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A Psychometric Evaluation of Emotional Responses to Horror Music

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ABSTRACT

This research explores and designs an effective experimental interface to evaluate people's emotional responses to horror music. We studied methodological approaches by using traditional psychometric techniques to measure emotional responses, including self-reporting, and galvanic skin response (GSR). GSR correlates with psychological arousal. It can help circumvent a problem in self-reporting where people are unwilling to report particular felt responses, or confuse perceived and felt responses. We also consider the influence of familiarity. Familiarity can induce learned emotional responses rather than listeners describing how it actually makes them feel. The research revealed different findings in self-reports and GSR data. Both measurements had an interaction between music and familiarity but show inconsistent results from the perspective of simple effects.

Introduction

The emotional effects of music are often considered the most important reason that people engage in music-related activities. Many video-games, the film industry, marketing and music therapy use music to induce emotions. However, scientific research has not yet thoroughly understood the connection between music and emotions. Current research on music and emotions focuses on the mainstream fields of music cognition, music psychology and music neuroscience [1].

Our work is based on psychoacoustic theory and evaluates a horror music generator using psychometric evaluations. The purpose is to create a system for adapting a soundtrack in realtime either to maximize listener engagement or to facilitate interactive media approaches (non-linear narrative film, for example). Horror music is intended to evoke an emotion of fear. We need to know if the music generated by our generator is scary, how it compares to horror music that listeners may well be familiar with, and whether different measures of emotion are correlated. We use traditional measurements to analyse the generator.

Measurements of Emotional Responses

There are two kinds of emotional feelings that music brings to people. One is the emotion expressed by the music, and the other is that the music itself evokes listeners' emotions. The former is normally referred to as **perceived emotion**; and the latter referred to as **induced emotion**. Perceived emotion, also called external locus, is "all instances where a listener perceives or recognizes expressed emotions in music (e.g., a sad expression), without necessarily feeling an emotion" [[2], p. 561]. On the other hand, induced emotion, also called internal locus, is "all instances where music evokes an emotion in a listener, regardless of the nature of the process that evoked the emotion" [[2], p. 561].

Through emotional inflections, the emotions that we perceive will sometimes become a part of the emotions we feel. Nevertheless, compared with other emotional stimuli and whether through theoretical or practical research, distinguishing perceived and induced emotions triggered by music is particularly important [3].

Conceptualization of Emotions

According to [[4]], there are three dominant models to conceptualize and differentiate emotions:

(1) the discrete model (or categorical model)
(2) the dimensional model, and
(3) the prototype model.

A recent review of music and emotion research studies showed that the two most dominant emotion models have been the discrete model and the dimensional model [5]. The discrete model classifies emotions based on basic emotion theory into basic emotions, labeling each category with an adjective such as: fear, happiness, anger, sadness, and disgust [6] [7]. The discrete model emphasizes that there is not necessarily a correlation between each basic emotion; they are independent of each other. A slight change in one emotion does not necessarily cause a change in other emotions. On the other hand, the dimensional model posits that emotions are continuous [8]. Each emotion is a location in a multi-dimensional plane, based on a reduced number of axes. Using several psychological dimensions (e.g. valence, activity, arousal and potency) to establish an emotional space and express the emotion as a point in space.

Subjective Measurements of Emotions

The most common method to measure emotional responses is **self-reporting**. Widely used self-reporting scales include Likert ratings [9], adjective lists and free verbal reports. However, with self-reported emotion, users can be unwilling to report particular felt responses, or confuse perceived responses with felt responses.

Objective Measurements of Emotions

Previous studies observed that music stimuli cause heartbeat, blood pressure, and other autonomic nervous reactions [10]. Physiological signals that measure reactions such as facial electromyography, respiration, heart rate, and **galvanic skin response** (**GSR**) also measure human emotional responses [10] and can overcome the issue of perceived responses.

Measurements used

Research shows that the prevalent approaches to evaluate emotions are self-report and physiological measurements [11]. Each approach has its drawbacks [12], so we apply multiple methods.

We use the Differential Emotion Scale (DES) [13] for **self-reporting**, rated on a 5-point Likert scale and formulated around ten fundamental emotions: fear, anger, joy, contempt, surprise, disgust, shame, guilt, interest, and sadness.

Our target emotion is fear. Research shows that fear increases skin electrical activity, cardiac acceleration, myocardial contractility and vasoconstriction [14]. We use **GSR** as it measures sympathetic activity more directly than other measures [15]. GSR refers to the change in electrical properties of human skin caused by the interaction between psychological states and environmental events. When the body is changed by external stimuli or emotional state, the activity of the autonomic nervous system causes changes in the relaxation and contraction of blood vessels in the skin and secretion of sweat glands, resulting in changes in skin resistance.

We can measure different variables, such as skin resistance or conductance, and its reciprocal. Applying Ohm's law skin resistance (R) equals the voltage (V) which is between two electrodes on the skin and divided by the current (I) passed through the skin. The formula of Ohm's law can be expressed as $R = V/I$. In general, GSR is measured using a GSR amplifier to apply a constant voltage to the skin. After measuring the resulting current through the skin, the GSR amplifier determines the skin conductance in microSiemens (µS). According to van Dooren [16], the GSR signal is best measured from the palms or fingers, although other body positions are occasionally used, such as shoulders or foot. The parameters of GSR that are commonly characterized by metrics are: amplitude (µS); latency, rise time, and half-recovery time (sec) [17]. We use amplitude to measure the strength of the emotion.

Aims

We aim to develop an efficient experimental framework to evaluate a horror music generator. The generator algorithmically composed two MIDI files *m1* and *m2*. We used the MAX/MSP (https://cycling74.com/products/max) software as it can generate MIDI files based on emotional responses. We use a transformative algorithm based on a second order Markov-model with a musical feature matrix. It allows discrete control over five parameters in a 2-dimensional model [8]. The model is generative and can be used to create new state sequences according to the likelihood of a particular state occurring after the current and preceding states. We pass this file through DAW and apply virtual instrument synthesizers to produce the final music. According to previous studies, the length of music excerpt needs to be 30 seconds to 60 seconds long to successfully induce emotions [2]. To analyse our generative music, we compare it to two horror movie soundtracks (*Jaws* and *Psycho*) composed to induce fear.

- Music excerpt *jaws* is from the movie soundtrack of 'Jaws', and is played in an ostinato motive comprising the alternation of two notes, with a minor scale at moderate speed [18].
- Movie soundtrack 'Psycho' is also chosen for music excerpt *psycho*. It played in a screeching upward glissandi on violin, which is still iconic to the feature of horror music [19].

Each music excerpt has added fade in/fade out to prevent abrupt clicks. Additionally, the four music excerpts have been normalized to avoid unbalanced volume, and to make sure there is a consistent loudness level across all music excerpts.

Our evaluation examines the music using subjective and objective measurements. We use the framework to explore the relationship between induced emotion, self-reports, and physiological responses to horror music.

Hypotheses

1. There will be significant interaction between horror music and familiarity.
2. There will be significant difference between horror movie soundtracks and generative music in the induced emotional responses, including self-reports and galvanic skin response.

Experiment

We recruited 23 female and 7 male subjects for the experiment. Subjects ranged in age from 21 to 45 years old, with 36.67 % in the range of 31 to 35 years old (Mean = 32 years, StDev = 5 years). 70 % of subjects had no musical experience, 20 % of subjects had some experience, and 10 % of subjects were professional musicians.

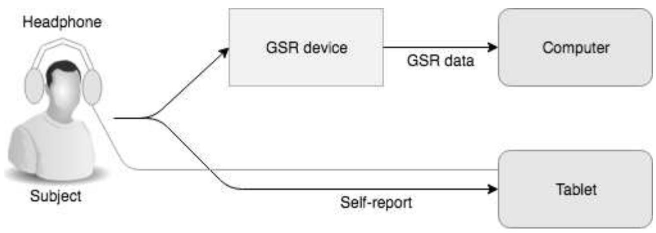

Fig. 1 The Evaluation Framework

Fig. 1 shows the framework. Subjects wore a Shimmer3 GSR+ Unit (see Fig. 2) - a small wireless sensor device that can detect very small changes of galvanic skin response.

Shimmer3 has built-in Bluetooth which connects to software to stream the data. We use ShimmerCapture in this experiment. ShimmerCapture is compatible with Windows PC and an Android App, it can stream data in real time, and is able to display and save the data in real-time. We increased its sampling rate from the normal setting to 51.2 Hz to collect data more precisely. Shimmer3 also has auto-range GSR, this setting aims to stream data automatically and can display the corresponding amplitude range and resolution of the device according to the response recorded from the subject.

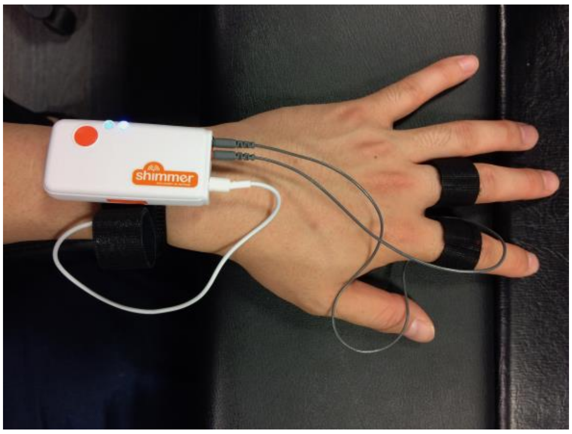

Fig. 2 Shimmer3 GSR+ Unit

The Shimmer3 GSR+ Unit has two electrodes which are placed on the fingers to record skin conductance response. As shown in Fig. 2, the electrodes are placed on the palm-side surface of the index and middle fingers of the non-dominant hand. The reason for choosing the non-dominant hand is because subjects are required to fill in the questionnaire during the experiment, hence the dominant hand should not wear the Shimmer device to avoid any movement artefact.

We synchronized the Shimmer3 using the computer, and the subject listened to the music excerpts through headphones to remove ambient noise and with their eyes closed to avoid visual interference. The experiment needed to record five GSR data series for each subject, *baseline*, *g1*, *g2*, *jaw*s, and *psycho*. For the baseline, we collected 30 seconds of GSR while the subject listened to no sound. The baseline of each subject is different due to many factors such as dryness, nervousness, temperature that causes variations in the baseline skin conductance value. Therefore, we need to calibrate to form a baseline (skin conductance response with music minus skin conductance response without music stimulation). We recorded 30 seconds of GSR data for each stimulus *g1*, *g2*, *jaws*, and *psycho*. We randomized the order of presentation of the music excerpts to exclude the ordering effect.

Before starting the experiment, subjects were asked to read the information sheet and sign the consent form. After explaining the purpose of the project, subjects were instructed to sit in front of the tablet, told not to move their non-dominant hands, and were requested to avoid sudden or jerky movements during the following tests. The subjects put the Shimmer3 GSR+ Unit on the index and middle fingers of their non-dominant hands. To ensure that the subjects were feeling comfortable during the experiment, several things needed to be checked, including the subject's emotional stability, comfort of the hand position and the comfort and tightness of the electrodes and wristband of the Shimmer3.

Following all adjustments, subjects were first required to complete a basic demographic questionnaire. Next, the subjects were asked to close their eyes and relax for 30 seconds to allow us to calibrate the GSR by recording the subject's GSR *baseline*. After calibration, the listening test began. The listening test contains four music excerpts, each 30 seconds in duration. The subject listened to a music excerpt in full and then answered a set of questions in an online questionnaire where they rated their familiarity with the music and their feelings in response to the music. Subjects were able to double check or change their answers at any time during completion of the online survey. We focused on quantitative analysis within-subjects, so every subject had to listen to all four music excerpts in full. There are two independent variables: horror music fear and familiarity. Dependent variables are self-reports and physiological responses.

To examine whether there is an interaction between music and familiarity, we conducted two-way repeated measures ANOVA [20] (also known as a within-within-subjects ANOVA) using SPSS [1] (version 25.0) analytics software to analyse the results of the self-reports and GSR. Two-way

[1] https://statistics.laerd.com/spss-tutorials/two-way-repeated-measures-anova-using-spss-statistics.php

repeated measures ANOVA compares the mean differences between groups that have been split on two within-subjects factors (independent variables) which are horror music fear and familiarity.

Results

We noticed that the GSR data collected from the Shimmer device had some abnormal perturbations when it started streaming the data. Hence, we filtered and excluded the first 5 seconds of data to avoid these incorrect results. Additionally, we subtracted all of the GSR data from the baseline to calibrate it and normalize it against the subject's baseline. We could then calculate the average GSR amplitude evoked by the four music excerpts.

Self-reports and GSR data both showed an interaction between music and familiarity.

Self-reports

Interaction between Music and Familiarity

Fig. 3 plots the mean "fear" ratings in the self-reports for each music excerpt *g1*, *g2*, *jaws*, *psycho* (1, 2, 3, 4 in x-axis) where subjects felt familiar='Yes' or unfamiliar='No'. Although there are parallel lines between music excerpt g2 and jaws, others are nonparallel lines, especially at the fourth music excerpt. As we can see, there is an obvious crossing line in music excerpt psycho, showing that it might have a statistically significant interaction between music and familiarity. People who are familiar with the excerpt feel less fear than those who are unfamiliar.

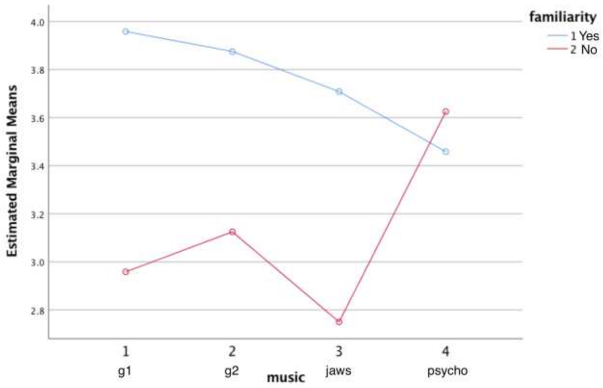

Fig. 3 The music × familiarity interaction for self-reports. The chart shows the average "fear" rating in blue for subjects familiar="Yes" and shows the average "fear" rating in red for subjects unfamiliar="No".

We note that we expected our generative music to be unfamiliar to the subjects. However, some of the subjects felt familiar. Equally surprisingly, over half of the subjects was unfamiliar with the movie soundtrack Jaws. It might have several reasons, such as individual variance of musical experience or subjects may not have not seen movie Jaws before.

- Before considering whether there is a statistical interaction, we conducted a Mauchly's sphericity test as the music has four levels as shown in Fig. 3. The sphericity test indicates that the variances of the differences are equal, which means that the assumption of sphericity has not been violated, $\chi2(5) = 4.229$, $p = 0.517$ ($p > 0.05$). Therefore, we do not need to correct the F-value for this effect.
- From Fig. 4, the interaction between music and familiarity is statistically significant from the two-way repeated measures ANOVA test $F(3,69) = 3.743$, $p = 0.015$ ($p < 0.05$).

Simple Effects of Familiarity

Analysing the simple effects of familiarity in self-reports reveals that there is a significant effect under the stimulation of music excerpts *g1*, *g2*, *jaws*, but there is no significant difference under the stimulation of music excerpt *psycho*.
g1: $F(1,23) = 13.143$, $p = 0.001$ ($p < 0.05$).

g2: $F(1,23) = 6.978$, $p = 0.015$ ($p < 0.05$).
jaws: $F(1,23) = 9.224$, $p = 0.006$ ($p < 0.05$).
psycho: $F(1,23) = 0.299$, $p = 0.59$ ($p > 0.05$).

Simple Effects of Music

Under self-reporting analysis, there is no significant difference in the simple effects of music when subjects felt either familiar or unfamiliar as ($p > 0.05$) for the F-value for both.

GSR

Interaction between Music and Familiarity

Fig 4 plots the average GSR amplitude for each music excerpt *g1*, *g2*, *jaws*, *psycho* (1, 2, 3, 4 in x-axis) and familiarity ('Yes' = familiar, 'No' = unfamiliar). The lines are not parallel and there is an obvious crossing line in music excerpt *g2*, demonstrating that it might have a statistically significant interaction between music and familiarity.

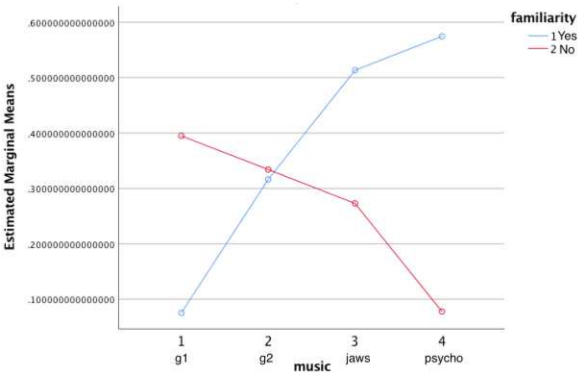

Fig. 4 The music × familiarity interaction for GSR. The chart shows the average GSR amplitude in blue for subjects familiar="Yes" and shows the average GSR amplitude in red for subjects unfamiliar="No"

- Before considering whether there is a statistical interaction, we conducted Mauchly's sphericity test. It demonstrates that the variances of the differences are equal, which means that the assumption of sphericity has not been violated, $\chi2(5) = 5.608$, $p = 0.347$ ($p > 0.05$).
- The interaction between music and familiarity is statistically significant:
  $F(3,69) = 8.785$, $p = 0.000052$ ($p < 0.05$).

Simple Effects of Familiarity

Analyzing the simple effects of familiarity in GSR data, there is a significant effect of familiarity under the stimulation of music excerpts *g1* and *psycho*, but there is no significant difference under the stimulation of music excerpts *g2* and *jaws*.
g1: $F(1,23) = 7.219$, $p = 0.013$ ($p < 0.05$).
g2: $F(1,23) = 0.021$, $p = 0.887$ ($p > 0.05$).
jaws: $F(1,23) = 3.262$, $p = 0.084$ ($p > 0.05$).
psycho: $F(1,23) = 21.942$, $p = 0.000102$ ($p < 0.05$)

Simple Effects of Music

- Before considering any statistical interaction, we performed Mauchly's sphericity test. It reveals that the assumption of sphericity has been violated, $\chi2(5) = 33.173$, $p = 0.00004$ ($p < 0.05$). Therefore, we needed to use the Greenhouse-Geisser correction[2]. The correction elicits a more accurate significance value. It increases the *p*-value to compensate for the fact that our ANOVA test is too liberal when sphericity is violated
- After the correction, analyzing the simple effects of music, where subjects felt familiar, shows that there is a significant difference in effect.
  $F(1.683,38.717) = 13.03$, $p = 0.0001$ ($p < 0.05$).
- However, there is no significant difference in the simple effects of music on the subjects when they were unfamiliar with the music.
  $F(2.121,48.784) = 1.89$, $p = 0.16$ ($p > 0.05$).

Discussion

For **hypothesis 1** in section 0, we proved that there is an interaction between music and familiarity in self-reports and GSR data. However, we revealed different results from the perspective of simple effects.

The generative music *g1* and *g2* and movie soundtrack *jaws* have significant difference in simple effects of familiarity in self-reports while

[2] https://statistics.laerd.com/statistical-guides/sphericity-statistical-guide-2.php

movie soundtrack *psycho* does not. In contrast, the results of GSR data shown that only music excerpts *g1* and *psycho* have significant difference in simple effects of familiarity. Previous research has proven that familiarity can influence people's emotional responses [21]. Other studies also stated that familiarity may cause unpredictable results in measuring emotional responses [10]. The two measurements do not have consistent results so it is not clear that familiarity has an effect on music excerpts *g2*, *jaws*, *psycho*. Nevertheless, the emotional responses to our generative music excerpt *g1* show a consistent result that is affected by familiarity.

Our initial expectation was that generative music should tend to be unfamiliar to the subjects. However, some of the subjects felt familiar with the generative music in self-reports, and surprisingly, over half of the subjects were unfamiliar with the movie soundtrack *jaws*. This familiarity and unfamiliarity may have several reasons, such as individual variance of musical experience. Subjects may think *g1* or *g2* is similar to something they have heard. It is also possible that subjects might not have seen Jaws before, for example.

Hypothesis 2 aimed to determine if the subjects' emotional responses are significantly different across the four music excerpts and between generated and well-known music.

In self-reports data, the subjects' emotional responses are not significantly different with respect to familiar and unfamiliar music. In GSR data, there is no significant difference when the subjects felt unfamiliar. However, in GSR data, we showed that there is a significant difference when the subjects felt familiar. As discussed earlier, our generative music excerpt *g1* and the well-known music excerpts *jaws* and *psycho* have a significant difference. Even in comparison between our generated music excerpts *g1* and *g2*, we found a significant difference. On the other hand, comparing movie soundtracks *jaws* and *psycho* does not reveal a significant difference. Comparing music excerpt *g2* and *jaws* does not show a significant difference either. Overall, the average GSR amplitude of movie soundtracks are higher than generative music under the situation that subjects felt familiar. This indicates that the subjects may be perceiving emotions in the movie soundtracks, i.e., feeling emotions that they expect from the nature of the horror film.

Limitations

We conducted the experiment in a sound studio that is not a "real world" setting. However, when comparing music designed for fictional films, one must consider that the original intended setting is also "not real".
Research studies indicate that familiarity may be related to "liking" effects caused by preferences, the preference ratings for familiar music are higher than for unfamiliar music [21]. This experiment did not consider preference. For instance, we can add ratings of how much the subjects like or dislike the music excerpts into self-reports.

Additionally, in self-reports data, there are other emotions that are involved when the subject undergoes this experiment, as shown in Fig. 5. However, the mean ratings for these emotions do not exceed half indicating that the subjects felt these emotions far less and fear was the dominant emotion which validated our focus on this emotion.

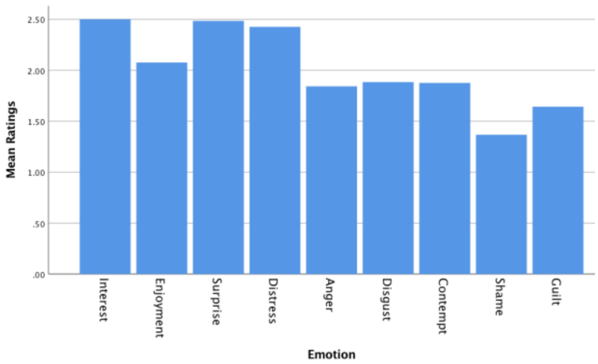

Fig. 5 Mean ratings of other emotions

We could also introduce a baseline for the self-reports to reduce variance. The subject's pre-test emotional state can influence their responses to both the questionnaire and GSR sensors. To take into account each individual's emotional state prior to the listening test, we could use the questionnaire to ask the subjects to rate their current feelings.

Conclusions

Our work demonstrated that it is possible to use MAX/MSP software to generate music excerpts capable of inducing fear in the listener.

Overall, there is increased GSR in each music excerpt. We conclude that GSR is a suitable detection tool to evaluate emotional responses. For our choice of subjective measurement, DES-based self-reporting is applicable in this experiment and is also suitable for differentiating different categories of emotions. The two measurements do not have consistent results. The results are not clear as to whether familiarity has an effect on music excerpts *g2*, *jaws* and *psycho*. Nevertheless, the emotional responses to our generated music excerpt *g1* showed consistent results with both self-reporting and GSR.

The self-reporting and GSR results indicated that there is an interaction between music and familiarity (perceived emotions). In self-reports, familiarity has insignificant effects. Conversely, in GSR data, there are differences in the simple effect of music between unfamiliar and familiar tracks. Familiar movie soundtracks also have higher GSR amplitude than unfamiliar ones but lower fear self-reports.

Hence, to induce fear reliably and avoid perceived emotions, we should focus on unfamiliar music composed using our computational algorithms. Being able to generate horror music using computational algorithms will also allow us to develop a framework where we can consider familiarity. We can match music pieces and ensure new pieces will or will not induce perceived emotions as required by the specific application.

This has significant impact on the creative industries where music is used to influence emotions. Our main aim for this work is to develop a music generator for games, the film and TV industries, and music therapy that produces music which induces specific emotions in the listener [22]. We will use the work described here to build the framework for a generic music generator capable of inducing specific emotions in the audience.

Acknowledgement

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The experiment was conducted with ethical approval from the University of York, Dept of Electronic Engineering review board.

References

[1] W.F. Thompson. 2015. Music, thought, and feeling: Understanding the psychology of music. Oxford university press.

[2] P.N. Juslin and D. Västfjäll. 2008. Emotional responses to music: The need to consider underlying mechanisms. Behavioral and brain sciences 31, 5 (2008), 559–575. https://doi.org/10.1017/S0140525X08005293

[3] A. Gabrielsson and E. Lindström. 2001. The influence of musical structure on emotional expression. Oxford University Press.

[4] P.N. Juslin and J. Sloboda. 2001. Music and emotion: Theory and research. Oxford University Press.

[5] J.K. Vuoskoski and T. Eerola. 2011. Measuring music induced emotion: A comparison of emotion models, personality biases, and intensity of experiences. Musicae Scientiae 15, 2, 159–173. https://doi.org/10.1177/10298649110150020 3

[6] P. Ekman. 1992. An argument for basic emotions. Cognition & emotion 6, 3-4 (1992), 169–200. https://doi.org/10.1080/02699939208411068

[7] J. Panksepp. 2004. Affective neuroscience: The foundations of human and animal emotions. Oxford university press.

[8] L.Feldman Barrett. 1998. Discrete emotions or dimensions? The role of valence focus and arousal focus. Cognition & Emotion 12, 4, 579–599. https://doi.org/10.1080/026999398379574

[9] R. Likert, 1932. A Technique for the Measurement of Attitudes, Archives of Psychology, 140, 55, 44-53.

[10] C.L. Krumhansl. 1997. An exploratory study of musical emotions and psychophysiology. Canadian Journal of Experimental Psychology/Revue Canadienne de Psychologie expérimentale 51, 4, 336. https://doi.org/10.1037/1196-1961.51.4.336

[11] T. Eerola and J.K. Vuoskoski. 2013. A review of music and emotion studies: approaches, emotion models, and stimuli. MusicPerception: An Interdisciplinary Journal 30, 3, 307–340. https://doi.org/10.1525/MP.2012.30.3.307

[12] P.N. Juslin and J. Sloboda. 2011. Handbook of music and emotion: Theory, research, applications. Oxford University Press

[13] C.E. Izard, et al. 1993. Stability of emotion experiences and their relations to traits of personality. Journal of personality and social psychology 64, 5. https://doi.org/10.1037/0022-3514.64.5.847

[14] S.D. Kreibig. 2010. Autonomic nervous system activity in emotion: A review. Biological psychology 84, 3, 394–421. https://doi.org/10.1016/j.biopsycho.2010.03.010

[15] M.E. Dawson, A.M. Schell, and D.L. Filion. 2007. The electrodermal system. Handbook of psychophysiology 2, 200–223. https://doi.org/10.1017/CBO9780511546396.007

[16] M. van Dooren, et al. 2012. Emotional sweating across the body: Comparing 16 different skin conductance measurement locations. Physiology & behavior 106, 2, 298–304. https://doi.org/10.1016/j.physbeh.2012.01.020

[17] M.E. Dawson, et al. 2007. The electrodermal system. Handbook of psychophysiology 2, 200–223. https://doi.org/10.1017/CBO9780511546396.007

[18] G. Biancorosso. 2010. The shark in the music. Music Analysis 29, 1-3, 306–333. https://doi.org/10.1111/j.1468-2249.2011.00331.x

[19] M. Brownrigg. 2003. Film music and film genre. University of Stirling.

[20] M. Kristensen and T. Hansen. 2004. Statistical analyses of repeated measures in physiological research: a tutorial. Advances in physiology education 28, 1, 2–14.

[21] C.S. Pereira, et al. 2011. Music and emotions in the brain: familiarity matters. PloS one 6, 11, e27241. https://doi.org/10.1371/journal.pone.0027241

[22] D. Williams, V.J. Hodge, L. Gega, D. Murphy, P.I. Cowling and A. Drachen, 2019, AI and Automatic Music Generation for Mindfulness, Audio Engineering Society International Conference on Immersive and Interactive Audio, March 27–29, York, UK