

An Experience Sampling Study of Emotional Reactions to Music: Listener, Music, and Situation

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The Experience Sampling Method was used to explore emotions to music as they naturally occurred in everyday life, with a focus on the prevalence of different musical emotions and how such emotions are related to various factors in the listener, the music, and the situation. Thirty-two college students, 20 to 31 years old, carried a palmtop that emitted a sound signal seven times per day at random intervals for 2 weeks. When signaled, participants were required to complete a questionnaire on the palmtop. Results showed that music occurred in 37% of the episodes, and in 64% of the music episodes, the participants reported that the music affected how they felt. Comparisons showed that *happiness-elation* and *nostalgia-longing* were more frequent in episodes with musical emotions, whereas *anger-irritation*, *boredom-indifference*, and *anxiety-fear* were more frequent in episodes with nonmusical emotions. The prevalence of specific musical emotions correlated with personality measures and also varied depending on the situation (e.g., current activity, other people present), thus highlighting the need to use representative samples of situations to obtain valid estimates of prevalence.

Keywords: music listening, emotion, everyday life, experience sampling method, personality

One of the most intriguing aspects of music is its apparent ability to evoke emotions in listeners. Yet, little is known about the conditions under which listeners normally experience emotions to music. The purpose of this study was to investigate the prevalence of emotional reactions to music, using a new approach that allowed us to obtain representative samples of music experiences from everyday life.¹

In the following, we briefly review evidence of emotional reactions to music, consider the need to study the interplay between the listener, the music, and the situation, and explain the role of the Experience Sampling Method in such an endeavor. Then, we report a study of musical emotions based on this approach. Finally, we discuss the implications of the findings for the study of music and emotion.

Evidence of Emotional Reactions to Music

Though many musicians and listeners seem to take the emotional powers of music for granted, it has been a matter of controversy whether music can evoke emotions. The answer to this question depends on how “emotion” is defined. Based on the increasing consensus in the affective sciences (e.g., Davidson,

Scherer, & Goldsmith, 2003, p. xiii; Oatley, Keltner, & Jenkins, 2006, pp. 29–31), emotions are usually regarded as brief but intense responses to changes in the environment featuring a number of subcomponents: (a) cognitive appraisal (e.g., you appraise a situation as dangerous), (b) subjective feeling (e.g., you feel afraid), (c) physiological response (e.g., your heart starts to beat faster), (d) expression (e.g., you shout), (e) action tendency (e.g., you want to run away), and (f) regulation (e.g., you calm yourself).² In addition, some researchers have proposed that the different components are *synchronized* during an emotional response (Juslin & Scherer, 2005, pp. 70–71); that is, emotions organize coordinated responses in different components to prepare the organism for appropriate action and regulation (Levenson, 2003).

Consistent with the idea that music can evoke emotions, there is evidence in terms of self-reported feeling (Gabrielsson, 2001), physiological response (Gomez & Danuser, 2007), activation of cortical as well as subcortical brain areas previously associated with emotions (Blood & Zatorre, 2001), expression of emotion (Witvliet & Vrana, 2007), action tendency (Fried & Berkowitz, 1979), and regulation (Becker, 2004). In addition, there is preliminary evidence of synchronization among the various response components (Lundqvist, Carlsson, Hilmersson, & Juslin, in press). Thus, most researchers today seem to agree that music can evoke emotions in listeners (for an overview, see Juslin & Sloboda, 2001). However, less is known about *how* music evokes emotions,

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This research was supported by The Swedish Research Council. We are grateful to the participants for sharing their music experiences with us. We also thank Lars-Olov Lundqvist and Petri Laukka for their helpful suggestions.

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¹ The term *prevalence*, borrowed from epidemiology, refers to the proportion or relative frequency of occurrence of a given phenomenon (e.g., emotions) in the population of interest.

² Not all researchers agree that emotions are distinguished by intensity and duration. Some regard intentionality (i.e., being directed at an object) as a more important criterion.

since few studies have focused on the underlying mechanisms or the factors that may influence them (Juslin & Västfjäll, in press).

Listener, Music, and Situation

We argue that key to a better understanding of how music evokes emotions is to study more closely the interplay among the listener, the music, and the situation (e.g., Gabrielsson, 2001); that is, we need to delineate the conditions under which musical emotions occur. This is important because listeners' emotional responses to music are likely to depend strongly on what function the music serves in a specific situation (e.g., Sloboda & O'Neill, 2001), which in turn reflects a number of individual and situational factors. Individual factors may include music preference (Iwanaga & Moroki, 1999), musical training (Lehmann, 1997), personality (Wheeler, 1985), and, most importantly, the listener's motives for listening to music (Behne, 1997). Listeners use music deliberately to achieve various goals: to alter emotions, to release emotions, to match the current emotion, to enjoy or comfort themselves, and to relieve stress (see DeNora, 2000; Knobloch & Zillman, 2002; Saarikallio, 2007; Sloboda & O'Neill, 2001). However, the situation is also important, since the goals of the listener vary depending on the situation: if there is a stressful situation music might be used to relieve stress whereas if there is a special occasion music might be used to evoke nostalgic memories. To capture such uses of music, one must study music listening in its natural context.

Survey Studies of Music Listening

A number of recent studies have used survey methods to investigate responses to music in everyday life. North, Hargreaves, and Hargreaves (2004) sent one text message per day for 14 days to 346 participants with mobile phones. On receiving this message, participants were required to complete a questionnaire about any music they could hear, or had heard since the previous message. The results revealed a high frequency of music occurrence (approximately 39% of the occasions), and suggested that participants listened to music primarily while they were alone. Whether they liked the music depended primarily on whether they had chosen to listen to the music. Music was mostly heard at home, it usually accompanied other 'everyday activities,' and it was most frequent in the evening and on weekends. However, the study did not focus specifically on emotional reactions.

In Juslin and Laukka's (2004) survey study, 141 participants answered questions about expression, perception, and induction of musical emotions in everyday life. Results indicated that most participants listened to music several times a day, mostly in combination with other activities. Participants estimated that they experienced emotions to music roughly 55% of the total listening time. No particular musical style dominated in the emotional reactions. Among the most frequently felt emotions to music, according to the participants' own estimates, were happiness, relaxation, nostalgia, calm, pleasure, love, sadness, and longing.

Survey studies are useful because they provide an estimation of the type of responses that may occur, and of the causal factors that may play an important role in these responses. A survey study may also, through its (relative to most experiments, at least) large sample of participants, help one to discover important background variables that may explain the large individual differences between

listeners. However, there are also a number of problems with surveys. For instance, they usually involve retrospective accounts, which are biased because they reflect reconstructive memory (Barrett & Barrett, 2001). Thus, some aspects of musical emotions may not be reported accurately in survey studies.

The Experience Sampling Method

One solution to this problem is the Experience Sampling Method (ESM) (e.g., Conner Christensen et al., 2003).³ The ESM usually means that participants are provided with small, handheld computers or palmtops that they carry with them at all waking hours, say, during a week. During the week, the palmtop emits several sound signals at certain predetermined or preferably randomized intervals. Each time the participant hears this signal, he or she should immediately respond to various questions administered by the palmtop about his or her latest experience. One advantage of the ESM is that it permits one to study personal events as they unfold in their natural and spontaneous context. Another advantage is that it renders possible repeated measurements over time, so that one may obtain a better sense of whether a specific phenomenon occurs in particular recurrent patterns—for instance at specific times of the day. When frequency estimates of specific emotions are needed, the ESM may yield more reliable data than the aggregated, retrospective, and cognitively biased data obtained in survey studies (Ready, Weinberger, & Jones, 2007).

The Importance of Situational Sampling

The ESM is consistent with Brunswik's (1956) notion of *representative design*, which involves randomly sampling stimuli from the environment, so that environmental properties are preserved. The method seems promising for those music researchers who are concerned about the limited external validity of data from laboratory-based studies. With the arrival of new technology (e.g., mp3 players, music phones), music is becoming increasingly available to a wide range of the population, expanding the ways in which music is experienced as well as the social contexts where these music experiences may occur (North & Hargreaves, 1997). Clearly, then, a representative sampling of listening situations is important to ensure generalizability of findings from studies of musical emotions. This is especially true when it comes to estimating the prevalence of specific emotions.

Musical Emotions Versus Nonmusical Emotions

There is currently a debate in the field of music and emotion about which emotions are evoked by music. This question has been the source of much speculation, but has rarely been investigated (Juslin, in press). Some researchers argue that music can induce "basic" emotions (Krumhansl, 1997), whereas others deny that this

³ Other terms used to refer to this method are *diary study* and *ecological momentary assessment* (Reis & Gable, 2000).

is possible (Scherer, 2003).⁴ Some researchers argue that music can induce only very broad positive and negative states (Clark, 1983), whereas others argue that music can induce a range of both basic and complex emotions (Gabrielsson, 2001; Juslin & Västfjäll, in press). So far, only three survey studies have offered estimates of the prevalence of musical emotions (Juslin & Laukka, 2004, Table 4; Sloboda, 1992, Table 1; Wells & Hakanen, 1991, Table 1), but these studies have two problems in common: They rely on retrospective and aggregated reports, and, more importantly, they do not directly compare musical and non-musical emotions. It can be argued that it is only when musical emotions are contrasted with other emotions that their uniqueness can be assessed. The ESM might resolve this issue, by providing accurate estimates of the prevalence of both musical and non-musical emotions.

Previous ESM Studies

Several studies have used the ESM to estimate the prevalence of different emotions, in general, in everyday life (Brandstätter & Elias, 2001; Myrtek & Brügger, 1996; Zelenski & Larsen, 2000). However, only two studies so far have used the ESM to measure emotions to music. Thompson and Larson (1995) investigated the psychological impact of rock music as a function of music type and social context. Thus, 483 participants (aged 9–15 years) carried pagers for 1 week, and reported their affect, arousal, and involvement in various activities, including music listening, when signaled. The results revealed that the social context had the largest effect on music listening that involved soft rock, where, for example, the presence of friends could help to transform experienced emotions. Hard rock was experienced positively across a variety of contexts, but not when heard in the presence of family members.

Sloboda, O'Neill, and Ivaldi (2001) tested the viability of the ESM in studying real life musical experiences. Eight participants were asked to carry a pager and a diary for one week. The pager was activated randomly once every 2 hours by a central computer. When paged, participants were required to as quickly as possible fill out the diary to describe the nature of any musical experiences that had occurred since the last paging. The items were intended to describe who the participants were with, what kind of music they were listening to, how the music was being played, their emotional response to the music, and its functions. Sloboda et al. concluded that the ESM is a robust method to study music listening in everyday life. Data indicated that music was heard in 44% of the recorded episodes, and that few of the episodes involved music listening as the primary focus. In general, music experiences tended to make the participants more positive, more alert, and more focused in the present, particularly when personal choice over the music was involved.

The study by Sloboda et al. was promising, but featured only eight participants and left many questions unanswered. For instance, it offered no comparison of the relative frequency of occurrence of different emotions in musical and nonmusical episodes; it did not study the underlying psychological mechanisms that might have caused the emotional reactions; and it did not study factors such as the degree of familiarity and liking of the music, or the intensity of the emotional reaction. Therefore, we regarded it as appropriate to replicate and extend the preliminary results of Sloboda et al. (2001) in a full-scale study that featured a

larger number of response items and participants. The use of a larger sample would also make it possible to consider individual factors of potential importance for emotional responses to music, such as personality characteristics. Several studies have discovered relationships between prevalence of nonmusical emotions and personality factors, such as Extraversion and Neuroticism (e.g., Rusting & Larsen, 1997; Watson & Clark, 1992), but similar relationships in regard to music have not been studied previously.

Rationale of the Present Study

The aim of this study was to investigate emotional reactions to music as they naturally occurred in everyday life, with a focus on the prevalence of different musical emotions and how such emotions are related to various factors in the listener, the music, and the situation. Furthermore, to better understand the data regarding prevalence of musical emotions, it was regarded as necessary to compare them to the prevalence data of nonmusical emotions. To investigate these issues, 32 college students were required to carry a palmtop computer for 2 weeks. The palmtop was programmed to signal ("beep") seven times per day, at random intervals. On each beep, participants were asked to stop what they were doing and to answer 16 questions concerning three broad aspects: (1) *the experienced emotion* (emotion category; valence; intensity; stress), (2) *the situation* (physical location; activity; other persons present; occurrence of music), and—depending on whether music was indeed present and influenced the participants' emotions—(3) *the characteristics of musical-emotion episodes* (music type; source of music; liking, familiarity, and choice over music; importance of music for activity; possible cause of the emotion; and listening motive). In addition, various participants' background variables (e.g., age, gender, occupation, musical interest, music preference, music education) were obtained by questionnaire and related to the prevalence of musical emotions. The study was mainly exploratory in nature, though based on previous studies it was hypothesized that musical emotion episodes would feature a larger proportion of positive emotions than would nonmusical emotion episodes (Juslin & Laukka, 2004).

Method

Participants

Thirty-two Swedish college students, 21 females (66%) and 11 males, 20 to 31 years old ($M = 24$), participated in the study. They studied various subjects (e.g., biology, psychology, law, musicology). Fourteen of the participants (44%) played a musical instrument; 10 (31%) had some formal music education. Self-reported interest in music on a scale from 0 to 4 was high ($Min = 1$, $Max = 4$, $M = 3.22$, $SD = 0.87$). Overall the listener sample may be described as homogeneous in terms of occupation (all were students), albeit as heterogeneous in terms of musical training. The participants were recruited by means of posters throughout Uppsala University. The participants contacted the research team, stated their interest in participating, and settled a date for an information meeting. The participants were paid (500 SEK) for

⁴ For a discussion of "basic" and "complex" emotions, see Plutchik (1994, pp. 53-62).

their voluntary and anonymous participation and also received a movie ticket after their first week to encourage continued participation. None of the recruited participants dropped out from the study, but two of the initial 34 participants were removed because of repeated computer failures.

Procedure

At an introductory meeting at the Department of Psychology, Uppsala University, the participants were individually and carefully informed about the study and their task. It was explained to them that the aim of the study was to study people's emotions in everyday life. In the instructions, the participants were told that they would carry a palmtop computer for 14 days, that the palmtop would "beep" seven times every day, and that each time it beeped, they would be asked to respond to some questions. It was further explained that they should not change their daily routines, but try as much as possible to live their lives as usual. After having received information about the study, they could decide whether they wanted to take part in the study (none of those contacted declined to do so). They were then asked to sign a written consent for participation and to fill out a questionnaire regarding various background variables (e.g., age, gender, occupation, musical interest, music preference, music education). Furthermore, they were shown the palmtop and the Experience Sampling Program (ESP) that administered the questionnaire (next section). One response trial was "simulated" to allow the participants to grasp the functions of ESP and to ask questions about it. Then, the participants were provided with a package including (1) one copy of the instructions, (2) a brief employer/teacher letter that the participants could present to those who might be disturbed by the study, (3) a manual explaining each questionnaire item, and (4) a sheet with contact information for the assistant responsible for downloading their data, whom they could contact if they had any unexpected problems or questions related to the study. Finally, the palmtops were delivered to the participants with the ESP started. Data from palmtops were downloaded by the respective assistant twice a week, as an information backup in the case of computer failure. At the final download session, participants returned their palmtops, filled out a personality inventory, and were interviewed about the study. The study had been approved by a Swedish scientific ethics committee.

Design and Measures

The questionnaires were administered using *Palm Z 22* palmtops and the most recent version of the ESP (e.g., Barrett & Barrett, 2001).⁵ The benefits of using computerized data recording include precise time recording of response duration and latency (thus enabling the verification of compliance), and the reduction of negative aspects of data entry such as time consumption and human error (Barrett & Barrett, 2001; Bolger, Davis, & Rafaeli, 2003).

Preliminary versions of the ESM protocol and the questionnaire items were developed and tested by the research team 2 weeks before the study. This allowed the researchers to better understand not only the pitfalls and strengths of palmtops and the ESP, but also how it might feel to participate in the study. In doing so, it was possible to adjust certain details and avoid some potential prob-

lems before the start of the study. The final questionnaire items are presented in the Appendix. The questionnaire was designed so as to measure musical as well as nonmusical emotions. We hoped that this aspect of the design would reduce the so-called 'demand characteristics' (i.e., the total sum of cues that convey the researcher's hypothesis to the participants and thus may influence the participants' behavior; e.g., Orne, 1962) that may result from a focus only on musical emotions.

It was regarded as important to be able to separate emotions that were evoked by music from emotions that were evoked by other stimuli. Hence, we included three response options in item number seven (i.e., *Did music occur in the situation?*): (1) *yes, and the music affected the feeling*, (2) *yes, but the music didn't affect the feeling*, and (3) *no, there was no music*. The distinction between (1) and (2) was regarded as important because there may be instances where music occurs, but where the emotion experienced is caused entirely by some other event (e.g., having an argument). Hence, it was explained to the participants that in all cases where music occurred, but where they were certain that the felt emotion was caused by another event, they should choose response alternative (2). The possibility of branching questions (administering a different set of questions depending on the responses to previous items) allowed us to use a different second half of questions for musical emotion episodes than for episodes that did not feature any music or that featured music that did not influence the emotions of the participant. The number of items to respond to was the same (16), regardless of whether the trial involved musical or nonmusical emotions. The items following branching that concerned nonmusical emotions were intended to test different aspects of appraisal theory (Scherer, 1999) and will, therefore, be reported in a separate paper. Because of technical limitations of the ESP, the number of response alternatives in each item was limited to 14, and participants could only select one alternative. The response alternatives were based on results from our previous survey studies, which used mostly open-ended response formats (e.g., Juslin & Laukka, 2004; Juslin, Laukka, Liljeström, Västfjäll, & Lundqvist, 2008).

Of special importance was the selection of emotion terms. Selecting only 14 terms from the several hundreds of terms available is no easy task, but the goal was to include both terms that are representative of the two dominant conceptualizations of emotion (i.e., categories and dimensions) and terms that could be particularly relevant with respect to music. Hence, the 13 emotion terms selected include the "basic" emotions typical of discrete emotion theories, such as anger, surprise, interest, and fear (Izard, 1977), cover all four quadrants of the "Circumplex" model in terms of valence and arousal (Russell, 1980), and feature typical music-related terms such as pleasure, nostalgia, and expectancy (Juslin & Laukka, 2004, Table 4). In addition, the participant could select the alternative 'other emotion,' if none of the provided emotion terms was found suitable.

Following the views of Russell and Barrett (1999), Brandstätter and Elias (2001), Izard (2007), Sloboda et al. (2001), and others, we assume that people are always in *some* affective state. When the states are intense and involve salient stimuli, we tend to call them 'emotions,' whereas when the same states are less intense, and their causes

⁵ For further information, see the ESP Website: <http://www.experience-sampling.org/>.

are not immediately apparent, we tend to call them ‘moods.’ However, evidence of a sharp distinction between emotion and mood is lacking (Beedie, Terry, & Lane, 2005), and the difference is perhaps better described as a matter of degree. In this study, we used the Swedish word ‘känsla’ (see Appendix), which is used to refer to the subjective experience (i.e., the *feeling*) of both emotions and moods.

Item 14 in the questionnaire asked the participants what they believed caused their emotions in the musical emotion episodes. The participants could choose from 10 alternatives (see Appendix) based on previous research and particularly the framework outlined by Juslin and Västfjäll (in press), namely *episodic memory* whereby an emotion is induced in a listener because the music evokes a memory of an event from the listener’s life; *emotional contagion* whereby an emotion is induced in a listener because the listener perceives a certain emotional expression (e.g., sad, happy) in the music and “mimics” this expression internally, which then leads to the arousal of the same emotion; *brain stem response* whereby an emotion is evoked by music because simple acoustic features of the music (e.g., a very loud sound) are taken by the brain stem to signal a potentially important event, thus producing arousal; *visual imagery* whereby an emotion is induced in a listener because he or she conjures up visual images (e.g., of a nice landscape) while listening to the music; *musical expectancy* whereby an emotion is induced in a listener because a particular feature of the music violates, delays or confirms the listener’s expectations about the continuation of the music; *evaluative conditioning* whereby an emotion is induced by a piece of music simply because this stimulus has been paired with other positive or negative stimuli in the past; and *cognitive appraisal* whereby an emotion is induced in a listener because of the listener’s subjective evaluation of the music on a number of dimensions in relation to his or her goals in life (see Juslin & Västfjäll, in press, for further discussion). Besides the mechanisms we also added the alternatives *lyrics*, *other*, and *I don’t know*, so that the participants would not feel forced to select one of the other alternatives.⁶

The ESP was programmed to beep seven times per day between 09.00 a.m. and 11.00 p.m. for 14 days. The precise timing of the beeps each day was randomized by the ESP. Whenever the palmtop beeped, the participant was required to fill out the questionnaire (see Appendix). The palmtop was set to beep at intervals of 3 seconds for a total of 3 minutes. If the participant did not respond within that time, the Palmtop would go back to sleep mode and the trial would be recorded as missed. After beginning to respond to the questionnaire the participant had a time limit of 2 minutes per item to respond. If the participant had not managed to respond within that time, the ESP would go to “sleep” mode and the trial would be recorded as missed. During the entire study, only the ESP was running on the computer to save battery life.

The participants responded to 2,324 of the 3,136 signals (i.e., 7 signals \times 14 Days \times 32 participants), resulting in an overall response rate of 74%. Missed trials were primarily because of the fact that the participants were unable to respond (e.g., being in the shower or lifting heavy furniture), could not hear the beep (e.g., because of loud traffic), or had forgotten to bring the palmtop. However, compared to other ESM studies, the present response rate was considered satisfactory (Conner Christensen et al., 2003, p. 62). Interviews with the participants revealed that few of the missed trials had involved music.

At their final lab meeting, the participants filled out the Swedish self-report version of the Revised NEO Personality Inventory

(NEO-PI-R; Costa & McCrae, 1992), measuring the Big Five personality factors *Extraversion* (E), *Neuroticism* (N), *Openness to experience* (O), *Agreeableness* (A), and *Conscientiousness* (C). The Cronbach’s alpha reliability coefficients (α) were .83 (E), .88 (N), .42 (O), .71 (A), and .83 (C), respectively.⁷

Data Reduction and Analysis

Data from ESM studies can be analyzed either at the “beep level” (i.e., in terms of the individual episodes), or at the “subject level” (i.e., in terms of averages for each participant). Data at the beep level are problematic with respect to common tests of significance, because the data points are not independent. Consequently, it is often recommended that analyses are conducted at the subject level by computing appropriate aggregate scores for each individual and analyzing these scores using the individual person as the unit of analysis (e.g., Larson & Delespaul, 1992).⁸ All significance tests in this study were conducted at the subject level.

We conducted three types of analyses. First, we analyzed *overall prevalence* of music and of musical emotions, and estimated correlations (Pearson’s *r*) between overall prevalence of musical emotions and various background variables such as age, gender, personality, music education, and the playing of an instrument. We also analyzed how musical emotion episodes were distributed over time across the morning, the afternoon, and the evening.

Second, we compared musical emotion episodes and nonmusical episodes regarding prevalence of *specific emotions* and different *situational factors* (e.g., physical location, main activity, other people present). The comparisons featured two of the conditions in item seven (see Appendix): emotion episodes without music, and emotion episodes where music caused the emotion. The third condition (i.e., emotion episodes featuring music, but where the music was reported to not have caused the current emotion) was regarded as problematic, because it could not be excluded that the music had some modulating effects on emotions, even in those cases where the participants believed it had not. Thus, excluding these ambiguous cases (only 13% of the total number of episodes) allowed for a more accurate comparison of musical and nonmusical emotions—either the emotion was caused by music, or it was not. Matched pair comparisons (*t* tests) were used in all comparisons of musical and nonmusical emotions. We also correlated the individual prevalence of specific emotions (both musical and nonmusical) with individual test scores on the NEO-PI-R.

Third, we analyzed in more depth the responses to the music-related items that were answered only in the musical emotion episodes. General characteristics of the episodes (e.g., source of music, musical style, choice, familiarity, liking, importance) were summarized, and further analyses of the seven most common musical emotions ($n > 20$ episodes) were carried out to study how

⁶ The meaning of each mechanism was carefully explained in the booklet given to the participants at the beginning of the study.

⁷ The alpha coefficient for *Openness to experience* is lower than those reported in the American NEO-PI-R manual (Costa & McCrae, 1992) and the Swedish NEO-PI-R manual (Bergman, 2003). Low alpha coefficients for *Openness* have been found in samples before (Zhang, 2006).

⁸ An alternative approach is to conduct a multilevel analysis, but the sample size of the present study was not considered optimal for such an analysis (Bickel, 2007, pp. 272-275).

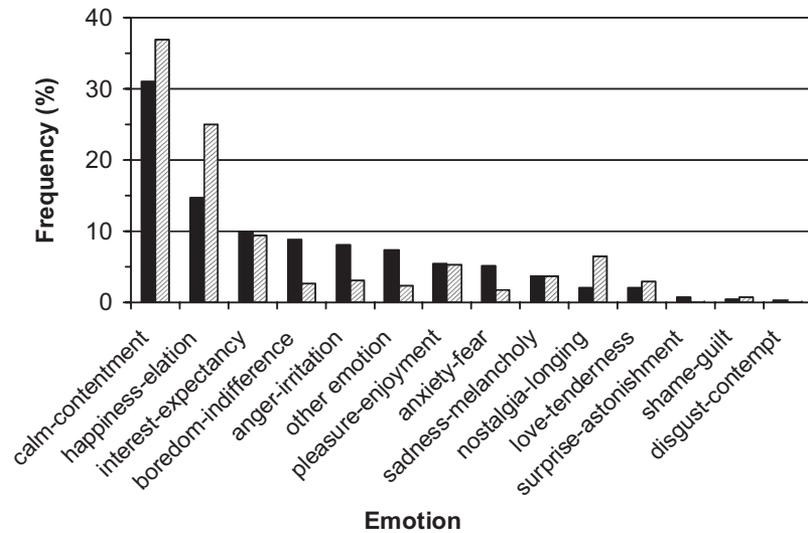


Figure 1. Relative frequency (in percent) of specific emotions in nonmusical emotion episodes (dark bars) and musical emotion episodes (striped bars).

specific emotions varied as a function of individual (e.g., listening motives) and situational factors (e.g., social context). We chose the most common emotions to obtain a reasonable number of observations for each emotion, and because they seemed most relevant.

Results

Overall Prevalence

Music occurred in 886 (37%) of the 2,424 randomly sampled episodes. In 571 (64%) of the episodes that featured music, the participants reported that the music influenced how they felt.⁹ Thus, musical emotions represented 24% of all sampled episodes. Individual prevalence of musical emotion episodes ($M = 18.13$ episodes, $SD = 8.64$) was correlated with individual frequency of music occurrence ($r_{30} = .84$, $p < .01$), though was not correlated with either age, gender, music education, or the playing of an instrument. Of the five personality factors, only *extraversion* correlated with individual prevalence of musical emotion episodes ($r_{30} = .45$, $p < .05$; correlations with specific emotions are discussed below).

Musical emotion episodes occurred across the whole time span (09.00 a.m. to 11.00 p.m.) of the day. However, analysis of the mean number of musical emotion episodes per hour and person indicated that musical emotion episodes were most frequent in the *evening* (06.00 p.m. to 11.00 p.m., $M = 1.44$, $SD = 0.63$), followed by the *afternoon* (01.00 p.m. to 06.00 p.m., $M = 1.33$, $SD = 0.92$) and the *morning* (09.00 a.m. to 01.00 p.m., $M = 1.08$, $SD = 0.65$). Matched pair t tests revealed that only the difference between *evening* and *morning* was significant ($t_{31} = 2.63$, $p < .05$), mainly because of large variability in the *afternoon*. As could be expected, the mean number of musical emotion episodes per hour and person was slightly higher during *weekend days* ($M = 2.63$, $SD = 1.62$) than during *workdays* ($M = 2.54$, $SD = 1.27$). However, this difference was not statistically significant.

Prevalence of Specific Emotions

Figure 1 shows the relative frequency in percent of musical emotions and nonmusical emotions, respectively. Inspection of the results suggests a fairly similar trend, regardless of the condition; thus, for instance, in both conditions *calm-contentment* and *happiness-elation* were the most commonly felt emotions and *surprise-astonishment*, *shame-guilt*, and *disgust-contempt* the least commonly felt emotions. Further, positively valenced emotions were, on the whole, more common than negatively valenced emotions in both conditions, since *calm-contentment*, *happiness-elation*, and *interest-expectancy* alone accounted for more than 50% of the emotion episodes in each condition. However, careful inspection of Figure 1 indicates that there were also some differences between musical and nonmusical emotions.

Matched pair t tests revealed that *happiness-elation* was more common during musical emotion episodes ($M = 24.83$, $SD = 17.17$) than during nonmusical episodes ($M = 14.66$, $SD = 10.97$, $t_{31} = 3.76$, $p < .001$). Similarly, *nostalgia-longing* was more common during musical emotion episodes ($M = 7.62$, $SD = 10.77$) than during nonmusical episodes ($M = 2.06$, $SD = 3.53$, $t_{31} = 3.58$, $p < .001$). On the other hand, *anger-irritation* was more common during nonmusical episodes ($M = 8.06$, $SD = 6.90$) than during musical emotion episodes ($M = 3.61$, $SD = 7.02$, $t_{31} = 3.08$, $p < .01$), and *boredom-indifference* was more common during nonmusical episodes ($M = 9.28$, $SD = 11.94$) than during musical emotion episodes ($M = 2.45$, $SD = 4.91$, $t_{31} = 3.47$, $p < .01$). Finally, *anxiety-fear* was more common during nonmusical episodes ($M = 4.99$, $SD = 6.49$) than during musical emotion episodes ($M = 1.54$, $SD = 3.16$, $t_{31} = 3.52$,

⁹ Assuming that most of the missed trials did not feature music (as was suggested by the interviews with the participants), the "true" rate of occurrence of music may lie closer to 30%.

Table 1
Correlations (R) Between Individual Frequencies of Experienced Emotions and Test Scores on the NEO-PI-R For Musical and Nonmusical (Within Parentheses) Emotions, Respectively

Emotion	Personality factor				
	Extraversion	Neuroticism	Openness	Agreeableness	Conscientiousness
Anger-irritation	-.01 (-.46*)	.04 (.27)	.09 (-.11)	.18 (-.09)	-.22 (-.09)
Anxiety-fear	.01 (-.14)	.08 (.16)	.14 (-.02)	.19 (.19)	.35* (.21)
Boredom-indifference	-.11 (-.37*)	.20 (-.05)	.19 (.14)	-.04 (-.32)	.07 (-.21)
Calm-contentment	-.15 (.17)	-.06 (-.07)	-.08 (.16)	.03 (-.03)	.05 (.20)
Disgust-contempt	-.02 (.17)	.03 (-.13)	.02 (.08)	.10 (.20)	.19 (.20)
Happiness-elation	.18 (.20)	-.12 (-.06)	-.02 (-.08)	-.12 (-.01)	-.16 (-.15)
Interest-expectancy	.02 (.31)	-.03 (-.14)	.01 (.13)	.07 (.40*)	-.03 (.14)
Love-tenderness	.27 (.12)	-.05 (.02)	-.33 (-.30)	.02 (-.12)	-.03 (-.05)
Nostalgia-longing	-.15 (.01)	-.13 (-.15)	.19 (.03)	-.10 (-.02)	.22 (.12)
Pleasure-enjoyment	.01 (-.11)	.39* (.05)	-.42* (-.35)	.01 (.13)	-.01 (-.25)
Sadness-melancholy	-.13 (.12)	.16 (.28)	.27 (-.04)	-.07 (.15)	.03 (.04)
Shame-guilt	.19 (.10)	.06 (.26)	.06 (-.11)	-.07 (-.24)	-.22 (.10)
Surprise-astonishment	-.02 (-.15)	.03 (.41*)	.02 (-.30)	.10 (-.15)	.19 (.14)

* $p < .05$ ($N = 32$).

$p < .01$). None of the remaining comparisons was significant—except that the alternative *other emotion* was selected more often during nonmusical than during musical episodes ($p < .01$). Note that *other emotion* was selected in only 3% of the musical emotion episodes.

The above comparisons suggested that positive emotions were more frequent in musical emotion episodes than in nonmusical emotion episodes. This impression was confirmed by a matched pair t test, which revealed that, overall, emotions commonly categorized as “positive” by emotion researchers (*calm-contentment*, *interest-expectancy*, *happiness-elation*, *nostalgia-longing*, *pleasure-enjoyment*, *surprise-astonishment*, *love-tenderness*; Plutchik, 1994, pp. 62–72; see also Russell, 1980) were reported more commonly in musical emotion episodes ($M = 87.43\%$, $SD = 12.27$) than in nonmusical episodes ($M = 71.15$, $SD = 19.14$; $t_{31} = -5.19$, $p < .01$). Further confirmation comes from the analyses of the participants’ ratings of *valence*. More specifically, matched pair t tests showed that *valence* was rated as higher overall during musical emotion episodes ($M = 4.03$, $SD = 0.50$) than during nonmusical episodes ($M = 3.49$, $SD = 0.47$, $t_{31} = 6.75$, $p < .001$). Further, musical emotion episodes were overall rated as more intense ($M = 3.09$, $SD = 0.63$) than nonmusical emotion episodes ($M = 2.76$, $SD = 0.60$, $t_{31} = 5.01$, $p < .001$).

Table 1 shows the correlations between individual prevalence of experienced emotions and individual test scores on NEO-PI-R, for musical and nonmusical emotions, respectively. The correlations are mostly small, which suggests that other factors had a much larger impact on the induced emotions. However, some significant correlations of a “medium” effect size ($r \geq .30$; Cohen, 1988) are yet apparent in the results (see Table 1).¹⁰ For musical emotions, it can be seen that *pleasure-enjoyment* was positively correlated with *neuroticism* and that *anxiety-fear* was positively correlated with *conscientiousness*. *Pleasure-enjoyment* was further negatively correlated with *openness*. For nonmusical emotions (within parentheses), it can be seen that *extraversion* was negatively correlated with *anger-irritation* and *boredom-indifference*, while *neuroticism* was positively correlated with *surprise-astonishment*. In

addition, *agreeableness* was positively correlated with *interest-expectancy*.

Situational Factors

The situation, or context, of each recorded emotion episode may be defined in terms of the *physical location*, the *main activity* that the participant was engaged in, and *other people being present*. Figure 2 presents the locations where the episodes took place as a function of musical condition. The most common locations, overall, were *home* (48%), *outdoors* (12%), *work/school* (12%), and *other’s house* (10%). These same locations were also most common in each musical condition. However, there were also a few notable differences. Matched pair t tests showed that participants were more often at *home* during musical emotion episodes ($M = 57.44$, $SD = 24.33$) than during nonmusical episodes ($M = 43.49$, $SD = 15.97$, $t_{31} = 3.66$, $p < .001$), and also that they were more often at *work/school* during nonmusical episodes ($M = 16.32$, $SD = 10.58$) than during musical emotion episodes ($M = 5.59$, $SD = 8.63$, $t_{31} = 5.56$, $p < .001$).

Figure 3 shows the main activities as a function of musical condition. Overall, the most frequent main activities were *work/study* (18%), *social interaction* (18%), *relaxation* (13%), *TV/movie watching* (9%), and *housework* (6%). *Music listening*, as a main activity, occurred in only 5% of the episodes. The most common activities specifically during musical emotion episodes were *music listening* (15%), *social interaction* (15%), *relaxation* (13%), *work/study* (11%), and *TV/movie watching* (10%). Matched pair t tests further indicated that *work/study* was significantly more common during nonmusical episodes ($M = 21.83$, $SD = 11.98$), than during musical emotion episodes ($M = 10.52$, $SD = 11.91$, $t_{31} = 4.46$, $p < .001$). Furthermore, *music listening* was, obviously, more

¹⁰ We did not regard it as necessary to correct for multiple tests with regard to these data, because considering the small size of the participant sample, the risk of committing a Type II error (failing to reject the null hypothesis when it is false) was clearly greater than the risk of committing a Type I error (incorrectly rejecting the null hypothesis).

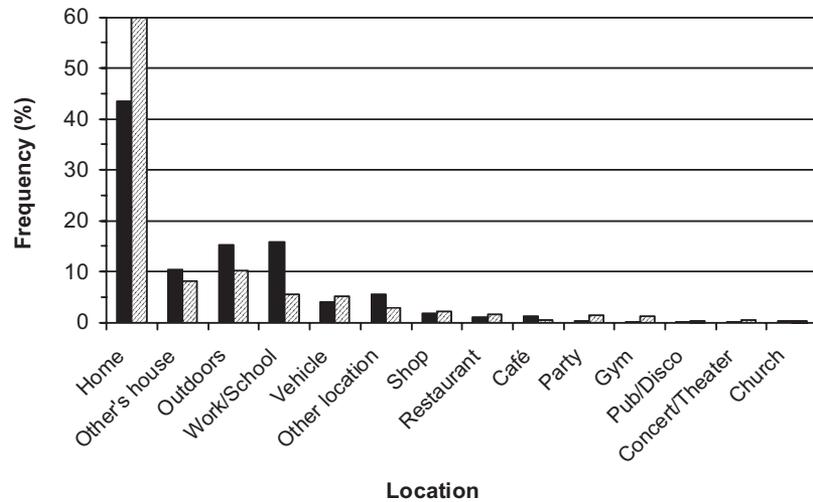


Figure 2. Relative frequency (in percent) of physical locations in nonmusical emotion episodes (dark bars) and musical emotion episodes (striped bars).

common during musical emotion episodes than during nonmusical episodes. More interesting, perhaps, is that *house work* and *partying* were both more common during musical emotion episodes ($M = 8.39$, $SD = 8.21$; $M = 2.00$, $SD = 3.33$, respectively) than during nonmusical episodes ($M = 4.40$, $SD = 3.60$, $t_{31} = 2.50$, $p < .05$; $M = 0.65$, $SD = 1.21$, $t_{31} = 2.37$, $p < .05$, respectively). Remaining differences were not significant.

The final feature of the context concerns the other people being present in the situation. Results showed that the overall most frequent condition was *alone* (41%), followed by *with a partner or close friend* (21%), *with several friends or acquaintances* (18%), *with one or more strangers* (7%), *with my family* (5%), *with an acquaintance or colleague* (5%), and *in a large crowd* (3%). The first three conditions accounted for 75% of the episodes in both

musical and nonmusical episodes—although matched pair t tests indicated that being *with several friends or acquaintances* was significantly more frequent during nonmusical emotion episodes ($M = 21.24$, $SD = 14.03$) than during musical emotion episodes ($M = 15.60$, $SD = 15.37$, $t_{31} = 2.50$, $p < .05$). Remaining differences were not significant.

Musical Emotion Episodes

The most frequent source of music in episodes where music influenced emotions was *stereo equipment* (32%), followed by *personal computer* (31%), *TV* (10%), *Walkman/MP3 player* (9%), *radio* (8%), *live music* (7%), and *public loudspeakers* (2%). The musical style heard was predominantly *pop/rock* (53%), followed

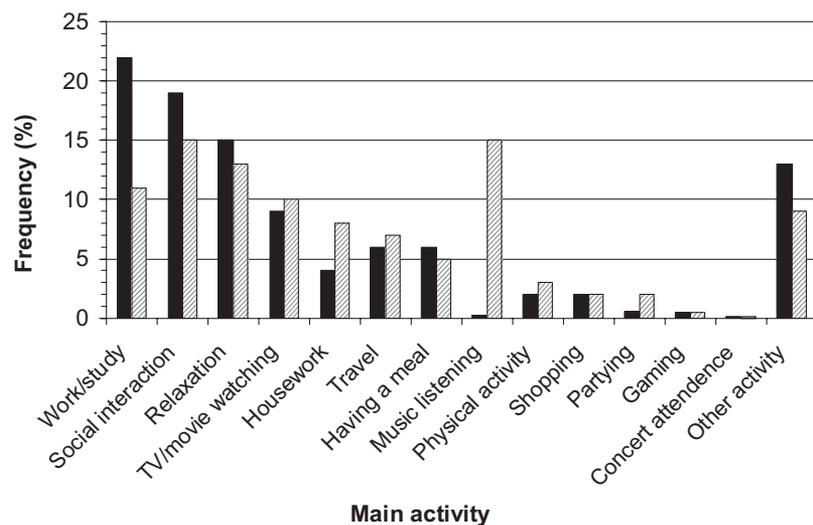


Figure 3. Relative frequency (in percent) of different activities in nonmusical emotion episodes (dark bars) and musical emotion episodes (striped bars).

by *hard rock* (5%), *world music* (5%), *classical music* (4%), *hip-hop* (3%), *reggae* (3%), *soul* (3%), *electronica* (3%), *jazz* (3%), *dance music* (2%), *country* (1%), *religious music* (0,7%), *blues* (0,3%), and *other* (14%). It was not feasible to conduct any systematic comparison of the emotions evoked by different musical styles, given the scarcity of episodes with specific styles other than pop/rock.

Choice, Familiarity, Liking, and Importance of Music

In 62% of the episodes, the participant had chosen the music him- or herself, and in 76% of the episodes, the music heard was familiar to the participant. In addition, when *choice* and *familiarity* were collapsed across specific emotions, it was found that all emotions showed the same tendency—except for *surprise-astonishment* and *disgust-contempt*, where 100% of the episodes involved music that was unfamiliar and not selected by the participant. *Liking of the music* varied considerably across musical emotion episodes (*Min* = 1, *Max* = 5, *M* = 3.90, *SD* = 1.10), but did not correlate strongly with specific emotions. The only tendencies were three negative and quite small correlations (r_{pb}) between *liking* and *anger-irritation* (−.15), *surprise-astonishment* (−.11), and *disgust-contempt* (−.11). The importance of the music for the current activity varied (*Min* = 1, *Max* = 5, *M* = 3.20, *SD* = 1.44). The lowest scores were observed for *shopping* (*M* = 2.00) and *work/study* (*M* = 2.30) and the highest for *concert attendance* (5.00), *physical activity* (4.21), and *music listening* (4.06).

Motives for Listening

What were the reasons for listening to music in the musical emotion episodes? Results indicated the following rank order of frequency among the reasons: (1) *to get some company* (16%), (2) *others chose to play music* (14%), (3) *to relax* (14%), (4) *to get energized* (14%), (5) *to pass the time* (12%), (6) *the music could not be avoided* (11%), (7) *to influence feelings* (10%), (8) *other*

reason (4%), (9) *I was curious* (about the music) (2%), (10) *to evoke personal memories* (1%), (11) *to create a certain image* (1%), (12) *I wanted to listen to the lyrics* (0.5%), and (13) *it's good for my health* (0.5%). Moreover, as shown by matched pair *t* tests, the four most common listening motives were not significantly different from each other, but were all different from the six *least* frequent motives (all *p*'s < .01, Bonferroni corrected). Remaining differences were not significant.

Causes of Emotions

Self-reported causes of emotions were, in order of frequency of occurrence: *Emotional contagion* (32%), *brain stem response* (25%), *episodic memory* (14%), *visual imagery* (7%), *evaluative conditioning* (6%), *lyrics* (4%), *musical expectancy* (4%), *other* (4%), *I don't know* (3%), and *cognitive appraisal* (2%). A matched pair *t* test indicated no significant difference between *emotional contagion* (*M* = 31.79%, *SD* = 21.05) and *brain stem response* (*M* = 23.94, *SD* = 19.04), although *emotional contagion* was reported significantly more often than *episodic memory* (*M* = 13.15, *SD* = 13.12; $t_{31} = -3.68$, $p < .01$). Furthermore, *episodic memory* was reported significantly more often than *lyrics* (*M* = 4.44, *SD* = 7.21; $t_{31} = 3.43$, $p < .01$). In addition, the three most commonly reported causes were all significantly different from those causes reported more rarely than *evaluative conditioning* (all *ps* < .01, Bonferroni corrected).

Distributions of Specific Emotions Across Situations and Listening Motives

In a final set of data, we consider in more depth the seven emotions that occurred most commonly ($n > 20$) in the musical emotion episodes—*calm-contentment*, *happiness-elation*, *interest-expectancy*, *nostalgia-longing*, *pleasure-enjoyment*, *sadness-melancholy*, and *anger-irritation*. Tables 2 and 3 show the distri-

Table 2

Relative Distribution (in Percent, Columnwise) of the Seven Most Common Emotional Reactions to Music Across Different Main Activities

Activity	Emotion						
	Calm-contentment	Happiness-elation	Interest-expectancy	Nostalgia-longing	Pleasure-enjoyment	Sadness-melancholy	Anger-irritation
Work/study (4)	13	7	7	8	0	23	39
Travel (8)	7	5	7	8	3	4	6
Social interaction (1)	11	27	6	5	21	4	22
Housework (7)	10	5	14	8	7	4	0
TV/movie watching (5)	9	7	16	14	3	19	11
Music listening (2)	14	18	14	14	11	14	0
Physical activity (10)	2	5	0	5	0	0	0
Shopping (12)	1	3	6	0	0	0	0
Having a meal (9)	6	5	2	5	14	9	6
Relaxation (3)	19	5	7	16	24	9	0
Partying (11)	1	6	0	3	7	0	0
Gaming (13)	1	0	0	0	0	0	0
Concert attendance (14)	0	1	0	0	0	0	0
Other activity (6)	6	6	21	14	10	14	16

Note. Values within parentheses show the rank order of frequency of occurrence of respective activity across all musical emotions ($N = 571$).

Table 3
Relative Distribution (in Percent, Columnwise) of the Seven Most Common Emotional Reactions to Music Across Social Conditions

Social condition	Emotion						
	Calm-contentment	Happiness- elation	Interest- expectancy	Nostalgia- longing	Pleasure- enjoyment	Sadness- melancholy	Anger- irritation
Alone (1)	55	37	50	60	17	64	17
With my partner or a close friend (2)	21	17	27	16	48	23	22
With my family (4)	3	9	3	8	10	5	0
With a colleague or an acquaintance (6)	4	2	3	2	4	4	11
With several of my friends (3)	11	27	11	3	17	0	39
With strangers (5)	4	4	2	11	0	4	6
In a crowd (7)	2	4	4	0	4	0	5

Note. Values within parentheses show the rank order of frequency of occurrence of respective condition across all musical emotions ($N = 571$).

butions of these emotions across activities and social conditions. As can be seen, the results for individual emotions are fairly similar to the overall tendencies shown earlier. However, some interesting patterns may be observed. For example, some emotions such as *happiness-elation*, *pleasure-enjoyment*, and *anger-irritation* occurred often in “social” settings (e.g., during social interaction, among friends). Others such as *calm-contentment*, *nostalgia-longing*, and *sadness-melancholy* occurred often in “solitary” settings (e.g., alone). In addition, *anger-irritation* occurred often during ‘work,’ whereas *calm-contentment*, *nostalgia-longing*, and *pleasure-enjoyment* occurred often during ‘relaxation.’

Table 4 presents the relative distribution of each of the seven most common emotional reactions to music across the various self-reported motives for listening to music. Inspection of the table reveals that the importance of the various listening motives varied depending on the emotion; for example, *to relax* is a common motive when *calm-contentment* was evoked, although not when *sadness-melancholy* was evoked. In contrast, *to influence my feelings* is a common motive when *sadness-melancholy* was evoked, but not when *calm-contentment* was evoked. Furthermore, *others chose to play music* accounts for many episodes when *pleasure-*

enjoyment and *anger-irritation* were evoked, but not when *calm-contentment* was evoked.

Discussion

Overall Prevalence

The present results replicate earlier findings about the frequent occurrence of music in everyday life. Music occurred in 37% of the 2,424 randomly sampled episodes. Notably, this estimate is similar to those of previous studies by Sloboda et al. (2001, 41%) and North et al. (2004, 39%). Music did not always produce an emotion in the listener, however; only in 64% of the episodes that featured music did the listener report that the music influenced how he or she felt, which is comparable to the average of listeners’ own aggregated estimates of 55% in the survey study by Juslin and Laukka (2004). This result shows that self-reports of emotions that are concurrent with occurrences of music cannot be taken as direct evidence of a musical impact on the listener: Whether it is the music that is evoking the emotion must be decided on a case-by-case basis. Why, then, does music evoke emotions only some of the time?

Table 4
Relative Distribution (in Percent, Columnwise) of the Seven Most Common Emotional Reactions to Music Across Listening Motives

Listening motive	Emotion						
	Calm-contentment	Happiness- elation	Interest- expectancy	Nostalgia- longing	Pleasure- enjoyment	Sadness- melancholy	Anger- irritation
To relax	24	9	5	8	17	0	17
To pass the time	17	11	5	13	3	10	0
To get energized	12	21	16	11	0	10	17
To get some company	19	10	18	18	13	15	0
To influence my feelings	4	14	9	13	10	20	11
I was curious	3	1	4	3	4	0	0
To listen to the lyrics	0	1	2	0	0	0	0
To evoke memories	1	0	4	5	0	0	5
To create an image	1	2	0	0	0	0	0
It’s good for health	1	1	0	0	0	0	0
Others chose to play music	8	15	13	21	33	20	28
Music could not be avoided	7	10	20	8	10	25	17
Other reason	3	5	4	0	10	0	5

Note. The question concerning listening motive was ‘Why did you listen to music?’ (see Appendix).

As noted by Juslin and Västfjäll (in press), the different mechanisms by which music may evoke emotions have particular requirements that may not be fulfilled in each musical event; for instance, a mechanism such as episodic memory requires that the music has been encountered before, whereas a mechanism such as visual imagery may require the attention of the listener. Sometimes, emotional responses to music may be prevented simply because something else is happening in the situation that recruits the same psychological “resources” that are required for a particular emotion-induction mechanism to be activated by the music.

Prevalence of Specific Emotions

This is the first study to report estimates of prevalence of specific emotions in response to both music and nonmusical events based on a representative sample of real-life situations. The results are directly relevant to the debate regarding whether music evokes a different set of emotions than other stimuli, and may perhaps be taken as support for both positions in the debate, depending on one’s perspective. That is, there were both similarities and differences.

The overall trend was rather similar for musical and nonmusical emotion episodes. For instance, *calm-contentment* and *happiness-elongation* were the most commonly felt emotions and *shame-guilt* and *disgust-contempt* the least commonly felt emotions, regardless of the type of episode. These results are consistent with the results from Zelenski and Larsen’s (2000) ESM study of emotions, in general. Furthermore, positively valenced emotions were, on the whole, more common than negatively valenced emotions in both types of episodes. This is consistent with previous findings that people in the Western world tend to experience more positive than negative emotions, overall (Diener & Diener, 1996). The similarity between musical and nonmusical emotions in the present study cannot be accounted for only in terms of an insufficient selection of emotion terms for music, because the participants rarely selected the “other emotion” alternative—especially in the musical emotion episodes. Further, the terms had been selected partly based on open-ended responses from listeners in previous studies.

The similarities notwithstanding, there were also some differences: *Happiness-elongation* and *nostalgia-longing* were more common during musical emotion episodes than during nonmusical episodes. Conversely, *anger-irritation*, *boredom-indifference*, and *anxiety-fear* were more common during nonmusical episodes than during musical emotion episodes. Moreover, and as hypothesized, musical emotions involved a larger proportion of positive emotions than did nonmusical emotions. Hence, it might be the case that, although music evokes several of the same emotions as other stimuli in life, music has a characteristic frequency distribution of emotions that is skewed toward positive emotions. This could be just one example of a more general phenomenon—that there are different frequency distributions across the spectrum of emotions as a function of the context (e.g., music, sports, politics, social relationships). In any case, it should be noted that contrary to previous claims in the literature (Kivy, 1990; Scherer, 2003), music did appear to induce “basic” as well as “complex” emotions, which is reasonable, considering the range of psychological mechanisms that can evoke emotions: from mere brain stem responses to cognitive appraisals in relation to goals in life (Juslin & Västfjäll, in press).

Situational Factors

The findings of the present study indicate that the participants experienced emotions to music mostly at home and outdoors. Similar results were obtained by both North et al. (2004) and Sloboda et al. (2001). However, in the present study at least, musical emotions were most frequent at home and outdoors mainly because participants spent most time there overall.¹¹ Yet, musical emotions did occur in a great variety of locations, indicating that they were not really dependent on any specific location. The increasing use of portable music players (e.g., mobile phones, mp3 players, walkmans) has probably contributed to the fact that emotional reactions to music can occur practically anywhere, not the least because these devices allow listeners to bring with them their favorite music—thereby enhancing the effects of choice, familiarity, and liking of music.

The results further indicated that the most frequent activities overall were *work/study*, *social interaction*, *relaxation*, *TV/movie watching*, and *housework*. These results seem fairly reasonable, considering that the participant sample consisted of students. More surprising is that, despite what would appear to be a lot of leisure time, music listening as a main activity accounted for less than 5% of the episodes (see Sloboda et al., 2001, for similar results). The least frequent of all activities was *concert attendance*, indicating that live music is becoming a rare form of exposure to music, even among people who are quite interested in music. The most common main activities during musical emotion episodes were: *music listening*, *social interaction*, *relaxation*, *work/study*, and *TV/movie watching*. However, even in these episodes *music listening* represented a minority (15%) of the episodes.

Perhaps the most important result of the present study is that the prevalence of specific musical emotions depended on several features of the situation and the listener. In particular, different situations tended to evoke different musical emotions. For example, some emotions such as *happiness-elongation*, *pleasure-enjoyment*, and *anger-irritation* occurred often in “social” settings (during social interaction, among friends), whereas others such as *calm-contentment*, *nostalgia-longing*, and *sadness-melancholy* occurred often in “solitary” settings (being alone). These findings show that prevalence estimates of emotions depend on the situations sampled. Hence, studies that do not use representative samples of situations will yield biased estimates. This is true not only of laboratory studies, but also of field studies that look at a single setting.

Individual Factors

The probability that an emotion would be evoked by music also depended on various individual features. As regards listening motives, results showed that participants listened to music for a number of different reasons, many of which were directly or indirectly related to emotions (e.g., to reduce boredom, to relax, to get energized, to influence feelings). Yet, the listeners were also emotionally affected by music in cases where others chose to play music, or where the music could not be avoided. Personal choice

¹¹ The frequency of episodes that occurred outdoors is partly related to the time of year (May) and the weather (mostly hot and sunny) during the study.

and familiarity with the music did increase the probability of a musically evoked emotion, though neither factor was absolutely required. Furthermore, neither choice, nor familiarity or liking of music, was associated with particular emotions. In contrast, the listener's motive did appear to influence which emotions were evoked. Thus, for instance, *calm-contentment* was associated with an intention to relax, and *sadness-melancholy* was associated with an intention to influence one's feelings. Hence, to understand why a certain emotion is evoked by music, one needs to know *why* the listener chose to listen to music.

Several individual factors failed to show any relationships to the prevalence of musical emotions. For example, whatever effects of age, gender, or music education that might exist were not large enough to yield significant effects in this relatively small listener sample (because of practical limitations). However, a few correlations between prevalence of specific musical emotions and the Big Five personality factors were found. For example, *pleasure-enjoyment* was positively correlated with *neuroticism*—which is interesting in the light of earlier results indicating that musicians tend to be more neurotic than the general population (Kemp, 1996). Consistent with an earlier survey study (Juslin et al., 2008), we found that overall prevalence of musical emotions was positively correlated with extraversion, which may partly reflect the different uses of music by extraverts and introverts (e.g., Furnham & Bradley, 1997). Though the small listener sample of this study was not optimal to detect personality effects, the results clearly suggest that personality correlates of musical emotions are worth investigating further.

Limitations and Directions for Future Research

There are several limitations of this study that should be acknowledged. First, the study was based only on self-report. As such, it suffers from the common problems of this measure (Barrett & Barrett, 2001). Particularly, participants only report what they can or are willing to report and their responses might be affected by factors such as social desirability and demand characteristics. However, the reliability of self-reports will presumably depend on the type of questions asked. As noted by Griffiths (1997), people are not likely to be mistaken about their own emotions—particularly if these occur in ecologically valid settings over a prolonged time period. Hence, the prevalence estimates may be quite reliable, though they could be enhanced by the addition of ambulatory (but unfortunately very expensive) equipment for measurement of physiological responses (for a review, see Fahrenberg & Myrtek, 1996). More problematic are the self-reports of the causes of the musical emotions. Participants may be unaware of the true causes of their emotions. Moreover, mechanisms that are “implicit” in nature (evaluative conditioning) are likely to be underreported, relative to mechanisms that are more “salient” in conscious experience (episodic memory; e.g., Janata, Tomic, & Rakowski, 2007). Hence, the results concerning causes should be interpreted with caution.

A crucial goal for future research could be to develop a set of diagnostic questions that can help researchers to indirectly determine which mechanism caused a particular emotion in a self-report context (see Juslin & Liljeström, in press). This might also encompass questions about the specific, acoustic characteristics of the stimulus in each episode (although we stress that it will be hard

to find direct links between acoustic parameters and emotions). The results did not reveal much about the artists or pieces that the participants listened to, and there were problems with the categorization of musical style (participants chose “other music” in 14% of the cases). This shows that we need improved procedures for the reporting of musical stimuli, such as, for instance, open-ended response formats that can be coded ‘post hoc.’ One hitherto unexplored method that we suggest here is to sample the actual music, using a portable sound recorder (see Mehl, Pennebaker, Crow, Dabbs, & Price, 2001), though a problem may be that one also records private conversations that participants do not want to share with strangers.

Another limitation of the present study concerns the participant sample, which included only students. Their daily habits (e.g., music listening) are likely to differ from those of other subgroups. It is further possible that these participants have a higher than average interest in music. Therefore, the study needs to be replicated with more heterogeneous samples in terms of age and occupation. The ideal scenario would be to sample both participants and situations representatively, although for practical reasons, this could be almost impossible to achieve. A compromise may be to alternate between representative sampling of participants (Juslin et al., 2008) and representative sampling of situations (the present study).

One final albeit important limitation is that field studies like this one do not permit the researcher to draw definitive conclusions about causal relationships—because of insufficient experimental control. Hence, it is necessary to conduct experiments in the laboratory, where factors that seem important on the basis of field studies (e.g., listening motives, the presence of other persons, activities, underlying mechanisms) are manipulated in a systematic, though simplified way. The ESM is expensive, time-consuming and demanding for both researchers and participants. On the other hand, the method offers unique opportunities to study musical emotions in ecologically valid settings. Studies of music and emotion that use the ESM have only begun. Already, however, the results illustrate the crucial role of situational sampling in trying to understand musical emotions. A strictly laboratory-based approach will not capture emotions to music in all their variety and complexity. Experiments are indispensable tools in drawing conclusions about causal relationships, but we first need to understand exactly what phenomena we are supposed to explain. The present study shows that emotional responses to music depend on complex interactions between the listener, the music, and the situation. Any serious attempt to estimate the prevalence of musical emotions in everyday life must thus use representative samples of musical events.

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Appendix

The 16-Item Questionnaire (Swedish/English)

1. Vilket alternativ motsvarar bäst hur du kände dig de senaste 10 minuterna?

- glädje-upprymhet
 sorg-vevod
 lugn-belåtenhet
 ilska-irritation
 nostalgi-längtan
 oro-rädsla
 kärlek-ömhhet
 förvåning-häpnad
 skam-skuld
 avsky-förakt
 välbehag-njutning
 uttråkan-likgiltighet
 intresse-förväntan
 annan känsla

What alternative corresponds best to how you felt over the last 10 minutes?
happiness-elation
sadness-melancholy
calm-contentment
anger-irritation
nostalgia-longing
anxiety-fear
love-tenderness
surprise-astonishment
shame-guilt
disgust-contempt
pleasure-enjoyment
boredom-indifference
interest-expectancy
other emotion

2. Hur intensiv var känslan?

- litet mycket

 1 2 3 4 5

How intense was the feeling?
(rating on scale from 1 to 5)

3. Hur negativ vs. positiv var känslan?

- negativ positiv

 -2 -1 0 1 2

How negative vs. positive was the feeling?
(rating on bipolar scale from -2 to 2)

4. Var befann du dig när du upplevde känslan?

- hemma
 fordon
 arbete/skola
 utomhus

Where were you when you experienced the feeling?
home
vehicle
work/school
outdoors

(Appendix continues)

<input type="checkbox"/> affär <input type="checkbox"/> kafé <input type="checkbox"/> annan persons hem <input type="checkbox"/> konsert eller teater <input type="checkbox"/> kyrka <input type="checkbox"/> fest <input type="checkbox"/> gym <input type="checkbox"/> pub/diskotek <input type="checkbox"/> restaurang <input type="checkbox"/> annat	<i>shop</i> <i>cafe</i> <i>another person's house</i> <i>concert or theatre</i> <i>church</i> <i>party</i> <i>gym</i> <i>pub/disco</i> <i>restaurant</i> <i>other</i>
5. Vilken var din huvudsakliga aktivitet? <input type="checkbox"/> arbete/studier <input type="checkbox"/> resa <input type="checkbox"/> socialt umgänge <input type="checkbox"/> hushållsarbete <input type="checkbox"/> TV/film tittande <input type="checkbox"/> musiklyssning <input type="checkbox"/> fysisk aktivitet <input type="checkbox"/> shopping <input type="checkbox"/> måltid <input type="checkbox"/> avkoppling <input type="checkbox"/> festande <input type="checkbox"/> datorspel <input type="checkbox"/> konsert/teater besök <input type="checkbox"/> annat	<i>What was your main activity?</i> <i>work/study</i> <i>travel</i> <i>social interaction</i> <i>house work</i> <i>watching TV/movie</i> <i>listening to music</i> <i>physical activity</i> <i>shopping</i> <i>having a meal</i> <i>relaxation</i> <i>partying</i> <i>computer games</i> <i>concert/theatre attendance</i> <i>other</i>
6. Vilka närvarade när du upplevde känslan? <input type="checkbox"/> ingen, jag var ensam <input type="checkbox"/> en partner eller nära vän <input type="checkbox"/> min familj <input type="checkbox"/> en bekant eller kollega <input type="checkbox"/> flera vänner eller bekanta <input type="checkbox"/> en eller flera okända personer <input type="checkbox"/> en stor folksamling	<i>Who was present when you experienced the feeling?</i> <i>nobody, I was alone</i> <i>a partner or friend</i> <i>my family</i> <i>an acquaintance or colleague</i> <i>several friends or acquaintances</i> <i>one or more strangers</i> <i>a large crowd</i>
7. Förekom det musik i situationen? <input type="checkbox"/> ja, och musiken påverkade känslan <input type="checkbox"/> ja, men musiken påverkade ej känslan <input type="checkbox"/> nej, det förekom ingen musik	<i>Did music occur in the situation?</i> <i>yes, and the music affected the feeling</i> <i>yes, but the music didn't affect the feeling</i> <i>no, there was no music</i>
(Branching to either <i>music items</i> or <i>non-music items</i> : choosing the first response alternative in question 7 meant that the questionnaire continued with music items; choosing any of the other two alternatives meant that the questionnaire continued with non-music items.)	
<i>Music items</i>	
8. Vilken musikstil var det? <input type="checkbox"/> klassiskt <input type="checkbox"/> hårdrock <input type="checkbox"/> jazz <input type="checkbox"/> pop/rock <input type="checkbox"/> religiös musik <input type="checkbox"/> world music <input type="checkbox"/> country <input type="checkbox"/> soul <input type="checkbox"/> hip hop <input type="checkbox"/> electronica <input type="checkbox"/> reggae <input type="checkbox"/> blues <input type="checkbox"/> dansmusik <input type="checkbox"/> annan musik	<i>What musical style was it?</i> <i>classical</i> <i>hard rock</i> <i>jazz</i> <i>pop/rock</i> <i>religious music</i> <i>world music</i> <i>country</i> <i>soul</i> <i>hip hop</i> <i>electronica</i> <i>reggae</i> <i>blues</i> <i>dance music</i> <i>other music</i>
9. Varifrån kom musiken? <input type="checkbox"/> Tv <input type="checkbox"/> radio <input type="checkbox"/> stereoanläggning <input type="checkbox"/> walkman/MP3-spelare <input type="checkbox"/> dator <input type="checkbox"/> levande musik	<i>Where did the music come from?</i> <i>television</i> <i>radio</i> <i>stereo equipment</i> <i>walkman/MP3 player</i> <i>computer</i> <i>live music</i>

<input type="checkbox"/> offentlig högtalare <input type="checkbox"/> 'hörde' musik i huvudet '	<i>public speaker</i> <i>heard' the music in my head</i>
10. Hade du hört musiken förut? <input type="checkbox"/> ja <input type="checkbox"/> nej <input type="checkbox"/> vet ej	<i>Had you heard the music before?</i> <i>yes</i> <i>no</i> <i>I don't know</i>
11. Var det du som valde musiken? <input type="checkbox"/> ja <input type="checkbox"/> nej	<i>Was it you who chose the music?</i> <i>yes</i> <i>no</i>
12. Hur mycket gillade du musiken? litet mycket <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 1 2 3 4 5	<i>How much did you like the music?</i> <i>(rating on a scale 1 to 5)</i>
13. Hur viktig var musiken för den aktuella aktiviteten? litet mycket <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 1 2 3 4 5	<i>How important was the music for the current activity?</i> <i>(rating on a scale 1 to 5)</i>
14. Vad tror du orsakade känslan? <input type="checkbox"/> personliga minnen <input type="checkbox"/> musikens känslouttryck <input type="checkbox"/> medryckande klang/rytm <input type="checkbox"/> inre bilder eller fantasier <input type="checkbox"/> infriad/ ej infriad förväntning <input type="checkbox"/> omedvetna associationer <input type="checkbox"/> musiken påverkade mina mål <input type="checkbox"/> sångtexten <input type="checkbox"/> annat <input type="checkbox"/> vet ej	<i>What do you think caused the feeling?</i> <i>personal memories</i> <i>the music's emotional expression</i> <i>arousing sound/rhythm</i> <i>inner images or fantasies</i> <i>confirmed or disconfirmed expectation</i> <i>subconscious associations</i> <i>the music influenced my goals</i> <i>the lyrics</i> <i>other</i> <i>I don't know</i>
15. Varför lyssnade Du på musik? För att... <input type="checkbox"/> koppla av <input type="checkbox"/> fördriva tid <input type="checkbox"/> pigga upp mig <input type="checkbox"/> fålite sällskap <input type="checkbox"/> påverka mina känslor <input type="checkbox"/> jag var nyfiken <input type="checkbox"/> jag ville lyssna påtexten <input type="checkbox"/> väcka personliga minnen <input type="checkbox"/> skapa en viss image <input type="checkbox"/> det är bra för min hälsa <input type="checkbox"/> andra valde att spela musik <input type="checkbox"/> musiken gick ej att undvika <input type="checkbox"/> annat skäl	<i>Why did you listen to music?</i> <i>to relax</i> <i>to pass the time</i> <i>to get energized</i> <i>to get some company</i> <i>to influence my feelings</i> <i>I was curious</i> <i>I wanted to listen to the lyrics</i> <i>to evoke personal memories</i> <i>to create a certain image</i> <i>it's good for my health</i> <i>others chose to play music</i> <i>the music could not be avoided</i> <i>other reason</i>
16. Hur stressad kände du dig?* inte alls mycket <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 0 1 2 3 4	<i>How stressed did you feel?*</i> <i>(rating on a scale from 0 to 4)</i>

Note. Non-musical emotion items regarding appraisal theory are reported separately.

* Stress data are reported separately.

Received September 10, 2007

Revision received June 25, 2008

Accepted July 25, 2008 ■