Towards a Dynamic Approach to the Study of Emotions Expressed by Music

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Abstract. The emotions expressed through music have often been investigated by asking listeners to fill questionnaires at the end of a given musical performance or an excerpt; only few studies have been dedicated to the understanding of the *dynamics* of emotions expressed by music in laboratory or in social contexts. Based on a specific model of emotions related to music, the Geneva Emotion Music Scale (GEMS), we tested to what extent such dynamic judgments are reliable and might be a promising avenue to better understand how listeners are able to attribute different kinds of emotions expressed through music and how the social contexts might influence such judgments. The results indicate a high reliability between listeners for different musical excerpts and for different contexts of listening including concerts, i.e. a social context, and laboratory experiments.

Keywords: Emotion, music, dynamic judgment, musical expressiveness.

1 Introduction

1.1 Definition of Emotion

The majority of studies on music and emotion propose to judge musical excerpts in terms of valence and arousal (Vieillard et al., 2008; Chapin, Jantzen, Kelso, Steinberg, & Large, 2010) or in terms of basic emotions (Fritz et al., 2009; Juslin, 2000). However, one might suppose that musical emotions are more complex or subtle and therefore these approaches might not be the best suited to understanding emotions related to music. As noted by Scherer (2004), a major problem in studying music and emotion is the tendency to confuse the terms "emotion" and "feeling". By adopting a componential approach to emotional processes and by using the component process model (CPM, Scherer, 2001) framework, we define the concept of "emotion" as brief episodes that are important and relevant for the adaptation and well being of individuals. In this context, Scherer (2004) proposed a distinction between "utilitarian emotions" and "aesthetic emotions". The former being emotions

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that humans can experience in everyday life, such as feelings of anger, fear, joy, and sadness. Scherer proposed the term "utilitarian" because this type of emotion has: "*[…] major functions in the adaptation and adjustment of individuals to events that have important consequences for their well being […]"* (p.241). Regarding aesthetic emotions, the author suggested that there are no appraisals concerning goal relevance or coping potential to the events that elicit them. Therefore, aesthetic emotions might not be governed by vital functions such as bodily needs or current goals. Consequently, the traditional approaches of emotions do not seem appropriate to the study of emotions related to music. In 2008, Zentner, Grandjean and Scherer made a set of experiments enabling them to propose a factorial model of the most relevant emotional terms for the understanding of emotions related to music. These studies gave rise to a nine factorial model of emotions induced by music: the GEMS. These include the dimensions of wonder, transcendence, tenderness, nostalgia, peacefulness, power, joyful activation, tension, and sadness.

1.2 Perception of Emotion vs. Induction of Emotion

The attribution of emotional qualities of music is a complex process allowing humans to represent and explicitly report feelings expressed through music, whereas the induction of emotions is the process of experiencing emotions, i.e. the feelings, as a result of listening to music. In other words, the subjective emotional responses one might have as a result of listening to music (Scherer & Zentner, 2001). This distinction is not always made and this leads to confusion in understanding the mechanisms underlying emotional processes in music which include the attribution of emotion qualities of music *and* the induction of emotion by music (Scherer, 2004). It would be logical to assume that what is expressed by music and what is felt by listeners is the same emotion (Evans & Schubert, 2008). However, several observations may challenge this assumption. Indeed, a piece of music which expresses sadness or melancholy could be listened to in order to provide a feeling of nostalgia in the listener, a state desired and appreciated by the listener (Zentner, Grandjean & Scherer, 2008). Likewise, "agitating music" could have a cathartic effect on the listener and help calm her/him down. Therefore, the correlation between felt emotions and emotions expressed through music is not necessarily positive. The listener does not necessarily feel the same emotions that the music expresses (Evans & Schubert, 2008). Broadly speaking, we can say that recognizing the emotions expressed by music is a process which is based on the perception of acoustical and musical features on which listeners could agree, as evidenced by numerous studies in which this is demonstrated; people have a high reliability on the emotions expressed by music (Hevner, 1935, 1936; Gabrielsson & Juslin, 1996; Fritz et al., 2009; Fabian & Schubert, 2003) whereas felt emotions are more related to subtle subjective and intimate process, as demonstrated in Gabrielsson's (2001) Strong Experiences in Music (SEM) and music preferences studies (Rentfrow & Gosling, 2003; Rentfrow & McDonald, 2010). And though the GEMS model proposed by Zentner, Grandjean & Scherer (2008) concerns emotions induced by music, it currently represents the most

effective attempt to study the specific emotions related to music, which is why we are using it to investigate emotions expressed by music as well.

1.3 The Dynamic Aspects of Music

An obvious feature of music is that it unfolds over time, as does emotion. In order to effectively apprehend the emotions expressed by music, it is preferable, and probably essential, to base the judgments on continuous measurements. For this purpose, we propose to use an approach called "dynamic judgment". The works of Emery Schubert (2001; 2004) have been among the first to take into account this characteristic of time and to use continuous measurements. This method allows experimenters to record the judgments of emotions expressed by music in real time and then to follow the changes of perception and attribution over time. As pointed out by Nagel and colleagues (2007), there are different ways of investigating the emotions related to music, such as self report, questionnaires and adjective scales, but all of these approaches are static and therefore unable to demonstrate the complexity of the unfolding of musical emotions. A very old assumption is that music communicates emotion (Gabrielsson & Juslin, 2003). In this context, it's interesting to consider how people decode this type of "message", which types of cues they use to build up a representation of emotions expressed by music. Many acoustical parameters and musical features have been identified as being relevant for the understanding of how musicians convey emotions. Among them, those that are most cited are sound intensity (loudness), timbre, intervals, rhythm, articulation, pitch level, accentuation and tempo (for a review, see Gabrielsson & Lindström, 2010). Performers use these different features in order to convey the emotion they want to express (Juslin, 2001). The contexts of the musical performances (e.g. solo versus ensemble) and the contexts of listening might also be important factors playing a role in emotional processes.

2 Method

We conducted a first laboratory exploratory study in order to investigate the dynamics of emotional judgments of the emotions expressed by music through time. More specifically, we wanted to test to what extent, on a given dimension, participants agreed on the emotion expressed by music using the GEMS model.

2.1 Participants

Seventy-one participants (8 men) took part in this experiment, for course credits. The average age is 21.97 (sd = 2.84).

2.2 Materials and Procedure

Based on our musical expertise and our knowledge of the GEMS dimensions, we chose a series of musical excerpts in order to correspond to the 9 dimensions of the

GEMS. We had 36 musical excerpts in total, i.e. 4 musical excerpts per dimension. The mean duration of the excerpts was 2'.36'' (range from 2'21'' to 3'18''). The new method of dynamic judgment, using a Flash Interface, allows us to record the dynamic judgments in real-time in a graphical manner. The width of the graph was 1000 pixels (equivalent to 4'16) and the height 300 pixels. Participants had direct visual feedback in the graphic interface of the judgments they were making by moving a cursor up and down as time advances (if necessary the graph-window scrolled). Measurements are made every 250 milliseconds. The x-axis represented time, while the y-axis represented the intensity of the emotion expressed by music (e.g. Nostalgia) through a continuous scale marked by three levels of intensity: low, medium, and high. The main instruction was: "*Rate to what extent the music expresses [dimension of interest]*". Before the beginning of the experiment the participants had to achieve a training trial in order to become familiar with the procedure. A description of the GEMS dimensions was provided before the beginning of the judgments. Each participant had to judge 9 excerpts, one excerpt per GEMS dimension.

3 Results

3.1 Reliability of the Emotional Dynamic Judgments

In order to estimate the reliability of the measure we computed the Cronbach alphas for all excerpts and GEMS dimensions across the participants. The Cronbach alphas ranged from 0.84 to 0.98 (Fig. 1).

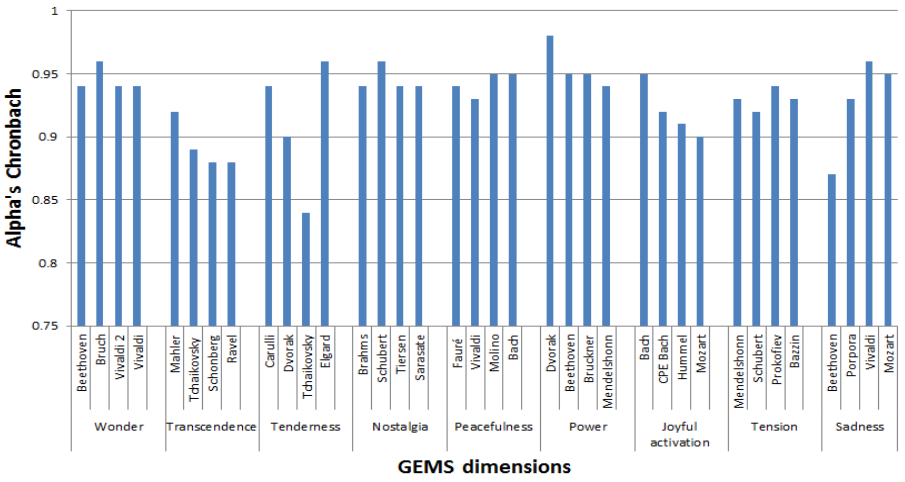

Fig. 1. Cronbach Alphas for the 36 musical excerpts (N=71). The best Cronbach's Alpha lies on the dimension of "Power" for the 4th movement of the New World Symphony by A. Dvorak (.98) and the worst Cronbach's Alpha lies on the dimension of "Tenderness" for the 2nd movement of the Symphony No. 6, *Pathétique*, by P.I. Tchaikovsky (.84).

Figure 2 illustrates the great agreement between participants regarding the emotion expressed by music. The lines represent the participant's judgments and we did a normalization transforming the data into z-scores in order to have all the scores on the same range. The average is represented by the red line.

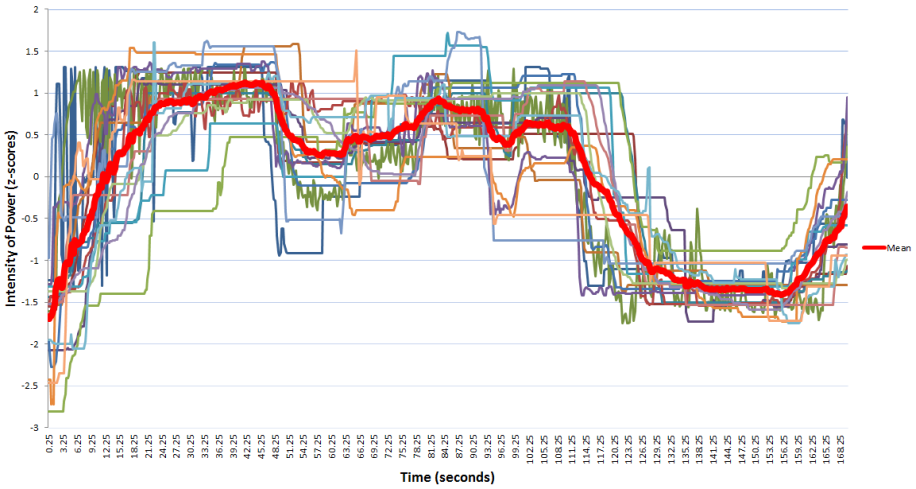

Fig. 2. Individual and averaged z-scores (N=18) for the dynamic emotional judgment of the 4th movement of the New World Symphony by Dvorak judged on the dimension of « Power » (duration: 2'80').

3.2 Dynamic Judgments during Live Performance?

Given the effectiveness of the method, we conducted an experiment with the famous Italian quartet, "Quartetto di Cremona", during a live performance and thus implying a social context at the Saint-Germain Church, in Geneva. We recruited a panel of 14 music lovers and placed them in the audience in front of the musicians. Each participant had a laptop computer and a cursor in order to judge the musical pieces during the concert. Figure 3 presents the Cronbach Alphas for the different movements of the pieces played during the concert. The pieces were the String Quartet n°4 in C major Sz 91 by B. Bartok and the String Quartet n°3 in A major op. 41 by R. Schumann.

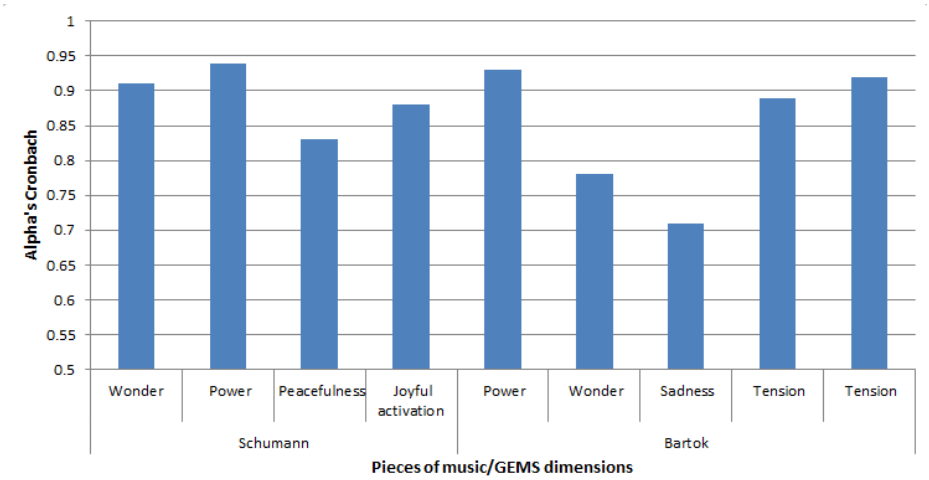

Fig. 3. Cronbach Alphas of the dynamic judgments made during a live performance. The best Cronbach's Alpha lies on the 2nd movement of the String Quartet n°3 in A major op. 41 by R. Schumann (.94) judged on the dimension of "Power" and the worst Cronbach's Alpha lies on the 3rd movement of the String Quartet n°4 in C major by B. Bartok judged on the dimension of "Sadness" (.71).

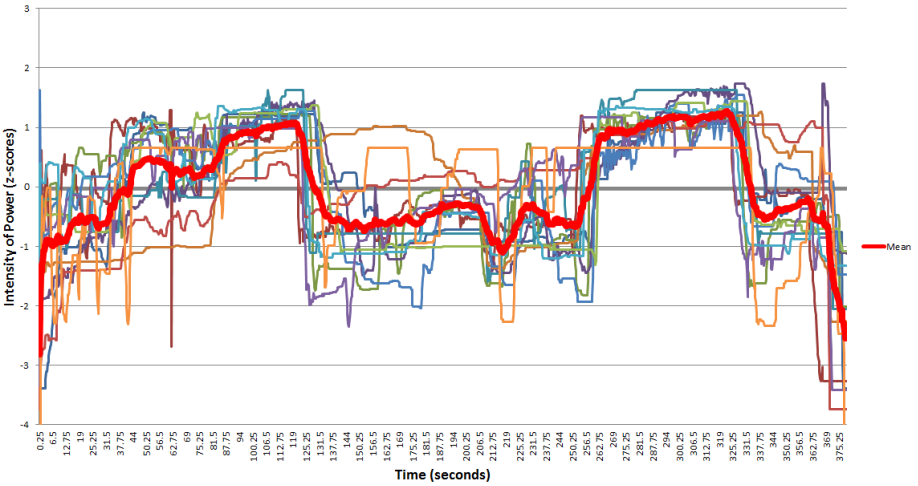

Fig. 4. Z-scores of the dynamic judgment on the dimension of "Power" for the 2nd movement of the String Quartet n°3 in A major op. 41 by R. Schumann (duration: 6'25'').

4 Perspectives

First, these results show that the method of dynamic judgments is very effective regarding the specific emotional dimensions (i.e. the GEMS dimensions) expressed by music through time, in a laboratory context (and short excerpts) as well as during

live performance implying social interactions (and with longer musical pieces). In a second step, by adopting a Brunswikian (Brunswik, 1956; Grandjean, Baenziger, & Scherer, 2006) perspective, we want to predict the emotional dynamic judgment by the acoustic parameters and musical characteristics in the music score, using a Granger Causality method. In future studies we also plan to systematically investigate the impact of social contexts at different levels including, i) the impact of live musical performances, with the presence of one or several musicians, versus recorded performance, and ii) the context of listening which might be isolated or in a small or big group of people. These kinds of methods will allow researchers to quantify the impact of two different social contexts, i) at the musician level and ii) at the audience level as well as their interactions.

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References

Brunswik, E.: Perception and The Representative Design of Psychological Experiments, 2nd edn. University of California Press, Berkeley (1956)

Chapin, H., Jantzen, K., Scott Kelso, J.A., Steinberg, F., Large, E.: Dynamic Emotional and Neural Responses to Music Depend on Performance Expression and Listener Expression. PLoS ONE 5(12) (2010)

Evans, P., Schubert, E.: Relationships between Expressed and Felt Emotions in Music. Musicae Scientiae 12, 75–99 (2008)

Fabian, D., Schubert, E.: Expressive devices and perceived musical character in 34 performances of Variation 7 from Bach's Goldberg Variations (Special issue). Musicae Scientiae, 49–71 (2003)

Fritz, T., Jentschke, S., Gosselin, N., Sammler, D., Peretz, I., Turner, R., Friederici, A.D., Koelsch, S.: Universal Recognition of Three Basic Emotions in Music. Current Biology 19, 573–576 (2009)

Gabrielsson, A.: Emotions in strong experiences with music. In: Juslin, P., Sloboda, J. (eds.) Music and Emotion: Theory and Research, pp. 431–429. Oxford University Press, Oxford (2001)

Gabrielsson, A., Lindström, E.: The influence of musical structure on emotional expression. In: Juslin, P., Sloboda, J. (eds.) Music and Emotion: Theory and Research, pp. 223–248. Oxford University Press, Oxford (2001)

Gabrielsson, A., Juslin, P.: Emotional Expression in Music. In: Davidson, R.J., Goldsmith, H.H., Scherer, K.R. (eds.) Handbook of Affective Sciences, pp. 503–534. Oxford University Press, New York (2003)

Grandjean, D., Baenziger, T., Scherer, K.R.: Intonation as an interface between language and affect. Progress in Brain Research 156, 235–247

Hevner, K.: The affective character of the major and minor modes in music. American Journal of Psychology 47, 103–118 (1935)

Hevner, K.: Experimental studies of the elements of expression in music. American Journal of Psychology 48, 246–268 (1936)

Juslin, P.: Cue utilization in communication of emotion in music performance: relating performance to perception. Journal of Experimental Psychology: Human Perception and Performance 26, 1797–1813 (2000)

Juslin, P.: Communicating emotion in music performance: a review and theoretical framework. In: Juslin, P., Sloboda, J. (eds.) Music and Emotion: Theory and Research, pp. 309–337. Oxford University Press, Oxford (2001)

Nagel, F., Kopiez, R., Grewe, O., Altenmüller, E.: EMuJoy: Software for continuous measurement of perceived emotions in music. Behavior Research Methods 39, 283–290 (2007)

Rentfrow, P.J., Gosling, S.D.: The Do Re Mi's of Everyday Life. The Structure and Personality Correlates of Music Preferences. Journal of Personality and Social Psychology 84, 1236–1256 (2003)

Rentfrow, P.J., McDonald, J.A.: Preference, personality, and emotion. In: Juslin, P., Sloboda, J. (eds.) Handbook of Music and Emotion: Theory, Research, Applications. Oxford University Press, Oxford (2010)

Scherer, K.R.: Appraisal Considered as a Process of Multilevel Sequential Checking. In: Scherer, K.R., Schorr, A., Johnstone, T. (eds.) Appraisal Processes in Emotion: Theory, Methods, Research, pp. 92–120. Oxford University Press, New York (2001)

Scherer, K.R.: Which Emotions Can be Induced by Music? What are the Underlying: Mechanisms? And How Can We Measure Them? Journal of New Music Research 33, 239–251 (2004)

Scherer, K.R., Zentner, M.: Emotion effects of music: Production rules. In: Juslin, P., Sloboda, J. (eds.) Music and Emotion: Theory and Research, pp. 361–392. Oxford University Press, Oxford (2001)

Schubert, E.: Continuous measurement of self-report emotional response to music. In: Juslin, P., Sloboda, J. (eds.) Music and Emotion: Theory and Research, pp. 361–392. Oxford University Press, Oxford (2001)

Schubert, E.: Modeling Perceived Emotion with Continuous Musical Features. Music Perception 21, 561–585 (2004)

Vieillard, S., Peretz, I., Gosselin, N., Khalfa, S., Gagnon, L., Bouchard, B.: Happy, sad, scary and peaceful musical excerpts for research on emotions. Cognition & Emotion 22, 720–752 (2008)

Zentner, M., Grandjean, D., Scherer, K.R.: Emotions Evoked by the Sound of Music: Characterization, Classification, and Measurement. Emotion 8, 494–521 (2008)