Comparative effects of music and recalled life-events on emotional state

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VLADIMIR J. KONEČNI, AMBER BROWN AND REBEKAH A. WANIC
UNIVERSITY OF CALIFORNIA, SAN DIEGO

ABSTRACT Several classical issues in the area of music and emotion were investigated in a $3 \times 3 \times 2 \times 2 \times 4$ experiment ($N = 144$). Participants recalled happy, neutral, or sad life-events, and they listened to happy, neutral, or sad music, in one of two orders of recall and listening. Four dependent measures were obtained: Own emotional state at the time that the recalled event originally occurred (ETHEN) and immediately after recall (ENOW); own emotional state after listening to music (IEM) and a rating of the emotional expressiveness of the music (EDEM), with the order of IEM and EDEM counterbalanced. All measures were on a 13-point happy–sad scale. The main, statistically highly significant, findings were: (a) the ETHEN ratings were more extreme on both the happy and sad tasks than the ENOW and IEM ratings; (b) the ENOW scores were more extreme than the IEM ones, but only on the sad task; (c) the EDEM ratings were more extreme than the IEM ones; (d) the IEM ratings were nevertheless different from the scale midpoint, especially when the participants listened to music before recalling events. The pattern of results and complex methodological issues cast considerable doubt on the idea of a direct causal link between music and emotion. It was also proposed that the notion of 'musical emotions' be replaced by the concepts of 'being moved' and 'aesthetic awe'.

KEYWORDS: *aesthetic awe, being moved, expression, music and emotion, recall of life-events*

Music, as a temporal array of auditory stimuli, clearly possesses the means to mimic the patter of feet of children at play, the sound of water bouncing off rocks in a mountain brook, and the slow motion of a profoundly sad person or a funeral procession (cf. Avison, 2003[1752]: 4; Gurney, 1966[1880]: 169; Langer's (1942: 185) symbolic ideas; Arnheim's (1954: 434) 'physiognomics' in art; Budd's (1985: 47), Davies's (2001: 31) and Kivy's (1989: 46) complementary analyses of the '"physiognomy" of musical expression'; and the 'iconic relationships' discussed by Sloboda and Juslin (2001: 93)). Through the appropriate choice of register, dynamics, event density, mode, rhythm, melodic contour and harmonic change, among other structural means, music can *express*, *depict*, *allude to* and *evoke* both the differential auditory patterns commonly associated in the abstract with the fundamental emotions (such as

joy, sadness and anger), and the specific physical and vocal behavior of a human or animal experiencing and displaying such emotions (cf. Gabrielsson and Lindström, 2001; Hevner, 1936, 1937). In short, music can tell a story about emotions; it can refer to and describe the features of emotions and their display. What is commonly labeled as 'emotional expression' or 'perceived emotion' in music is really a semiotic issue, one of *denotation* (Meyer, 1956: 8) or *representation*.[1]

Generally, both the performers and listeners of music are intimately familiar with the morphological and acoustic features of emotion-driven behaviour. Therefore, it is not surprising that a skilled guitarist can take a folk tune, such as 'Greensleeves', perform it in four versions – 'happy', 'sad', 'angry' and 'fearful' – and justifiably expect that these intended emotional expressions will be correctly identified by the listeners (Juslin, 2000). Note, however, that communicating, by musical means, some surface attributes of emotion is very different from 'communicating emotion' in the sense of a genuinely happy or sad person conveying his emotions to others – yet this crucial difference is minimized in the very title and abstract of Juslin's (2000: 1797) article (Konečni, 2003: 337).

The above point brought us a step closer to the central issue of our article: the possibility of music being able to *induce* emotions in the listeners (including in its composers and performers; however, these categories of participants in the music process require separate consideration: see many contributors' chapters in Juslin and Sloboda (2001), and also Konečni (2003), London (2001–02: 26) and Waterman (1996)). The question of induction of emotion can be broken down into two related parts. One concerns the ability of music to induce emotions that are comparable to those that are induced by real-life events or their intensive recall (cf. Juslin and Zentner, 2001–02: 9; Krumhansl, 1997: 349; Sloboda and Juslin, 2001: 91). The second deals with the possibility that music induces 'musical emotions' – states that are different in kind or intensity from those caused by real-life events (that is, events other than music), but are nevertheless, somehow, emotions (cf. Krumhansl, 2002: 45; London, 2001–02: 30). The first question is largely empirical and is directly addressed by the research we report here. The second is largely theoretical and definitional, and one of us has dealt with it by suggesting that the term 'musical emotions' (and, more broadly, 'aesthetic emotions') be replaced by 'being moved' and 'aesthetic awe' (Konečni, 2005, 2007; see 'Discussion' later).

In our experiment, all research participants intensively recalled (the RE factor, Remembering Events, modeled after the Relived Emotion task of Levenson et al., 1991: 30) either 'the most happy' (REH level) or 'the most sad' event (RES level) in their lives that 'they could think of at the moment'. They then rated their emotional state 'now' (ENOW measure) and 'at the time the event originally occurred' (ETHEN measure) on a 13-point bipolar happy–sad scale. All participants also listened to music (the LM factor, Listening to Music) that had been selected on the basis of prior research (Krumhansl, 1997: 340) and our pilot studies: They listened either to Happy (LMH level) or Sad (LMS level) music and then rated, using the same 13-point happy–sad scale, both their emotional state (Induction of Emotion by Music (IEM) measure) and how the music sounded (Expression or Depiction of Emotion by Music (EDEM) measure). Note that the designations of happy and sad music should have the adjectives in quote-marks; even though the designations follow folk parlance and music

researchers' perhaps unfortunate habit of going along with it (cf. Kivy, 1989: 153), it is important for theoretical reasons to remember that music is not a sentient being (Budd, 1985: 37; Davies, 2001: 25–6). The mentioned aspects of the design and its other features – for example, both the RE and LM factors also had neutral controls – allowed us, above all, to compare the emotions arising in the non-musical 'real world' to those potentially induced by music. To the best of our knowledge, this is the first attempt in the literature to make this comparison directly and experimentally.[2]

The question of induction of emotion by music contains several additional complications. One is the classical question of the role of associations that people have when listening to music (e.g. Avison, 2003[1752]: 4; Goldstein, 1980: 127; Kivy, 1989: 29; Scherer et al., 2001–02: 150; Sloboda and Juslin, 2001: 94; Waterman, 1996: 59). The bubbling vivacity of Vivaldi's 'Spring' may make someone who had never heard it before think of a budding love affair and of life's bountiful offerings and seemingly endless possibilities, in addition to producing someone else's explicit 'our tune' or 'my time in Venice' memories. A causal model of the form M → E that many music psychologists implicitly espouse is theoretically very different from the one in which the causal effect of music on emotion is fully dependent on the interpolated cognitive content (M → Assoc → E). In the latter model, music has an effect on emotions only because it gives rise to mental associations; even though non-musical events may also trigger such associations, music may be, for a variety of reasons, a particularly powerful trigger.[3]

In our experiment, one-half of the participants did the RE task first, followed by the LM (RE1LM2 level of the RELM Order factor), whereas the other half encountered the reverse order of tasks (RE2LM1). The RELM factor did not simply control for order effects. Our thinking was that the participants who listen to music in the RE1LM2 order would be more likely to have vivid associations to the music (especially in the congruent REH/LMH and RES/LMS cells) than those in the RE2LM1 order of the two tasks – which is, of course, not to say that listening to music without prior pondering of real-life emotional events precludes associations with emotional content.

Another matter that complicates the research on the induction of emotion by music lies in the prevailing romantic-sentimental folk theories about the inescapable link between music and emotion that most participants bring to experiments – and the response 'errors' that they consequently tend to commit. Specifically, a considerable amount of unpublished interview data from our laboratory shows that the participants' tendency is to take into account the music's *message about emotion* when asked to rate, on some intensity scale, their own *emotional response* to the music – with the extent of this misattribution depending on the details of the instructions. The common outcome of such a tendency is to inflate the ratings of own emotion. This is a problematic conceptual and measurement issue of considerable significance for the field of music and emotion (Gabrielsson, 2001–02: 124; Juslin and Zentner, 2001–02: 11; Kivy, 1989: 162; Meyer, 1956: 8; Scherer and Zentner, 2001: 379–80).

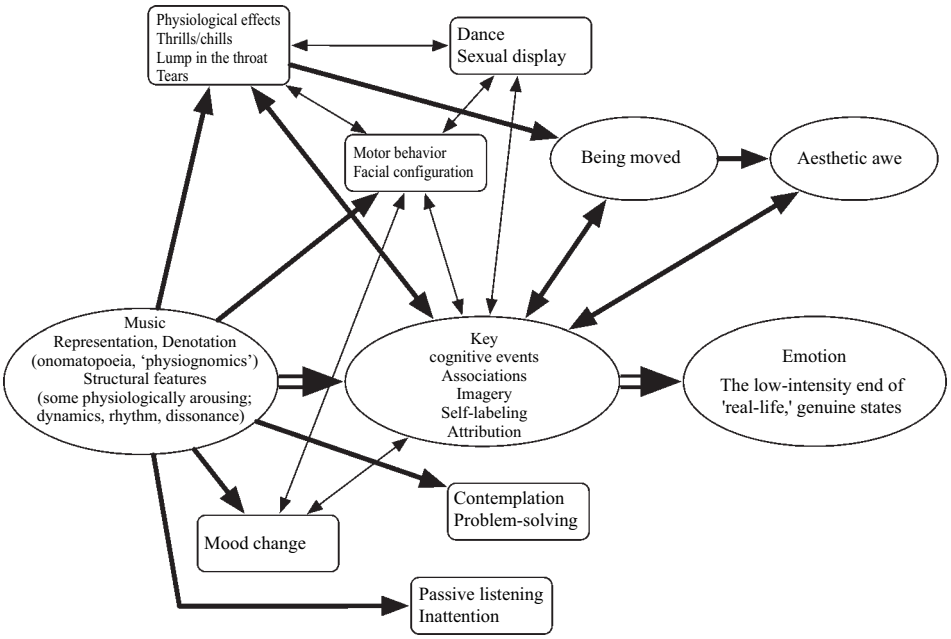
In the present experiment, the issue was addressed by having one-half of the participants, after listening to music, answer first the question about how the music sounded, before telling us how they themselves felt (EDEM1IEM2 level of the EDEM/IEM Order factor), whereas the other half first reported about their own state and then rated the music (EDEM2IEM1 level). In addition to this being another control

order factor, we thought that, for the IEM measure, the participants would be less likely to be rating the sound, even though they were asked to rate themselves, in the condition in which the rating of the music was salient by being made first (EDEM1IEM2). A complementary possibility, for the EDEM measure, was that having rated their own state first, in the EDEM2IEM1 order, the participants would subsequently additionally increase (that is, make more extreme) their EDEM ratings. We say 'additionally,' because the above analysis should be viewed against the backdrop of our expectation, based on years of pilot data, that the ratings of the 'expressivity' of the music (EDEM) would overall be more extreme than the ratings of own emotional reaction to music (IEM). After all, the Happy and Sad pieces were chosen for their maximum objective respective valence in the domain of instrumental classical music by both Krumhansl (1997) and us, whereas many of the participants may well have been indifferent (or even hostile) to the classical idiom.

The last, but not least, issue of concern when contemplating the induction of emotion by music concerns the often rather different viewpoints of the psychology-of-emotion and music-psychology researchers. In general, emotion theorists do not regard fluctuations in peripheral arousal or, for example, changes in cerebral blood flow in brain areas that are also involved with emotion, motivation and consumption, as sufficient evidence to indicate *emotion* (e.g. Konečni, 2003: 333, 2005: 38; Konečni et al., 2007; Scherer and Zentner, 2001: 363), whereas music and neuro-music psychologists often do (e.g. Blood and Zatorre, 2001: 11823; Peretz, 2001: 116; Rickard, 2004: 373). Our view (see Figure 1) is that one can be highly aroused, for example, by the rhythmic aspects of the music, one can be foot-tapping and dancing, one can be startled by the dynamics and the dissonances and yet experience no identifiable emotion whatsoever (in accord with Konečni's, 2007, prototypical emotion-episode model, PEEM). The physiological record alone does not equal the presence of emotional experience: ratings of one's subjective state or verbal reports of one's experience are indispensable to show the induction of emotion (cf. Gabrielsson, 2001–02: 128; Konečni, 2007). In our view, music can add to the physiological substrate of genuine emotions, but not cause the emotions themselves. This view would augment the above-mentioned M → Assoc → E model. In short, if for no reason other than the fact that the matter of the induction of emotion by music is very complicated and multi-faceted, the 'cognitivist'–'emotivist' dichotomy (Kivy, 1990: 146), often cited by music psychologists, seems to be a considerable oversimplification (although we, unlike many music psychologists, agree in general with Kivy's rejection of the 'emotivist' position).

The position on the music – emotion relationship that we have presented so far is summarized in Figure 1. It serves as the background for the experimental design and the predictions.

Before presenting our predictions, we shall examine several experiments that are usually quoted as supportive of the idea that music is an inductor of emotion. The foremost of these is Krumhansl's (1997) study, in which one group of 10 Cornell participants was 'instructed to continuously adjust ... the slider on the display to indicate the amount of sadness they experienced while listening' (p. 340) to six three-minute musical selections (including two meant to represent 'sadness', two 'happiness' and two 'fear'). Three other groups of 10 participants each were asked to adjust the slider



Note: Major processes and end-states are shown in ellipses. The main route from music to basic emotions is designated by the thickest arrows. Arrows of medium thickness indicate other possible effects of music and the ways by which the states of Being Moved and Aesthetic Awe may arise. Thin arrows indicate other bidirectional and unidirectional effects and relations.

FIGURE 1 *The authors' theoretical position regarding the major relationships in the 'music and emotion' area.*

to 'judge fear, happiness, and tension, respectively' (p. 340) in response to the same six music selections. To ask participants to report their 'sadness' continuously (in emotion theory and in real life a powerful fundamental emotion), in response to six three-minute musical selections of different valence appears a somewhat odd task, one that seems particularly prone to incline the participant toward judging the music instead of her own state. In the Berkeley part of Krumhansl's study (in R.W. Levenson's laboratory), involving 38 participants, although there were physiological differences in response to the various musical selections (as would also be expected from our viewpoint expressed above), 'few of the correlations between self-reports and average physiological measures were either significant or marginally significant ... [n]or did they correspond with correlations using dynamic measures of physiology and emotion' (Krumhansl, 1997: 347) – again, as one might expect from the standpoint that the physiological response does not necessarily equal or lead to emotional experience. Krumhansl (1997: 349) took an important additional analytic step and compared her physiological data to those obtained in three major published studies of emotion physiology, finding 'little correspondence with [her] results'.

Another well-known study that is often imprecisely cited by music psychologists as showing the induction of emotion by music was performed by Nykliček et al. (1997). In fact, all 25 (Dutch) research participants, who listened, in the 'music selection stage',

to 25 music fragments (each 65–230 seconds in duration), explicitly did not report their own emotional state, but were instead asked to '[i]ndicate on each 5-point scale how strongly *each emotion is expressed by the music*' (Nykliček et al., 1997: 307; italics added). The authors state that in an earlier (American) study (J.F. Thayer's 1986 doctoral dissertation), the 1997-like instructions and the 1986 instructions (presumably for the participants to report their own emotional state) 'yielded highly correlated and not substantively different results' (p. 307) – but they provided no data in the 1997 paper. Note that in the 'Results' section for this stage of the study, the authors refer to the participants' responses not simply as verbal report, but as 'self-report' (p. 310), which may erroneously be understood as alluding to the (apparently nonexistent) ratings of own state. In the main experiment, although there is considerable ambiguity in the writing (see pp. 307 and 311), it appears that the participants also rated the music and not their own state. In summary, the Nykliček et al. (1997) study is valuable in that it provides solid cardiorespiratory data that show that different musical pieces produce different patterns of physiological response (which would indeed be expected on the basis of our view that the different combinations of structural variables should have different physiological effects; see Figure 1), but it is inconclusive with regard to the key question of the induction of emotion by music.

In two studies, van Oyen Witvliet and her colleagues (van Oyen Witvliet and Vrana, 1996; van Oyen Witvliet et al., 1998; apparently available only as 250-word abstracts) also obtained informative results showing differential effects of musical selections 'that varied in emotional valence and arousal' (van Oyen Witvliet and Vrana, 1996: S91) on heart rate, skin conductance and, significantly, on the facial electromyographic response. However, in these studies, participants rated only the musical selections on valence and arousal and did not provide ratings of their emotional state.

In a notable study that is often cited in support of the idea of induction of emotion by music, Waterman (1996: 56) played five different musical pieces to participants who were asked to 'press the button when the music causes something to happen to you'. In this manner, the participants indicated ('mere' listeners by pressing a button, performers by using either a bite-switch or a foot pedal) the structurally significant events in the music (an admirable goal), but not necessarily their emotional experience. In the retrospective interview following each music excerpt, Waterman asked the participants to elaborate why they had activated the switch. Only one of the 13 categories in Waterman's response-coding scheme (category 'A,' 'sensual/physical reactions'; see 1996: 58–9, Table 2) seems to capture events that can be thought of as emotionally relevant (the two examples given are: 'I felt a lump in the throat;' 'I felt calm') and, moreover, this category was one of the five least frequently applicable (see 1996: 62, Figure 4). Furthermore, there was considerable inter-participant disagreement about the reasons for activating the switch at the same point in the music (cf. Sloboda and Juslin, 2001: 91).

'The lump in the throat' response in Waterman's (1996) study[4] is akin to the thrills/chills response that has recently received a fair amount of attention (Blood and Zatorre, 2001; Goldstein, 1980; Konečni et al., 2007; Panksepp, 1995; Rickard, 2004; Sloboda, 1991). Most of these studies were extensively reviewed by Konečni et al. (2007), whose conclusion was that the thrills/chills response under most circumstances does not qualify as a full-blown, genuine, emotional state; an analogous assessment

can be made of the status of tears in response to music (e.g. the retrospective research by Scherer et al., 2001–02). An exception may occur in studies in which the participants responded to music that they themselves had selected as emotionally meaningful and brought to the experiment (Blood and Zatorre, 2001: 11818; Rickard, 2004: 373), and in Gabrielsson's (e.g. 2001: 434) strong-experiences-with-music (SEM) approach, in which the respondents are asked to describe 'the strongest, most intense experience of music that [they] have ever had'. In these cases, it is possible that any induction of emotion by music is due largely to the participants' associations and memories (or, in SEM, to other powerful ingredients of the listening situation) – which is explicitly acknowledged by Rickard (2004: 384) and explicitly denied by Blood and Zatorre (2001: 11819; cf. Konečni, 2007 and Konečni et al., 2007).

Main experimental predictions were based on our reading of the cited articles and our work in the area of music and emotion (e.g. Konečni, 1982, 2005; Konečni and Sargent-Pollock, 1976; Konečni et al., 2007):

1. Remembering happy and sad real-life events would result in more extreme ratings of one's emotional state (the ENOW and ETHEN measures in the REH and RES conditions) than would listening to happy and sad music (the IEM measure in the LMH and LMS conditions); the ETHEN measure would yield the most extreme ratings of own state in the experiment.
2. The IEM measure (rating of own state after listening to music) would be more extreme in the RE1LM2 order than in the RE2LM1 order, because prior remembering of events would increase the probability of strong associations to the subsequently heard music, especially in the congruent REH/LMH and RES/LMS conditions; there is admittedly some uncertainty about this prediction, because prior remembering of real-life events and doing the ENOW and ETHEN ratings might temper the extremity of the participants' IEM ratings after listening to music.
3. The EDEM measure (ratings of the music's 'expressiveness') would overall be more extreme than the IEM measure (the effect of music on own state). This difference would be observed at both levels of the EDEM/IEM Order factor (no interaction). Both the IEM and the EDEM ratings would be less extreme in the EDEM1IEM2 than in the EDEM2IEM1 order. The IEM rating would be less extreme because the focus on rating oneself would be made salient by the prior explicit rating of the music. The EDEM rating could be expected to be less extreme when given first than when a prior rating of own state is made salient by preceding it. In short, the IEM rating in the EDEM1IEM2 order would be the least extreme rating, and the EDEM rating in the EDEM2IEM1 order the most extreme, in this 2×2 view of the data.

Method

OVERVIEW OF THE DESIGN AND DEPENDENT MEASURES

The experimental design was a $3 \times 3 \times 2 \times 2$ factorial ($N = 144$) with four participants randomly assigned to each of the 36 conditions. All four factors were between-subjects. The first factor, Remembering Events (RE), had the levels of remembering Happy (REH),

Neutral (REN) and Sad (RES) events, respectively. The second factor, Listening to Music (LM), consisted of the levels of listening to Happy (LMH), Neutral (LMN) and Sad (LMS) music, respectively. The third factor (RELM Order) concerned the order in which the participants encountered the RE and LM tasks: One-half of the participants remembered an event first and then listened to music (the RE1LM2 order), whereas the other half first listened to music and then remembered an event (RE2LM1). There were four dependent measures. After the RE task, the participants first indicated how they felt at the time in the experiment (the ENOW measure), and then how they felt at the time that the remembered event had originally occurred (the ETHEN measure; not taken in REN). The ENOW measure was always collected before the ETHEN measure. Responses on both measures were given on 13-point scales anchored by 'Very Sad' and 'Very Happy'. The left–right placement was counterbalanced. After the LM task, participants indicated how the music sounded, which was the EDEM measure (Expression and Depiction of Emotion by Music), and how they felt, which was the IEM measure (Induction of Emotion by Music). These two responses were also given on 13-point scales, anchored by 'Very Sad' and 'Very Happy'. The fourth experimental factor (EDEM/IEM Order) concerned the order in which the two dependent measures were collected after the LM task: EDEM1IEM2 or EDEM2IEM1. The dependent measures were treated as the fifth, within-subjects, factor (MEAS) with four levels.

PARTICIPANTS

The participants were 107 female and 37 male undergraduates at the University of California, San Diego, who signed up online for an experiment on 'music listening' and received credit in their psychology courses as compensation. Broad ethnic categorization was 84 Asian, 55 Caucasian and five 'Other'. Music background was not a factor in the recruitment.

MATERIALS

The music stimuli were: Antonio Vivaldi, 'La primavera' ('Spring'; first three minutes) from *The Four Seasons*, King's Consort/Robert King ('happy' music); Ottorino Respighi, 'La fontana di Valle Giulia all'alba' ('The Valle Giulia fountain at dawn'; first three minutes) from *Fountains of Rome*, The Philadelphia Orchestra/Riccardo Muti ('neutral' music); and Tomaso Albinoni, Adagio in G minor for strings and orchestra (first three minutes), Berlin Philharmonic/Herbert von Karajan ('sad' music). The three-minute sections from the Vivaldi and Albinoni pieces were previously used by Krumhansl (1997: 340) as 'happy' and 'sad' stimuli, respectively. These selections, and the Respighi, were also pre-tested in our laboratory.

Experimental instructions and music files were digitally recorded on compact discs appropriate for the various experimental conditions.

PROCEDURE

Participants arrived two at a time in an anteroom where they were greeted and gave their written consent to remembering events in their lives and listening to music. (On 18 occasions, only one participant arrived; however, participants who worked singly did not significantly differ on any of the measures from those who worked in pairs.)

Participants were then escorted to a spacious laboratory room where they were comfortably seated facing away from each other. They were asked to relax and clear their minds. After two minutes, the participants were instructed to put on the headphones and thereafter responded exclusively to pre-recorded instructions. Presentation was calibrated such that all instructions and music selections were heard at the same, comfortable volume. Sheets with rating scales were on the table in front of each participant.

Remembering events (RE)

Participants were asked to close their eyes throughout this three-minute task. The REH and RES instructions were identical except for the words 'happy' and 'sad'. Participants were asked to remember a particularly [happy/sad] event in their lives, the most [happy/sad] they could think of that moment. They were asked to think about the detailed circumstances and of how they had felt at the time of the original event. To assist them in this task, several questions were put to the participants during the three-minute session, such as: 'Were there any other people involved in this experience?' 'What did you do during this event?' 'What did you see?'

In the 3-minute REN task, the participants were asked to imagine typical pieces of furniture, including a table, bookcase, door and chair. The questions were temporally spaced similarly to those in the REH and RES conditions.

Listening to music (LM)

Each participant was randomly assigned to one of three three-minute musical selections, the Vivaldi (LMH), Respighi (LMN), or Albinoni (LMS), to which they listened with eyes closed.

A participant's random assignment to either the RE1LM2 or the RE2LM1 level of the RELM Order factor determined whether she first remembered an event and then listened to music or did these tasks in the reverse order.

RATING SCALES

The four responses that constituted the dependent measures were all made by circling tick marks on identical 13-point unnumbered scales anchored by 'Very Happy' and 'Very Sad' (with the scale-ends counterbalanced over rating occasions and participants). After the RE task, the participants were first asked to indicate how they felt 'at this moment' (ENOW), followed by the question of how they had felt 'at the time when the event originally occurred' (ETHEN; the two questions were always asked in the ENOW/ETHEN order; the ETHEN question was omitted in the REN condition).

After the LM task, participants also answered two questions. One instruction was for the participants to rate 'how happy or sad you think the *music* was overall ... in other words, how you would describe this music on this scale' (the EDEM measure). The other question concerned 'how happy or sad *you feel* having listened to the music ... again, this is a rating of how *you* feel' (the IEM measure). One-half of the participants responded in the EDEM1IEM2 order, whereas the other 72 did so in the EDEM2IEM1 order.

Following the described procedure, all participants were given additional tasks that are outside the scope of the present article. They then took part in the exit interview and were thanked for their contribution to our research.

Results

Before turning to the hypotheses, some overall statistics are of interest. The grand mean (GM) for the five-factor experiment, over all measures (including ETHEN, and thus excluding the REN conditions) was 7.40. With ETHEN excluded and REN included, GM = 7.56. Because the midpoint of all scales was 7 and the design was perfectly balanced on the Happy–Sad dimension, this shows a slight pro-happy tendency (perhaps a measure of sorts of young people's or young Californians' mentality). Although a part of the reason may lie in the three musical compositions not being perfectly calibrated around the midpoint (overall EDEM mean = 7.45), the overall measure of own state after listening to music (IEM) was even more off-center in the happiness direction (7.96).

The main effect of Remembering Events (RE) was significant, $F(2, 108) = 24.95$, $p < .01$ (REH = 8.49; REN = 7.51; RES = 6.67), as was the main effect of Listening to Music (LM), $F(2, 108) = 108.99$, $p < .01$ (LMH = 9.27; LMN = 7.88; LMS = 5.52). These findings show that the manipulations had the intended effects.

There were several significant interactions; these will be discussed with regard to the three major predictions that were outlined at the end of the introduction earlier.

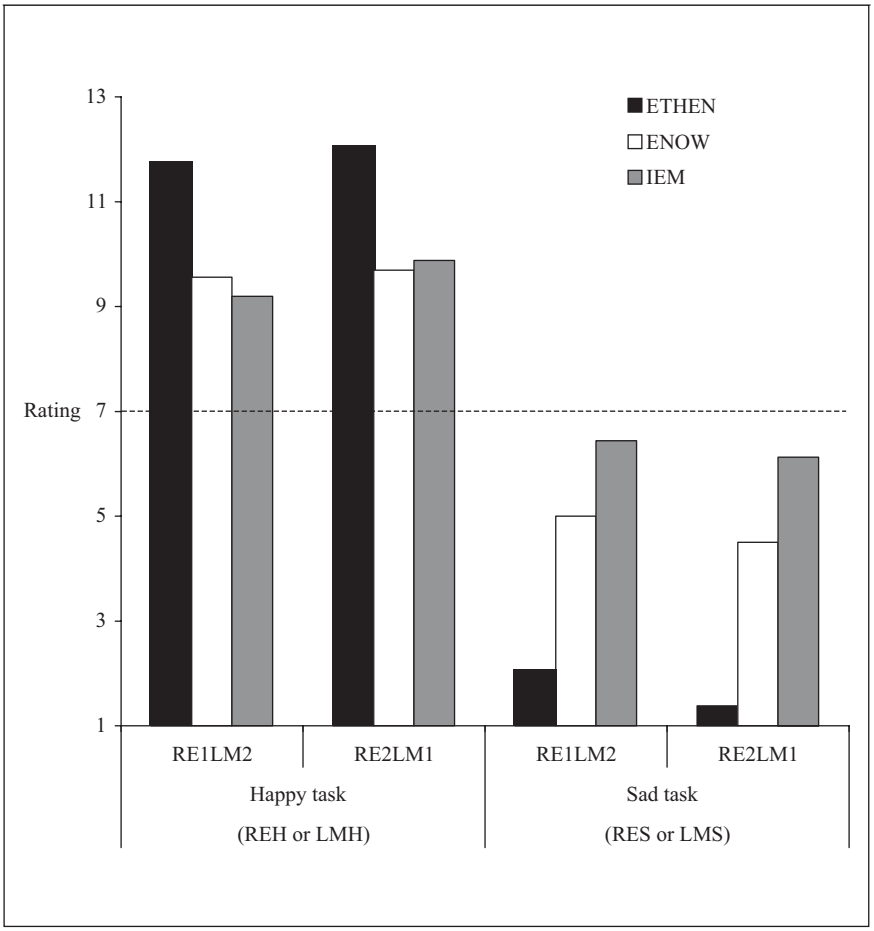
REMEMBERING EVENTS VERSUS LISTENING TO MUSIC

We predicted that remembering happy and sad real-life events would result in more extreme ratings of one's emotional state (the ENOW and ETHEN measures in the REH and RES conditions) than would listening to happy and sad music (the IEM measure in the LMH and LMS conditions). In addition, it was expected that the ETHEN measure would yield the most extreme ratings of own state in the experiment.

The effects that concern these predictions were all significant – the overarching four-way interaction RE × LM × RELM × MEAS, $F(6, 216) = 2.14$, $p = .05$; the subsumed three-way, RE × RELM × MEAS, $F(3, 216) = 3.15$, $p < .03$, and two-way interactions: RE × MEAS, $F(3, 216) = 232.42$, $p < .01$, and LM × MEAS, $F(6, 216) = 39.97$, $p < .01$; and the main effects of RE and LM (mentioned above), as well as of the within-subjects factor, MEAS, $F(3, 216) = 8.71$, $p < .01$.

The relevant subset of the results is presented in Figure 2. In this analysis, only the three dependent measures of own state were compared (omitting EDEM, the rating of music). The neutral conditions, REN and LMN, were also omitted, because the ETHEN measure was not available (REN) and to achieve a meaningful test (LMN). As predicted, for both the Happy (REH, LMH) and Sad (RES, LMS) task valence, the ETHEN measure yielded the most extreme ratings, significantly different from the ENOW and IEM measures (ETHEN *vs.* ENOW: $t(63) = 10.73$, $p < .01$; ETHEN *vs.* IEM: $t(63) = 11.94$, $p < .01$). Also as predicted, the ENOW measure was overall more extreme than IEM, but this was due exclusively to the significant difference on the Sad task, $t(31) = 3.38$, $p < .01$. Except for the minor ENOW/IEM crossover on the Happy task (*ns*), there was no differential effect of the RELM Order on any measure, $F(3, 216) = 1.22$, NS, for the RELM × MEAS interaction.

The data show that the emotional states produced in the laboratory by remembering the past happy and sad events were only a pale version of what the participants originally experienced: our participants were not Stanislavskian actors trained in the



Note: Neutral conditions (REN and LMN) were excluded to enable a meaningful comparison of Happy (REH and LMH) and Sad (RES and LMS) tasks on the ETHEN (emotion at the time the recalled event occurred), ENOW (emotion in the experiment after recall), and IEM (emotion induced by music) dependent measures.

FIGURE 2 Rating of own state by task valence, order and question format. The means are based on responses on a 13-point scale (1 = Very Sad and 13 = Very Happy) and are drawn from the RE × LM × RELM × MEAS interaction.

use of the 'emotion memory' procedure. It can be argued that the true test of the relative intensity of real-life- and music-induced emotional states is therefore in the highly significant ETHEN *vs*. IEM comparison – especially considering the mentioned general pro-happy tendency in the IEM ratings that the participants displayed.

The ETHEN data on both the Happy and Sad tasks, and the ENOW data on the latter, put the notion of the effects of music on emotion and specifically the results such as Krumhansl's (1997), which were based in part on the same Vivaldi and Albinoni music excerpts, in much-needed perspective – by providing a real-life emotional anchor.

COGNITIVE ASSOCIATIONS AND THE IEM MEASURE

It was tentatively predicted that the IEM measure, a rating of own state after listening to music, would be more extreme in the RE1LM2 order, in which remembering events preceded listening, than in RE2LM1, in which listening occurred before remembering. We thought that the detailed recall of a significant, emotion-laden, real-world event would make emotion-inducing associations more likely during the subsequent listening to music, especially in the congruent REH/LMH and RES/LMS conditions. This prediction was tentative because the possibility also existed that the act of rating one's emotional state after remembering events would cause the participants to be more restrained when subsequently rating their state in response to music. In other words, it seemed possible that a potential substantive effect (conceptually analogous to 'carry-over') would be offset by a scaling counter-effect.

The results for the IEM ratings in all nine RE × LM combinations in both RELM orders are presented in Figure 3 (these are data from all 144 participants). In seven of the nine combinations, the IEM ratings were less extreme in the RE1LM2 than in the RE2LM1 order (in one, RES/LMS, they were identical, and in only one, REN/LMS, the rating was more extreme in the RE1LM2 order). To test the overall effect properly, the IEM ratings were transformed in terms of extremeness (absolute difference from 7): The RELM main effect was indeed statistically significant, $F(1, 108) = 4.07$, $p < .05$. The interactions RE × RELM, LM × RELM, RE × LM × RELM and RE × LM × RELM × MEAS all did not approach significance for these transformed data.

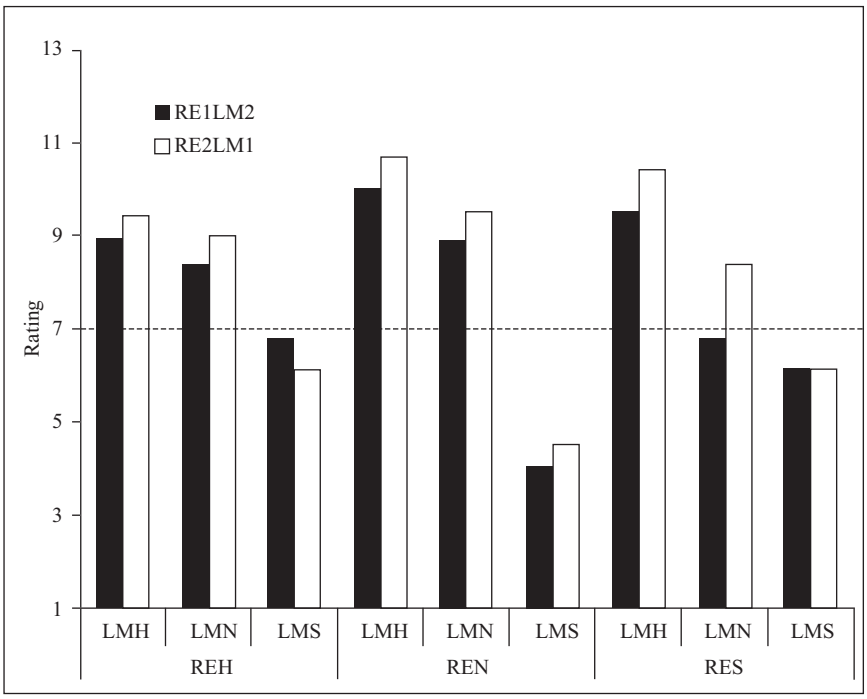


FIGURE 3 *Effect of task order on IEM (emotion induced by music) ratings. The means are based on responses of all 144 participants on a 13-point scale (1 = Very Sad and 13 = Very Happy).*

The results are analogous when the REN conditions are excluded and the IEM scores of the remaining 96 participants transformed in terms of extremeness. The RELM main effect is significant, $F(1, 72) = 6.97$, $p = .01$, and none of the relevant interactions are.

There was, therefore, no support for the notion that the associations that presumably arose while cognitively representing real-life emotional situations carried over into the participants' subsequent response to the music. Instead, it seems that the 'reality test' of providing the ENOW and ETHEN ratings restrained the rated impact of the music on IEM.

Of course, these data and conclusions do not address the distinct possibility that the before-mentioned, strong, differential effect of the three music excerpts, Vivaldi *vs*. Respighi *vs*. Albinoni, on IEM was mediated, fully or partly, by the different associations induced by these music selections themselves.

EXPRESSION VERSUS INDUCTION OF EMOTION BY MUSIC

We predicted that the ratings of the music's expressiveness and the degree to which it depicted emotions would overall be more extreme than the ratings of own state in response to music. In the analysis of the transformed extremeness scores (absolute difference from 7), the EDEM ratings ($M = 3.14$) were indeed significantly more extreme than the IEM ratings ($M = 2.36$), $F(1, 216) = 17.66$, $p < .01$.

Some more detailed predictions were also made and they were confirmed by the fact that the effect of the EDEM/IEM Order was negligible and that the interaction was also not statistically significant, $F(1, 216) = 2.48$, $p = .12$. Despite this, the pattern of the means shown in Table 1 only partially confirmed our predictions. As predicted, the IEM ratings were significantly less extreme than the EDEM ones at both levels of the EDEM/IEM order (the p level ranging from .02 to .0001), but the IEM rating in the EDEM1IEM2 order was not lower than the IEM rating in the EDEM2IEM1 order, contrary to our prediction. On the other hand, the obtained EDEM ratings matched our prediction precisely: the EDEM rating when given first was significantly less extreme than when it followed a rating of own emotional state, $t(142) = 2.12$, $p = .03$.

In addition to the substantively important finding that the respondents rate (specially selected) music more extremely in terms of the emotional qualities it expresses and depicts than they rate their own emotional response to that music, the data have methodological implications, especially for studies dealing with the key issue of subjective experience. One is the importance of the conceptual and verbal context in which the participants are asked questions in the area of music and emotion.

TABLE 1 *Comparison of self and music ratings by question order*

	EDEM1IEM2	EDEM2IEM1
IEM_{extrem}	2.39	2.33
$EDEM_{extrem}$	2.88	3.40

Note: Cell means are based on $n = 72$. IEM_{extrem} (Induction of Emotion by Music) and $EDEM_{extrem}$ (Expression or Depiction of Emotion by Music) represent data transformed to extremeness scores, which were computed as the absolute value of each original rating's distance (on a 1–13 scale) from 7. Columns represent the levels of the EDEM/IEM Order factor.

The other concerns the care with which it is necessary to formulate the questions in order to reduce the previously noted tendency to attribute the music's expressive qualities to one's emotional state. We say 'reduce' rather than 'eliminate' because, after all, the IEM extremeness ratings in Table 1 (2.36 on the average), though lower than the EDEM ones, were nevertheless significantly greater than zero (the 95% confidence interval: 2.09–2.63). This issue will be addressed in the final section of the article.

Discussion

EXPRESSION: AND NEVERTHELESS IT'S SAD

> For I consider that music is, by its very nature, essentially powerless to *express* anything at all, whether a feeling, an attitude of mind, a psychological mood, a phenomenon of nature, etc ... *Expression* has never been an inherent property of music. That is by no means the purpose of its existence. If, as is nearly always the case, music appears to express something, this is only an illusion and not a reality. It is simply an additional attribute which, by tacit and inveterate agreement, we have lent it, thrust upon it, as a label, a convention – in short, an aspect unconsciously or by force of habit, we have come to confuse with essential being. (Stravinsky, 1998[1936]: 53–4)

Igor Stravinsky's articulate dismissal of expression in music, in the tradition of Hanslick (1957[1854]; see also Levinson's, 1996, discussion), has long been the object of many musicologists', music teachers' and music lovers' derision and hostility. Our respondents would also read Stravinsky's account with incredulity, because, as can be seen in Table 1, the average extremeness score (absolute distance from 7, maximum score 6) on the Expression and Depiction of Emotion by Music measure was 3.14. (The only measure that provided a more extreme average score was ETHEN, 5.09, see Figure 2). The EDEM measure and our conversations with these and many other research participants confirm the obstinate 'and nevertheless it's sad' state of affairs (the title of Chapter XIII in Kivy, 1989).

Stravinsky's view of music's expressiveness as a ubiquitous illusion is, in our opinion, more an aesthetic and intellectual preference than elitist detachment. He *wished* (and so do we) that people would analyze and enjoy music's syntax more and its semantics and symbolism less. But, as our EDEM data show – and whether because of a 'convention [or] unconsciously or by force of habit' – people do 'confuse [music's] essential being' with expression.

Things are as they are and need to be understood. Various effects of music are shown in Figure 1. Their multiplicity and versatility – the fact that the effects are on mood, physiology and motor behavior – presumably contribute to the common perception of 'expression'.

INDUCTION: AND NEVERTHELESS *I'M* SAD? NO, NOT REALLY, BUT ...

The data show conclusively that people are able to distinguish between their real-world emotions of happiness and sadness, on the one hand, and the subjective states resulting from listening to music specially selected to express these emotions, on the other. The difference between the ratings of ETHEN (happy–sad real-world emotion as originally experienced) and IEM (happy–sad emotional state induced by music) was so large (see Figure 2) that one is tempted to conclude, even though a quantitative intensity scale

was used, that the participants were conveying an entirely different quality of experience by their scalar responses. If the technical term 'emotion' is to draw significance from key relationships among people, with an evolutionary backdrop, then our data suggest that the term 'music and emotion' – to the extent that it implies a causal relationship, as frequently enough seems to be the case in the literature – is seriously misleading and ought to be abandoned. At the very least, music-and-emotion experimenters might habitually remind their respondents, in one comparative way or another, of their real-world emotional life. The rejoinder might be, we suspect, that music is the most important part of many young people's real-world emotional life (e.g. Panksepp, 1995: 176) and our Figure 1 shows how this might arise; nevertheless, in the life of every person there occur, sooner or later, instances of powerful socially induced fundamental emotions that put the music-induced states in perspective.

In our opinion, the fact that the ENOW scores (reflecting the effects of recall of the happy–sad real-world events on the current emotional state) were significantly less extreme than the ETHEN scores (Figure 2) simply reflects the difficulty of recreating powerful real-world emotions in the laboratory. However, even the ENOW scores were significantly more extreme than the IEM ones, albeit only on the Sad task (see Figure 2; more on this later).

When the erudite Eduard Hanslick, in the heyday of the Romantic era that for all practical purposes, through Hollywood and the three-minute tear-jerker, persists to this day, said that 'the beautiful [in music] is and remains beautiful though it arouse[s] no emotion whatever' (1957[1854]), he may have kept to himself the thought that *sometimes* the beautiful in music does arouse emotion. If so, he would have meant, it is safe to assume, that real emotions could be produced by music only by means of associations and the recollection of powerful real-world emotional events. In Figure 1, we present various cognitive operations as the 'royal road' from music to the (low-intensity end of the) fundamental emotions.

Our attempt to measure, by means of the RELM Order factor, a potential relative increase in associations to music after recalling a same-valence real-world event, failed – apparently because the first-given ENOW ratings subdued (i.e. decreased the extremeness of) the subsequent IEM ones (Figure 3). Of course, this finding is informative in another sense – that of the contextuality, often substantively informative, of the ratings of 'own emotional state in response to music' given by respondents in music-emotion experiments.

The mediating role of associations and other cognitive operations (see Figure 1; cf. Konečni, 2007) in investigating the relationship of music and emotion is a methodologically complex, but an essential and fascinating, research topic.

... I'M HAPPY!

Unlike on the Sad task, the IEM ratings were almost identical to the ENOW ones on the Happy task (Figure 2). This result may be partly explicable by the fact, mentioned at the beginning of the 'Results' section, that the IEM ratings were overall 'pro-happy' (GM = 7.96). More specifically, for the 96 participants in Figure 2, IEM LMH ($M_{extrem} = 2.66$) was significantly more extreme than IEM LMS ($M_{extrem} = 1.72$), $t(62) = 2.32$, $p < .03$; and for all 144 participants in Figure 3, IEM LMH ($M_{extrem} = 2.92$) was similarly more extreme than IEM LMS ($M_{extrem} = 2.23$), $t(94) = 1.97$, $p = .05$.

The happy–sad asymmetry is hardly surprising, given that the respondents were young Californians, much of whose lives are spent being urged to be 'up' by 'happy music' (or muzak, including snippets of Vivaldi's 'Spring', used by Krumhansl, 1997 and by us) in the context of commercial hype. The introduction of music into every conceivable public and consumer space is supposed to make people happy and buy (see Figure 3 in Konečni, 2007; also North et al., 1997).

More substantively, 'happy mood' may be linked to dance and the attendant sexual display (see Figure 1 for the various possible paths) that have been unfortunately much neglected in the music-emotion analysis (cf. Darwin, 1902[1871]: 734; Gurney, 1966[1880]: 409; Konečni, 2005: 31; Miller, 2000: 348), but which we think play a major part in the effect of music.

'MUSICAL EMOTIONS': BEING MOVED AND EXPERIENCING AESTHETIC AWE?

Ratings of own state induced by music (IEM) were significantly less extreme than those of the emotions induced by the recall of real-world emotional events – especially at the time those events occurred (ETHEN), but also within the experiment (ENOW, for the Sad task only). Moreover, the IEM ratings were substantially tempered by having rated one's recalled real-world emotion beforehand. In addition, ratings of the 'expressiveness' of the music (EDEM) were far more extreme than ratings of own state. Nevertheless, the fact remains that the IEM ratings were significantly different from the neutral point overall, and that this effect was particularly notable after listening to the 'happy' Vivaldi three-minute excerpt (over 2.5 units above the neutral point on the 13-point scale).

Does one, then, have unequivocal proof here that the fundamental emotions of sadness and, especially, happiness were directly induced by music in our participants? The answer is negative. Despite Figure 3, one cannot completely eliminate the previously mentioned possibility of the expression-misattribution effect (cf. Gabrielsson, 2001–02: 124); nor ideas, such as Walton's (1988: 359; cf. Robinson, 1994: 18), that sad music does not induce sadness, but induces in the listeners the imagination of sadness; nor various lay theories and consequent language use that are summarized by Stravinsky's 'force of habit' (1998[1936]: 54). Finally, and most importantly, the musical excerpts themselves (as opposed to the preceding recall of emotion) may have given rise to mental imagery and associations regarding real-life emotion-inducing events, as shown by the 'royal road' in Figure 1.

Our assumption is that the fundamental emotions of happiness and sadness, if they were indeed (indirectly) induced by music in our participants, would have been at the low end of the intensity range of these emotions (as indicated in Figure 1). The overall data pattern strongly supports such an assumption. The idea of induction of comparatively weak fundamental emotions by music through associations can be traced, for example, to Darwin (1902[1871]: 736) and has been accepted by many contemporary philosophers and psychologists of music (e.g. Davies, 1994; Levinson, 1990; Sloboda and Juslin, 2001).

Admittedly, many scholars have held a different viewpoint (and some, Darwin included, have seemingly held both simultaneously), namely, the idea of 'musical emotions' – according to which music induces powerful emotions but they are qualitatively different from at least some of the fundamental emotions. Thus, 'Music arouses in us various emotions, but not the more terrible ones of horror, fear, rage'

(Darwin, 1902[1871]: 735). And 'Music['s] ... essential effect ... [is a] production in us of an emotional excitement of a very intense kind, which yet cannot be defined under any known head of emotion' (Gurney, 1966[1880]: 120). These themes concerning the 'musical emotions' have been echoed with minor variations by generations of scholars interested in music, with no conceptual advance that we can discern. Recent users of the term have been, to name just a few: Kivy (1999: 13), Krumhansl (2002: 45), Peretz (2001: 105) and Scherer et al. (2001–02: 154).

Much as we find the term misleading, we think that the notion behind 'musical emotions' is sound – in fact, crucial for understanding some of the effects of music (and of other aesthetic 'objects'). One of us (Konečni, 2005) has developed the theory of the 'aesthetic trinity', involving the responses of thrills/chills, being moved and aesthetic awe (see Figure 1); exploratory tests have been performed by Konečni et al. (2007). The concepts are akin to those discussed by Gabrielsson (2001: 431), Keltner and Heidt (2003: 310) and Scherer and Zentner (2001: 384). In this view, the state of being moved is the prototypical profound response to music. Aesthetic awe, which includes being moved, but is far less frequent, is considered to be the ultimate human aesthetic state: a response to the sublime stimulus that – among other attributes – includes colossal size. For music to be sublime, in this view, it must be performed in a grand setting, or one that has acquired a unique appeal by, among other means, classical conditioning.

According to Darwin (1902[1871]: 735), 'Music ... stirs up in us the sense of triumph and the glorious ardor [*sic*] for war. These powerful and mingled feelings may well give rise to the sense of sublimity.' Of course, 'sublimity' is here referred to as a subjective experience, not as an objective stimulus, and on the former Darwin did woefully little research. Nobody's perfect!

NOTES

1. Needless to say, there is a great deal of music that has neither the mentioned characteristics nor effects (see the 'Contemplation/Problem Solving' and 'Passive Listening/Inattention' boxes in Figure 1; also see Figures 2 and 3 in Konečni, 2007).
2. In the retrospective study by Zentner et al. (2000), according to Juslin and Zentner (2001–02: 10), the (unspecified) participants 'were instructed to rate the frequency with which they experienced over a hundred emotional states when listening to music and in non-musical daily life contexts' (see also Scherer and Zentner, 2001: 380).
3. Konečni (2007) has described and compared 13 different causal models in the music-and-emotion area.
4. No data are actually presented in Waterman's (1996) article about the frequency with which this codable response happened or if, in fact, it ever happened.

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VLADIMIR J. KONEČNI (PhD University of Toronto, experimental and social psychology) is Professor of Psychology in the Department of Psychology, University of California, San Diego, La Jolla, California. He has been a John Simon Guggenheim Fellow. Research interests include: psychology of music; psychological aesthetics (in architecture, music, theatre, visual arts); emotion and motivation; psychology of law; methodology.
Address: Department of Psychology, University of California, San Diego, La Jolla, California 92093–0109, USA. [email: vkonecni@ucsd.edu]

AMBER BROWN (BA Hampshire College, USA, music and mathematics; MBA. George Washington University, St Louis, Missouri; Master's in City and Regional Planning, University of Memphis, Tennessee) is a graduate student in Psychology at the University of California, San Diego (Doctoral Advisor: V.J. Konečni). Research interests include: psychology of music; architecture and urban planning; creativity.
Address: Department of Psychology, University of California, San Diego, La Jolla, California 92093–0109, USA. [email: amberbrown@ucsd.edu]

REBEKAH A. WANIC (BA with Honors in psychology, University of Illinois, Urbana-Champaign) is a graduate student in Psychology at the University of California, San Diego (Doctoral Advisor: V.J. Konečni). Research interests include: psychological aesthetics and social psychology.
Address: Department of Psychology, University of California, San Diego, La Jolla, California 92093–0109, USA. [email: rwanic@psy.ucsd.edu]