not limited to any genre. Essentially, any kind of music was acknowledged as suitable for the following analysis. On top of that, allowing the participants to freely select any piece of music and not using a specific pre-selected set of songs or restrictions related to particular genre was another crucial factor to prevent from not obtaining enough of usable data in the first place aimed to minimize the research design error. It was expected that the majority of the recipients of the questionnaire were avid music listeners of popular music and virtually all the samples of music were from the popular genre.

The second question prompted the participant to specify a particular segment inducing peak in the given piece of music. This occurrence of the peak segment was to be specified from its initial moment until its end and was requested in minutes and seconds.

The third and last question aimed to find out more about the subjective perception of that peak and required the participant to critically think about the musical qualities of the peak. The question operated with the four aforementioned musical features discussed briefly in the section 2.0: 1. Melody, 2. Harmony, 3. Rhythm, 4. Instrumentation. As the presumption of the project was that the hierarchy between the elements related to peak experiences can be quantified, the participant was asked to select preferably only one out of four categories based on his/her own evaluation of the peak segment. Alternatively, in cases where the structural interplay of elements would seem to be less clear-cut, the participants were allowed to select two features whose importance was considered as equal. In other words, only those parameters which have a prominent function in the interplay of these fundamental parameters.

The questionnaire was distributed using the University of Jyväskylä network with a view to address the large sample of students as it was expected that the younger people of an average age between 20-30 year old are active music-listeners and thus might have interest in the project. In total, there were 22 responses acquired from the students. In addition, another 37 participants were obtained in a physical form personally from the meetings with the eager music listeners. None of the participants was an active musician, nor a musically-educated person. This prerequisite was stated in the introduction of the questionnaire and was crucial to the entire project since the thesis was to investigate the pattern of a common listener and how it might differ from/correlate with the imaginary "trained" listener.

3.3 Musicological analysis

In order to reveal what are the statistically significant musical parameters inducing peak experiences and how do these match with the respondents' reports, a musicological analysis was performed. In this analysis each of the events was examined on a case by case basis and the outcome was used as the control group. The four variables were created which corresponded to the musical parameters: 1. Melody, 2. Harmony, 3. Rhythm, 4. Instrumentation. The analysis scheme was devised with respect to the stated research questions.

The most challenging task in the process of analyzing was to determine which out of the four categories was the prominent one in each of the peak inducing segments. This might appear a highly subjective evaluation. Therefore, to minimize the subjectivity and to increase the reliability of data, the outcomes of the prior studies were used. These studies (Sloboda 1991, Panksepp 1995, Grewe et al. 2007) have successfully derived a list of the structural triggers of musical peak experiences and the division into the four major variables applied in the thesis more or less adhered to these results. These triggers can be systematized into the four categories without much difficulties. Sections 3.3.1 through 3.3.4 below describe each category and some of the associated features.

This project deliberately dismisses the lyrics of songs. The reasons for that were related to the research design which involved the musicological analysis. The lyrical content of the music would have posed an element impossible to analyze. In order to keep the design consistent and functioning, the vocals were analyzed as the part of the whole musical texture from a melodic, harmonic, rhythmic and timbral point of view. Nevertheless, it can be suggested that disregarding the lyrics does not significantly decrease the relevance and validity of the project, for it is generally

expected that the triggers of these emotional responses are predominantly musical and the peak experience would occur even without the verbal content which has been indicated by prior research.

3.3.1 The Melody variable

Interestingly, even though the melody seems to be an element most commonly associated with the music as such, it is the melody whose theory is the least explored and might be considered problematic. In essence, the melody – as the most abstract and the least definable notion out of given four elements can be negatively defined in relation to the other three categories. The functioning and attributes of harmony, rhythm and orchestration are known and their theoretical comprehension has been established through respective disciplines. Hence, if "it" is not due to specific means of harmony, instrumentation or rhythm, then "it" is due to extraordinary melodic potential and quality, to put it in plain terms. Any obvious prominent melodic activity like melodic appoggiaturas, melodic sequence was evaluated as the prominence of the melody. In most cases, the prominent melody were the vocals.

3.3.2 The Harmony variable

Any interesting harmonic activity such as unprepared harmony, harmonic instability, atypical harmonic chord resolution, modulation, departure from the key, any sign of polytonality, any obvious change of harmony texture was attributed to belong to the harmony category.

3.3.3 Rhythm variable

Similarly, any interesting and striking rhythmical characteristics such as syncopation, change of time signature, tempo increase/decrease, polyrhythm or any sign of rhythmical irregularity was assigned to the rhythm category.

3.3.4 Instrumentation variable

Last but not least, if the event achieves a strong response in a listener by means related to instrumentation like textural transition, change of instrumentation, occurrence of combination of instruments other than before, apparent change in arrangement, sudden dynamic increase/decrease,, other dynamic effects, the instrumentation category was chosen.

3.4 Violation of expectancy

Another guide which was applied in the process of evaluating the musical excerpts was related to the phenomenon of expectancy and the violation of this expectancy. As mentioned earlier, it has been observed and reasonably suggested that the peak experiences are closely interlinked with this very violation of expectancy. Indeed, most of the instances of the musical events clearly manifest certain violation of at least one of the parameters (a more detailed explanation of the expectancy phenomenon is summarized in the section 2: Prior Research On Peak Experiences). What needs to be emphasized is the fact that the violation, basically, corresponds to the principal activity of a parameter and thus there is only a minimal risk that the two principles would not match. In fact, while analyzing the events, very often the final decision was made based on the violation of the expectancy, rather than by scrutinizing the musical elements. In general, the popular music utilizes song forms which consists of two to three main sections. These sections repeats in a more or less regular pattern such as, most typically, verse-chorus-verse-chorus (-bridge-chorus-chorus). Since these sections repeat, composers and arrangers tend to present the musical themes in these segments in a guise other than before. Technically speaking, they violate what was established in the previous occurrences of the theme. Hence, this worked as another principle while analyzing the events. The musical feature which apparently violated the usual expectancy pattern was given priority.

3.5 Data analysis and significance tests

Several statistical analyses were carried out once the data was collected and sorted out. Essentially, there were two types of analytical processing. As the first research question was to enquire about the tendencies among the respondents' listening to musical peak experiences, a simple arithmetic and proportional comparison was performed which processed only the data from the participants.

The next stage of analysis used as the input data all the participants' responses as well as the data retrieved by examining the songs. Since the data retrieved from the samples of songs was used as control group, essentially, the analysis utilized comparing these two sets of data. The number of samples was high enough and none of the cells in the analysis tables contained a value lower than 5. Therefore, a chi-square test (without Yates' correction) was chosen as opposed to Fisher's exact test which would be a necessary alternative should the values be significantly lower.

The level of agreement between the groups was measured in two ways. The first analysis summed up the number of successes in each variable and number of fails in each variable. The latter value was subtracted from the first value, giving thus the rough, yet relevant, percentage of the success.

This measurement was complemented with the Cohen's Kappa (κ) test which is the most frequently used test in studies examining the agreement between the two observers. Kappa provides a measure of the degree to which two judges (in this case the experimental group/participants vs. the control group/musicological analysis) concur in their respective sortings of samples into several mutually exclusive categories. The Kappa value is more precise and reveals more objective relationship to the control group as it takes into account that some of the choices might have been random; both accidentally correct and incorrect.

3.6 Statistical issues

The fact that the participants were allowed to select one single category or the two of them turned out to be a minor obstacle as far as the statistical framework was concerned. Originally, the idea was to consider each song as a whole unit which would either represent one single category of the value "1" or two categories each of the value "0.5". These values would be afterward summed up and used in the significance tests. However, this would result in troublesome, even impossible, calculations since most of the tests for categorical data are not designed to process the decimal numbers or fractions. Therefore, eventually the main input unit used in the analysis was not a song, but a category itself. In other words, every occurrence of the category was assigned with the value of "1" notwithstanding whether it was the sole evaluation for the particular song or in combination with another category. In this way, the initial problem was overcome without losing any methodological relevance. Furthermore, the number of the samples was increased from 59 to 68 (the listener's responses), respectively to 95 (the musicological analysis) which at the same time enhanced the accuracy and reliability of the significance tests.

4 RESULTS

With respect to the research questions, several calculations were performed ranging from the simplest to more complex ones described in the preceding section.

In total, there were 59 events of peak experience collected for the project. Out of these, in as many as 50 cases the participant opted only for a single category and in remaining 9 cases for the combination of two categories. As opposed to listeners' ratio of 50:9 with a strong imbalance towards the single category, the examination of the events resulted in 23 single categorical samples and 36 two-categorical pairs. Altogether, the sample size of the experimental group was 68, whereas the sample size of the control group was 95.

The entire set of samples consisted solely of songs falling into a modern pop/rock genre. Most frequent subgenres were found to be the alternative rock, soft rock and pop music. Largely, the Western popular music accounted for the majority of the collection, the rest being the contemporary music of the non-Western provenance (mostly Japanese). Out of 59 songs, only 2 were purely instrumental and altogether there were 5 peak experience samples (8.5%) not containing vocals. The mean value of the duration of the songs was 3:47 (mm:ss), whereas the mean value of the duration of the peaks was 0:22 (mm:ss). Generally, the peak events occurred in the inner third of a song. Most typically, between the 1:24 and 3:02 (mm:ss).

4.1 Distribution of frequencies

The most unproblematic task was to answer the first research question. As explained earlier, all the selections of a particular category were summed up notwithstanding whether they were the sole selection in a song or in combination with the other category. The mere examination of the

distribution of frequencies of variables between the experimental group and the control group revealed important findings and shed light on the major questions which prompted the entire research project. Most importantly, in the experimental group, the melody variable achieved the highest number of occurrences. Roughly a half (51.47%) of the peak segments were evaluated to contain the melody as the crucial parameter. Moreover, out of these 35 instances, in 27 was the melody selected as the sole parameter. This prevalence indicates the tendency to perceive the melody as the essential parameter which is further supported by imbalance of the melody in relation to other three parameters since the other three categories achieved relatively comparable percentage values: Rhythm 17.65%, Harmony 11.76%, Instrumentation 19.12%.

Another easily noticeable observation was related to the harmony variable which received considerably lower percentage from the respondents (11.76%) in comparison with the actual number of occurrences (24.21%).

As a whole, a comparison of the frequencies reveals that the actual distribution of the four features is more balanced and even as opposed to the listeners' pattern.

FIGURE 1: The pie-graph representation of the proportional distribution of the four musical categories as calculated from the participants' evaluations

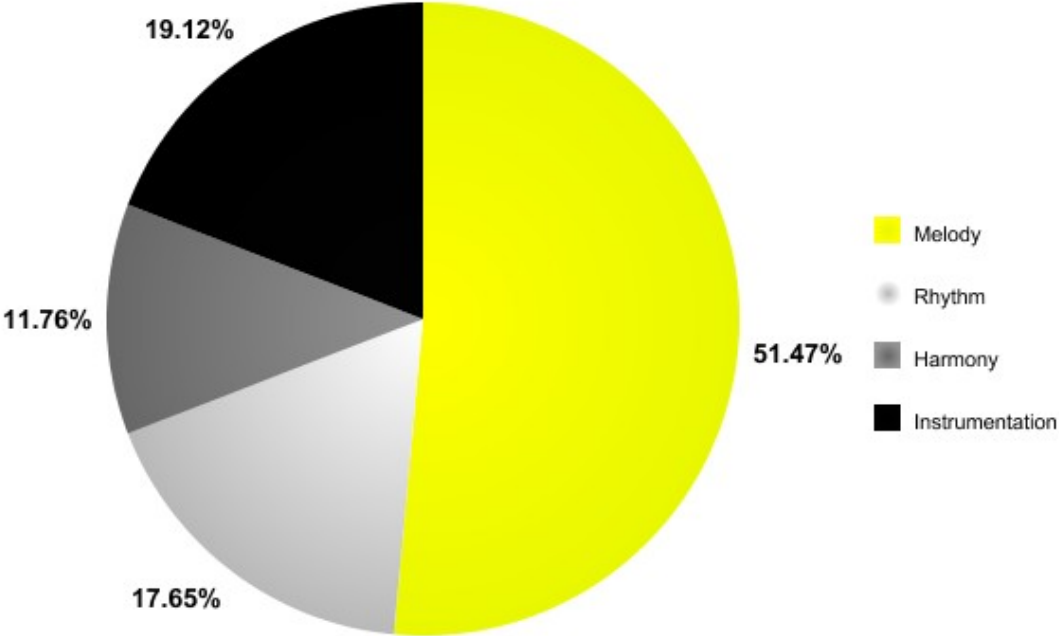
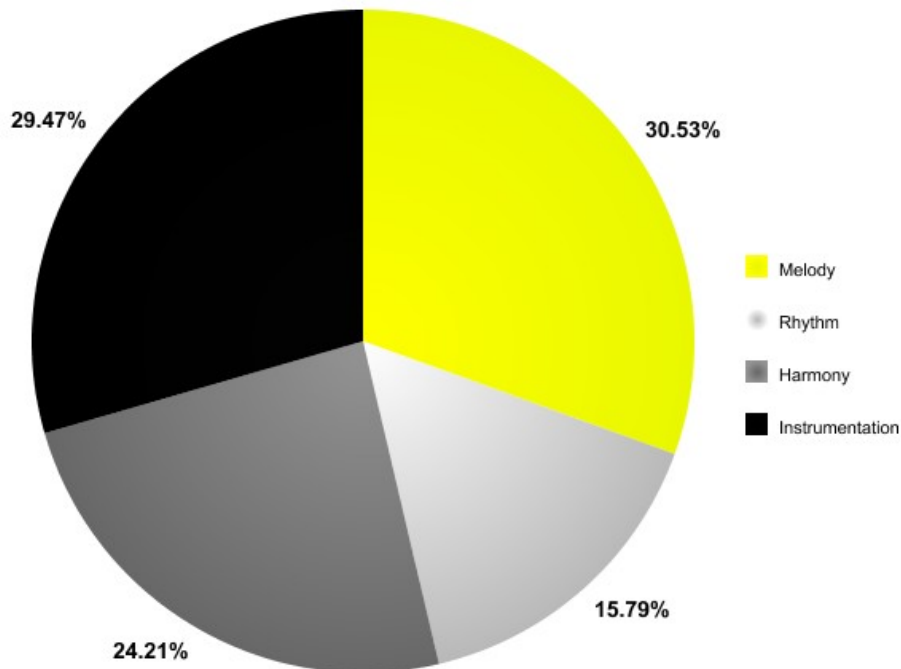


FIGURE 2: The pie-graph representation of the proportional distribution of the four musical categories as calculated from the musicological analysis



4.2 Tests of significance

4.2.1 Category vs. category

Subsequently, the frequencies of each of the four structural parameters between the experimental and control group were statistically tested to find if they significantly differ. Chi-square test of significance was performed on the data in the following way. The sum of occurrences of a particular category was measured against the sum of occurrences of the remaining three categories using a chi-square contingency table. Concretely, each contingency table operated with the constant number of 163 peak-inducing events - 68 collected from the participants responses and 95 retrieved from

the musicological analysis (Experimental group and Control group, respectively).

The actual number of frequencies for each category and the associated p-values of significance are shown in the Table 1. Statistically very significant result (p-value < 0.01) was achieved for the melody variable which once again underpins a major discrepancy with respect to the melody category mentioned earlier. Secondly, the statistically significant difference between the groups (p-value < 0.05) was observed in the harmony variable.

Table 1: Summary of the frequencies of the evaluations for each category obtained from the respondents (the experimental group) and from the musicological analysis (the control group); significant p-values are highlighted with an asterisk

	Experimental group	Control group	P-value
Melody Category			
Melody	35	29	0.0069*
Rhythm, Harmony, Instrumentation	33	66	
Rhythm Category			
Rhythm	12	15	0.7531
Melody, Harmony, Instrumentation	56	80	
Harmony Category			
Harmony	8	23	0.0459*
Melody, Rhythm, Instrumentation	60	72	
Instrumentation Category			
Instrumentation	13	28	0.1330
Melody, Rhythm, Harmony	55	67	

4.2.2 Experimental group vs. Control group

Last but not least, the two most general statistical analyzes concerning the proportions were carried out. The values from the experimental group and the control group were measured against each other and finally against a hypothetical, perfectly balanced distribution pattern. Taking all the four categories into consideration, it was revealed that the experimental group and the control group differ rather significantly as the p-value equals 0.0241.

Table 2: Summary of the calculation of the inter-group chi-square test

	Melody	Rhythm	Harmony	Instrumentation	
Actual data contingency table					
Respondents	35	12	8	13	68
Analysis	29	15	23	28	95
	64	27	31	41	163
Expected data contingency table					
Respondents	26.7	11.3	12.9	17.1	
Analysis	37.3	15.7	18.1	23.9	
Chi-square = 9.4 Degrees of freedom = 3					P-value = 0.0241

4.2.3 Experimental group/Control group vs. "4 x 25%" Distribution pattern

From the Experimental group vs. Control group comparison it was apparently discernible that the data in the musicological analysis follow substantially more proportionally balanced pattern as opposed to the biased pattern of the listeners' data. To give a substantial ground to this observation, a measurable test with a numeral outcome had to be devised. A statistical comparison to the ideal and purely notional case in which all the four categories would be represented by the identical fraction $\frac{1}{4}$ was performed with an intention to measure the overall distribution of the categories.

Interestingly, the chi-square goodness-of-fit test with four mutually exclusive categories resulted in extremely low p-value ($p\text{-value} < 0.0001$) further indicating the major disproportion among the variables in the experimental group. On the other hand, the control group's proportions did not differ significantly from the "4 x 25%" pattern ($p\text{-value} = 0.1599$).

Table 3: Summary of the chi-square test calculation for the experimental group vs. hypothetical "4 x 25%" pattern comparison

	Observed	Expected	Expected %	Chi-square = 26.235 Degrees of freedom = 3
Melody	35	17	25.00%	
Rhythm	12	17	25.00%	P-value < 0.0001
Harmony	8	17	25.00%	
Instrumentation	13	17	25.00%	

Table 4: Summary of the chi-square test calculation for the control group vs. hypothetical "4 x 25%" pattern comparison

	Observed	Expected	Expected %	Chi-square = 5.168 Degrees of freedom = 3
Melody	29	23.75	25.00%	
Rhythm	15	23.75	25.00%	P-value = 0.1599
Harmony	23	23.75	25.00%	
Instrumentation	28	23.75	25.00%	

4.3 The strength of agreement

The level of agreement was calculated to provide the results to address the second research questions. Firstly, a down-to-earth approach was applied in which the negative/incorrect answers were subtracted from the positive/correct leading to the fraction which was consequently converted to the percentage value.

In addition, the values were processed in a more sophisticated and scientifically rigorous method. In essence, the data consisted of samples which were classified by two observers into the four categories. For this purpose, the calculation of Cohen's Kappa coefficient was executed. Firstly, each category was tested independently in order to find the success rate for each variable. Ultimately, the Kappa test with all the four variables was performed evaluating the inter-rater agreement of the entire set of data.

Overall, the results indicate a good success rate for the melody and rhythm variables and moderate strength of agreement for the harmony and instrumentation variables. On the whole, the level of agreement scored 48.42% which is considered to be, according to the standard criteria, a mild strength.

Table 5: Summary of the calculation of the level of agreement

	Correct	Incorrect	Missed	% agreement	K coefficient
CATEGORY					
Melody	27	8	2	65.52%	0.707
Rhythm	11	1	4	66.67%	0.770
Harmony	8	0	15	34.78%	0.414
Instrumentation	10	1	18	32.14%	0.365
TOTAL					
	56	10	39	48.42%	0.498

5 CONCLUSION

5.1 Implications based on the frequencies

Above all, the melody category "won" in what might be labeled as "a landslide victory". In point of fact, this finding emerged as not so surprising outcome of the whole research project. It is a widespread conception among both the casual music-listeners and even some music professionals that the melody is "the essence" of the music. Not only the melody achieved by far the highest percentage with the p-value 0.0069, but there was a strikingly high number of the incorrect melody evaluations observed. Further, the lowest number of missed evaluations can be also attributed to the dominant standing of the melody category. As revealed in comparison with the actual frequency pattern, the melody achieved significantly higher percentage at the expense of the other 3 categories, particularly the harmony. Therefore, as indicated by the frequency ratios it might be suggested that the melody seems to have a firm and dominant position among the common music consumers and from their perspective it is the melody which triggers their most profound music experiences. On the other hand, the fact that the vast majority of listeners identified the melody as the crucial parameter should not be overestimated since the other three categories pose certain level of ambiguity, especially as far as the untrained music-listeners are concerned.

Another category with the significant p-value turned out to be the harmony (p-value = 0.0459). The ratio of 11.76% to 24.21% shows the largest discrepancy among all the variables. All in all, this finding does not seem to be surprising as the harmony is, probably, the least easily traceable feature. The structural devices related to the harmony usually require a more experienced listener to be spotted. As a matter of fact, in the process of the analysis of the peak events of the songs, it was the very harmony feature which posed a minor problem in contrast with the remaining three

parameters.

The category matching the frequency patterns the best and achieving remarkably high p-value 0.7531 was the rhythm. The rhythm, unlike the harmony, is relatively well known concept and even musically untrained people are aware of the distinctive features of the rhythm. Moreover, the rhythm variables success rate was reached as high as 66.67%.

With regards to the frequency patterns on the whole, these differ rather significantly. As expected, the number of responses retrieved from the participants was substantially lower than from the analysis of the same set of songs. The ratio between the participants number of responses to the number resulting from the analysis was 95:68. Generally, where the peak segment contained two categories, the participant often spotted only one, predominantly the melody category.

Some further generalizations can be drawn from the comparison of the groups to the hypothetical even distribution pattern. The experimental groups frequencies distribution achieved extremely low p-value in contrast to comparatively high p-value of the control group. In fact, this might be considered as a slightly surprising finding as this only became apparent in the process of data analysis and there was no presumption that the four categories would be represented by more-or-less balanced values. In a prior research, the studies did not address the question of frequencies of the structural features which are at work in the peak events. Therefore, it is suggested that in the musical events inducing peak experiences are these features likely to be present in relatively balanced proportions and the melody, rhythm, harmony and instrumentation seem to play a relatively comparable role in profound musical experiences. Less surprising is the extremely significant difference of the experimental group which was to a large extent caused by the superior standing of the melody category.

5.2 Implications based on the level of agreement

Two categories - the melody and the rhythm - achieved a better than average score in terms of the strength of agreement. Evidently, the fact that the melody and the rhythm are, in comparison with the harmony and the instrumentation/orchestration, far more familiar concepts is reflected in the results of the thesis. However, it needs to be noted that the melody category's success rate should not be overestimated since as much as 51% of the selections made by respondents were in favor of the melody which yields a possibility of purely coincidental agreements. The melody variable also resulted in the highest number of the incorrect evaluations as well as the lowest number of the missed evaluations.

Interestingly, the overall strength of agreement was very close to 50% (precisely 48.42%) which is a value rather difficult to assess and to comment on as there was no reference point from any prior studies which might be used as a basis for the comparison.

5.3 Concluding remarks

The major result of the project shows the the chills as the accompanying effect of the peak experiences might arouse due to special characteristics of the voice. Most of the listeners identify the melody to be the element which causes the peak. Since in majority of the popular music utilizes vocals as the principal vehicle for the melody, it is not out of question that voice can have a n inherent capacity to induce intense experiences. This would support Panksepp's assumptions who traces voices' similarity and potential connection with the separation calls of the young mammals from their parents (1995). Secondly, the lyrics might have also played certain role in the prevalence of the melody category. Some participants might have linked, albeit subconsciously, the meaning of the lyrics with the melody of the vocals and thus selected the melody variable.

5.4 Limitation of the study

As in any other studies of the similar scope, the major limitation lies in the size of the samples and associated statistical power of the significance tests. The results of the study have limited validity and the same research project conducted in the larger population may come up with the different findings and generalizations. Except for the calculations with the extremely low p-values, other studies and experiments might result in slightly different proportions.

The limitation of the songs to a rock/pop subgenre definitely puts another constraint on the results. It goes without saying that the popular music is normally less complex than classical or jazz music. Accordingly, the listeners of the classical or jazz music are usually endowed with higher ability to distinguish the intricate features of music.

As mentioned earlier, the categories themselves do not possess the same degree of clarity among the listeners. This is even more true when it comes to the consumers of the popular music.

It is further important to recognize that the results of the the thesis should not be generalize to the entire spectre of the musical experiences. The peak experience is psychologically complex phenomenon and possibility of any extrapolation to a more "ordinary" listening experiences should be cautiously examined. There is no evidence whatsoever that by extrapolating these frequencies of the four fundamental parameters to a more general level we may obtain an identical overall distribution pattern and thereby find how the majority of listeners listen to the music as such.

5.5 Recommendations for further study

In accord with the ideas from the preceding section, the main recommendations for the future are

related to the methodology and research design. A future study might utilize an interview as the best method of obtaining the respondents' evaluations. The questionnaire does not leave any room for the discussion and for the clarification of more problematic questions. Therefore, a face to face interview might result in a more reliable data regarding the evaluation of the peak experience segments in the first place.

Another potentially fruitful approach might utilize different type of questionnaire. Rather than asking which structural parameters are responsible for the peak experience, a negative question may be posed such as: "Which out of the four categories do you find the least important?". This type of question may produce less concrete and specific but more reliable and statistically more significant results.

In order to overcome the issues related to rather abstract terms like "harmony" or "orchestration", an alternative question asking a participant to specify what particular musical instrument(s) is/are triggering a profound musical experience might as well bring about the relevant data while bypassing the above-mentioned obscure terms.

Another improvement of the research design would be to work with the pre-selected samples of songs in order to increase the inter-subject consistency. This design, however, at the same time reduces the possibility to arouse the peak experience which was the major reason why it was not utilized in the present thesis.

Alternatively, a similar research project might obtain a data regarding the respondents' ability to choose which of the structural parameters violates the expectancy and compare these evaluations to the actual violation. Further, these results may put the present thesis' findings into a broader

perspective since the addressed issues are closely related.

By all means, what calls for investigation is to find what is the relationship between the musical peak experiences and "non-peak" musical experiences. This study focused on the most intense music experiences and managed to trace certain tendencies in terms of listeners perception of these musical events. Naturally, a study which would examine more generally what do the listeners like/dislike about their favourite music might provide an overall picture and put the results of this thesis into a different perspective. The question remains whether or how the peak experiences essentially differs from the perception of music on the whole. Perhaps the musical events corresponding to peaks just represent a type of interplay – a type of hierarchy – between the four elements which somehow meets the highest aesthetic criteria in the given genre and in the cultural context.

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ATTACHMENTS

QUESTIONNAIRE:

1. Please, choose a particularly favourite song of yours which contains an exceptionally pleasurable passage. Write the name of the artist and the name of the piece.

Artist:

Title of the selected piece of music:

2. Please, specify a time location in the song when the peak occurs, i.e. the event corresponding to the peak.

Strong Experience/Event starts at (min:sec): ends at (min:sec):

3. Which of the musical features of the passage do you consider as the most important? In other words, which musical element(s) do you personally find the most appealing and mostly contributing to the overall intense character of this passage?

Please circle a single one, or two features.

1. Melody

2. Harmony

3. Rhythm

4. Orchestration (timbre, dynamic/loudness levels changes, instruments/voice "colour")