Psychomusicology: Music, Mind, and Brain
2013, Vol. 23, No. 1, 21–32

0275-3987/13/$12.00 DOI: 10.1037/a0032316

The Influence of Social Normative and Informational Feedback on Musically Induced Emotions in an Online Music Listening Setting

Hauke Egermann
Technische Universität Berlin and Hanover University of Music, Drama, and Media

Reinhard Kopiez
Hanover University of Music, Drama, and Media

Eckart Altenmüller
Hanover University of Music, Drama, and Media

This study investigates whether the emotional effects of music can be manipulated by social influence in an online music listening setting. More than 5000 participants listened to five randomly chosen music excerpts (of a total of 23 excerpts) and, after each one, rated induced emotions along arousal and valence dimensions. By providing different labels for the same information about the emotional effects of music, we were able to compare social influence with nonsocial informational influence. Accordingly, participants were confronted with four different rating conditions. In contrast to a control group (without feedback), two groups received feedback allegedly based on the ratings of preceding participants (social feedback), and one group received feedback allegedly based on a computational analysis of the excerpts (informational feedback). Instead of using real feedback from previous participants or computations, the feedback was manipulated, in that the upper or lower quartiles of a pretest rating were presented to the participants. Confirming predictions, results show that the manipulated feedback significantly influenced participants' ratings in groups with social feedback. Additionally, social feedback was more influential than informational, indicating that conformity might have been also based on a social and normative basis. We conclude that emotional effects of music might be socially influenced owing to normative and informational motivations to conform.

Keywords: emotion, music, social appraisal, web experiment

Supplemental materials: http://dx.doi.org/10.1037/a0032316.supp

Many different studies show that music affects the so-called "subjective feeling" component of emotion (Juslin & Västfjäll, 2008), and those effects are among the most frequent motivations to listen to and engage in music (Juslin, Liljeström, Västfjäll, Barradas, & Silva, 2008; Sloboda & O'Neil, 2001). Music is also often an object of social interaction that has been described as an important means for self-socialization and identity building (Müller, Glogner, & Rhein, 2007; North & Hargreaves, 2008). It might have its evolutionary origins in its social bonding function within human communities (Freeman, 2000; Kirschner & Tomasello, 2010; McNeill, 1995). However, previous studies on music-induced affective responses have primarily focused on individuals in a social vacuum; social influences have not been the focus of research. This lack of research is evident in scholarship about emotional processing in general. Emotional responses are regarded as consequences of a cognitive appraisal process (Scherer, 2004), but social influences on this appraisal have rarely been investigated (Manstead, 2005).

In the modern and digitalized Web 2.0 world, Internet users often engage with each other in social network sites (Boyd & Ellison, 2008). They also listen to music online, purchase music online, and discuss music online (Xia, Huang, Duan, & Whinston, 2009). The long-tail strategy (selling smaller quantities of many different products in addition to larger quantities of only a few products) of many online music businesses leads to an increasingly large selection in the music market (e.g., iTunes currently offers more then 14 million songs worldwide). As a means for orientation within these cultural markets, online content platforms often provide social feedback mechanisms (Crane & Sornette, 2008). Users offer each other recommendations and provide music ratings or

Hauke Egermann, Audio Communication Group, Technische Universität Berlin, Berlin, Germany and Institute of Music Physiology and Musicians' Medicine, Hanover University of Music, Drama, and Media, Germany; Reinhard Kopiez, Hanover Music Lab, Hanover University of Music, Drama, and Media, Germany; Eckart Altenmüller, Institute of Music Physiology and Musicians' Medicine, Hanover University of Music, Drama, and Media, Germany.

This work was partially funded by a DFG grant (AL 269-6) awarded to Reinhard Kopiez, and Eckart Altenmüller. The authors thank all participants and the team of graphic design students from the University of Applied Sciences and Arts, Hannover for designing the Web application used for the online music personality test. A subset of these data (comparing only group NoFB and group $SFB_{listening+rating}$) has been previously published as a short article: Egermann, H., Grewe, O., Kopiez, R., & Altenmüller, E. (2009). Social feedback influences musically induced emotions. *Annals of the New York Academy of Sciences, 1169*, 346–350.

A photo and brief biography of the corresponding author is available at http://dx.doi.org/10.1037/a0032316.supp

Correspondence concerning this article should be addressed to Hauke Egermann, Fachgebiet Audiokommunikation, Technische Universität Berlin, Sekr. EN-8, Einsteinufer 17c, 10587 Berlin, Germany. E-mail: hauke@egermann.net

reviews (qualitative descriptions) that are visible to others. For example, when selecting music at Amazon.com or iTunes, one is usually presented with preceding visitors' ratings of the music that one might intend to purchase. Apple Inc. also recently integrated the social networking platforms Facebook and Twitter into iTunes that allow clients to follow their peers' music purchases and comments.

In a pioneering Internet study, Salganik, Dodds, and Watts (2006) investigated similar online communities, to explain the unpredictability of success in cultural markets. The authors asked participants to choose songs from unknown bands to download. In the experimental condition, feedback regarding the frequency of peer downloads was varied and displayed to the participants. As a result, popular songs (as indicated by feedback) were downloaded more often than less popular songs, suggesting that music listeners tend to base their aesthetic choices not only on the quality of music, but also on the behavior of others. Thus, these social online interactions are thought to influence how preferences and aesthetic choices are made (Berns, Capra, Moore, & Noussair, 2010). Furthermore, they might influence emotional appraisals of music, given the previously mentioned findings that music is strongly related to emotional and social processes. Our study investigates the potential influence of social online interactions on subjective emotional appraisals of music. Whereas Salganik et al. (2006) did not describe the psychological mechanism that was responsible for their participants' behavior, the present study investigates whether the emotional effects of music can be manipulated by feedback associated with the emotional ratings of others, allowing us also to make assumptions on how corresponding mechanisms of social influences might operate in online settings. Here, feedback from different sources will be compared as social and possibly normative influence (from peers) with unsocial-informational influence (from the computer).

However, as there are ongoing controversies related to the question of what emotions induced by music really are (for a review Juslin & Västfjäll, 2008), we will first outline in the following section, the theoretical constructs used to operationalize emotion in this investigation.

Emotion Theory

Here, *emotion* is used according to the *component process model* presented by Scherer (2004, 2005). According to this model, an emotion episode consists of coordinated changes in three major reaction components: (a) physiological arousal, (b) motor expression, and (c) subjective feelings. A cognitive appraisal process often evokes this emotion episode. Furthermore, Scherer distinguishes between *utilitarian* and *aesthetic emotions*, which are assumed to differ in appraisal concerning goal relevance. The absence of direct personal relevance in aesthetic emotions leads to rather diffuse and uncorrelated physiological and behavioral changes in contrast to distinct and proactive changes in the case of utilitarian emotions, including the so-called *basic emotions* like fear, anger, sadness, or happiness (Ekman & Davidson, 1994; Scherer, 2004, 2005). As music induces emotions that are not always fully synchronized (Grewe, Nagel, Kopiez, & Altenmüller, 2007), we focused in this investigation on measuring only the subjective feeling component.

In addition to the categorical assessment of basic emotions, the subjective feeling component can also be measured on dimensional scales during music listening (Zentner & Eerola, 2010). Two feeling dimensions, arousal (from calm to exited) and valence (from unpleasant to pleasant), were derived by Russell (1980), who applied factor analyses and multidimensional scalings of different emotional terms. Using these dimensions, Russell could project all terms that he examined onto the *emotion space,* a circular structure model with two orthogonal axes. The heuristic value of the two-dimensional emotion space was subsequently confirmed in numerous other studies measuring emotional reactions to music (Egermann, Nagel, Altenmüller, & Kopiez, 2009; Nagel, Kopiez, Grewe, & Altenmüller, 2007; Schubert, 1999, 2001). Participants were able to easily understand the model, which captures the basic qualities of a wide spectrum of emotional responses. As a consequence, we applied the model in the present study.

Social Influences on Emotion in Music

According to Manstead (2005), emotions are social for three reasons: first, emotions refer to objects that are often social, for example, one person who makes another person angry/happy/sad may represent such a social object. Second, many emotions are functionally social, meaning that their predominant function is to increase social coherence, such as love, shame, embarrassment, or sympathy. Third, Manstead emphasizes the human need for and capacity of social sharing of experienced emotion, which is most powerfully reflected in instances when we feel empathy.

Emotions induced by music are also likely to be socially influenced. Juslin and Västfjäll (2008) present a theoretical framework to explain different mechanisms of music-induced emotions. Although not described by the authors, some mechanisms may involve social influences. According to their comprehensive review, music might induce emotion through brainstem reflexes, visual imagery, musical expectancy, evaluative conditioning, episodic memory, emotional contagion, and cognitive appraisal. The first three emotion-inducing mechanisms described by Juslin and Västfjäll do not seem to be directly linked to social processes. According to the authors, brainstem reflexes occur when, for example, a sudden increase in loudness in the music provokes a startle response in the listener. Furthermore, visual imagery induces emotion during music listening when mental images are evoked by the music. Music is also thought to affect emotions by violating or confirming listeners' expectations, a mechanism already described by Meyer (1956). But all other mechanisms described by Juslin and Västfjäll allow social influences to take place. Evaluative conditioning refers to an unconditioned positive or negative stimulus that is paired with the music and affects the emotional response to it. Such an emotion-inducing stimulus can be social—for example, the presence of a close friend with whom one repeatedly goes to concerts. Thus, the conditioned response (the music in the concert) will be socially affected. Emotional contagion also has a social dimension. Here, emotion is induced by internally "mimicking" the emotional expression of the music. Often this expression is attributed to a musician or composer, and the music itself has voice-like perceptual characteristics (Juslin & Laukka, 2003). Observing another person's emotional reactions to music could also lead to emotional contagion. Episodic memory can be related

to social aspects as well when a past social event, like the loss of a loved one, is remembered with the music. Although not considered an important mechanism by Juslin and Västfjäll, cognitive appraisal might also be socially affected and will be in focus in the investigation presented here, because there are several ways in which it might influence emotional responses to music.

The appraisal theory of emotion states that emotions emerge from a cognitive evaluation of the emotion-inducing events on the dimensions novelty, urgency, coping potential, norm compatibility, and goal congruence (Juslin & Västfjäll, 2008; Scherer, 1999). We assume that this evaluation process can be influenced by social feedback because norms are socially determined, and being socially accepted is one important human goal (Brehm, Kassin, & Fein, 1999). Manstead and Fischer (2001) suggest that appraisals are often influenced by social experiences, a phenomenon they call *social appraisal*. This happens in two different ways: in one, another person is part of the emotional event appraised (e.g., being insulted by someone leads to social appraisal, because the insult from another person is appraised); in the other, social appraisal occurs when we observe another person's reactions to an emotional event. In this case, the person is not part of the emotional event, but still has an influence on our appraisal. This type of social appraisal shapes one's perception of emotional situations, making it possible for other people to be involved in the construction of appraisal. Such a process is exemplified by a male watching a sexist comedy in the company of a female friend; her presence might influence the male's amusement, leading to different emotional reactions than if he had been watching the film with other male individuals or alone (Manstead & Fischer, 2001).

Research on Social Conformity and Music

Listeners who adjust their music appraisals owing to the opinion of others might be described as socially conforming. Two general types of conformity are described in the social psychological literature (Brehm et al., 1999; Cialdini & Goldstein, 2004): *informational influence* describes the reliance on others' judgments owing to insufficient information to evaluate for oneself. Sherif (1936) experimentally tested this phenomenon on a stationary dot of light in darkness, which appeared to move due to the *autokinetic effect* (a perceptual illusion due to the lack of surrounding reference points). Participants' descriptions of this movement were found to be affected by social feedback of other observers. This informational influence described by Sherif can also lead to private acceptance, meaning that one privately believes in the other's feedback with which one conforms. The other type of conformity is called *normative influence*, which occurs when people follow group norms to be included in that group. Some of the most prominent studies on normative conformity were the experiments by Asch (1955). He showed that participants were affected by normative social feedback when asked to judge the length of simple lines, leading them to give wrong answers. This form of social influence often leads to public compliance only, without changing one's attitude or perception. In a neuroimaging replication of Asch's studies, Berns et al. (2005) showed that a mental rotation task was also affected by social influence. To physiologically differentiate between social and informational influences, they either presented the influencing task solutions as resulting from other participants (social source) or from a computer (informational source), with the latter manipulation having less influence than the former. We followed this operationalization, by including an informational control condition (information from a computational analysis) to differentiate between the two routes of emotional appraisal influences.

Besides the already mentioned experiment by Salganik et al. (2006), only a few studies have examined the effect of social feedback and conformity related to music listening (Crozier, 1997; North & Hargreaves, 2008). Radocy (1975) used confederate actors to ascertain whether they would influence participants' perception judgments. Participating students were asked to match pairs of simple tones differing in loudness or pitch, and they complied with the confederates in 30% (pitch ratings) and 49% (loudness ratings) of trials when incorrect social feedback was given. He also reported that greater conformity was observed in the loudness-discrimination task when the discrepancy between the confederates' judgments and the correct response was small. Thus plausible feedback manipulations were more effective than implausible manipulations, and social conformity occurred for this simple perceptual task. Furman and Duke (1988) investigated preferences of music listeners and found that ratings of unfamiliar orchestral music were affected by social feedback, but that this did not occur with familiar pop music.

In a follow-up to their 2005 article, the research group led by Gregory Berns investigated functional neuronal correlates of conforming behavior of adolescents during music preference ratings (Berns et al., 2010). Participants rated 20 unfamiliar music clips (each 15 seconds in length) from the Web site MySpace.com—first, autonomously, and second, with information about the song's online popularity. The authors demonstrated that participants often changed their ratings toward the presented majority feedback, and the tendency to conform was associated with activations in the anterior insula and anterior cingulate gyrus. Both regions are thought to be related to emotional arousal and negative affective states. Their conclusion was that a mismatch between one's private and an assumed group evaluation leads to negative feelings that motivate to conform. However, only behavioral preference ratings were measured in this study; no information about participants' subjective feelings was gathered. Unlike in their previous study (Berns et al., 2005), they did not include an informational control condition, which might have helped to fully explain the underlying mechanism behind the assumed normative origin of social conformity. Our study attempts to overcome these limitations by investigating social influences on musically induced emotions in a nonsocial control condition.

Aims of the Study

The results of previous research suggest that both music listening and the cognitive appraisal component of emotion are subject to social influences. However, there is no previous research on how emotional appraisals of music are affected by social feedback. Our study aims to fill in this gap by providing insights into the social world of subjective experience of online music listeners. We investigated whether emotional experiences while listening to music can be manipulated by social feedback. Furthermore, our goal was to expand on previous research on music-related conformity by adding an informational control condition.

To test all assumptions, we developed an online music personality test. Using a between-subjects design, we directed participants to various versions of a Web site that provided different listening contexts. In some of the contexts, they received feedback about the effects of the music listened to, and one version served as a control condition without any feedback information. Our first empirical hypothesis was that the ratings of felt emotions are affected by manipulative feedback compared with the ratings of the unbiased control group. Similar to the methods used in previous research, the assessment of emotional reactions to music was based on the two-dimensional model of emotions (Egermann et al., 2009; Nagel et al., 2007; Russell, 1980).

According to the feedback paradigm used by Salganik et al. (2006), the social feedback in our study was provided in the supposed ratings of preceding participants. But to differentiate social and, presumably, normative influence from unsocial informational influence, an additional control condition was created in which participants were told that the identical feedback presented was the result of a computational analysis, rather than the previous participants' ratings (similar to Berns et al., 2005). Comparing the two feedback origins, we predicted that (a) if normative motivations were the cause to conform, social feedback would be more influential than informational; and (b) if informational motivations were the cause to conform, informational feedback would be more influential than social.

Method

Online Music-Personality-Test

Because of its nature, the present study was conducted online. Furthermore, Web experiments have many advantages compared with conventional laboratory experiments (Reips, 2002): they ensure larger sample sizes, participation in a natural environment, and less researcher bias. Egermann et al. (2009) previously showed that online experiments provide valid results when measuring emotion induced by music.

As a cover story, this experiment was implemented in a German online music-personality-test that could be reached through the URL www.musik-typ.de. After listening to music and rating it, participants received their personalized test results describing their music preferences and personality at the end of the online questionnaire. This cover story helped to blind participants about the intended manipulations, and they were encouraged to complete the test to reach the personalized results section. The music-personality-test was based on a survey of Rentfrow and Gosling (2003). The authors reported that people who like certain music styles tend to prefer certain other music styles as well; for instance, classic listeners often like jazz as well. Accordingly, they described four different underlying music preference factors. These factors were also shown to correlate to certain personality measures in their survey. Using these results in our study, we formulated a different text passage describing related music preferences and personalities of people with high scores on each of those four factors. Furthermore, participants in our study had to rate their preference of the same 11 music styles used by Rentfrow and Gosling that were then summed up according to the underlying factors (each rated music style was associated with one of the four factors). Subsequently, at the end of the online questionnaire, every participant was shown the text related to the factor for which he or she had the highest sum of ratings.

The test was embedded in a visually appealing Flash-applet ("Adobe Flash [Version 9.0]," 2007). It presented instructions, played back the music, displayed the questions, and collected answers from participants. It was connected through PHP ("PHP: Hypertext Preprocessor (Version 4.4.2)," 2006) to a MySQL-database ("MySQL [Version 5.0]," 2004) that stored the data.

Participants

Participants were recruited by our linking the study to several German Web sites. After a couple of weeks online, the test spread over the Internet (e.g., it was discussed in several online forums). As a result, 5,730 participants completed the study (age in years: $M = 30.7$; $SD = 12.4$); 46.6% were female and 53.4% male; and 45% were nonmusicians, 47.4% amateur musicians, and 7.6% professional musicians.

Stimuli

All participants listened to five music excerpts (30 seconds each) randomly chosen from a total of 23 excerpts in a random order. The excerpts (drawn from pieces of various different music styles) were experimenter-selected to represent all four emotional quadrants described in the two-dimensional emotion model by Russell (1980), thus expressing negative or positive valence with low or high arousal. A complete list of all stimuli used can be found in the Appendix.

Emotion Measurement

After each excerpt, participants rated the music-induced emotions retrospectively using the bipolar arousal and valence dimensions. To rate the effect of every music excerpt, participants had to indicate their felt emotions by moving a slider of two visual analog scales from negative (internally measured as 0) to positive (internally measured as 100) for both dimensions. Negative valence was defined as "unpleasant" and positive valence as "pleasant." Negative arousal was defined as "calming" and positive arousal as "arousing."

Procedure and Study Design

As a between-subjects factor, the strength of social feedback was operationalized on three levels. Therefore, every site visitor was randomly directed to one of three versions of the music-personality-test. Participants directed to the first version served as controls ($n = 1{,}618$) and got no social feedback (Group NoFB). Participants in version 2 ($n = 1{,}905$) were presented with the social feedback only during the music listening (Group $SFB_{listening}$), whereas participants in version 3 ($n = 1{,}653$) saw the feedback during the music listening and rating (Group $SFB_{listening + rating}$). Thus the assumed strength of social feedback increased from Group NoFB to Group $SFB_{listening + rating}$. After the main data collection, we recruited an additional control group ($n = 554$) with informational feedback only during listening (Group InFB), to compare social influence with informational. As there was no random assignment of participants to Group InFB, comparisons with

this group are based on a pairwise matching algorithm using propensity scores (Bacher, 2002).

At the beginning of the study, all participants were asked to read instructions regarding their tasks and to provide informed consent about taking part in a scientific study. Subsequently, they could test the music playback capabilities of their computers. After this point, they had to pass an instruction comprehension test and could take part in a test trial as a warm-up. This test ensured that only those participants could proceed who understood their task to rate felt instead of recognized emotions and at the same time were using a correct definition of valence. After music listening and rating, participants answered questions concerning their sociodemographic background and their music preferences. Then participants were presented with their personalized test results and had the opportunity to take part in a lottery. They had the opportunity to win one of five Amazon vouchers amounting to 10 (EUR) by pulling the lever of a virtual gambling machine. Completing the test from beginning to end took 10.8 minutes on average.

Social Feedback

Participants of Groups $SFB_{listening}$, $SFB_{listening\ +\ rating}$, and InFB received feedback, which was presented by the position of the two sliders used to rate induced arousal and valence. During the presentation of feedback, a display above the two sliders read for Groups $SFB_{listening}$ and $SFB_{listening\ +\ rating}$, "This was how preceding participants rated this excerpt" (social influence), and for Group InFB, "This was how a computer predicted the effect of this excerpt" (informational influence).

Figure 1 illustrates how the different levels of social feedback were presented to the participants: For Group $SFB_{listening\ +\ rating}$, the two sliders remained in the feedback position after the music excerpt was presented. Thus the feedback was presented during music listening and rating. For Group $SFB_{listening}$ and InFB, the sliders were automatically moved to the middle position after the music was presented. Thus participants of Group $SFB_{listening}$ and InFB received feedback during music listening only and not during rating. For Group NoFB, the sliders appeared after music listening and presented no feedback.

Participants were informed that the position of the two sliders indicated how preceding participants had rated the corresponding excerpt or how a computer predicted the effect of the corresponding excerpt; however, the feedback was not based on the ratings of peers or an analysis. Rather, it was manipulated to achieve a variation of conditions between the groups with feedback and without. This manipulation was based on the ratings of a pretest group (conducted in a laboratory, $n = 11$). As values for all feedback manipulations, the upper or lower quartiles of these pretest ratings were used and randomly assigned to the 23 excerpts before we conducted the Web experiment. Because pretest participants provided their ratings on 9-point Likert scales, their values were transformed to the visual analog scale from 0 to 100 used in the main experiment. That way we could ensure that participants were presented with naturalistic ratings that represented extreme opinions about these excerpts' effects.

Because participants were blinded to the true origin of feedback, they were debriefed with the help of an informational text describing the purpose of the study that was posted on the Web site containing the study after data collection was completed. A debriefing right after taking part in the study was not possible, as the information about the manipulative nature of the experiment might have spread in the Internet.

Data Analysis

To ensure data quality for every data set, we established a number of criteria that had to be fulfilled by the participants (Reips, 2002). Only participants completing the whole study were included. They were also asked to indicate on a visual analog scale, how seriously they were willing to participate and their level of concentration during participation. The scale ranged from 0 ("not serious/no concentration") to 100 ("very serious/high concentration"). Participants who rated in the rejection regions (lower than 50) of the seriousness/concentration scales were excluded

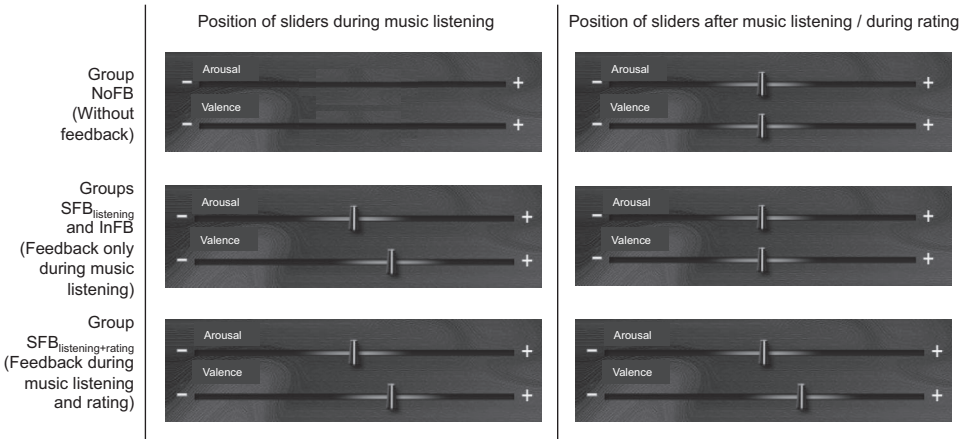

Figure 1. Valence and arousal rating sliders presenting the different levels of feedback (screenshot from group NoFB, screenshot from group $SFB_{listening}$ and InFB, and screenshot from group $SFB_{listening+rating}$), separated by point of time (during music listening vs. after music listening). *Note.* Feedback example from one music excerpt.

from the data analysis. Participants who had not passed the comprehension test after three trials were not included in data analysis, as were those whose participation durations were less than 5 minutes or more than 30 minutes. These criteria led to an exclusion rate of 44.4% of participants who started the experiment.

To test for a possible influence of feedback on ratings of emotion, we used a linear mixed effect modeling approach (west, Welch, & Galecki, 2007). Several models were estimated to determine the predictive power of the feedback values, assuming that the more participants conformed to the feedback values, the higher their contribution to predicting the emotion ratings were. To correct for the lack of independence in observations (repeated measurements within participants), we included in all models, a fixed effect of rating trial (from first to last, fifth trial), and additionally partially crossed random effects for participants and items (music excerpts), as suggested by Baayen, Davidson, and Bates (2008). All analyses were done using the software R (2.13) with the lmer function from the lme4 package (Bates, Maechler, & Bolker, 2011). Estimation of parameters was based on restricted maximum likelihood, and likelihood ratio tests were used to test for significance of random effects. Finally, Markov chain Monte Carlo sampling of all significant model parameters produced their mean estimates and *p* values (alpha errors). Modeling assumptions were tested by inspecting the model criticism plots produced by the associated mcp function (Tremblay, 2011).

Results

Rating Manipulations Through Social Feedback

The first analyses investigated the effect of the presence of social feedback on induced emotion ratings, comparing no feedback with feedback during listening and with feedback during listening and rating. Figure 2 shows how arousal and valence ratings were positively correlated to corresponding feedback values in all groups, including the control group (the higher the feedback was, the higher the ratings were). This corresponds to the independent main effect of feedback on emotion ratings, which is present in both models estimated (for arousal and valence ratings, see Table 1). This indicates that the feedback taken from the pretest corresponds with actual emotional effects of the pieces. There were also two significant main effects of being in one of the feedback groups (recoded as dummy variables): ratings of groups with feedback (dotted lines) indicated slightly more negative and calmer emotions than those without (solid lines).

More importantly for our hypothesis, there was a highly significant interaction between membership in one of the two groups with social feedback and the feedback values (Table 1). This interaction is also visible in Figure 2: both groups with feedback (dotted lines) show a steeper slope than the no-feedback group (solid line). Comparing $SFB_{listening\ +\ rating}$ with $SFB_{listening}$, we can see that the fixed effect coefficient for this interaction is bigger in the first group (Table 1). This is the case for both arousal and valence ratings. Comparing the size of interaction coefficients, we also see that the feedback effect was stronger for arousal than for valence ratings. There were two significant random intercepts for subjects and excerpts in both models that show that the different intercepts (means) per excerpts and participants significantly contributed to the variance in the two dependent variables. There was no significant effect for rating trial or any of its interaction terms. Thus, the observed effects did not change over time from the first to the last excerpt rating within participants.

To summarize, feedback values were estimated to be a significant predictor of ratings in all groups, and this effect was intensified in groups actually receiving feedback, indicating that both groups were significantly influenced by it. Finally, social feedback was more effective when it was also presented during rating and not only during listening, and it influenced arousal ratings more than valence ratings.

Social Versus Informational Feedback

Data for Group InFB with informational feedback (computer origin) were collected after those of Groups NoFB, $SFB_{listening}$ and $SFB_{listening\ +\ rating}$. To compare Group InFB with others, we used a pairwise matching algorithm based on propensity scores to rule out that any group differences were caused by differences in the sample and not by the experimental manipulation (Bacher, 2002). By doing so, all sociodemographic variables were identified that differed between Groups NoFB, $SFB_{listening}$, and InFB. Then, the propensity scores were computed by running logistic regressions with those variables as predictors and group membership as dependent variable. Subsequently, a pairwise matched subset of participants (with similar predicted propensity scores) in Groups NoFB ($n = 554$) and $SFB_{listening}$ ($n = 554$) was used to compare the two types of feedback not differing in the distribution of these variables from Group InFB.

Figure 3 and Table 2 present the results of comparing Group NoFB with $SFB_{listening}$ and with Group InFB. There was a significant negative main effect for being in Group $SFB_{listening}$ (vs. NoFB) for both types of ratings, but not for being in InFB (vs. NoFB), indicating that Group $SFB_{listening}$, in general, reported slightly more negative and calmer emotions. There was a significant main effect of valence feedback on valence ratings, but not for arousal feedback on arousal ratings. However, there was a significant interaction between being in the Group $SFB_{listening}$ and feedback, indicating that in this subsample, participants were influenced by feedback for both dimensions. This interaction is visible in both graphs (Figure 3): for arousal and valence, the slope observed in this group is slightly steeper. For InFB, this interaction with feedback values was not significant, indicating that participants in this group were less influenced by the feedback than those in the $SFB_{listening}$ group. Instead, there was an interaction between membership in Group InFB and trial number, with higher numbers (equal to later ratings) leading to lower arousal ratings in general. This could be an effect of fatigue at the end of the experiment. Furthermore, for Group InFB, a second positive interaction with trial number and feedback was significant, indicating that later ratings of arousal in this group were influenced by the informational feedback after all. Similar to models in Table 1, fixed effects coefficients of feedback interactions for arousal were bigger than those for valence ratings, indicating that arousal ratings were more strongly influenced by the feedback than were valence ratings. Both models included also significant random intercepts for arousal and valence ratings, indicating again that there was significant rating variance between participants and between excerpts.

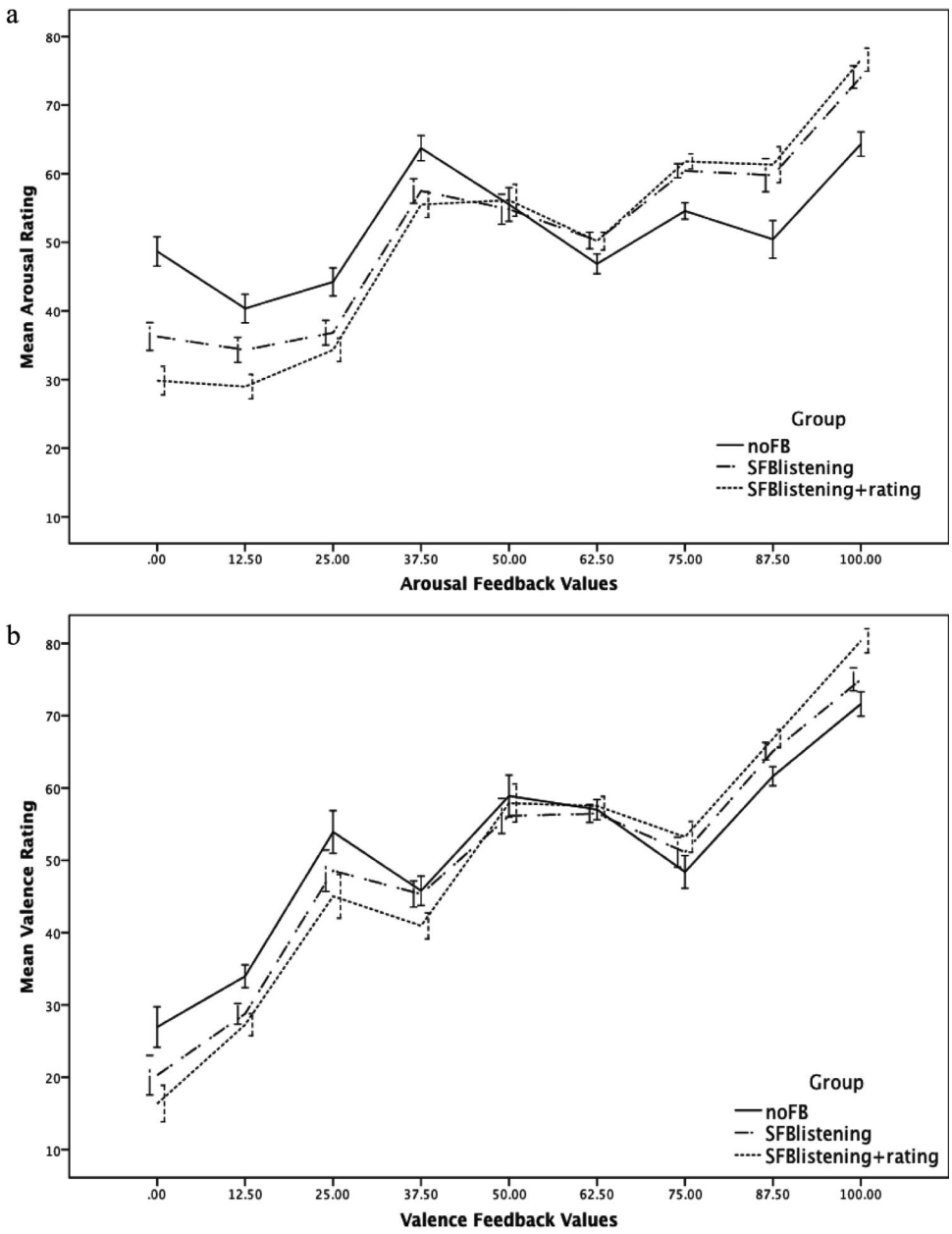

Figure 2. Error bar graph showing (a) mean arousal and (b) mean valence ratings, separated by participant group (both SFB groups vs. noFB group) and feedback values (positions on the sliders) presented. Error bars indicate 95% confidence interval of mean.

Discussion

The main purpose of this study was to investigate whether manipulated social feedback influences participants' ratings of felt emotions during music listening in an online setting that is similar to real-world online interactions. Using this Internet-based setup, we found that participants with social feedback during listening only and during listening and responding were influenced by social feedback, as the linear mixed models showed a significant interaction between being in the social feedback groups (vs. the control Group NoFB) and the feedback values. Thus participants in this study conformed to the supposed preceding participants' ratings, a finding that corroborates the main hypothesis.

The effect of social feedback was stronger in Group $SFB_{listening\ +\ rating}$ than in Group $SFB_{listening}$, as indicated by larger fixed effect coefficients for interactions with feedback for the latter group. This condition was subjected to the highest feedback intensity, because social feedback was also present during rating. This difference might be explained by the *social impact theory,* which states that social influence depends on the

Table 1
Mixed Effects Modeling Parameter Estimates for Arousal and Valence Ratings Predicted Through Feedback Group (NoFB vs. $SFB_{Listening}$ and $SFB_{Listening + Rating}$), Feedback Values, Rating Trial Number, and All Interactions

	Mean estimated coefficients[a]	
Fixed effects	Arousal	Valence
Intercept	44.97	33.31
Being in $SFB_{listening + rating}$ group[b]	−14.71**	−10.75**
Being in $SFB_{listening}$ group[b]	−11.72**	−7.42**
Feedback (arousal or valence)[c]	0.16*	0.35**
Being in $SFB_{listening + rating}$ group[b] × feedback	0.27**	0.18**
Being in $SFB_{listening}$ group[b] × feedback	0.23**	0.13**
Random effects	*SD*	
Subject intercept[d]	8.65**	6.95**
Music excerpt intercept[d]	9.72**	11.07**
Residual	24.02	25.25

Note. n = 25,855. Trial number n.s.
[a] MCMC sampling (n = 5,000). [b] Dummy variables with NoFB as reference group. [c] Feedback for arousal ratings = arousal feedback values, and for valence ratings = valence feedback values. [d] Chi-square log-likelihood test.
* $p < .05$. ** $p < .001$.

strength, immediacy, and the number of sources exerting influence on target persons (Latané, 1981). The longer the feedback was present, the stronger was its effect.

Interestingly, fixed effects were bigger for predicting arousal ratings versus valence ratings, indicating that the latter were less influenced by the social feedback than arousal ratings. Thus, it seems more difficult to be socially influenced on the judgments about pleasantness than on judgments about arousal. Owing to the general lack of research and theorizing about social influences on emotions induced through music, it remains difficult to explain this difference. However, this finding might indicate that context-specific appraisal processes in general might affect resulting arousal more strongly than other, more stimulus-related appraisal processes. These might be based on much more stable evaluations that reflect more musical preferences in general that are valid independently from any listening context.

In summary, online music listeners changed their emotional ratings based on information from previous music listeners. As participants of Group $SFB_{listening}$ were also influenced by social feedback, social influences must have occurred during music listening and not only during rating. In that way, randomly chosen music excerpts were intensified or lowered in their rated emotional impact. Differences were shown for rating valence (less affected) and arousal (more affected).

Fixed effects of feedback interactions were significant, but rather small, with coefficients between .10 and .27. A maximum effect of feedback would have resulted in a coefficient of 1. The small size of effects might be explained by the following two considerations: (i) on the one hand, the feedback was taken from extreme rating positions of pretest participants to simulate naturalistic social influences and was, for that reason, correlated with ratings in all groups (even to those without feedback). At the same time, this diminished the probability of observing the feedback in both experimental groups as a strong predictor of emotion ratings, as even a strongly biased evaluation was still somehow similar to the original unbiased ratings. (ii) On the other hand, cognitive appraisal has been discussed as only one of many emotion induction mechanisms that are likely to work together in creating emotional responses (Juslin & Västfjäll, 2008).

The Underlying Psychological Mechanism

The question still remains, which psychological mechanism can be accounted for after looking at the results presented in this study and at those previously published (Salganik et al., 2006; Berns et al., 2010). In contrast to previous research, we included an additional control condition, under which the feedback presented resulted from a computational analysis. We predicted that the feedback from a social source would be more influential than from an informational source, if participants conformed for social reasons instead of just being primed by the position of rating sliders (an informational influence). Our results suggest that the interaction between the informational feedback from a computer and membership in the group receiving this feedback was not significant (for arousal ratings and valence ratings). Only for arousal ratings in later trials, did the feedback have a significant influence on the InFB group. Perhaps due to fatigue after rating the first pieces, participants followed the feedback values for later ratings. Furthermore, being in one of the two groups with social feedback also led to a feedback-independent negative main effect on arousal and valence ratings, indicating that, in general, ratings of arousal and valence were lowered. This finding might be interpreted as a general negative emotional effect of being presented with the feedback and conforming to it, similar to findings in Berns et al.'s (2010) study. However, more research is needed here to see if this finding could be replicated.

To summarize, there was no significant influence of informational feedback on valence, and only limited influence on arousal ratings. The fact that the social feedback showed a significant effect on ratings might indicate that it was more important to participants than the results of a computation. Furthermore, these results replicate those of Berns et al. (2005), who found that, in

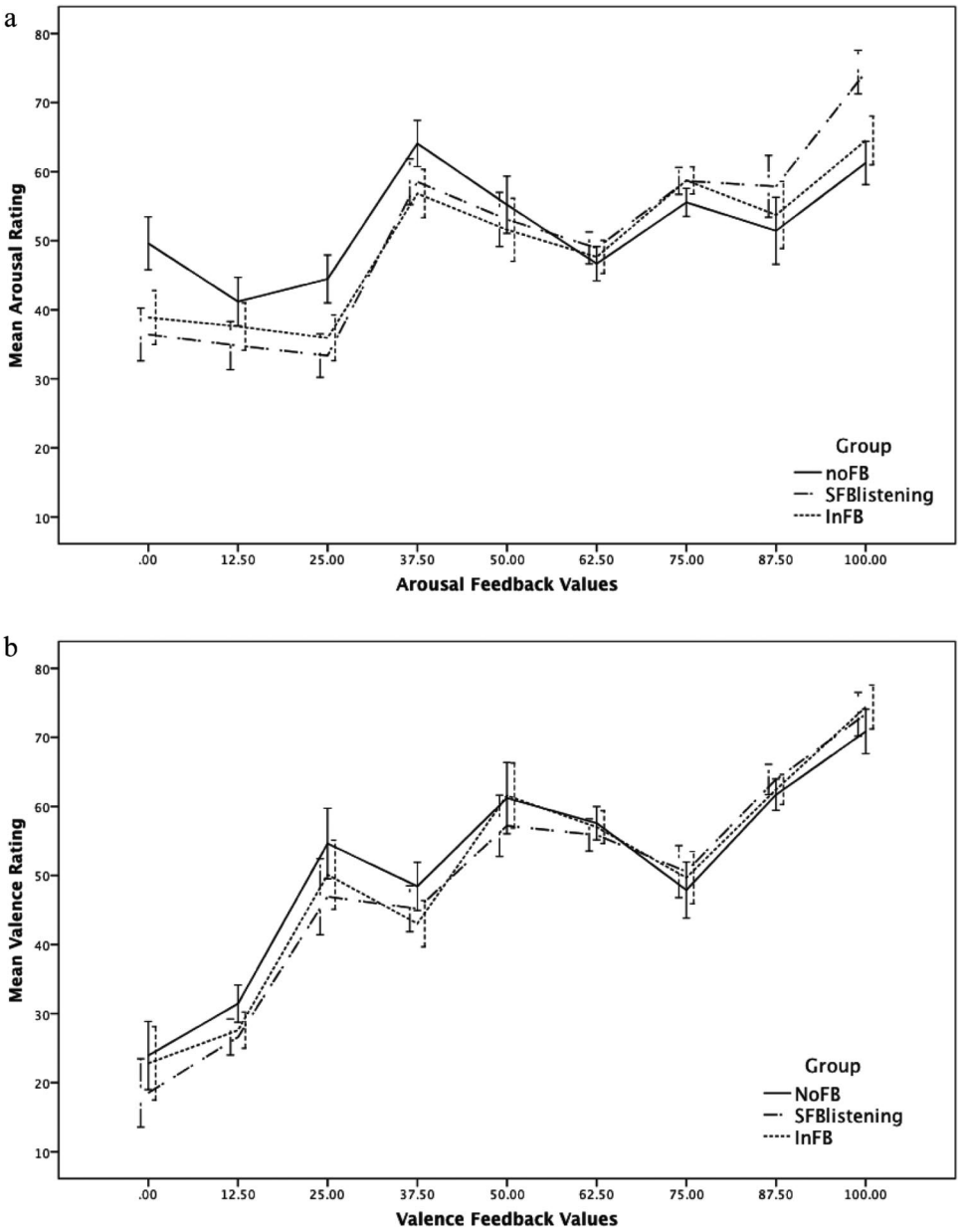

Figure 3. Error bar graph showing (a) mean arousal and (b) mean valence ratings, separated by participant group ($SFB_{listening}$ and InFB vs. noFB) and feedback values (positions on the sliders) presented. Error bars indicate 95% confidence interval of mean. Only ratings from pairwise matched samples are presented.

general, informational feedback provided by a computer was less influential than social feedback in a nonemotional cognitive task.

Limitations and Proposals for Future Research

One possible criticism of the paradigm used in this study is that participants were not influenced by social feedback, but simply by the position of the sliders that were used to present the feedback. However, social feedback was more influential than informational, indicating that not only slider positions were influencing participants but also the meaning attributed to the slider position.

A second limitation of the design used could be that the observed social and informational influence might not reflect changes in underlying emotional responding, but mere changes in ratings or interpretations of participants' emotions. To prevent such a bias, we included Group $SFB_{listening}$, in which the sliders were moved to the middle of the rating scales after presenting the feedback during music listening. Also in this condition, the feedback significantly influenced ratings of subjective feelings in that group. Further research might use additional control conditions like presenting the feedback only after the music presentation and compare it with feedback presented during

Table 2
Mixed Effects Modeling Parameter Estimates for Arousal and Valence Ratings Predicted Through Feedback Group (NoFB vs. $SFB_{Listening}$ and InFB), Feedback Values, Rating Trial Number, and All Interactions

	Mean estimated coefficients[a]	
Fixed effects	Arousal	Valence
Intercept	47.11	30.08
Being in $SFB_{listening}$ group[b]	−15.55**	−8.18*
Being in InFB group[b]	−2.61	0.85
Feedback (arousal or valence)[c]	0.12	0.39**
Being in $SFB_{listening}$ group[b] × Feedback	0.28**	0.11*
Being in InFB group[b] × Feedback	0.05	−0.02
Being in InFB group[b] × Trial number	−2.35*	−1.84
Being in InFB group[b] × Trial number × feedback	0.034*	0.028
Random effects	*SD*	
Subject intercept[d]	9.75**	7.56**
Music excerpt intercept[d]	9.79**	11.06**
Residual	24.90	25.78

Note. n = 8,305 (matched subsamples of NoFB and $SFB_{listening}$ groups).
[a] MCMC sampling (n = 5,000). [b] Dummy variables with NoFB as reference group. [c] Feedback for arousal ratings = arousal feedback values, and for valence ratings = valence feedback values. [d] Chi-square log-likelihood test.
* $p < .05$. ** $p < .001$.

music listening. Also, feedback could be presented in a different way than the rating procedure, for example, in the form of free text descriptions from peers. Another approach would be to measure additional emotion components. In a laboratory setting, action tendencies (e.g., choosing a certain music over another or buying it), motor expression, or physiological arousal could also be considered. However, if no fully synchronized correlates are found, it might also be owing to the fact that aesthetic emotions were induced by the music (Scherer, 2004) and affected by the feedback. Further research measuring several emotion components simultaneously could help to clarify this. For example, Egermann et al. (2011) investigated group music listening and found that musically induced emotional responses were less physiologically activated (skin conductance response) when other people were present than when subjects listened alone, possibly owing to a diminished attentional focus on the music. Berns et al. (2005) also demonstrated the influence of social feedback on physiological measures. Their results indicate that social information leads to a different visual perception of the task, accompanied by an increased activation of an occipital–parietal network (which lacks involvement of frontal executive decision-making areas and thus indicates that participants indeed perceived something differently). Their more recent article (Berns et al., 2010) suggests that changes in music rating due to conformity were not accompanied by brain activation patterns that were correlated to preference ratings. However, unlike in our study, music was rated two times: first, autonomously, and second, with social feedback. Participants in Berns et al.'s study were also not blinded to the origin and purpose of feedback (they might have known that it was intended to influence them). Thus, even if participants changed their rating according to the majority feedback, a basic internal evaluation could have already happened during the first listening and was not changed by the feedback. In our study, participants listened to the music only once.

Conclusions

In this study using an innovative Web-based method, >5,000 participants listened to music in an online setting that might have been much more natural than one in conventional laboratory experiments. Rating feedback influenced how people rated induced emotions of the music, which was presented in a way similar to everyday online interactions with music in the digital world (Xia et al., 2009). Results helped to clarify the mechanism behind these influences by comparing social and informational influences. Informational feedback was not as influential as social, which presumably indicates that participants' behavior observed in this context might be understood as resulting from the need to conform with peer norms.

Taken altogether, the results also emphasize the need to study musically induced emotions in many different social circumstances, as these situations might potentially affect the outcome of appraisals. Juslin and Västfjäll's (2008) list of mechanisms explaining emotional responses to music still lacks an explicit social reference; our study could be a first approach to fill this gap. Furthermore, if the social influences on emotion ratings that were reported in this study can be shown to also represent social influences on induced emotions, these results might underscore the importance of the cognitive appraisal component of emotion (Scherer, 2004, 2005). Emotions are assumed to be consequences of appraisal processes, which then might be socially influenced. In light of these results, social online interactions are also likely to not only change music-related consumption behavior (Salganik et al., 2006), but also influence deeper perceptual evaluations of music and its induced emotions.

In general, arousal ratings were more likely to be manipulated by external contextual information about the music than valence ratings, a result that might be of meaning for those trying to market music. The broad categorization of whether music is good or bad, liked or not liked, or inducing pleasant or unpleasant emotions (valence) seems less likely to be influenced by advertising and recommendations, but

already existing pleasant/unpleasant evaluations of music might be more strongly manipulated in terms of excitement. This effect is even bigger when the biasing information is of social origin and claims that something is more arousing or calming than it really is.

References

Adobe Flash (Version 9.0) [Programming language]. (2007). San Jose, CA: Adobe Systems.

Asch, S. E. (1955). Opinions and social pressure. *Scientific American, 193,* 31–35. doi:10.1038/scientificamerican1155-31

Baayen, R. H., Davidson, D. J., & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language, 59,* 390–412. doi:10.1016/j.jml.2007.12.005

Bacher, J. (2002). Statistisches Matching: Anwendungsmöglichkeiten, Verfahren und ihre praktische Umsetzung in SPSS. *ZA-Informationen, 51,* 38–66.

Bates, D., Maechler, M., & Bolker, B. (2011). lme4: Linear mixed-effects models using S4 classes, R package version 0.999375–39 [Computer software].

Berns, G. S., Capra, C. M., Moore, S., & Noussair, C. (2010). Neural mechanisms of the influence of popularity on adolescent ratings of music. *NeuroImage, 49,* 2687–96. doi:10.1016/j.neuroimage.2009.10.070

Berns, G. S., Chappelow, J., Zink, C. F., Pagnoni, G., Martin-Skurski, M. E., & Richards, J. (2005). Neurobiological correlates of social conformity and independence during mental rotation. *Biological Psychiatry, 58,* 245–253. doi:10.1016/j.biopsych.2005.04.012

Boyd, D. M., & Ellison, N. B. (2008). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication, 13,* 210–230. doi:10.1111/j.1083-6101.2007.00393.x

Brehm, S. S., Kassin, S. M., & Fein, S. (1999). *Social psychology* (4th ed.). Boston, MA: Houghton Mifflin Company.

Cialdini, R., & Goldstein, N. (2004). Social influence: Compliance and conformity. *Annual Review of Psychology, 55,* 591–621.

Crane, R., & Sornette, D. (2008). Viral, quality, and junk videos on YouTube: Separating content from noise in an information-rich environment. In *Proceeding of AAAI Symposium on Social Information Processing,* Menlo Park, CA.

Crozier, W. R. (1997). Music and social influence. In D. Hargreaves & A. North (Eds.), *The social psychology of music* (pp. 67–83). Oxford: Oxford University Press.

Egermann, H., Nagel, F., Altenmüller, E., & Kopiez, R. (2009). Continuous measurement of musically-induced emotion: A web experiment. *International Journal of Internet Science, 4,* 4–20.

Egermann, H., Sutherland, M. E., Grewe, O., Nagel, F., Kopiez, R., & Altenmüller, E. (2011). The influences of a group setting on the experience of music: A physiological and psychological perspective on emotion. *Musicae Scientiae, 15,* 307–323. doi:10.1177/1029864911399497

Ekman, P., & Davidson, R. J. (Eds.). (1994). *The nature of emotion*. Oxford: Oxford University Press.

Freeman, W. J. (2000). A neurobiological role of music in social bonding. In N. Wallin, B. Merker, & S. Brown (Eds.), *The origins of music* (pp. 411–424). Cambridge, MA: MIT Press.

Furman, C. E., & Duke, R. A. (1988). Effect of majority consensus on preferences for recorded orchestral and popular music. *Journal of Research in Music Education, 36,* 220–231. doi:10.2307/3344875

Grewe, O., Nagel, F., Kopiez, R., & Altenmüller, E. (2007). Emotions over time: Synchronicity and development of subjective, physiological, and facial affective reactions to music. *Emotion, 7,* 774–88. doi:10.1037/1528-3542.7.4.774

Juslin, P. N., & Laukka, P. (2003). Communication of emotions in vocal expression and music performance: Different channels, same code? *Psychological Bulletin, 129,* 770–814. doi:10.1037/0033-2909.129.5.770

Juslin, P. N., Liljeström, S., Västfjäll, D., Barradas, G., & Silva, A. (2008). An experience sampling study of emotional reactions to music: Listener, music, and situation. *Emotion, 8,* 668–683. doi:10.1037/a0013505

Juslin, P. N., & Västfjäll, D. (2008). Emotional responses to music: The need to consider underlying mechanisms. *Behavioral and Brain Sciences, 31,* 559–575; discussion 575–621. doi:10.1017/S0140525X08005293

Kirschner, S., & Tomasello, M. (2010). Joint music making promotes prosocial behavior in 4-year-old children. *Evolution and Human Behavior, 31,* 354–364. doi:10.1016/j.evolhumbehav.2010.04.004

Latané, B. (1981). The psychology of social impact. *American Psychologist, 36,* 343–356. doi:10.1037/0003-066X.36.4.343

Müller, R., Glogner, P., & Rhein, S. (2007). Die Theorie musikalischer Selbstsozialisation: Elf Jahre . . . und ein bisschen weiser? *Jahrbuch der Deutschen Gesellschaft für Musikpsychologie, 19,* 11–30.

Manstead, A. S. R. (2005). The social dimension of emotion. *The Psychologist, 18,* 484–487.

Manstead, A. S. R., & Fischer, A. (2001). Social appraisal: The social world as object of and influence on appraisal processes. In K. R. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 221–232). New York: Oxford University Press.

McNeill, W. H. (1995). *Keeping together in time*. Cambridge: Harvard University Press.

Meyer, L. B. (1956). *Emotion and meaning in music*. Chicago, IL: The University of Chicago Press.

MySQL (Version 5.0) [Software]. (2004). Uppsala: MySQL AB.

Nagel, F., Kopiez, R., Grewe, O., & Altenmüller, E. (2007). EMuJoy: Software for continuous measurement of perceived emotions in music. *Behavior Research Methods, 39,* 283–290. doi:10.3758/BF03193159

North, A., & Hargreaves, D. (2008). *The social and applied psychology of music*. Oxford: Oxford University Press. doi:10.1093/acprof:oso/9780198567424.001.0001

PHP: Hypertext Preprocessor (Version 4.4.2) [Programming language]. (2006). The PHP Group.

Radocy, R. E. (1975). A naive minority of one and deliberate majority mismatches of tonal stimuli. *Journal of Research in Music Education, 23,* 120–133. doi:10.2307/3345285

Reips, U.-D. (2002). Standards for Internet-based experimenting. *Experimental Psychology, 49,* 243–256. doi:10.1026//1618-3169.49.4.243

Rentfrow, P. J., & Gosling, S. D. (2003). The do re mi's of everyday life: The structure and personality correlates of music preferences. *Journal of Personality and Social Psychology, 84,* 1236–1256. doi:10.1037/0022-3514.84.6.1236

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39,* 1161–1178. doi:10.1037/h0077714

Salganik, M. J., Dodds, P. S., & Watts, D. J. (2006). Experimental study of inequality and unpredictability in an artificial cultural market. *Science, 311,* 854–856. doi:10.1126/science.1121066

Scherer, K. R. (1999). Appraisal theory. In T. Dalgleish & M. Power (Eds.), *Handbook of cognition and emotion* (pp. 637–663). Chichester: Wiley.

Scherer, K. R. (2004). Which emotions can be induced by music? What are the underlying mechanisms? And how can we measure them? *Journal of New Music Research, 33,* 239–251. doi:10.1080/0929821042000317822

Scherer, K. R. (2005). What are emotions? And how can they be measured? *Social Science Information, 44,* 695–729. doi:10.1177/0539018405058216

Schubert, E. (1999). Measuring emotion continuously: Validity and reliability of the two-dimensional emotion-space. *Australian Journal of Psychology, 51,* 154–165. doi:10.1080/00049539908255353

Schubert, E. (2001). Continuous measurement of self-report emotional response to music. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 393–414). Oxford: Oxford University Press.

Sherif, M. (1936). *The psychology of social norms*. New York: Harper.

Sloboda, J. A., & O'Neil, S. A. (2001). Emotions in everyday listening to music. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 415–429). Oxford: Oxford University Press.

Tremblay, A. (2011). A suite of functions to back-fit fixed effects and forward-fit random effects, as well as other miscellaneous functions. R package version 1.6 [Computer software].

West, B. T., Welch, K. B., & Galecki, A. T. (2007). *Linear mixed models: A practical guide using statistical software*. Boca Raton, FL: Chapman & Hall/CRC Press.

Xia, M., Huang, Y., Duan, W., & Whinston, A. B. (2009). Ballot box communication in online communities. *Communications of the ACM, 52,* doi:10.1145/1562164.1562199

Zentner, M., & Eerola, T. (2010). Self report measures and models of musical emotions. In P. N. Juslin & J. A. Sloboda (Eds.), *Handbook of music and emotion* (pp. 361–392). Oxford: Oxford University Press.

Appendix

Music Stimuli Used

Performer	Composer	Title/movement	Album	Label/source	Year
4 Holter-buam	—	Jubiläums Jodler	Dila, dala. . . . (20 Jahre)	MCP Records	2005
Africando All Stars	—	Doni Doni	Betece	Stern's Africa	2000
At the Gates	—	World Of Lies	Slaughter of the Soul	Earache Records	1995
BBC Scottish Symphony Orchestra	Edward Grieg	Peer Gynt-Suite I: Morning Mood	Das ABC der klassischen Musik	Naxos	1995
Circle Takes the Square	—	Same Shade as Concrete	As the Roots Undo	Robotic Empire	2004
Danubius Ensemble	Antonio Vivaldi	Trio sonata B-Major, op. 5,5, Corrente: Allegro	Das ABC der klassischen Musik	Naxos	1999
Erik Truffaz/Nya	—	Siegfried	Bending New Corners	Kameleon Music	1994
Horváth István	—	Nem kell nékem pogácsa	Mulatok, Mert Jó Kedvem Van	Hungaroton Classic Ltd.	1995
Jeno Jando	Wolfgang A. Mozart	Piano Concerto. 21 C-Major, KV 467	Das ABC der klassischen Musik	Naxos	1988
John Coltrane	Duke Ellington	In a Sentimental Mood	Duke Ellington and John Coltrane	Impulse!	1988
Kronos Quartet	Philip Glass	String Quartet No. 4 (Buczak), 2. Movement	Kronos Quartet Performs Philip Glass	Nonesuch	1990
Kronos Quartet	Terry Riley	Salome Dances For Peace: Half-Wolf Dances Mad In Moonlight	Winter was Hard	Nonesuch	2004
Kronos Quartet	John Zorn	Forbidden Fruit	Winter was Hard	Nonesuch	2004
Kronos Quartet	Aulis Sallinen	Winter Was Hard, Op. 20	Winter was Hard	Nonesuch	2000
Muungano National Choir	—	Vanga Yohana	Missa Juba	Philips	2001
O. Markovic	—	Ti ne znas sta je ljubav	Starogradski biseri 1	Hi-Fi Centar	2002
Sigur Rós	—	Olsen Olsen	Agaetis byrjun	Fat Cat Records	1999
Sigur Rós	—	Staralfur	Agaetis byrjun	Fat Cat Records	1999
Sigur Rós	—	Agaetis byrjun	Agaetis byrjun	Fat Cat Records	1999
Standstill	—	Un Gran Final	First Album	Defiance Records	1994
Stefan Mross	—	Il silenzio	Von Herzen alles Gute	Montana	1994
The London Virtuosi	Tommaso Albinoni	Oboe Concerto C-Major, op. 9,5, Allegro	Das ABC der klassischen Musik	Naxos	1962
Village of Savonga	Wolfgang Petters	My Mind - Your Mind	Philipp Schatz	Kollaps/Haus-musik	1994

Received August 5, 2012
Revision received February 4, 2013
Accepted February 15, 2013 ■