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Dynamic Rating of Emotions Elicited by Music

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Abstract

In this study college students' feelings about ten music excerpts were compared to their thoughts of what the excerpts were intended to express. Each participant recorded his/her own response with a computer mouse, moving a point within an emotion circumplex (Barrett & Russell, 1999) to provide ratings each second along two dimensions, pleasantness and activation. Participants were 8 college students, ages 18 to 23, with an average of 4.25 years of music lessons or school music. The students changed their ratings rather infrequently. Correlations between ratings on the two dimensions varied across excerpts from strongly negative to strongly positive. Correlations between the students' feelings and their thoughts on the intent of the music were generally positive, though there were notable exceptions. For example, students thought A. Piazzolla's "Tanguedia III" was intended to decrease in pleasantness, but their reported feelings showed slight increases. Students indicated that the intent of J.S. Bach's "Sarabande, Suite #6 D Major" was neutral in pleasantness, but their feelings were high on the pleasantness scale. The results suggest that these dimensions of emotional response to music are relatively independent and reported music-elicited feelings are similar but not identical to the judged intent of the performer and composer.
Keywords: Emotions. Music. Structure of Affect.

1. Introduction

Music has long been recognized for its ability to elicit emotions. Musicians are traditionally preoccupied with the task of delivering an experience to the listener that is emotionally meaningful. In fact, performers and composers will frequently measure their success by how much emotion they believe they have produced in their audiences. Scientific interest in emotional responses to music has a long history. In the 1930s, Hevner performed a set of studies to discover whether music could communicate meaning in a systematic way (Gentile, 1998). More recently, it has been shown that music produces physiological responses in its hearers (Krumhansl, 1997). Given this evidence, it seems we can assume music to have real emotive power, opening up possibilities for new studies that examine its potential more closely.

Although emotions have been studied for many years, researchers have only recently begun to reach consensus regarding the necessary dimensions for describing affect. Two dimensions in particular have appeared in studies of self-reported feeling, in the semantics of affect-related words across many cultures, and in ratings of facial expression of emotion (Barrett & Russell, 1999). One dimension, pleasure-displeasure (or valence), refers to hedonic tone. The other dimension, activation-deactivation, refers to a sense of mobilization or energy. Independent pleasure and activation dimensions are required in order to describe emotion adequately. Whether these dimensions are also adequate to describe emotions elicited by music has been investigated in a recent study (North & Hargreaves, 1997). Thirty subjects rated 32 music excerpts on separate 11-point scales for the extent to which each music excerpt expressed one of eight specific emotions. The remaining 30 subjects used 11-point scales to rate how much they liked the pieces and also how arousing they thought the pieces were. North and Hargreaves found that emotion ratings elicited by musical stimuli were predictable on the basis of independent ratings of liking (similar to

the valence dimension) and arousal potential (the activation-deactivation dimension). For example, excerpts rated as being of high liking/low arousal potential by one group were also rated as the most 'relaxing' and the most 'peaceful' by the other group. Thus, the two-dimensional model of affect appears to be applicable to music-elicited as well as to other emotions.

Since music is dynamic, continuous rating of music by the listener may provide a more accurate method to study the relationships between music and emotions than does a single rating at the conclusion of an excerpt. Such methods have been developed and validated in a number of recent investigations (e.g. Madsen, 1997; Schubert, 2000). These methods are also based on a two-dimensional model of affect, similar to that described above. The present investigation utilized a computerized dynamic measurement device similar to those employed in the recent work just cited. The emotions that a person experiences at different stages of listening are not made public so often as is the overall impression that a piece of music imparts, mostly because we do not generally communicate our moment-by-moment feelings to each other as we listen. People are more likely to talk about what they have listened to after it is over. Thus dynamic measurement methods may provide a more comprehensive view of what other people are thinking and feeling during their listening experience than do single ratings or the informal assessments of experience that listeners commonly make.

Some recent studies of music and emotion have assessed emotional responses to music (e.g. Krumhansl, 1997; Madsen, 1998) whereas others have measured ability to decode the emotions that performers intended to express (e.g. Juslin, 2000). The study reported here used a dynamic measurement method to assess both the listeners' emotional responses to music excerpts and their judgments of the intentions of the composer and performer so as to allow comparison of these two aspects of listener response.

2. Method

2.1 Subjects

Twelve students in a general psychology class at Bethel College, North Newton, Kansas participated in this experiment. Of the twelve students that participated in this experiment four students produced unusable data. Three of these four students were not asked to listen to two practice excerpts at the beginning of their first session and the other student did not use our program correctly which resulted in the loss of this student's data. Of the eight students that produced usable data, five of these students were female and three were male. Mean age for these eight students was 20 years (range of 18-23 years). All students were non-music majors. Two of the students had not participated in high school or college band, orchestra, or choir and had not taken private lessons in a musical instrument or in voice. The other six students had participated in high school or college band, orchestra, or choir for two to five years. Two of these six students had not taken private lessons in a musical instrument or in voice. The other four students had taken private lessons for two to ten years. Two students indicated that they like any type of music. The other six students prefer rock, classical, country, alternative, new age, rap, R & B, or folk music. Types of music the students dislike included rap, jazz, country, Christian, opera, R & B, and heavy metal.

2.2 Experimental stimuli

In order to avoid the extra dimension of emotional response to words and verbally expressed ideas, the experiment employed ten non-vocal musical excerpts, each lasting one to two minutes. The excerpts represented a wide variety of types of music. The excerpts are listed in Table 1 in the Results section of this paper. The ten excerpts were presented in a different random order for each participant and session. In addition, two practice excerpts were played for each student at the beginning of the first session for each participant. The same two excerpts were played for all students.

2.3 Design

The quantification of emotion in this experiment was based upon the two-dimensional structure of affect proposed by Barrett and Russell (1999). The words expressing positive feelings were on the right half of the circle, while negative feelings were expressed by words on the left (the pleasantness dimension). More activated or aroused feelings were on the top half, while less activated or less aroused feelings were toward the bottom (the activation dimension). Words on opposite sides of the circle expressed opposite feelings. The circumplex was incorporated into a LabVIEW virtual instrument (National Instruments, Austin, TX). The instrument superimposed a little red X on an image of the circumplex, and the X could be positioned by means of the mouse pointer. The

instrument recorded the position of the X once per second. The point where the lines crossed on the circumplex was a neutral point—the position of the X at this point indicated that one was emotionally indifferent to the music. The closer the student moved the X toward a particular word, the more purely that word expressed the student's feeling. Thus, if a particular moment in the music made the student feel calm, he or she moved the X toward that word. If the music began to make the student feel more tense, then he or she would move the X away from "calm" and toward "tense," and so on. If a feeling was best expressed by a mixture of the meaning of two words the X could be positioned at an intermediate location that indicated that fact. The instrument actually recorded the coordinates of the X's position on the two dimensions, pleasantness and activation, of the emotion circumplex.

2.4 Procedure

Testing was carried out on a personal computer on which each participant completed two thirty-minute sessions, representing the two conditions of the experiment. For the first session, one of two sets of instructions was read to the student. The other set of instructions was read to the student at the second session. Students were randomly assigned to which set of instructions they would follow first with the stipulation that four students would follow one set of instructions first and the other four students would follow the other set of instructions first. One set of instructions asked the student to indicate what emotion he or she thought the music was intended to express (the "Think" condition). The other set of instructions asked the student to indicate his or her own emotional response to the music (the "Feel" condition). After the instructions were read the student was allowed to ask questions. Once it was established that the instructions were understood, two trial excerpts were played to familiarize the student with the program. Excerpts had been recorded on a compact disc; these excerpts were played and the LabVIEW virtual instrument recorded the participants' responses. Data obtained from the trial excerpts was excluded from analysis. Following any further questions, the first of the ten excerpts was played. The student followed the instructions by moving the mouse pointer to position a little red X on the emotion circumplex at the location that best described the emotion. Each student was asked to move the X every time his or her judgment changed, as often as he or she liked. The computer kept track of the moment-to-moment changes, recording the ratings once per second. At the end of each excerpt, the program paused allowing the student to rest. When the student was ready to proceed, he or she could click on the "Continue" button of the virtual instrument with the mouse pointer. This action immediately moved the X back to the neutral point and started the compact disk player on the next excerpt. The program stopped when the "Continue" button was clicked after the last excerpt. At the end of the listening experience, a questionnaire was administered. The questionnaire gathered information regarding age, gender, year in college, and musical training, experience, and preferences.

3. Results

Generally speaking, the students changed their ratings on the emotion circumplex rather infrequently. Figure 1 shows the movement of the computer mouse by two students (p11 and p4) while listening to two of the excerpts.

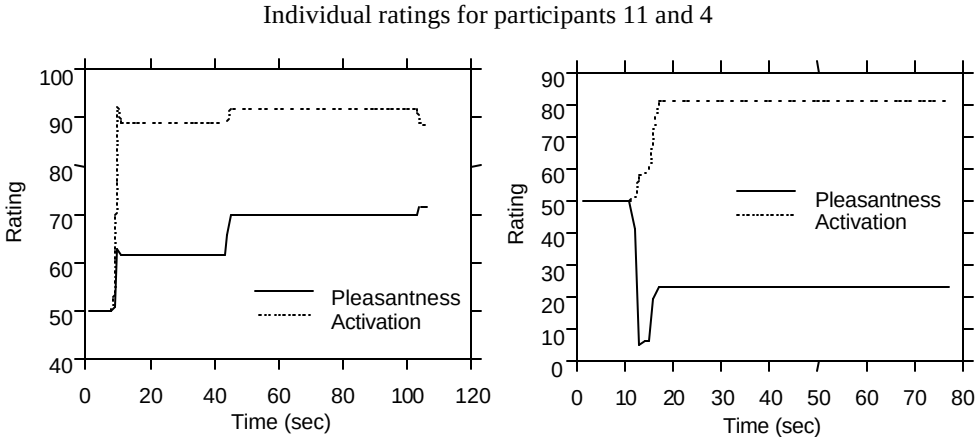

Figure 1. Pll ratings per second in terms of feelings of D. Shostakovich's "Symphony #5 Movement 4" (left panel) and p4 ratings per second in terms of thoughts of A. Piazzolla's "Tanguedia III" (right panel)

Each student's second-by-second ratings for each excerpt were saved in a spreadsheet file. The mean across the eight participants' ratings per second were then calculated for both dimensions in both conditions of the experiment for each excerpt. Pearson correlations between the mean ratings for the two dimensions and between thoughts and feelings in terms of these dimensions were calculated. These correlations are listed below in Table 1.

Table 1.
Pearson correlations between the two dimensions and between thoughts and feelings.
("Think-Ac" = Think condition, Activation dimension; "Think-Pl" = Think condition, Pleasantness dimension; "Feel-Ac" = Feel condition, Activation dimension; "Feel-Pl" = Feel condition, Pleasantness dimension. P-values are Bonferroni-corrected within the six possible correlations among the four variables measured on each excerpt.)

Excerpt	Think-Ac with Think-Pl		Feel-Ac with Feel-Pl		Think-Pl with Feel-Pl		Think-Ac with Feel-Ac	
	r	p	r	p	r	p	r	p
"Alabama", John Coltrane	0.738	<0.001	0.905	<0.001	0.911	<0.001	0.719	<0.001
"Symphony # 5 Movement 4", D. Shostakovich	0.558	<0.001	0.767	<0.001	0.796	<0.001	0.941	<0.001
"Hobo Ho", Charles Mingus	0.751	<0.001	0.642	<0.001	0.118	1.000	0.330	0.020
"Scheherazade", N. Rimsky-Korsakov	0.629	<0.001	0.839	<0.001	0.937	<0.001	0.878	<0.001
"Tanguedia III", A. Piazzolla	-0.727	<0.001	0.593	<0.001	-0.741	<0.001	0.877	<0.001
"The Dreams and Prayers of Isaac the Blind", O. Golijov	-0.313	0.001	-0.338	<0.001	0.315	0.001	0.871	<0.001
"Prelude # 5 in G Major", S. Rachmaninoff	-0.623	<0.001	-0.685	<0.001	0.922	<0.001	0.856	<0.001
"Sarabande, Suite # 6 D Major", J.S. Bach	-0.196	0.228	-0.900	<0.001	0.233	0.078	0.867	<0.001
"Piece en forme de Habanera", M. Ravel	-0.195	0.190	0.214	0.110	0.535	<0.001	0.535	<0.001
"Gran jota", F. Tarrega	0.683	<0.001	0.506	<0.001	0.963	<0.001	0.714	<0.001

Correlations between ratings of the two dimensions varied across excerpts from strongly negative to strongly positive; this wide variation is especially marked for reported feelings (Feel-Ac with Feel-Pl, Table 1). For example, the strong negative correlation between the two dimensions of feeling for J.S. Bach's "Sarabande, Suite # 6 D Major" is related to the fact that students reported increased pleasantness over time but decreased activation. Data gathered for M. Ravel's "Piece en forme de Habanera" demonstrated a weak correlation between reported feelings of pleasantness and activation. However, students indicated a high correlation between the two dimensions for "Alabama" by John Coltrane. (See Table 1 for correlation values.)

Correlations between the students' feelings and their thoughts on the intent of the music were generally positive (see Think-Pl with Feel-Pl and Think-Ac with Feel-Ac, Table 1). Students indicated that they thought S. Rachmaninoff's "Prelude # 5 in G Major" increased in pleasantness over time. This increase correlated highly with their reported feelings of pleasantness. Their thoughts on the intent of the piece regarding activation also correlated highly with their feelings of activation. Similarly, student's ratings of their thoughts on the intent of N. Rimsky-Korsakov's "Scheherazade" in terms of pleasantness correlated highly with their feelings of pleasantness. Student's ratings of their thoughts on activation in this excerpt also correlated highly with their feelings of activation.

Three excerpts showed low or negative correlations between the students' feelings and thoughts. For example, the intent of J.S. Bach's "Sarabande, Suite #6 D Major" was reported as neutral in pleasantness by students. These ratings showed a rather low correlation with their feelings (Table 1), which were high on the pleasantness scale. Students' thoughts on activation for this excerpt correlated highly with their feelings of activation (Table 1). These relationships between thoughts and feelings are demonstrated in Figure 2.

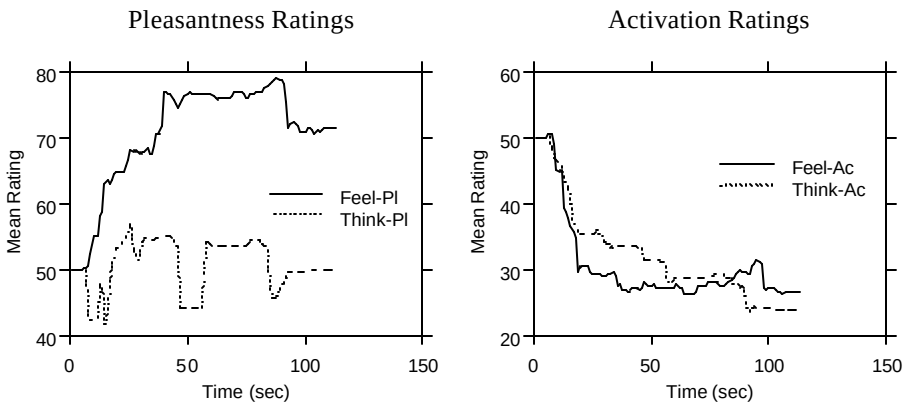

Figure 2. Mean ratings per second of J.S. Bach's "Sarabande Suite #6 D Major"

Students thought that Charles Mingus's "Hobo Ho" was intended to increase slightly in pleasantness, but their reported feelings showed a fall followed by a rise in pleasantness (Figure 3), hence the low correlation between their thoughts and feelings of pleasantness in Table 1. Students thought "Hobo Ho" was intended to stay at a high level of activation, but their reported feelings showed a relatively low level of activation, and thus there was a rather low correlation between their thoughts and feelings of activation as well.

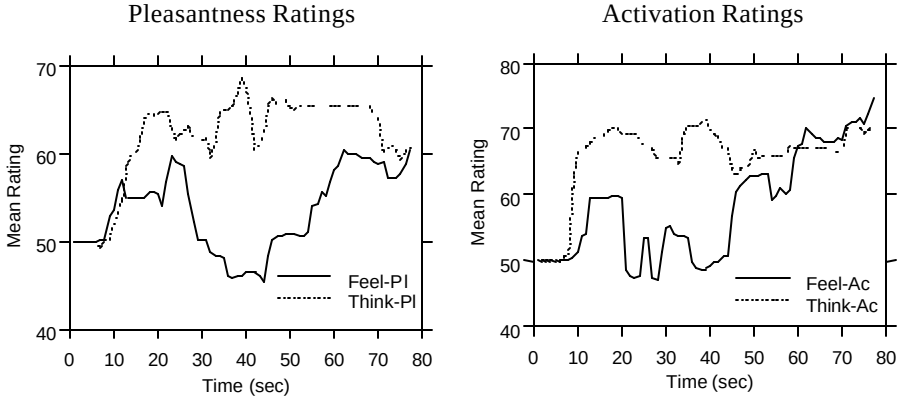

Figure 3. Mean ratings per second of Charles Mingus's "Hobo Ho"

There was a strong negative correlation between thoughts and feelings regarding pleasantness of A.Piazzolla's "Tanguedia III" (Table 1), and the patterns of change over time in these two conditions are indeed quite different (Figure 4, left panel). Students, however, thought the music was intended to increase in activation and their reported feelings also showed an increase in activation (Figure 4, right panel), hence the correlation between their thoughts and feelings in terms of activation is high and positive (Table 1).

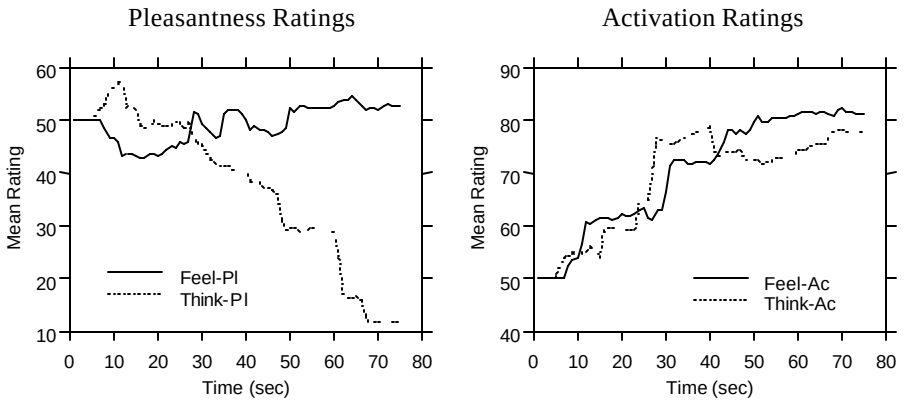

Figure 4. Mean ratings per second of A Piazzolla's "Tanguedia III"

4. Discussion

Our results suggest that the two dimensions of emotional response (i.e., the Feel condition) employed in this study, pleasantness and activation, are relatively independent. Some excerpts elicited responses with a strong positive correlation between these dimensions, others a very low correlation, and still others a strong negative correlation. Correlations between these dimensions for the perceived intent of the music (the Think condition) are similarly variable. The results imply that the negative correlation between beauty and arousal reported by Madsen (1998) for Haydn's "Symphony No. 104" might not be a general rule about how these dimensions are related in music. The way these dimensions are related may be highly specific to particular musical passages, with different passages showing quite different patterns of relationship.

Our results also suggest that reported music-elicited feelings (the Feel condition) are similar but not identical to the perception of the performer's and the composer's intentions (the Think condition). The results shown in Figures 2-4 indicate that the tasks in these conditions are psychologically distinguishable for participants. These data imply that participants may be able to report the emotions intended by the composer and performer, irrespective of whether they actually experience them. Whether music actually elicits emotion or merely expresses emotion that listeners recognize has been controversial, but recent evidence indicates that music can indeed elicit emotion (Krumhansl, 1997). Other work has shown that listeners can quite accurately discern the emotions in music that performers have intended to express (Juslin, 2000), and appear to do so on the basis of characteristics such as tempo, sound level, etc. The present study raises the interesting possibility that judgment of the intended emotion may be somewhat independent of the emotion actually experienced. If this finding can be replicated, it will be interesting to investigate the factors producing these independent outcomes. For example, it seems possible that the evocation of emotion by music might be more affected by the laboratory context than would be judgments of the composer's and performer's intentions.

It is possible that our results may have differed had we studied people at different levels of training than those of our participants. Students participating in this experiment changed their ratings rather infrequently, and the majority of the participants had little or no musical training. Musically trained individuals may recognize elements such as tempo, dynamics, timbre, rhythm, etc. as devices that specifically contribute to the intensity or aesthetic quality of a piece of music. Several such factors have been shown to be important in the perception of intended emotion in music (Juslin & Madison, 1999). Thus, one might expect that musically trained individuals would move the mouse pointer more frequently throughout the musical excerpts, providing a more subtly varied report of emotions elicited by music. However, comparisons of musically trained and non-trained participants in reporting music-elicited emotion have often not found significant differences (e.g. Madsen, 1997; Juslin, 1997), and recent work has demonstrated that emotions similar to those of adults are reliably evoked by music even in young children (Gentile, 1998). Whether musical training will affect the responses measured in our tasks will be an interesting question for future research.

In summary, the present study has employed an adaptation of recently developed methods for dynamic measurement of responses to music and has demonstrated independence across musical passages of two dimensions of emotional response and partial independence of emotional responses from the perception of composers' and performers' emotional intentions.

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