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Experimental evidence of the roles of music choice, social context, and listener personality in emotional reactions to music

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Abstract

Music may arouse intense emotions in listeners, but little is known about the circumstances that contribute to such reactions. Here we report a listening experiment that investigated the roles of selected musical, situational, and individual factors in emotional reactions to music. In a 2 × 2 factorial design, we manipulated music choice (self-chosen vs. randomly sampled) and social context (alone vs. with a close friend or partner). Fifty university students (20–43 years old) rated their emotional responses to the music in terms of overall emotion intensity and 15 emotions. We also measured personality traits (NEO-PI-R) and psychophysiological responses (skin conductance, heart rate). Consistent with predictions based on previous field studies, listeners reported more intense emotions (1) to self-chosen music than to randomly selected music and (2) when listening with a close friend or partner than when listening alone. Moreover, listeners scoring high on the trait *Openness to experience* experienced more intense emotions than listeners scoring low. All three factors correlated positively with the experience of positive emotions such as happiness and pleasure.

Keywords

choice, emotion, intensity, music, personality, psychophysiology, social context

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Music may arouse intense emotions in listeners (Gabrielsson, 2001), but what are the precise circumstances that contribute to such responses? In this study we investigated three factors proposed in previous field studies, using an experimental approach to obtain stronger evidence of their causal role in musical emotions.[1]

Music has been linked to emotions since ancient Greece (e.g., Budd, 1985), and modern studies confirm that people commonly listen to music to achieve various emotional outcomes (e.g., Juslin, Liljeström, Laukka, Västfjäll, & Lundqvist, 2011). Results from both survey and experience sampling method (ESM)[2] studies (e.g., Juslin & Laukka, 2004; Juslin, Liljeström, Västfjäll, Barradas, & Silva, 2008; North, Hargreaves, & Hargreaves, 2004; Sloboda, O'Neill, & Ivaldi, 2001) suggest that music, in some form, occurs frequently in everyday life, and that music may arouse anything from mere arousal and typical 'basic' emotions such as *happiness* and *sadness* to more 'complex' emotions such as *nostalgia* and *pride* (Juslin, 2011).

Still, music does not *always* arouse an emotion. In fact, preliminary results indicate that we are only 'moved' by music in roughly half of the episodes including music (e.g., Juslin et al., 2008). Unfortunately, the literature does not yet contain a theoretical account of exactly which circumstances are likely to arouse an emotion, and which are not. Thus one of the key challenges in the present field is to delineate the factors that contribute to emotional reactions to music.

Contributing factors

As noted by Sloboda (2010), everyday emotions to music rarely, if ever, arise out of a de-contextualized aesthetic relationship to the music as 'object.' All musical emotions occur in complex interactions between the listener, the music, and the situation (Gabrielsson, 1993), each of which may involve a range of contributing factors (Scherer & Zentner, 2001).

Musical factors

Musical features that are involved in the expression and perception of emotions have been mapped in previous work (Juslin, 2009; Juslin & Laukka, 2003), but the features that *arouse* emotions in listeners are less understood. Gabrielsson's (2001) study of strong experiences with music offered several clues about features that listeners thought had influenced their own emotional reactions, such as 'high volume, heavy drumming, screaming saxophone, monotonous and howling song, a dissonant chord in Mahler's "Tenth Symphony", tempo accelerando, mode transition from minor to major, beautiful melodies and harmonies, thick texture' (pp. 442–443). However, in general it is difficult to find simple links between musical features and aroused emotions. This is partly because musical features are mediated by underlying mechanisms that respond to different types of information (Juslin & Västfjäll, 2008), but it is also because the emotions are influenced by the listener's musical preferences (Gowensmith & Bloom, 1997). Given individual differences in musical taste, it is difficult to predict how a listener will respond to a piece of music simply on the basis of musical factors such as sound level or tempo. Previous survey studies have shown that, in principle, musical emotions may involve *any* genre of music (e.g., Gabrielsson, 2001). Accordingly, it could be assumed that, more important than the music genre as such, is whether the music matches the musical taste of the listener. Thus whether the music was chosen by the listener or not could be an important contributing factor in emotional reactions to music (Sloboda et al., 2001).

Situational factors

People can listen to almost any type of music in almost any situation due to the profusion of mobile music players in daily life. Whether self-chosen or selected by someone else, music occurs naturally in a broad variety of contexts. Yet serious study of the context had to await the blossoming of the social psychology of music (Hargreaves & North, 1997), which moved the field of music psychology away from the typical 1980s paradigm of laboratory-based experiments to a broader exploration of the manifold ways in which music is used and experienced in daily life (Juslin & Sloboda, 2010, p. 934). The impact of music has now been explored in a broad variety of settings, for example while driving (Brodsky, 2001), shopping (Yalch & Spangenberg, 1990), eating (Stroebele & de Castro, 2006), and attending church (Miller & Strongman, 2002), as well as in everyday life in general (Juslin et al., 2008; North et al., 2004; Sloboda et al., 2001). The fact that musical emotions can occur in a variety of locations indicates that they are not dependent on a specific location, with the exception of special concert experiences. This might seem to suggest that the context is not that important as a determining factor. However, the context may influence *which* emotions are evoked. For instance, consider the influence of social context (e.g., if other people are present or not in the situation). More general studies of the effect of social context on emotional experience have suggested that the company of others is associated with the experience of positive emotions (Fischer, Manstead, & Zaalberg, 2003). Whether this applies to music is less clear. However, in a recent ESM study by Juslin and co-workers (2008), it was observed that 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 *nostalgia-longing* and *sadness-melancholy*, occurred often in solitary settings (e.g., listening alone). Thus the social context could be an important contributing factor in emotional reactions to music.

Individual factors

Individual differences between listeners appear larger for induction of emotion than for perception of emotion (Sloboda, 1996), but few studies have focused on individual differences in musical emotions. Even so, studies have revealed several factors in the individual that might influence emotional reactions to music, including the listener's age, gender, musical training, musical preferences, and personality (e.g., Abeles & Chung, 1996). Personality traits are particularly interesting, given that individual differences in the quality, intensity, and frequency of emotions represent a crucial type of data concerning personality. Previous studies have explored the roles of such traits as sensation seeking, locus of control, empathy, and absorption (Garrido & Schubert, 2011; Grewe, Nagel, Kopiez, & Altenmüller, 2007; Kreutz, Ott, Teichmann, Osawa, & Vaitl, 2007; Rawlings & Leow, 2008). Here we focus instead on the more widely adopted 'five-factor model' (e.g., Costa & McCrae, 1992), which decomposes personality into the five traits *Extraversion, agreeableness, openness to experience, neuroticism*,[3] and *conscientiousness* (e.g., Digman, 1990). Several studies have shown that these traits are correlated with emotions, in particular that people scoring high on *Extraversion* experience more positive emotions, whereas people scoring high on *Neuroticism* experience more negative emotions (e.g., Costa & McCrae, 1980; Rusting & Larsen, 1997; Watson & Clark, 1992). Similar

findings have been obtained in regard to music (Juslin et al., 2011), for which the *Openness to experience* trait is of particular interest, because it has been argued that this trait is associated with a tendency to experience intense transient emotions to works of art (e.g., McCrae, 2007). Therefore the listener's personality could be an important contributing factor in emotional reactions to music.

Limitations of previous research

As shown by the previous review, field studies have suggested a number of factors that may contribute to musical emotions. However, field studies do not enable researchers to draw definitive conclusions regarding causal relationships due to insufficient experimental control. Thus it is necessary to conduct experiments where factors that seem important on the basis of field studies are manipulated more systematically.

In a Swedish project, we are adopting a method triangulation approach, which consists of a close interplay between field studies (e.g., survey studies, ESM studies) and experiments (Juslin, Liljeström, Västfjäll, & Lundqvist, 2010; see Figure 1). Specifically, field studies that enable us to capture listeners' responses to music in their natural environment may generate hypotheses about contributing factors that influence musical emotions. These hypotheses may then be tested in experiments. By combining different methods, we hope to eventually arrive at conclusions that hold regardless of the method of data collection. Further, we may achieve the aim of a (more or less) representative sampling of participants (survey), situations (ESM), and musical stimuli (experiments), respectively.[4]

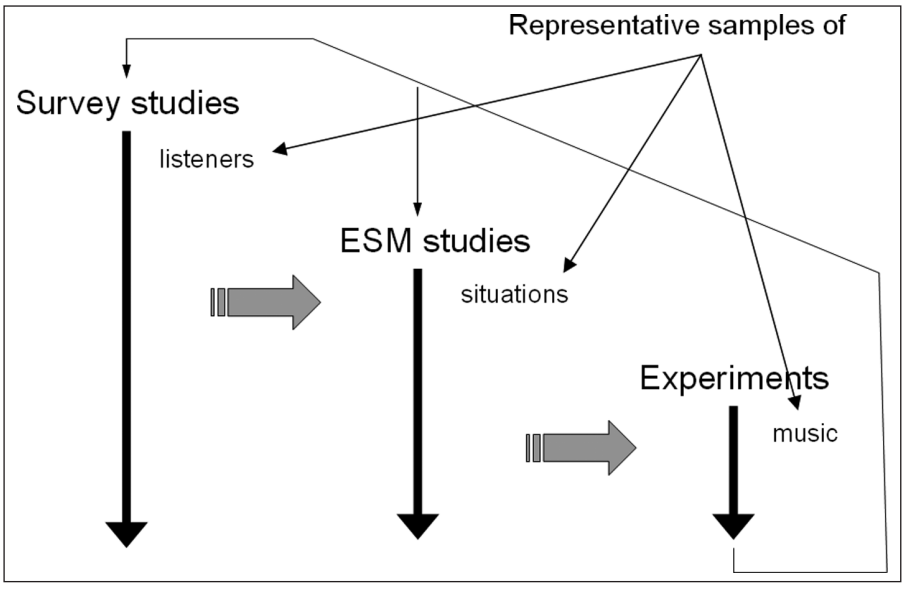

Figure 1. A method triangulation approach to studying emotional reactions to music. (adapted from Juslin et al., 2010).

Rationale for the present study

The aim of the present study was to adopt an experimental approach to test predictions about possible contributing factors based primarily on previous field studies. The main focus was on how these factors would influence the intensity of experienced emotions, although we also looked at effects on discrete emotions.

We examined one factor each for the *music*, the *situation*, and the *listener*, as described in the following. The first variable of interest was *music choice*. Field studies using the ESM approach have indicated that self-chosen music is most likely to produce a positive change in experienced emotions (Sloboda et al., 2001). Similarly, a few laboratory studies suggest that self-chosen music arouses more intense responses than other-chosen music (Blood & Zatorre, 2001; Grewe et al., 2007; Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011), although these studies focused mainly on the specific phenomenon of 'chills' (e.g., 'goose bumps,' 'shivers down the spine'). In this study, we investigated the influence of music choice on emotions more generally, with a focus on both overall intensity and discrete emotions.

There are several reasons why self-chosen music should be expected to differ from other-chosen music in its effects. First, self-chosen music is likely to be more familiar to the listener than other-chosen music. Familiarity in itself may enhance a listener's liking (North & Hargreaves, 1995), and allows a greater number of underlying mechanisms for arousal of emotions to be activated, including memory-based mechanisms like evaluative conditioning and episodic memory (Juslin, 2011). Second, self-chosen music may offer a greater sense of control over the situation, which is conducive to experiencing positive emotions (Fox, 2008, p. 324). However, the present study aimed to examine whether music choice *does* influence experienced emotions, rather than to determine the precise reasons for any such effect. Based on previous studies, we predicted that self-chosen music would arouse more intense emotions than randomly selected music and, further, that self-chosen music would arouse more positive emotions than randomly selected music. The latter music type was obtained here by means of randomized sampling from a large music database rather than through experimenter selection. Experimenter-selected music may be biased with regard to personal preferences and thus lack representativeness for the particular genre. However, with the arrival of online music services such as *Spotify*, one is able to obtain a randomized selection of music from pre-chosen genres containing tens of thousands of musical pieces (see method section).

The second variable of interest in the present study was the *social context*, which was manipulated in terms of whether the participant was alone or together with a close friend or partner during the listening procedure. These were two frequently occurring music listening conditions in a representative sample of episodes from everyday life (Juslin et al., 2008). In addition, Lamont (2011) found that a large percentage of 'peak' experiences with music of young people occurred during concerts. As well as the fact that the music is played 'live,' these situations are also characterized by the experience being shared among several people. It appears plausible that this shared experience among the listeners can serve to intensify the emotions felt to the music (e.g., Zajonc, 1965). Thus, in the present study, we predicted that listening to music together with a close friend or partner would evoke more intense emotions to music than listening alone. In addition, we expected that the evoked emotions would differ with respect to valence. In the recent ESM study by Juslin et al. (2008), *pleasure-enjoyment* was more frequent during music listening together with a close friend or partner than during music listening in a solitary setting. Hence we predicted that listening to music together with a close friend or partner would evoke more positive emotions than listening alone.

The final variable of interest in this study was *listener personality*. As noted previously, personality factors such as *extraversion* and *neuroticism* have been linked to the *prevalence*[5] of emotions – both in general (e.g., Costa & McCrae, 1980; Rusting & Larsen, 1997; Watson & Clark, 1992) and in connection with music (e.g., Juslin et al., 2011, Tables 2 and 10). Here we shall focus particularly on the *Openness to experience* dimension, since this trait has been linked to the prevalence of emotional experiences in response to the arts (Silvia & Nusbaum, 2011). In the survey study by Juslin et al. (2011), episodic reports of musical emotion events obtained from 706 listeners were correlated with their scores on the ten-item personality inventory (TIPI) test, which is a brief inventory of the five-factor model traits (see Gosling, Rentfrow, & Swann, 2003). The results revealed among other things a significant correlation between self-reported emotion intensity and *openness to experience*. Based on this result and on findings that *Openness* could also be linked to overall prevalence of musical emotions and self-ratings of how 'easy' it is to arouse emotions using music, we predicted that listeners scoring high on the *Openness to experience* dimension would experience more intense emotions than listeners scoring low. Finally, based on results in Juslin et al. (2011, Table 2), we predicted that listeners scoring high on *Openness* would experience more positive emotions than listeners scoring low.

Method

Participants

Fifty university students, 19 males and 31 females, 20–43 years old ($M = 26$, $SD = 3.95$) participated in the experiment. They were given either course credits or a cinema voucher for their anonymous and voluntary participation. Thirty-four percent played a musical instrument and 12% had received music education. Self-reported musical interest (on a scale from 0 to 4) was generally high ($M = 3.44$, $SD = 0.61$). Mean number of hours per week spent listening to music was 25 ($SD = 6.42$, range: 5–40). Music preferences varied widely, but pop music was the most preferred genre overall.

Design

The experiment used a 'split plot' design with music choice as within-subjects factor (two levels; self-chosen vs. randomly sampled music) and social context as between-subjects factor (two levels; alone vs. with a close friend or partner). The dependent variables were self-reported emotions (overall intensity, discrete emotions) and psychophysiological indices. In addition, individual scores on a personality inventory (NEO-PI-R) were correlated with self-reported emotions (detailed below).

Musical material

Sixteen musical pieces were used for each participant. Eight of these were chosen by the participant (as personal favorites) in a pre-test questionnaire (detailed below). The remaining eight pieces were randomly sampled from a music database on the internet (*Spotify*), and were the same for all participants.[6] To ensure that the pieces covered a wide range of genres despite the small number of pieces, a *stratified sampling procedure* (e.g., Visser, Krosnick, & Lavrakas, 2000) was used, and the strata corresponded approximately to the short test of music preferences (STOMP) factors outlined by Rentfrow and Gosling (2003) based on their factor analyses of music preferences and ratings of pieces of music: 'reflective and complex' (R&C: classical, jazz), 'intense and rebellious' (I&R: punk, hard rock), 'upbeat and conventional' (U&C: country, pop),

Table 1. Sampling statistics for the randomly selected pieces of music.

STOMP genre	Artist	Piece	Length	Stratum size*
R&C				
	Donald Byrd	*The Dude*	7:50	99 453
	O. Merikanto	*Valse Lente*	3:03	22 703
U&C				
	Crooked Still	*Wind and Rain*	3:46	47 525
	David Bowie	*Blue Jean*	3:12	19 577
I&R				
	Van Halen	*Little Dreamer*	3:22	47 183
	Bad Religion	*Struck a Nerve*	3:47	12 676
E&R				
	Eminem	*You Don't Know*	4:14	31 211
	Infected Mushroom	*Eat it Raw*	6:30	10 324

Note. R&C = reflective and complex; U&C = upbeat and conventional; I&R = intense and rebellious; E&R = energetic and rhythmic. *Stratum size indicates the size (i.e., the number of pieces) of the strata from which the pieces were sampled.

and 'energetic and rhythmic' (E&R: house, hip-hop/rap). Two pieces were sampled from each stratum. Table 1 presents the sampling statistics. All pieces were stored on a computer in high-bit-rate MP3 format. Length of the pieces varied between 01:42 and 07:50 minutes (M = 3:57, SD = 1:11).

Self-reports

We measured the subjective feeling component of the aroused emotions in listeners by means of a 15-item adjective list, which was developed at Uppsala University specifically for the purpose of measuring emotions to music (see Appendix 1). In putting together this list, the aim was to feature both terms that are representative of the most common conceptualizations of emotions in the emotion field in general and terms that could be particularly relevant with regard to music. Thus the selected terms included 'basic emotions' characteristic of discrete emotion theories (Izard, 1977), covered all four quadrants of the Circumplex model in terms of valence and arousal (Russell, 1980), and featured possibly more music-related terms such as *pleasure, nostalgia*, and *expectancy*. Finally, it included terms based on data regarding the prevalence of musical emotions (Juslin et al., 2008, 2011). The list thus featured the emotions reported most frequently in previous studies, but also included other emotions in order to not 'pre-judge' the question of which emotions the musical examples might evoke. In addition to discrete emotions, the participant also rated the overall *intensity* of the response. Finally, to be able to check the manipulation of music choice, the participant also rated the degree of *liking* and *familiarity* of each piece. All ratings were made on a scale from 0 (*not at all*) to 4 (*a lot*).

Psychophysiology

To increase the validity of the emotion measurement, we also obtained physiological indices in terms of skin conductance and heart rate, which are two non-obtrusive and highly common physiological measures (Hodges, 2010). The goal was not to distinguish particular emotions based on physiological response, which (to the extent that it is possible) requires a more

complex set of indices (Lundqvist, Carlsson, Hilmersson, & Juslin, 2009; Nyklíček, Thayer, & Van Doornen, 1997). The aim here was rather to obtain some evidence of autonomic arousal, which is believed to correlate with the intensity of musical emotions (Rickard, 2004).

Skin conductance was measured using the Biopac Systems MP100 hardware, with the GSR 100B Electrodermal Activity Amplifier Module and AcqKnowledge 3.5.7 software. Two electrodes covered with a gel paste with a molarity of 0.05 NaCl were attached to one finger each on the participant's non-dominant hand. Skin conductance was measured continuously in microSiemens (μmho). Prior to analysis, data were checked for skewness and outliers (no such problems were found).

Heart rate was measured using the PASPORT Heart Rate Sensor PS-2105 hardware and Data Studio version 1.9.5 software. A clip sensor was attached to either an earlobe or the web between the thumb and the forefinger of the participant's non-dominant hand. Heart rate was measured in beats per minute (bpm) using a sampling rate of 50 Hz. It was recorded every five seconds throughout each musical piece. Prior to analysis, outliers (2.5 SD from the mean, circa 1% of all data points) were removed and replaced by the mean for each participant.

Baseline recordings were made for one minute prior to the listening test, in order to check the equipment. Our predictions, however, concern differences between the four experimental conditions, rather than between baseline and conditions.

Background variables

A questionnaire was used to measure various background variables such as age, gender, music education, experience of playing a musical instrument, music preferences, and listening habits. The participant was also required to make a short list of favorite pieces: 'List 8 pieces of music that you very much enjoy listening to (your "favorite songs"). State the name of the artist and the piece.' Personality was measured using the NEO-PI-R inventory developed by Costa and McCrae (1992). This inventory measures the 'Big Five' dimensions of personality (i.e., *neuroticism* [N], *extraversion* [E], *openness to experience* [O]], *agreeableness* [A], *conscientiousness* [C]). The Cronbach's alpha reliability coefficients were .91 (N), .92 (E), .90 (O), .81 (A), and .87 (C), respectively.

Procedure

The experiment was divided into two sessions. During the first session, the participants filled out the background questionnaire and the 'Big Five' personality inventory (see earlier). As part of the manipulation of social context (design), half of the participants were asked to 'bring a close friend or partner to the second experimental session.' This was described to the participants as a matter of practical efficiency (i.e., 'being able to run two subjects at the same time') and did not evoke any questions from the participants. Friendship was defined in terms of the characteristics proposed in the study by Laurenceau, Barrett, and Pietromonaco (1998): spending time together; interacting in varied situations; self-disclosure; and mutual emotional support. An additional requirement was that they should have a roughly similar musical taste. This resulted in 25 extra participants who would listen to the music and report their responses along with their co-participants (although the ratings of the extra participants were not further analyzed). The first session took approximately one hour.

When the participants arrived at the laboratory for the second session, they were seated in a comfortable armchair and were informed that they were now going to listen to 16 pieces of music. They were further informed that after each piece they would report their emotional

reactions by filling out a questionnaire (overall intensity of their response, discrete emotions, liking, familiarity; see Appendix 1). They were also informed that psychophysiological indices were going to be recorded during the test. The participants who listened together with a close friend or partner were told not to talk to each other during the experiment, but were otherwise given the same instructions as aforementioned. The two co-participants were seated next to each other, but psychophysiological data were not recorded for the friend/partner. Regardless of the social condition (alone vs. with friend/partner), the only other person present during testing was the experimenter.

Before the test, the participants were asked if they had any questions. If not, the testing started with the first piece, which was always one of the randomly sampled pieces so that the participant would not immediately understand that his or her favorite pieces were going to be used. The order of the pieces was otherwise randomized. After each piece, the playback was paused while the participant filled out the rating questionnaire regarding his or her emotional reactions. The music was played through comfortable headphones, connected to an amplifier and a computer. Sound level was pre-set to a comfortable level, and was held constant across participants. Participants were not fully de-briefed about the 'true' purpose of the experiment until all participants had been tested, to prevent confounding effects (Neale & Liebert, 1986). The second session took approximately one and a half hours.

Results

Emotion intensity

To evaluate the effects of the experimental manipulation on rated emotion intensity, we conducted a 'split-plot' 2 × 2 factorial analysis of variance (ANOVA), with music choice as within-subjects factor (two levels) and social context as between-subjects factor (two levels). The ratings were aggregated according to condition to produce four mean values per listener. The results indicated a significant main effect of music choice, where self-chosen music aroused more intense emotions ($M = 2.64$, $SD = 0.62$) than randomly sampled music ($M = 1.52$, $SD = 0.53$), $F(1, 48) = 613.39$, $p < .001$. This effect may be regarded as 'large' (partial $\eta^2 = .93$) in terms of Ferguson's (2009) guidelines for interpretation. As a manipulation check with regard to music choice, we analyzed the ratings of *liking* and *familiarity* for self-chosen versus sampled music. As could be expected, liking was higher for self-chosen music ($M = 3.98$, $SD = 0.05$) than for randomly sampled music ($M = 1.63$, $SD = 0.39$), $t(49) = 41.95$, $p < .001$. Similarly, self-chosen music was more familiar ($M = 4.00$, $SD = 0.00$) than randomly sampled music ($M = 0.073$, $SD = 0.14$), though due to zero variability in familiarity for self-chosen music, it was not feasible to conduct a statistical test of the difference. Further, there was a significant main effect of social context, where listening together with a close friend or partner aroused more intense emotions ($M = 2.41$, $SD = 0.41$) than listening alone ($M = 1.77$, $SD = 0.50$), $F(1, 48) = 24.11$, $p < .001$. This effect was 'moderate' (partial $\eta^2 = .33$). No interaction between music choice and social context was observed.

Physiological arousal

To investigate the effects of the experimental manipulation on the psychophysiological indices, we conducted two ANOVAs, with music choice as within-subjects factor (two levels) and social context as between-subjects factor (two levels). The dependent measures

were skin conductance and heart rate, respectively, and data were aggregated according to condition to obtain four mean values per listener. With regard to skin conductance, there was a significant main effect of music choice, where self-chosen music yielded higher skin conductance level ($M = 0.023$, $SD = 0.028$) than randomly-selected music ($M = 0.016$, $SD = 0.029$), $F(1, 48) = 25.41$, $p < .001$. This effect was 'moderate' (partial $\eta^2 = .35$). Further, there was a significant main effect of social context, where listening together with a close friend or partner yielded higher skin conductance level ($M = 0.034$, $SD = 0.028$) than listening alone ($M = 0.005$, $SD = 0.018$), $F(1, 48) = 18.60$, $p < .001$. This effect was also 'moderate' (partial $\eta^2 = .28$). Finally, there was an interaction between music choice and social context, $F(1, 48) = 8.84$, $p < .01$, though this effect was 'small' (partial $\eta^2 = .16$). As can be seen in Figure 2, the manipulation of music choice yielded a slightly smaller effect on skin conductance level when the listener was together with a close friend or partner than when he or she was alone.

For heart rate, there was a significant main effect of music choice, where self-chosen music yielded a higher heart rate ($M = 71.77$, $SD = 4.20$) than randomly-selected music ($M = 69.88$, $SD = 5.63$), $F(1, 48) = 13.11$, $p < .001$, and this effect was 'moderate' (partial $\eta^2 = .21$). In contrast, although listening together with a close friend or partner yielded a slightly higher heart rate ($M = 71.97$, $SD = 3.81$) than listening alone ($M = 69.77$, $SD = 4.87$), this tendency was not significant (*ns*), $F(1, 48) = 3.15$, *ns*. However, there was a significant interaction between music choice and social context, $F(1, 48) = 12.01$, $p < .01$, a 'moderate' effect (partial $\eta^2 = .20$). As seen in Figure 3, the interaction was 'catalytic' (Neale & Liebert, 1986) in that music choice had an effect on heart rate *only* when the music was heard together with a close friend or partner. Finally, there were significant correlations between self-reported emotion intensity (discussed earlier) and skin conductance ($r_{48} = .45$, $p < .01$) and heart rate ($r_{48} = .31$, $p < .05$), respectively. Both these correlations

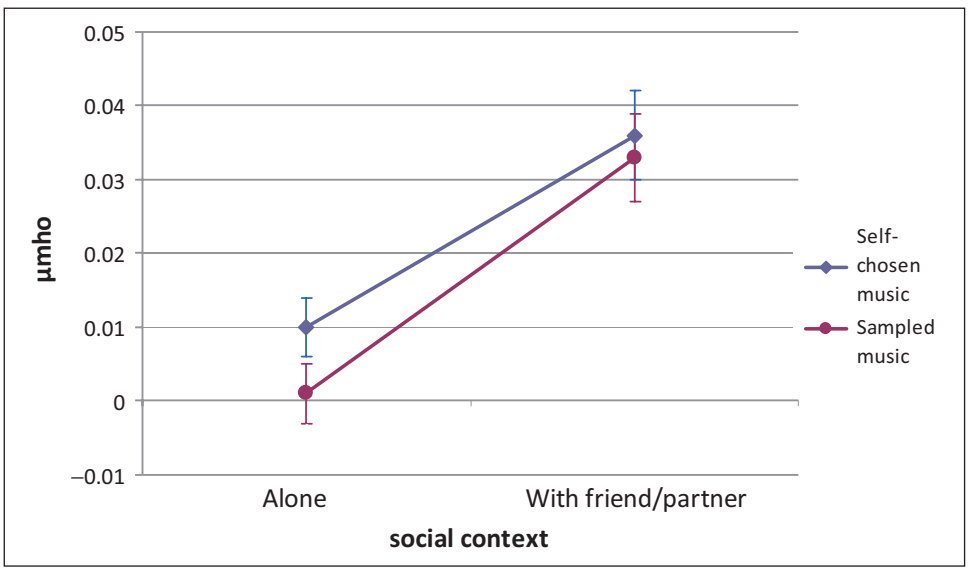

Figure 2. Skin conductance level as a function of music choice and social context. (means and standard errors).

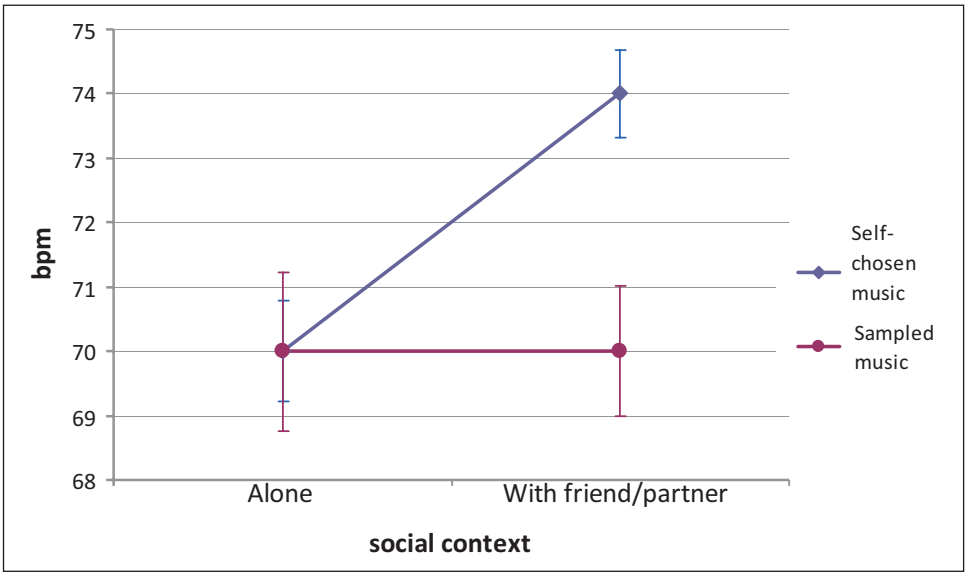

Figure 3. Heart rate as a function of music choice and social context. (means and standard errors).

were 'medium,' according to Cohen's (1988) guidelines for interpretation (approaching 'large' for skin conductance).

Discrete emotions

In addition to the ratings of emotion intensity, we also explored how the manipulation of music choice and social context affected the listeners' mean ratings on the 15 emotion scales. Table 2 presents the mean values and standard deviations of the listeners' ratings on each scale as a function of music choice. As indicated, this manipulation caused significant changes in all scales except one (i.e., *spirituality-transcendence*). Note further that listening to self-chosen music yielded higher mean ratings of *happiness-elation, sadness-melancholy, calm-contentment, nostalgia-longing, interest-expectancy, love-tenderness, admiration-awe, enjoyment-pleasure*, and *pride-confidence* than listening to randomly sampled music. Effect sizes in terms of Cohen's *d* show that the largest increases occurred for *enjoyment-pleasure, nostalgia-longing*, and *happiness-elation* (Table 2). Randomly sampled music, on the other hand, yielded higher ratings of *surprise-astonishment, anger-irritation, anxiety-nervousness, disgust-contempt*, and *boredom-indifference* than self-chosen music. That is, in general, self-chosen music tended to increase the ratings of positive emotions, whereas randomly sampled music tended to increase the ratings of negative emotions. One exception was that the ratings of *sadness-melancholy* increased with self-chosen music.

To investigate how the manipulation of social context influenced the listeners' ratings on the 15 emotion scales, we computed means and standard deviations for each scale (see Table 3). This revealed three significant differences. Specifically, listening with a close friend or partner yielded higher mean ratings of *happiness-elation, admiration-awe*, and *enjoyment-pleasure*. Effect

Table 2. Mean ratings of discrete emotions as a function of music choice.

Scale	Sampled music	Self-chosen music	t^a	*d*
	M (SD)	*M (SD)*		
Happiness-elation	1.26 (0.48)	2.71 (0.60)	23.13***	−2.69
Sadness-melancholy	0.64 (0.17)	0.90 (0.54)	3.67***	−0.65
Surprise-astonishment	0.79 (0.44)	0.59 (0.53)	−3.39**	0.41
Calm-contentment	1.35 (0.34)	1.83 (0.46)	7.97***	−1.19
Anger-irritation	0.60 (0.41)	0.04 (0.11)	−9.26***	1.87
Nostalgia-longing	0.64 (0.29)	2.24 (0.52)	23.03***	−3.80
Interest-expectancy	0.84 (0.42)	1.33 (0.55)	9.46***	−1.00
Anxiety-nervousness	0.59 (0.52)	0.08 (0.17)	−7.60***	1.32
Love-tenderness	0.31 (0.35)	0.50 (0.70)	2.28*	−0.34
Spirituality-trans.	0.19 (0.30)	0.16 (0.45)	−0.63	*ns*
Disgust-contempt	0.20 (0.24)	0.01 (0.02)	−5.66***	1.17
Admiration-awe	0.29 (0.35)	0.86 (0.72)	7.45***	−1.01
Enjoyment-pleasure	1.30 (0.40)	2.80 (0.44)	22.11***	−3.57
Pride-confidence	0.29 (0.59)	0.45 (0.71)	3.26**	−0.25
Boredom-indifference	0.86 (0.35)	0.01 (0.04)	−17.19***	3.41

Note: [a] dependent *t* test; $N = 50$.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 3. Mean ratings of discrete emotions as a function of social context.

Scale	Alone	Close friend/ partner	t^a	*d*
	M (SD)	*M (SD)*		
Happiness-elation	1.70 (0.44)	2.52 (0.38)	−4.73***	−1.99
Sadness-melancholy	0.80 (0.33)	0.74 (0.30)	0.60	*ns*
Surprise-astonishment	0.80 (0.49)	0.57 (0.36)	1.88	*ns*
Calm-contentment	1.60 (0.42)	1.58 (0.25)	0.15	*ns*
Anger-irritation	0.27 (0.18)	0.37 (0.23)	−1.68	*ns*
Nostalgia-longing	1.42 (0.42)	1.47 (0.25)	−0.54	*ns*
Interest-expectancy	1.16 (0.55)	1.01 (0.31)	1.14	*ns*
Anxiety-nervousness	0.25 (0.23)	0.42 (0.36)	−2.00	*ns*
Love-tenderness	0.50 (0.57)	0.30 (0.31)	1.56	*ns*
Spirituality-trans.	0.14 (0.37)	0.21 (0.32)	−0.72	*ns*
Disgust-contempt	0.08 (0.10)	0.12 (0.14)	−0.97	*ns*
Admiration-awe	0.35 (0.51)	0.82 (0.35)	−3.82***	−1.07
Enjoyment-pleasure	1.95 (0.35)	2.15 (0.30)	−2.13*	−0.61
Pride-confidence	0.38 (0.84)	0.35 (0.27)	0.16	*ns*
Boredom-indifference	0.40 (0.18)	0.47 (0.17)	−1.36	*ns*

Note: [a] independent *t* test; $N = 50$.
*$p < .05$; ***$p < .001$.

sizes show that the largest increase occurred for *happiness-elation*. It should be noted, however, that positive emotions received higher mean ratings overall than negative emotions, regardless of the experimental condition.

Personality

In a final set of analyses, we correlated the listeners' ratings of overall emotion intensity and discrete emotions with the individual test scores on the NEO-PI-R inventory; see Table 4. (Data were aggregated in order to obtain one mean value per listener for each emotion scale.) Careful inspection of Table 4 shows that 31 out of the 80 correlations (39%) were significant, and that these correlations were all 'medium' ($r \geq .30$) or 'large' ($r \geq .50$) in terms of Cohen's (1988) guidelines for interpretation. Note particularly that emotion intensity was significantly correlated with *Openness to experience* ($r = .34$). In addition, however, emotion intensity was correlated with *extraversion* and *agreeableness*.[7]

With regard to discrete emotions, one notable tendency is that listeners scoring high on *Neuroticism* experienced more negative emotions (e.g., *sadness-melancholy, anger-irritation*, and *anxiety-nervousness*) and fewer positive emotions (e.g., *enjoyment-pleasure*) than those scoring low. For *Extraversion, Openness to experience*, and *Agreeableness*, the tendency was largely the opposite. That is, listeners scoring high on these traits experienced more positive emotions (e.g., *happiness-elation*) and fewer negative emotions (e.g., *anxiety-nervousness*) than listeners scoring low. Finally, listeners scoring high on *Conscientiousness* experienced less *sadness-melancholy, anger-irritation, anxiety-nervousness*, and *disgust-contempt* than those scoring low.

Table 4. Pearson correlations between listeners' mean ratings and personality traits.

Scale	Personality				
	Neuro	Extra	Open	Agree	Consc
Emotion intensity	−.21	.40**	.34*	.55***	−.01
Happiness-elation	−.27	.39**	.40**	.59***	.06
Sadness-melancholy	.37**	−.18	−.32*	−.17	−.29*
Surprise-astonishment	−.03	.11	.09	.06	−.09
Calm-contentment	−.19	.32*	.26	.44**	.13
Anger-irritation	.46***	−.28	−.44**	−.31**	−.35**
Nostalgia-longing	.06	.20	.06	.28*	−.22
Interest-expectancy	−.10	.33*	.23	.42**	.05
Anxiety-nervousness	.50***	−.30*	−.45***	−.33*	−.48***
Love-tenderness	−.06	.26	.18	.41**	.03
Spirituality-transcendence	.02	.13	.11	.22	−.28
Disgust-contempt	.26	−.11	−.18	−.10	−.32*
Admiration-awe	.06	.16	.14	.35*	−.26
Enjoyment-pleasure	−.29*	.42**	.42***	.54***	.00
Pride-confidence	.07	.19	.08	.41**	−.06
Boredom-indifference	.08	.04	−.02	.08	−.10

Note: neuro = neuroticism; extra = extraversion; open = openness to experience; agree = agreeableness; consc = conscientiousness; $N = 50$.
*$p < .05$; **$p < .01$; ***$p < .001$.

Discussion

The aim of this study was to test predictions based on previous field studies regarding various factors that contribute to musical emotions. Adopting an experimental approach, we examined one factor each for the music, the situation, and the listener. The results permit us to draw the following conclusions.

First, as predicted, self-chosen music aroused more intense emotions in listeners than randomly sampled music. This effect was 'large,' in terms of Ferguson's (2009) guidelines, and supports the suggestion that researchers may be able to arouse more intense emotions to music if the participants are asked to bring their own music to the laboratory (e.g., Harrer & Harrer, 1977). In addition, self-chosen music produced an increase in positive emotions. The emotions that increased the most correspond to the emotions that seem most prevalent for music in general; that is, *happiness-elation, calm-contentment, nostalgia-longing, interest-expectancy*, and *enjoyment-pleasure* (e.g., Juslin et al., 2008).[8] There are a number of possible explanations for these effects of music choice. The results revealed that self-chosen music was more familiar and well-liked than randomly-selected music, which may partly account for the observed effect on rated intensity. As noted earlier, familiarity with the music enables a larger number of underlying mechanisms for emotion induction to be activated, including evaluative conditioning and episodic memory. In addition, self-chosen music might bring a greater sense of control over the situation, which enhances positive emotions. Future studies should attempt to disentangle the various factors that may account for the observed effects of music choice.

Second, as predicted, participants who listened to music together with a close friend or partner experienced more intense emotions than participants who listened alone. This effect was 'moderate,' in terms of Ferguson's (2009) guidelines. It is quite remarkable that such a simple manipulation of the social context could yield such a difference in emotion intensity. The mere *presence* of someone close with a similar musical taste during the music listening produced a significant increase in emotion intensity, despite the fact the participants did not actually interact (e.g., talk) in any way during the experiment. Exactly why the presence of a close friend or partner leads to a more intense emotional reaction is not clear. One possible explanation could be that the two affiliated listeners experience a sense of 'joint adventure' and 'discovery,' which renders them more attentive and responsive to the musical stimulus. Another possibility is that the situation involves some subtle form of 'emotional contagion' (e.g., Hatfield, Cacioppo, & Rapson, 1994) through non-verbal cues. This could be just one example of a more general social-psychological phenomenon, where the company of others might influence one's emotional experience (e.g., Fischer, Manstead, & Zaalberg, 2003).

In addition to the effect on overall intensity, listening together with a close friend or partner produced significantly higher mean ratings of *happiness-elation, enjoyment-pleasure* and *admiration-awe* across the conditions of music choice. All three emotions are commonly regarded as 'positive' emotions by researchers (e.g., Plutchik, 1994; Russell, 1980). This finding is quite similar to the results in the ESM study by Juslin et al. (2008), where it was found that listeners experienced more *pleasure-enjoyment* when listening with a partner or close friend than when listening alone. Note, however, that in that study the social context was confounded with other factors that differed between the two contexts. Here we directly manipulated the social context while other factors were held constant, which provides more convincing evidence of its role. It could perhaps be argued that the observed effect is merely a reflection of the fact that it is 'cozy' to sit together with a close friend or partner. However,

speaking against such an interpretation is our finding that the condition yielded a significant increase of *admiration-awe*. We can speculate that this reaction reflects a kind of heightened appreciation of the music as an aesthetic object (Ortony, Clore, & Collins, 1988). Our results are intriguing, since another study (published after this experiment was conducted) failed to obtain any significant effect of social listening on retrospective emotion ratings. The authors did find a (non-significant) trend towards more self-reported 'chills' as well as significantly higher skin conductance responses in the *solitary* listening condition, however (Egermann et al., 2011). The different results can perhaps be attributed to design differences between the two studies. Egermann et al. (2011) used a within-subjects design; the musical excerpts were only one minute long and consisted of classical music; listeners rated emotions using a different set of labels; and statistical analyses were based on factor-analyzed data. Most importantly, perhaps, the social condition featured 14 members of an orchestra seated in a circle. The present study focused on an arguably more common social context in everyday life: two friends or partners listening to music together (e.g., Juslin et al., 2008, Table 3). In any case, future research will hopefully resolve these conflicting results.

Finally, and as predicted, the personality trait *Openness to experience* was significantly correlated with experienced emotion intensity. The effect was 'medium' (e.g., Cohen, 1988) and represents a quasi-experimental replication[9] of the finding in Juslin et al. (2011), which was based on field data on musical emotion episodes in everyday life. This confirms the idea that *Openness to experience* might play a particular role with regard to aesthetic experiences: While other traits (e.g., *extraversion, neuroticism*) are associated with the overall experience of specific emotions, *Openness to experience* involves an overall sensitivity to art and beauty (McCrae, 2007). Less expectedly, overall emotion intensity also correlated with *extraversion* and *agreeableness* in the present study. The precise meanings of these relationships need to be further investigated in future research.

The results also revealed several correlations between specific emotions and personality traits: for instance, listeners who scored high on *Neuroticism* reported more negative emotions and fewer positive emotions – consistent with the emotional instability associated with a neurotic personality (see Costa & McCrae, 1992). Similar results have been reported in previous field studies (Juslin et al., 2011). In addition, listeners scoring high on *extraversion, openness to experience*, and *agreeableness* experienced more positive emotions and fewer negative emotions. These findings are arguably in line with tendencies to be extraverted, to enjoy novel experiences, and to be friendly, which is how these personality traits are defined in the literature (e.g., Costa & McCrae, 1992). Finally, listeners scoring high on *Conscientiousness* reacted with fewer negative emotions (e.g., *sadness-melancholy, anger-irritation*, and *anxiety-nervousness*) than those scoring low. This might be due to the fact that *Conscientiousness* is, in general, a 'positive' trait. As such, it would be expected to share the tendency of the other 'positive' traits to be associated with fewer negative emotions.

The results concerning self-reported emotion intensity were at least partly validated by the results from the psychophysiological measures. More precisely, the highest arousal level (as indexed by skin conductance and heart rate) was obtained during listening to self-chosen music together with a close friend or partner. That this pattern of results was similar for self-reported intensity and autonomic arousal further supports the conclusion that the self-chosen music, at least, managed to arouse genuine emotions in listeners. That is, the concordance of self-reports and psychophysiology serves to validate our measurement of emotion in general. We acknowledge, however, that the psychophysiological indices provided less clear-cut data than the self-reports (discussed further in the following sections).

Implications for research

More generally, the present study illustrates the feasibility of adopting an experimental approach to confirm preliminary findings obtained in field studies. We have shown that it is possible to manipulate and test even features of the social context in a laboratory setting and thereby influence the emotions experienced by listeners to music. Whereas field studies are limited when it comes to inferring causal relationships, the present experiment clearly shows that the social context *can* influence listeners' emotional reactions, even those emotions that would appear to be focused on the music as an 'art' object (i.e., *admiration-awe*). This result will hopefully lead to more focus on the social context in future research.

The results concerning music choice highlight the importance of using musical stimuli that are somehow 'representative' of the listener's ordinary listening environment. Precisely what should be regarded as 'representative' is, of course, a complex problem, and may differ depending on the listener. One thing is certain, however: experimenter-selected music cannot be regarded as representative. More likely, the music encountered in everyday life consists of a mixture of self-chosen music and music that the listener simply happens to hear. A unique aspect of this study is that the sampled music was obtained from large strata through internet-based music services. To our knowledge, this is the first study to utilize this method to select music for an experiment. This helps to ensure that the musical stimuli used in the experiment are not selected based on the personal preferences of the researcher – which could 'bias' the music selection and thus influence the responses.

Most importantly, however, the present experiment has clearly demonstrated that music chosen by the participant evokes more intense emotions (and also slightly different emotions) than music not selected by the participant. Most experimental studies to date have used music selected by the experimenter that is unfamiliar to the listener, and it remains an open question how this aspect has influenced the results of those experiments. Judging from the present data it would appear that both quantitative (intensity of emotion) and qualitative (type of emotion) aspects could be affected. In particular, previous studies that have used experimenter-selected music may have underestimated the relative intensity of musically-induced emotions as they occur in everyday life. If we briefly extend our perspective to possible implications for public education policy, our findings suggest that positive music listening habits may be fostered by increasing the level of personal choice among students and focusing on shared experiences in the music teaching context.

Problems and limitations

There are several limitations of this study that should be acknowledged. To begin with, although we sampled musical pieces in a more representative manner than is usually the case in music-psychological studies, the number of pieces included is still very small compared to the 'total' number of pieces in the population. Also, the duration of the featured pieces varied widely, which may have affected the results. Clearly, the present results need to be replicated with other pieces of music. Similarly, we only covered a few causal factors in this study, and even those factors were investigated in a limited way. For instance, the study only featured a very specific situation (i.e., being alone or together with a close friend or partner). Thus it is impossible to generalize to other social contexts, such as being with a group of close friends, strangers, or your family. This is clearly a limitation of experimental studies, as compared to field studies: because of the practical requirements of an experiment, they can only address a few causal factors at the time. However, one solution to this problem is to conduct successive

replications that feature partly overlapping stimulus materials and experimental procedures to eventually cover all relevant factors and their levels (cf. Juslin & Lindström, 2011).

Another problem in the present study is that the psychophysiological measures were not quite consistent. Skin conductance levels were significantly affected by manipulations of both music choice and social context (as well as an interaction between the factors), whereas heart rate indices indicated only a significant effect of music choice – conditioned by an interaction with social context so that music choice only had an effect during listening with a close friend or partner. However, note that skin conductance level is generally more consistently related to arousal-inducing music than heart rate in previous studies (Hodges, 2010), and was also more strongly correlated with self-reported emotion intensity in the present study. Furthermore, the two indices *did* concur in suggesting that the highest level of arousal occurred in the condition that involved self-chosen music and listening with a close friend or partner.

Concluding remarks

It is becoming increasingly clear that music may arouse emotions in listeners, involving multiple components of emotion (Juslin, 2011). Thus focus in future research should instead be on explaining under what circumstances music can evoke emotions. The present study has investigated some of the factors that contribute to such emotions, replicating preliminary data from previous field studies (Juslin et al., 2008, 2011). In doing so, the study demonstrates the overall utility of a method triangulation approach to musical emotions, through which one can systematically capture the various factors in the music, the listener and the context that shape how music comes to move us, time and time again.

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Notes

1. 'Musical emotions' is used here simply as a short term for emotions that were aroused by music (Juslin & Sloboda, 2010, Table 1.2). We define emotions as relatively brief, intense, and rapidly changing reactions to (potentially) important events that involve a number of sub-components (e.g., subjective feelings, physiological responses, expressive behaviors).
2. In the experience sampling method, the participant is signaled, repeatedly, at random intervals. Each time the participant hears the signal, he or she should respond to a number of questions about his or her latest experience (Juslin et al., 2008).
3. The neuroticism dimension is sometimes referred to as emotional stability, which is then the opposite of being neurotic (Gosling et al., 2003).
4. In proposing this triangulation approach, we do not exclude that other approaches (e.g., qualitative research) may also provide valuable information about musical emotions.
5. 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.
6. In principle, one could have obtained a unique randomized sample for each participant, but this was not practically feasible in this experiment and would probably have decreased the statistical power of the choice/no-choice comparison by introducing additional error variance.

7. We do not to correct for multiple tests in these correlation analyses because doing so would radically reduce statistical power and render the probability of making a type II error (failing to reject the null hypothesis when it is false) unacceptably high.
8. Note further that positive emotions received higher mean ratings overall than negative emotions, regardless of the experimental condition, which is consistent with prevalence data from field studies (Juslin et al., 2008).
9. The replication is regarded as quasi-experimental, because personality traits cannot be systematically manipulated in the same way as the other factors (e.g., the social context).

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Appendix 1

Rating questionnaire

1. How intense (strong) was your feeling as a whole?
Not at all 0 1 2 3 4 *Very intense*

2. Describe how you felt (circle a number for each emotion below)

	Not at all				*A lot*
1. happiness-elation	0	1	2	3	4
2. sadness-melancholy	0	1	2	3	4
3. surprise-astonishment	0	1	2	3	4
4. calm-contentment	0	1	2	3	4
5. anger-irritation	0	1	2	3	4
6. nostalgia-longing	0	1	2	3	4
7. interest-expectancy	0	1	2	3	4
8. anxiety-nervousness	0	1	2	3	4
9. love-tenderness	0	1	2	3	4
10. spirituality-transcendence	0	1	2	3	4
11. disgust-contempt	0	1	2	3	4
12. admiration-awe	0	1	2	3	4
13. enjoyment-pleasure	0	1	2	3	4
14. pride-confidence	0	1	2	3	4
15. boredom-indifference	0	1	2	3	4

3. How much did you like the music?
Not at all 0 1 2 3 4 *A lot*

4. How familiar were you with the music?
Not at all 0 1 2 3 4 *Very*