Study Concerning the Influence of Some Sound Objects upon Emotions

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Abstract: *Throughout all humankind history, music has been a major component of creating emotional states and of modulating feelings and even physiology. The study analyses the emotional aspects of various key components of sound objects (as defined by Bernard Seve), seeking a deeper understanding of the sound emotional fingerprint. This is achieved with analysis of data collected from a representative echelon of listeners, exposed to several type of sound objects, with very similar musical characteristics. The musical samples were analysed using sound analysis tool and delivered to the subjects, for personalized audition, in a pre-established order. The matrix data collected from the subjects were correlated with the musical element of each the piece, and represented in a field, prone to indicate the emotional potential of some combinations of musical characteristics. This approach contributes to a better understanding of how one can predict the emotional trigger of one sound object or musical fragment.*

Key-words: *sound object analysis; music elements; emotional triggers*

1. Introduction

One of the most challenging issue in the music physiology, is the reality of the emotions felt during and after audition. Emotions evolved as answers to environments with significant potential for survival. Emotions help to build an answer to various stimuli, are multidimensional, generate alterations in subjective feelings, physiology and behavioural responses[2]. The absence of some tangible, utilitarian scope of musical auditions questions the reality of the induced emotions. Nevertheless, there is an impressive corpus of research which proves that music conveys a multifold response, in the same way as "utilitarian", non- aesthetic induced emotions.

There are several mechanisms to explain how music conveys emotions[3]. All these theories target a primary response, consequence of psychoacoustic musical elements and other auditive stimuli.

BRECVEMA theory proposed by Juslin et al. (2010) describes a brain reflex, activated by acoustic basic modifications, as rhythm or intensity changes. This reflex is correlated with an archaic, evolutionary survival complex system. These events are associated with events linked with relevant survival signals (loud sounds, approaching animal sounds). As such, any unexpected change of an acoustic elements, tone, timbre, intensity or tempo is decoded as an attention trigger and stimulates a response.

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[2] Scherer KR, Zentner MR., 2001. Emotional effects of music: Production rules. In: Juslin PN, Sloboda JA, editors. Music and emotion: Theory and research. Oxford: Oxford University Press. p. 371.
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Huron (2006) discussed the way music exploits this kind of response[4], extension of anticipation and expectations, to intensify an emotional response. High order musical events, as motif or instrumental changes induce emotions through expectation mechanisms. Sloboda (1991) required participants to identify musical passages, correlated with the strongest physiological, emotional response, as tears or shivers[5]. It resulted that the most frequently events in such passages were new or unexpected harmonies, appoggiaturas (delaying of principal tone). Scherer et al. (2013) proved that the musical structure and acoustic elements are more important in determining the emotional reactions than the mood[6]. Cowen (2020), mentioned the most linked musical events with physiological and emotional response[7]:

- Hart rate and dermal conductivity – general musical expectations.
- Accelerated ventilations, hart rate and dermal conductivity – tempo, accents and rhythmic articulations; rapid, staccato. Shivers – vocal entries, intensity changes
- Dermal conductivity and facial contractions – first vocal solo or choir
- Shivers and dermal electroconductivity – adagios, largos contrasts and alternations between main instrument and orchestra, strange progressions, sudden intensity changes, ambiguity.

1.1 IT tools in research on music and emotions

Since the creation of the International Society for Music Information Retrieval, were accelerated the research for metadata and significant musical characteristic of Sound Objects (SO). SO were defined by Bernard Seve (Sève, 2013) as "organized assemblies of sound events"[8]. Usualy, the musical libraries access metadata as the content (title, album, genre), author (intellectual properties, copyright, composer, performer), material information as data, format, duration, sampling. In modern multimedia libraries are novel visions and needs, with respect to classification from the conveyed emotion or mood. Social media slowly impose new classification paradigm and eligibility criteria for music and SO, in general. The extent to which such classification criteria can be generalized and materialized is still a hot issue in research.

Up to now, are known some essential musical properties, for example: for joy are correlated the vivid tempo, major chords, positive lyrics. One may conclude that a SO with these properties will be, supposedly, a "joyful" one. But, in real life, thigs are far from being so simple. *Ears to science project* aimed, among others, to correlate some classes of properties with classes of emotions, and its results are under validation. Because the music is a redoubtable cohesion force in all cultures, it is expected a certain level of objective impact, for all humans, in general, with slight differences, linked with culture and habits. In 2020, Cowen et al. examined the semantic space of the subjective experience, associated with musical audition, in two cultures – western and Chinese. The research focused on the conceptualization, the focus on the feeling specificity and affect elements linked with the audition; the dimensional aspect, or the number of distinct feelings, associated with the music; and the feeling distribution, their clear boundaries.

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[4] Huron, D., 2006. Sweet anticipation: Music and the psychology of expectation. The MIT Press.
[5] J. A. Sloboda, 1991. "Musical structure and emotional response: Some empirical findings." *Psychol. Music* 19, p. 114.
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[7] Cowen Alan S., Xia Fang, Disa Sauter, and Dacher Keltne, 2020 „What music makes us feel", PNAS, 117 (4), p. 1928.
[8] Seve Bernard, 2013. L'Instrument de musique. Une étude philosophique, Seuil. p. 47.

The emotions conveyed by the audition were represented in a field of 13 emotions, with intensity characteristics.

1.2. Psychological substrate of musical preferences

Despite the large variation and short lives of the musical genres, there is a limited number of dimensions in musical preferences which mirror specific psychological needs. Rentfrow P. J. and Gosling S. D., grouped these dimensions as Reflective and Complex, Intense and Rebellious, Upbeat and Conventional, and Energetic and Rhythmic[9]. Preferences for these music dimensions were related to personality dimensions, self-views, and cognitive abilities. There should be some explanations why one choses music in resonance with one's current mood, or with the need to change this mood. One of most basic evidence discovered is that people tend to choose the music tempo according with their current heartbeat rate with the heartbeat associated to the target state.

2. Research method

2.1 The research objectives

Research objectives are to identify the correlations between the characteristics of SO and certain emotion, conveyed by the audition. Due to the dimensional limitation of such an approach, a limited number of musical characteristics will be analyzed, as factors to influence the feelings reported during the audition.

2.2. Participants and research instruments

Research targeted adult public, heterogenous in terms of age, education, musical education, traditions and ethnicity. For this pilot study a sample of 35 persons were enrolled, 65% women, and 82% of urban provenience, 68% with high education and 36% possessing a postgraduate degree. 42% had at least 7 years of specific, musical education, in public education system.

The present study used two types of research instruments: a survey, structured in two items and a set of virtual instruments for signal analysis, built in LabView environment.

The first part of the survey collected general data, as age, gender, provenience, general education, musical education. The second item collected the responses regarding the emotions conveyed, their intensity and body dynamics associated with the respective emotions, on a 1 to 6 Lickert scale. The emotions felt were to be chosen from a list of 25, encoded with a valence code: anger, sadness, melancholy, solitude, depressed, anxiety, nervousness, fright, fear, terror, serenity, joy, happiness, delight, amusement, sensuality, extasy, love, adoration, compassion, sacred love, surprise, shock, disgust, sorrow, regret.

2.3. Research methodology

The means of research included a set of 6 SO, sequenced in a music file, excerpts from various musical pieces, from several genres. The median duration was 1,3 minutes, with fading on the last 10 seconds and 1 min and 30 seconds pause between consecutive SOs. The means

[9] Rentfrow PJ, Gosling SD, 2003. „The do re mi's of everyday life: The structure and personality correlates of music preferences". *Journal of Personality and Social Psychology 84*:1241.

included the personal audition equipment of the participants (playback device and headphone set). The SO set is presented in the table 1. Because of extremely large variation of the musical elements combinations, the following elements were "fixed": binary time signatures, all are at the beginning in their parts, all have pulsatory beats and musical accents, all are sung by several instruments, in, basically, homophonic texture. Timbre, tempo, and dynamics are, among all, variable. An analysis of the SO was performed, with respect to the Beat, Higher Frequency Specter Energy (the median energy of higher pitches), Lower Frequency Specter Energy (the median energy of lowest pitches) and the correlation analysis between the occurrence of these characteristics and the emotions induced was performed.

Nr.	**Title**	**Composer**	**Duration min:sec**	**Instrument**
1	Song from Maramureș	Anonymous	1:23	traditional band
2	Mozart: Serenade Nr. 10 for winds 'Gran Partita', III. Adagio	W. A. Mozart	1:16	Orchestra
3	Wood dove, Op. 110	A. Dvořák	1:26	Orchestra
4	Symphony nr. 7 in A, op. 92, p 2, Allegretto	Ludwig van Beethoven	1:19	Orchestra
5	Song	Anonymous	0:58 remix	traditional band
6	The Hours/ The poet acts	Philip Glass	1:23	Orchestra

Table 1. *The set of the Sound Objects*

Each participant received the electronic format of the sequenced SOs and the printed survey, with the task to find a quiet period and space for the audition, listen each OS and immediately, fill in the conveyed emotion, its intensity and body dynamics associated. Body dynamics included any movement of any part of the body, induced/ appeared during the audition (including balance, beats, contractions, shivers, and tears). The responses were collected and built in a data base, along with the results of the sound analysis and musical characteristics. The field of emotion distribution was built for each SO, using the median of the values collected.

3. Results

The distribution of the intensities (blue) and body dynamic (ochre) of emotions are represented in figures 1- 6 and indicate the most predominant emotion conveyed by the SO. For example, for Doină from Maramureș, Happiness and Enchantment contain the emotional spectre induced. Mozart, Beethoven, and Philip Glass pieces show a larger spread of emotion throughout the spectre. The spread on the emotional field increases as a response to the complexity of the sound. In most cases, the body dynamics almost overlaps the emotion intensity.

The Higher Frequency Specter Energy is positively correlated with Joy ($r = 0,97$) and Happiness ($r = 1$), Amusement ($r = 1$), Sorrow ($r = 1$), and Solitude ($r = 1$), with Melancholy ($r = 0,90$) and less with Anxiety ($r = 0,73$) and Enchantment ($r = 0,67$). The Lower Frequency Specter Energy is negatively correlated with Sorrow, Solitude, Happiness, Amusement ($r = -1$), Melancholy ($r = - 0,99$, $P< 0.01$), Anxiety ($r = -0,96$), Serenity ($r = -0,73$). The beat is negatively correlated with Sorrow and Solitude ($r = -1$), and Surprise ($r = -0.68$) but has positive correlation with Joy ($r = 0,98$) and Happiness ($r = 0,78$).

Regarding the couplings between the emotions, Anxiety is correlated with Melancholy (r = 0,97) and Solitude (r = 1), Enchantment is correlated with Serenity (r = 0,98) and Joy (r = 0,97).

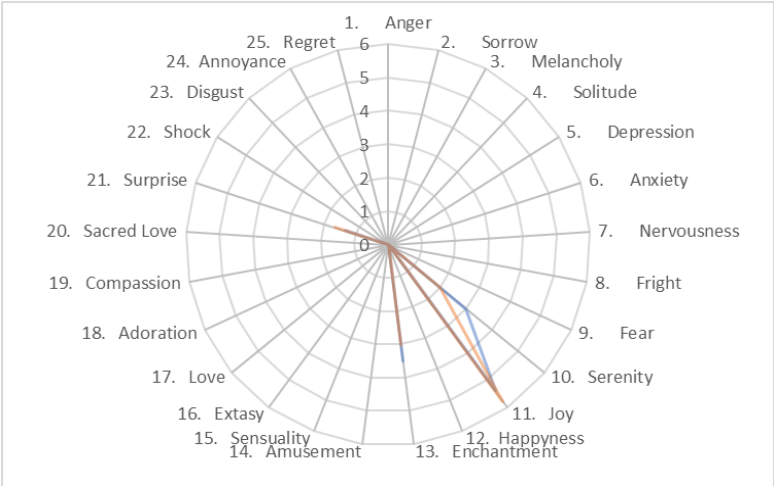

Fig. 1 *Emotion field for Doină from Maramureș*

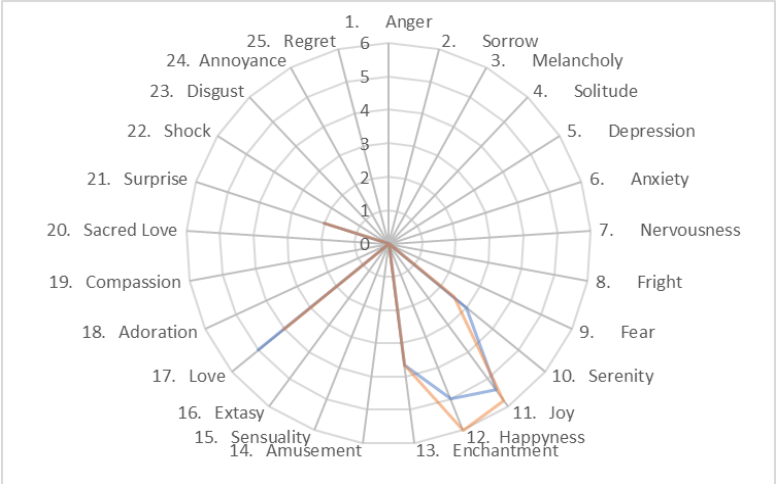

Fig. 2 *Emotion field for Mozart's Grand Partita, Adagio*

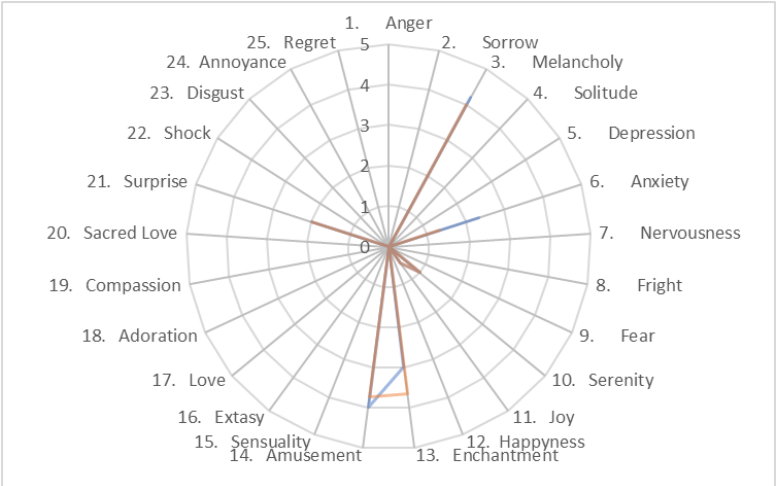

Fig. 3 *Emotion field for Dvorjak's Wood Dove*

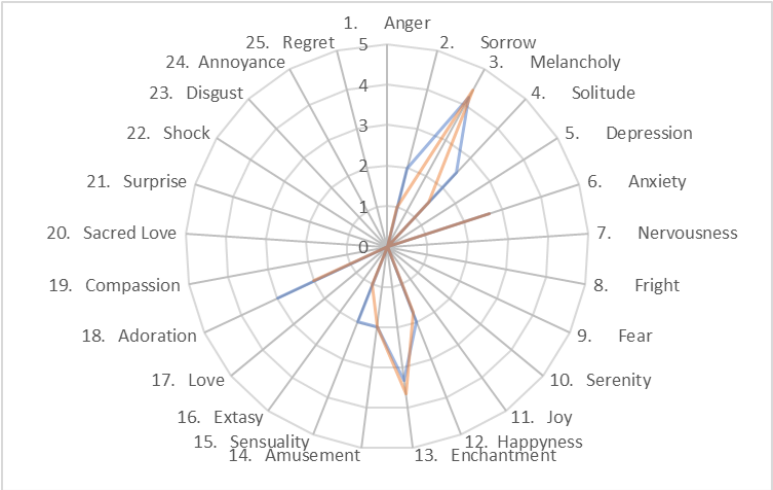

Fig. 4 *Emotion field for Beethoven's 7th Symphony, 2nd Movement*

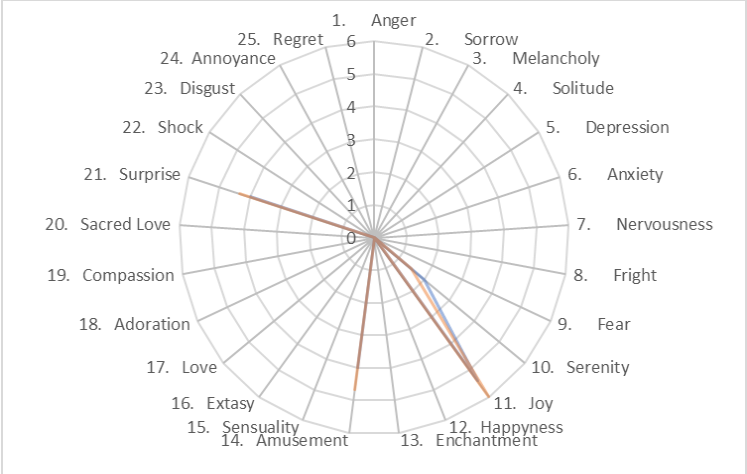

Fig. 5 *Emotion field for Song*

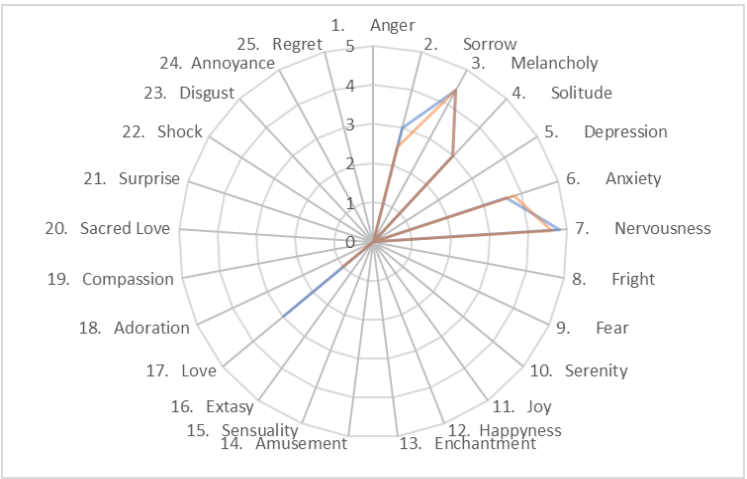

Fig. 6 *Emotion field for Philip Glass, The Hours-The Poet Acts*

4. Conclusions

Music conveys emotions, feelings, with the same intensity as emotional response involved in real life situations, for survival or adaptation purpose. There is a plethora of research that successfully report how these emotions, preferences, personality traits can be detected and measured, correlated with sound and musical characteristics, musical genres, and audition context. There are new needs in modern societal structures, induced by novel communication patterns, regarding the exposure to Sound Objects and Music. More and more emerges the need to be able to predict the emotional trigger and potential of a given music sample, with sufficient confidence in terms of generality and objectivity. Therefore, there is a need to understand the correlation between various combinations of musical characteristics and emotional valence, intensity, and body dynamics. This understanding facilitates new classification of Sound Objects and music samples and can be, in future, defined as a new entry in the metadata, to be used in music libraries.

The present study presented a pilot research, with an attempt to measure the correlations between the characteristics of SO and certain emotion, conveyed by the audition. The results showed that the more complex a SO is richer and spread is the conveyed emotional reported. The Higher Frequency Specter Energy seems to be more influential on the emotional specter than the Lower one. The Beat is strongly correlated with Joy and Happiness and less with Mellow zone of the Emotional specter. The results of this study offer a ground for larger, more complex approaches, that could link the multifold emotional experience with objective musical characteristics, to a level that will allow predictions regarding the influence and vector of specific music samples or Sound Objects.

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