Online measurement of emotional musical experiences using internet-based methods - An exploratory approach

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ABSTRACT

Emotional musical experiences were measured via internet-based methods. Therefore, an Internet version of software for real-time measuring of self-reported emotions (EMuJoy) was tested. 83 of 107 subjects who took part in the experiment listened to music pieces and at the same time continuously rated their emotional state using mouse movements in a two-dimensional emotion space based on the dimensions arousal and valence. Results showed that a web experiment seems to be a promising approach for emotion research: most of the subjects evaluated nearly all aspects of the study in a positive way.

Keywords

Emotion; Music; Web Experiment.

INTRODUCTION

Music is able to induce strong emotions (so-called "chills" when accompanied by goose pimples or shivers down the spine) (Sloboda, 1991; Panksepp, 1995). The continuous measurement approach has been established (Schubert, 1999) as a standard method for the measurement of emotions induced by music. The *EMuJoy* software for continuous emotion rating (Nagel et al., in press) was used in a previous lab study by our research group. Subjects had to continuously rate their felt emotions induced by music. Therefore, an emotion space (see Figure 1) with the two dimensions arousal and valence (Russell, 1980) was used.
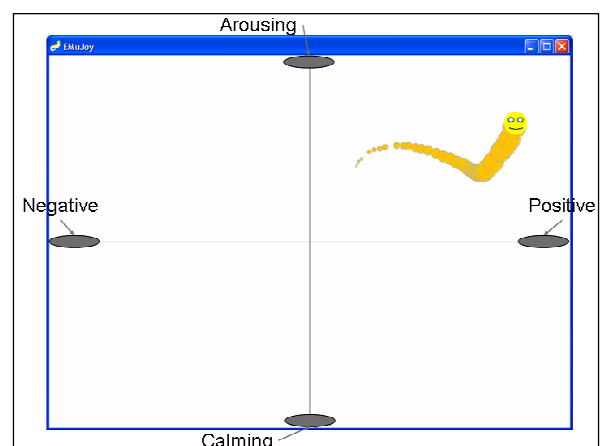

Figure 1. Emotion space with valence on the horizontal and arousal on the vertical axis as used by Nagel et al. (in press) for continuous measurement of music induced emotions

Web experiment might be a promising way to advance Nagel et al.'s (in press) method. According to Reips (2002), Web experiments have many useful advantages:

- High number of participants because of easy access to the experiment (bringing the experiment to the participants instead of the opposite)
- No time constraints for participation
- High standardization
- No direct social interactions
  - Fewer demands on participants
  - Minimum researcher bias
- Participation in a more natural environment

Reips also names some disadvantages of web experiments:

- Dropout
- Less control than lab experiments
- Technical problems

However, he also gives some hints on how to eliminate these potential problems. For instance, he suggests using the "high hurdle technique" to control dropout and motivational problems. By collecting the main data in reverse, only highly motivated subjects who participated in the entire experiment can take part. This can be accomplished by including a warm-up section, which subjects have to pass in order to reach the main section (in this study, it is the self report of musically induced emotions). Up until now, Web experiments have rarely been used in music psychology, even though modern computer users are equipped with broadband Internet access and soundcards. This generates many interesting opportunities for testing this new method.

AIMS

The purpose of this study is to clarify if the continuous measurement of emotions while listening to music (Nagel et al., in press) is possible over the internet. As an initial step, the web-based version of the *EMuJoy* software (the Java-Applet *ESeRNet*) was pre-tested. It was necessary to investigate whether or not it is possible to induce emotions with music and measure self-reported emotions via the Internet.

METHOD
Subjects

Subjects were recruited using various mailing lists and by personal invitation. For copyright purposes, all participants were given a personal account to use for the study. Subjects could take part after logging in on the webpage www.musik-emotion.de.

Stimuli

As a warm-up, four pictures were chosen from the International Affective Picture System (IAPS) (Lang, 2001) to cover all four quadrants of the emotion space. Additionally, one neutral picture was used. Pictures were presented in a fixed order for 10 seconds each.

In the music listening section, subjects listened to a maximum of 7 musical pieces (see Table 1) in randomized order. Pieces were chosen to cover all quadrants of the emotion space. All participants were asked to listen to at least 4 pieces, but it was up to the subjects to decide how many pieces they actually listened to.

Name of Piece	Name of Composer	Performer	Style
"Tuba mirum"- Requiem KV 628	Wolfgang Amadeus Mozart	Karajan, 1989	Classical with vocal soloists
"Toccata" BWV 540	Johann Sebastian Bach	Walcha, 1997	Classical instrumental (organ)
"Main title" – Soundtrack from the movie "Chocolat"	Rachel Portman	Portman, 2000	Film music
"Coma"	Apocalyptica	Apocalyptica, 2004	Rock music on classical instruments
"Bossa nova"	Quincy Jones	Jones, 1997	Dance music
"Skull full of maggots"	Cannibal Corpse	Cannibal Corpse, 2002	Death metal
"Making Love out of nothing at all"	Air Supply	Air Supply, 1997	Pop music

Table 1. Musical stimuli used

Procedure:

The online questionnaire contained 4 sections (see Figure 2) that, altogether, took approximately 45 to 60 minutes to complete (depending on the number of musical pieces listened to).

a. Instructions

This section provided information about the background of the study and the time needed to participate. In addition, subjects had to enter their login data on the first page. It was subsequently tested whether or not the necessary Java-Plug-in was installed. If needed, a hyperlink to a free Java download could be used. The subjects also had to give a self-assessment of the sincerity of their participation. At the end of this first section, the

subjects were able to test the playback capacity of their computer equipment. They were asked to use headphones for playback. Information about their technical equipment and where their participation took place was collected.

b. Warm-up

The emotion space was explained after section one. The continuous rating of the emotions felt by the subjects was expressed for the dimensions of valence and arousal by moving the computer mouse and chills were expressed by pressing the mouse button. High arousal was defined as being exciting and low arousal as being calming. Positive valence was defined as pleasurable and negative valence as unpleasant.

Subjects had to rate their current emotional state before the stimuli were presented. To become familiar with the rating system, all subjects were shown 5 pictures from the IAPS (Lang, 2000) and simultaneously rated their felt emotions continuously within the emotion space. Mouse movements were recorded with the Java-Applet *ESeRNet,* which was presented in a pop-up window. The pictures were presented in the background of the emotion space.

This warm-up section was included to familiarize the subjects with the rating system within the emotion space and implement Reip's (2002) "high hurdle technique". After the warm-up, subjects were asked whether they had fully understood the instructions. If their answer was "no" they were sent back to the instruction section; if it was "yes" they were sent on to the music listening section.

c. Ratings of emotions induced by music

In part three, the subjects listened to musical pieces and reported the emotions they felt in the same manner as in the warm-up. After every piece, subjects filled in a questionnaire related to the piece to which they were just listening.
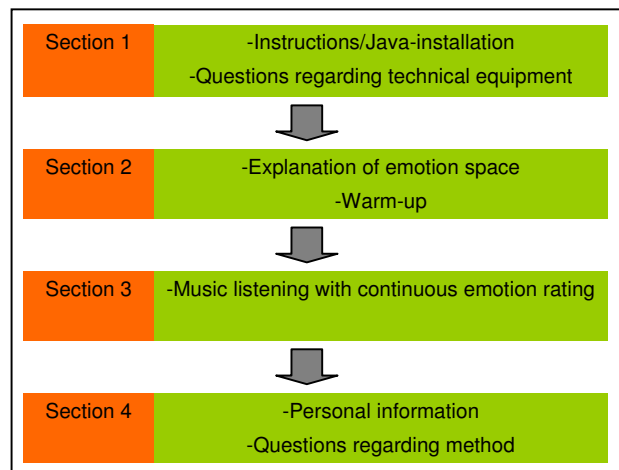

Figure 3. Flowchart of Online Questionnaire.

d. Personal information

In this final section, various personal information was collected from the subjects. For example, they were asked for information about their socio-demographic background (e.g. age, sex, or profession) and about their musical training. Finally, all participants evaluated different aspects of the study and had the opportunity to give feedback about the experiment.

**Data Recording and Data Analysis**

Web questionnaire

The data related to the questionnaire was stored in a MySQL database.

Emotion rating

The subjects' self-reported emotions while looking at the pictures or listening to the music were transmitted and recorded via the Internet in real-time. For each distinct mouse-movement and mouse-click, the absolute position of the users' mouse in the emotion space and the actual times were registered. For comparison of the emotional time-series of different subjects, data had to be interpolated in post-processing. A sample rate of 1 Hz was chosen for interpolation.

RESULTS

Methodological Results

Subjects

A maximum of 107 subjects logged in at least one time. 87 participants gave information about themselves: 48 of them were male and 41 female. Their mean age was 32
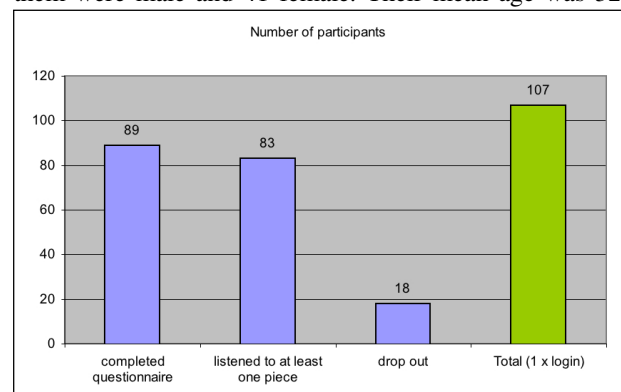
years old (range: 14-66 years). Most of them were highly educated: 58% with a university degree and 36% the German "Abitur" (university-entrance diploma). Most subjects were also skilled musicians: only 18% were non-musicians, whereas 52% were amateur and 30% professional musicians. The main language and nationality was German (88%).

Dropout

A major problem with Internet experiments is the dropout rate of participants. In this study, the dropout rate was not a significant problem (see Figure 3). 107 subjects made an initial effort to participate and 83 of them listened to at least one piece of music and completed the questionnaires. The other 18 subjects may have had technical problems or had lost interest.

Figure 4. Frequency of dropout. The first bar represents the number of subjects who completed the entire questionnaire; the second shows the number of subjects who also listened to one piece of music, the third the number of subjects who dropped out, and the fourth the number of subjects who logged in at least one time.

Evaluation of method by participants

Subjects were asked for a subjective evaluation of the study. The result of the 83 valid subjects who answered these questions is displayed in Figure 4. Sound quality was rated as "good" by the majority of subjects. Almost everyone agreed that they were able to display emotions in the emotion space reasonably well. Almost no one had trouble understanding the functionality of the emotion space, had technical problems or mentioned that downloading some of the pages took too long. Furthermore, practically no subjects had difficulties installing the Java software. Additionally, most people agreed that the music listening experience was similar to a normal listening situation. Only the item "participation time" was negatively evaluated: One third of the subjects indicated that the experiment took too long to complete.
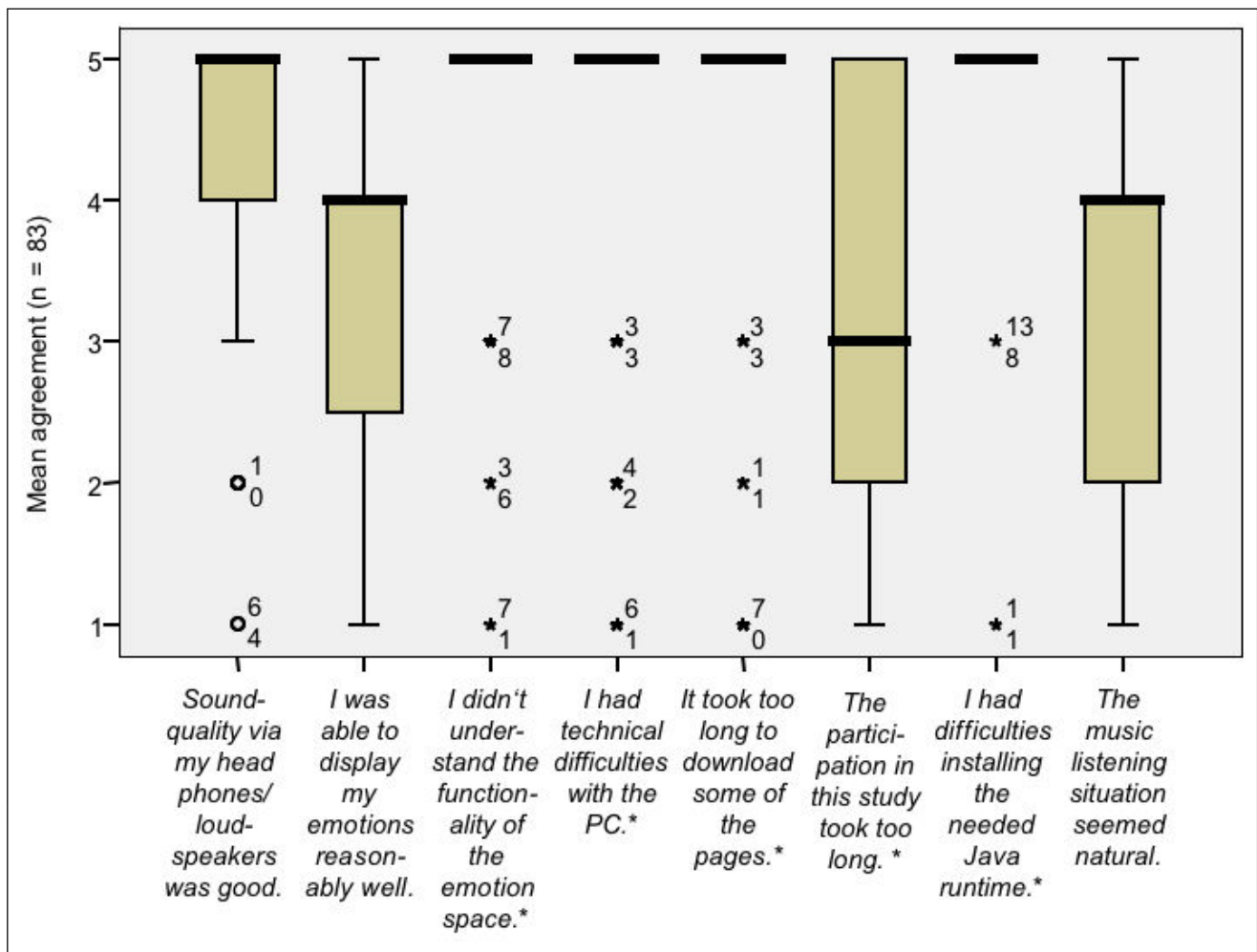
Figure 5. Box plot of mean agreement for certain aspects of the study.

Note: Answers were given on a 5-point scale: from 1 = "*I do not agree*" to 5 =" *I highly agree*"

*For better comparability with the other items, values have been recoded: 1=5, 2=4, 4=2, 5=1.

Emotional self reports of musical pieces

Figure 5 shows the mean rating of arousal and valence for all seven pieces averaged over time and for all subjects. The death metal piece induced high arousal and negative valence for most participants. The "Bossa Nova" also caused high arousal but positive valence, maybe because of its dance music character. The "Main title" and "Tuba

mirum" both elicited low arousal and positive valence. "Coma" had a mean arousal and valence was

balanced. Both pieces, "Toccata" and "Making Love", were rated in the upper right quadrant of the emotion space (high arousal and positive valence).
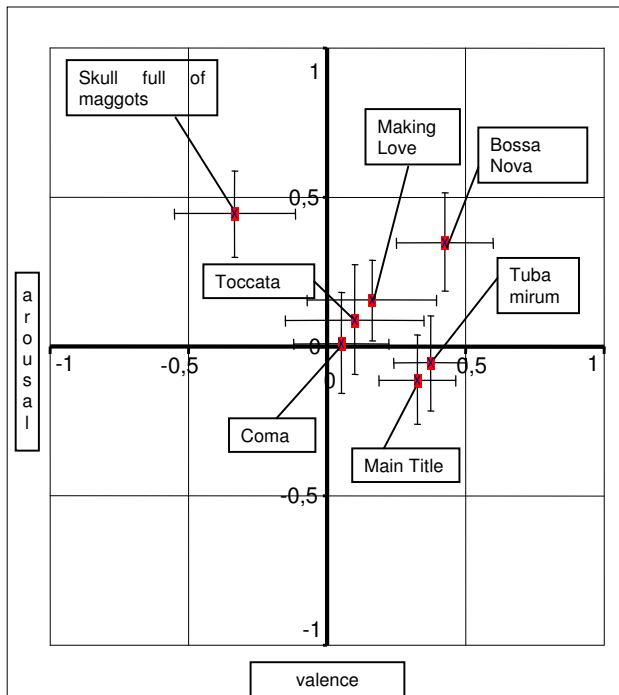

Figure 6. Emotion space with mean and SD of all seven musical pieces. Arousal und valence ratings were averaged for time and subjects.

DISCUSSION

This pre-test showed that the measurement of emotions induced by auditory stimulation over the internet is a promising approach. Although the sample was not representative of the entire population with respect to general und musical education, a great heterogeneity in terms of age and gender was realized in this study.

Dropout was not terribly high even though some subjects had to install software. Subject's evaluation of the study was satisfying, but one has to bear in mind that only those subjects who successfully took part reached the section of the online questionnaire where the evaluation of the method took place. Participants who had problems most likely did not get to these questions. Overall, 77,5% of the 107 people who logged in at least one time completed the online questionnaire and listened to at least one musical piece. The only negative result from the evaluation was that for some subjects, participation took too long. In the future, perhaps less personal information could be collected to save time.

After investigating the means of the arousal and valence ratings in the emotion space, structural and psychoacoustical changes in the musical pieces over time related to the emotional perception of the music were revealed.

To summarize, web experimenting seems to be a promising tool for emotion research related to music and music perception research. This might lead to a deeper insight into the emotions experienced while listening to music in everyday life.

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