COGNITION AND EMOTION
2008, 22 (2), 327–352

Psychology Press
Taylor & Francis Group

Mixed affective responses to music with conflicting cues

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We examined whether listening to music induces simultaneously happy and sad affective responding. The stimuli were instrumental excerpts from musical recordings that included a broad range of genres. The excerpts varied in tempo (fast or slow) and mode (major or minor), such that they had consistent happy (fast/major), consistent sad (slow/minor), or inconsistent (fast/minor or slow/major) affective cues. Listeners rated how each excerpt made them feel using separate scales for happiness and sadness. When tempo and mode cues conflicted, "mixed" happy *and* sad feelings were evoked. Mixed ratings on control measures (pleasantness and unpleasantness) did not show the same pattern.

Pleasant and unpleasant feelings are often thought to lie on a single, bipolar continuum (Russell & Carroll, 1999; Wundt, 1896; see also Reisenzein, 1992, 1994). From this perspective, one cannot feel opposite emotions, such as happiness (a pleasant feeling) and sadness (an unpleasant feeling), at the same time. Many experiences are consistent with this bipolar model of pleasure and displeasure (Reisenzein, 1995). A death in the family can lead to feelings of sadness without any happiness, whereas an unexpected gift can lead to feelings of happiness without any sadness.

But how does one feel in an ambiguous situation with conflicting happy and sad affective cues? Recent empirical evidence (Hemenover & Schimmack, 2007; Larsen, McGraw, & Cacioppo, 2001; Larsen, McGraw, Mellers, & Cacioppo, 2004; Schimmack, 2001, 2005; Schimmack & Colcombe, in press; see also Diener & Iran-Nejad, 1986) suggests that positive and negative affect represent separate dimensions (Cacioppo & Berntson, 1994; Watson, Clark, & Tellegen, 1988). From this perspective, ambiguous situations can elicit *mixed feelings*, or concurrent experiences of opposite

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Supported by the Social Sciences and Humanities Research Council of Canada.

We thank Jane Campbell for her assistance in recruiting and testing the participants.

www.psypress.com/cogemotion DOI: 10.1080/02699930701438145

valence such as happiness *and* sadness. The present article examines whether mixed feelings occur systematically in response to music with mixed affective cues.

Researchers often make a distinction among feelings depending on whether they are object-directed or non-intentional (Frijda, 1993; Reisenzein & Schönpflug, 1992; Schimmack & Crites, 2005; Schimmack & Diener, 1997). Previous studies of mixed feelings examined object-directed feelings. For example, Schimmack and Colcombe (in press) presented pairs of positive and negative pictures. The mixed feelings that were evident were the likely result of feeling good about the positive picture and bad about the negative picture. In another study (Larsen et al., 2004), mixed emotions were induced in a gambling task, which involved a single event that could be appraised in two ways. For example, in the "disappointing win" condition, individuals were told that they could win either \$5 or \$12, but they actually won \$5. Mixed affective responding was presumably a consequence of feeling happy about winning \$5 but sad about not winning \$12.

The present study examined whether it is possible to induce non-intentional mixed feelings. Music is the most widely used method to elicit non-intentional feelings in the laboratory (see Västfjäll, 2001/2002, for a review). Music is also used widely in everyday life to alter non-intentional feelings (i.e., moods; e.g., Sloboda, 1992). In the present investigation, our listeners heard several 30 s excerpts of music with cues to happiness and sadness. After each excerpt, they judged how happy and how sad the music made them feel. We consider these affective responses to be non-intentional because it is unlikely that participants' feelings were directed at the music even though they were caused by the music. Non-intentional feelings can have a clear and identifiable cause (e.g., I am happy because I drank a glass of Sauvignon Blanc; I am happy because I listened to Yellow Submarine), without being directed at the cause (e.g., I am happy about the wine; I am happy about the Beatles; Arnold, 1960).

It is theoretically important to examine feelings in response to music because previous reports of object-directed mixed feelings could stem primarily from *cognitive ambivalence*—conflicting mental representations of an event—rather than feelings of opposite valence that are solely affective. According to Clore, Ortony, and Foss (1987), people may have conflicting representations of two emotional objects without actually having mixed feelings about them. The present study provided a more conservative test of mixed affective responding by using musical excerpts as the stimuli. Although self-reports of affective responding (used here) could be influenced by cognitions as well as feelings, self-reports of emotions evoked by music are paralleled by changes on more objective physiological measures (Krumhansl, 1997).

Another unresolved issue concerns whether mixed feelings are actually experienced simultaneously, or whether they are rapidly *alternating* experiences that change with the focus of attention (Kellogg, 1915; Ortony, Clore, & Collins, 1988). For example, in the paired-picture method (Schimmack & Colcombe, in press), individuals could have alternated their attention between the pleasant and unpleasant pictures. Similarly, in Larsen et al.'s (2004) study of disappointing wins, individuals may have switched their attentional focus between winning $5 and feeling happy at one moment, and failing to win $12 and feeling sad at the next moment. In either case, reports of mixed feelings could stem from *alternating* experiences of two semantically opposite emotions. As such, they would be consistent with bipolar models of affect (Russell & Carroll, 1999). Larsen et al. (2004) attempted to address this concern by asking participants to press separate buttons while they experienced happiness or sadness. Many participants pressed both buttons simultaneously for prolonged periods of time. These results suggest that mixed affective responses are experienced concurrently rather than alternately. Nevertheless, firm conclusions require corroborating evidence obtained with a different method (see also Schimmack, 2005).

The multi-dimensional nature of musical stimuli provides a unique opportunity to study mixed affective responding because listeners do not typically alternate their focus of attention between different affective cues. That is, the average listener (with little or no musical training) does not generally focus on the tempo (i.e., speed) of the music at one moment, only to focus on the mode (i.e., major or minor key) at the next moment. Musical experts would find it relatively easy to attend to specific dimensions but the typical listener does not listen to music in this manner. More importantly, affective responses to music do not depend on explicit knowledge about the characteristics of music, or on years of formal or informal exposure to music. For example, music that is selected by researchers to be happy or sad sounding induces the corresponding moods in listeners recruited without regard to musical training (Husain, Thompson, & Schellenberg, 2002; Schellenberg, Nakata, Hunter, & Tamoto, 2007; Thompson, Schellenberg, & Husain, 2001). Even 5- and 6-year-old children identify (Dalla Bella, Peretz, Rousseau, & Gosselin, 2001) and respond (Schellenberg et al., 2007) to happy and sad sounding music in a manner similar to adults. One explanation of the relative independence between experience with music and affective responding is that emotional responding to music may be subserved by neural pathways that are isolable and distinct from those involved in more cognitive tasks, such as recognising music (Peretz & Zatorre, 2005).

It is well established that some dimensions of music have bipolar effects on happiness and sadness. For example, fast tempo is associated with happiness whereas slow tempo is associated with sadness (Gagnon & Peretz, 2003; Gundlach, 1935; Hevner, 1937; Juslin, 1997; Peretz, Gagnon, & Bouchard, 1998a; Rigg, 1937, 1940; Scherer & Oshinsky, 1977; Webster & Weir, 2005). These associations are evident across musical cultures (Balkwill & Thompson, 1999; Balkwill, Thompson, & Matsunaga, 2004). In Western music, major mode is also associated with happiness whereas minor mode is associated with sadness (Crowder, 1984; Dalla Bella et al., 2001; Gagnon & Peretz, 2003; Gerardi & Gerken, 1995; Gregory, Worall, & Sarge, 1996; Hevner, 1935; Husain et al., 2002; Kastner & Crowder, 1990; Peretz et al., 1998a; Rigg, 1937, 1939; Scherer & Oshinsky, 1977; Webster & Weir, 2005; Wedin, 1972). Thus, for Western listeners, the most happy-sounding music is fast and in major mode, whereas the most sad-sounding music is slow and in minor mode. Consequently, intensity of happy responding is usually correlated negatively with intensity of sad responding.

Negative correlations between subjective experiences of happiness and sadness do not preclude the possibility that ambivalent stimuli lead to mixed feelings at low levels of intensity (Diener & Iran-Nejad, 1986; Schimmack, 2001). Because musical dimensions such as tempo and mode vary independently, a particular musical piece can have a happy affective cue on one dimension and a sad cue on another dimension. For example, fast music in minor mode may elicit mixed feelings because the fast tempo is associated with happiness and the minor mode is associated with sadness. Similarly, mixed feelings could be evoked by slow music in major mode. In the present investigation, we predicted that musical dimensions such as tempo and mode would have a bipolar influence on happiness and sadness, in line with previous research. A more important and novel prediction was that music with mixed affective cues would elicit mixed feelings.

Previous examinations of associations between music and emotions have asked participants to link a musical piece with a specific affective adjective (Cunningham & Sterling, 1988; Gundlach, 1935; Kastner & Crowder, 1990; Robazza, Macaluso, & D'Urso, 1994; Terwogt & Van Grinsven, 1991), or to provide ratings using bipolar happy–sad response scales (Dalla Bella et al., 2001; Gagnon & Peretz, 2003; Peretz et al., 1998a; Webster & Weir, 2005). These methods require participants to choose between the two "opposite" affective responses (e.g., happy or sad). Hence, they presume that only one of the two feelings can be evoked, in line with the bipolar view (Russell & Carroll, 1999), while potentially obscuring mixed responses that might have arisen. A reasonable alternative is to require listeners to use two unipolar rating scales, one for ratings of happiness and one for ratings of sadness (e.g., Larsen et al., 2001; Schimmack, 2001). Only one study to date has measured music-induced happy and sad affective responses separately (Dibben, 2004), but the analyses did not examine the possibility of simultaneous happy *and* sad feelings.

We conducted two experiments to test whether music with mixed affective cues evokes mixed feelings. Both experiments used stimulus excerpts from commercial recordings selected because of consistent tempo and mode cues (fast–major, slow–minor) or inconsistent cues (fast–minor, slow–major). The experiments differed in response format. Experiment 1 required listeners to rate their happiness and sadness separately on two unipolar scales. Although most participants interpret this response format correctly, misinterpretations of unipolar scales as bipolar can produce artificial evidence for mixed feelings (Russell & Carroll, 1999; Schimmack, 2001). To examine this possibility, Experiment 2 required participants to report their feelings on a two-dimensional grid (Larsen, Norris, & Cacioppo, 2007).

To measure mixed feelings, we used the MIN statistic (Kaplan, 1972; Schimmack, 2001), which is the minimum of scores on two unipolar scales. For example, if participants provide a rating of 4 for how happy a musical piece makes them feel and a rating of 2 for how sad it makes them feel, their MIN rating for mixed happy and sad feelings would be 2. The rationale is that the higher the lowest rating, the greater the amount of co-activation across both feelings. Our main prediction was that mixed happy and sad feelings would be elevated in conditions with mixed cues for happiness and sadness compared to conditions with consistent cues.

EXPERIMENT 1

Our participants listened to instrumental excerpts from recordings that were taken from commercially available sources. After each excerpt, they rated how "happy" and how "sad" the music made them feel. We also asked listeners to rate how "pleasant" and "unpleasant" they felt in response to each excerpt.

In line with previous research, we expected that major modes and fast tempi would be associated with higher ratings on our measure of happiness, and that minor modes and slow tempi would be associated with higher ratings on our measure of sadness. Mixed happy and sad feelings were expected to be higher in conditions with conflicting happy and sad cues. More specifically, mixed ratings for excerpts presented at fast tempi should be higher for those in minor rather than major mode; at slow tempi, mixed ratings should be higher for major than for minor mode.

We did not have specific predictions about which excerpts would be deemed particularly pleasant or unpleasant because listeners often enjoy sad sounding music. Rather, the pleasant–unpleasant ratings served primarily as a control measure (as in Schimmack, 2001) to ensure that any observed mixed happy and sad feelings were not an artefact of asking listeners to rate happiness and sadness separately. Moreover, although mixed pleasantness and unpleasantness might vary as a consequence of the tempo or mode manipulations, we did not expect these mixed ratings to be systematically higher for conditions with inconsistent rather than consistent cues to happiness and sadness. Rather, the most ambivalent responses were likely to be evident for sad music, which could be unpleasant because it evokes sadness, but pleasant at the same time because of its aesthetic appeal. In line with this view (and with results from Husain et al., 2002; Thompson et al., 2001), we predicted that happy and pleasant ratings would be correlated positively, as would sad and unpleasant ratings, but that the latter correlation would be smaller than the former. We also expected somewhat ambivalent responding to sad-sounding music in general.

Method

Participants. Forty undergraduates (24 women, 16 men) enrolled in an introductory psychology class participated for partial course credit. They had an average of 5.0 years of music lessons ($SD = 5.2$; range = 0–22 years) but the distribution was skewed positively and the majority (65%) had 2 years of lessons or less.

Apparatus. Stimuli were presented over high-quality stereophonic headphones (Sony MDR-CD370) while participants sat in a sound-attenuating booth in front of an iMac computer. Stimulus presentation and response recording were controlled with customised software written in REALbasic.

Stimuli. The stimuli were 48 excerpts from recordings available commercially on compact disk (see Appendix). Each excerpt was approximately 30 s in duration. The excerpts were copied and stored as CD-quality sound files. In order to minimise differences in perceived loudness, excerpts were normalised such that the maximum amplitude was identical across excerpts. All excerpts were instrumental (no vocals) to avoid possible influences of the semantic content of the lyrics and extraneous affective cues of the human voice. Half of the 48 excerpts were selected to have consistent affective cues, with 12 conveying happiness (major mode and fast tempo) and the other 12 conveying sadness (minor mode and slow tempo). The remaining 24 excerpts were selected because they had conflicting affective cues, with 12 having a major mode and slow tempo and the other 12 having a minor mode and fast tempo.

To make the results as general as possible, the excerpts were selected from a wide variety of musical styles (e.g., jazz, rock, orchestral, alternative, classical, African, and so on). Because we were using actual recordings, the different stimuli varied in multiple ways. Hence, to ensure that the pure and mixed excerpts did not vary *systematically* in any characteristic other than tempo or mode, they were selected in pairs such that each "pure" excerpt (i.e., with consistent affective cues) was matched with a "mixed" excerpt (i.e., with conflicting cues). Each of these pairs was chosen from the same musical genre—from the same CD or artist in all but three instances—such that the presence of consistent or inconsistent affective cues was not confounded with musical style. This process yielded four types of pairings: fast–major and fast–minor, fast–major and slow–major, slow–minor and slow–major, slow–minor and fast–minor (see Appendix). In pairs with contrasting tempi, the faster excerpt had more musical events per unit time than the slower excerpt. In pairs with contrasting mode, the major excerpt was judged to sound more "major" than the minor excerpt. There was no absolute threshold for classifying tempo as fast or slow, and some of the pieces were not unequivocally in a Western major or minor key.

Procedure. Participants were tested individually in a sound-attenuating booth. They were told that they would hear forty-eight 30-s excerpts from recordings. After each excerpt, they were asked to rate how happy, sad, pleasant, and unpleasant they felt in response to the music. The excerpts were presented in a different random order for each participant. After each excerpt, four response scales appeared simultaneously on the computer monitor. A question at the top of the screen asked, "How did the music make you feel?" Four 7-point Likert-type rating scales labelled "Happy" (upper left), "Sad" (upper right), "Pleasant" (lower left), and "Unpleasant" (lower right) were positioned below the question. Scales were presented simultaneously in a fixed position on the monitor to avoid confusion. Values on each scale ranged from 0 to 6, with 0 labelled "Not at all", 3 labelled "Moderately", and 6 labelled "Extremely". After making the four ratings, participants clicked the mouse to hear the next excerpt. Before the session began, we stressed to participants that they should give a rating of 0 if they did not experience the feeling, a midpoint rating for moderate (not neutral) feelings, and a high rating for strong feelings. These instructions have been used successfully in previous studies to ensure that most participants use the response formats in the intended unipolar manner (Schimmack, 2001, 2005; Schimmack & Diener, 1997; Schimmack & Hartmann, 1997).

Results and discussion

Outcome measures included listeners' ratings of how happy, sad, pleasant, and unpleasant the music made them feel. For each measure, each listener had four scores (averaged over 12 responses), corresponding to the four cells in the design (fast–major, fast–minor, slow–major, and slow–minor). Two measures of mixed feelings were derived from the pure responses. One was a measure of mixed happy and sad feelings (MIN[happy, sad]). The other was a measure of mixed pleasant and unpleasant feelings (MIN[pleasant, unpleasant]). Two-way repeated-measures analyses of variance (ANOVAs) were used to examine each of the six outcome dependent variables separately, with tempo (fast or slow) and mode (major or minor) as independent variables.

Pure feelings. Pairwise correlations among the pure outcome measures were calculated separately for each listener for each pair of ratings. Median values are reported in Table 1. Nonparametric tests (r is not distributed normally) revealed that each of the six pairwise correlations differed consistently from 0, $ps < .0001$ (one-sample sign tests, Bonferroni-corrected alpha = .05/6). As expected, negative associations were observed between happy and sad feelings for 39 of 40 listeners, and between pleasant and unpleasant feelings for all 40 listeners. These findings are consistent with previous findings that "opposite" feelings tend to be activated reciprocally. Music evoking happiness was also experienced as pleasant (40 of 40 listeners), whereas music evoking sadness tended to be experienced as unpleasant (34 of 40). As predicted, correlations between happy and pleasant ratings were much stronger (i.e., median of 57% variance in common) than correlations between sad and unpleasant ratings (i.e., median of 12%), $p < .0001$ (paired sign test).

Mean ratings are illustrated in Figure 1 separately for each condition and each outcome variable. As expected, ANOVAs revealed main effects of tempo and mode. Fast tempi enhanced happy and pleasant feelings, $Fs(1, 39) = 271.48$ and 76.88, respectively, $ps < .0001$, whereas slow tempi elevated sad and unpleasant feelings, $Fs(1, 39) = 227.19$ and 54.03, respectively, $ps < .0001$. Major modes led to higher happy and pleasant ratings, $Fs(1, 39) = 105.00$ and 55.09, respectively, $ps < .0001$, whereas minor modes

TABLE 1
Median pairwise correlations among rating scales for pure feelings in Experiments 1 (upper) and 2 (lower, $N = 48$ excerpts). Each correlation was significantly different from 0

	Sad	Pleasant	Unpleasant
Experiment 1			
Happy	−.68	.76	−.56
Sad		−.41	.34
Pleasant			−.73
Experiment 2			
Happy	−.65	.66	−.52
Sad		−.32	.52
Pleasant			−.67

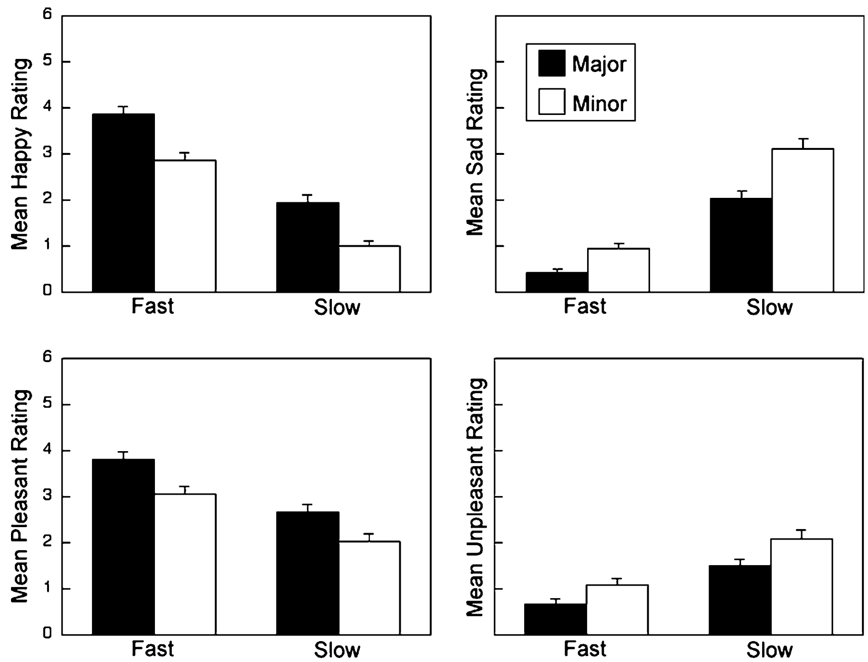

Figure 1. Mean ratings on happy (upper left), sad (upper right), pleasant (lower left), and unpleasant (lower right) scales in Experiment 1. Error bars are standard errors.

made listeners feel sad and unpleasant, Fs(1, 39) = 91.39 and 32.19, respectively, ps < .0001.

Effects of tempo and mode did not interact for happy, pleasant, or unpleasant feelings, but they did for sad feelings, $F(1, 39) = 21.91$, $p < .0001$. Follow-up tests confirmed that minor modes received significantly higher sad ratings than major modes at both fast and slow tempi, ts(39) = 5.05 and 9.50, respectively, ps < .0001. The interaction indicated that the effect was exaggerated at slow tempi. In other words, sad feelings were particularly high for music with consistent sad cues. It is also noteworthy that although pieces with consistent sad cues (slow–minor) elicited more sadness than happiness, they elicited virtually identical pleasant ($M = 2.03$) and unpleasant ($M = 2.07$) ratings (see Figure 1). In other words, listeners were ambivalent about the pleasantness of sad sounding music.

Mixed feelings. Mixed happy and sad feelings were correlated with each of the four pure feelings separately for each listener. Mixed feelings were associated positively with sad feelings for 39 of 40 listeners, a finding that was significant by a one-sample sign test, $p < .0001$ (median $r = .36$,

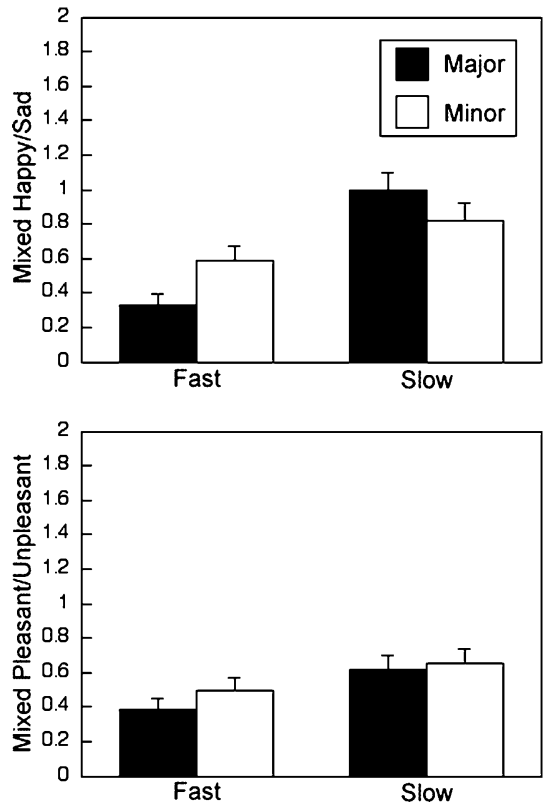

Figure 2. Mean mixed happy–sad (upper) and pleasant–unpleasant (lower) ratings in Experiment 1. Error bars are standard errors. A score of 0 means no mixed responding.

Bonferroni corrected alpha = .05/4). Mixed happy and sad feelings were not associated with the other three pure feelings.

Mean ratings for mixed happy and sad feelings are illustrated in Figure 2 (upper). A main effect of tempo revealed that slow tempi were associated with higher mixed feelings, $F(1,\ 39) = 30.04$, $p < .0001$. There was no main effect of mode, but the tempo effect was qualified by a significant interaction between tempo and mode, $F(1,\ 39) = 14.98$, $p < .001$. As expected, fast–minor and slow–major music (with conflicting cues) evoked higher levels of mixed happy and sad feelings ($M = 0.80$) than fast–major and slow–minor music (with consistent cues, $M = 0.57$). Follow-up tests confirmed that at fast tempi, music in minor mode evoked higher mixed feelings, $t(39) = 4.35$, $p < .0001$, whereas at slow tempi, music in major mode evoked higher mixed feelings, $t(39) = 2.15$, $p < .05$. These response patterns provide clear support for the hypothesis that music with conflicting cues evokes mixed feelings. Nonetheless, it should also be noted that mixed happy and sad responding was actually higher (albeit non-significantly) for slow–minor music (consistent sad cues) than for fast–minor music (conflicting cues).

One possible explanation for higher levels of mixed responses to music with conflicting cues is that some participants misinterpreted the unipolar response formats as bipolar (e.g., for the happy scale, 6 would be interpreted as very happy, 3 as neutral, and 0 as sad; Russell & Carroll, 1999). If so, they would report high levels of sadness and low levels of happiness in response to sad sounding (slow–minor) pieces, high levels of happiness and low levels of sadness for happy sounding (fast–major) pieces, and ratings at mid-points on the two scales for the pieces with conflicting cues. Such a response style would inflate mean ratings of mixed feelings in the two conditions with conflicting cues. We addressed this concern by identifying one group of participants who may have misinterpreted the response format, and another group who responded clearly in a unipolar manner. The interaction between tempo and mode remained robust when the analysis was limited to participants who treated the scales unambiguously as unipolar.[1]

Unlike mixed happy and sad feelings, our control measure of mixed pleasant and unpleasant feelings was associated with each of the pure feelings (Bonferroni corrected): negatively with happiness (31 of 40 listeners,

[1] Russell and Carroll (1999) proposed that participants may misinterpret unipolar scales as bipolar, such that the low ends of the scales are considered to be the semantic opposites of the high ends. For these participants, the happy and sad scales would be identical but reversed. In the present experiment, this response style would lead to neutral feelings (i.e., neither happy or sad) receiving happy and sad ratings of 3 and 3 (rather than 0 and 0), and for any given excerpt, happy and sad ratings would typically sum to 6 (happy = 6 + sad = 0; happy = 5 + sad = 1; happy = 4 + sad = 2, and so on). Accordingly, participants who felt neutral (rather than happy and sad) in response to music with mixed cues could have relatively high MIN scores (= 3). In principle, the observed interaction between tempo and mode could be an artefact of a subset of participants who adopted this unexpected response style.

To test this possibility, we summed each listener's happy and sad ratings separately for each excerpt, and calculated the total number of sums that equalled 6. A median split was used to divide participants into two groups: those with a relatively low number of sums equal to 6 (i.e., participants who treated the scales correctly as unipolar) and those with a relatively high number (i.e., participants who potentially treated the scales as bipolar). Three-way ANOVAs on happy and sad MIN ratings included response style as a between-subjects variable and tempo and mode as within-subjects variables. The three-way (mode × tempo × response style) interaction was not significant in Experiment 1 or in Experiment 2, $F\text{s} < 1$. In other words, elevated mixed ratings for music with inconsistent cues to happiness and sadness was similar for both groups of participants. Moreover, the two-way interaction between tempo and mode remained robust when participants who had a clearly unipolar response style were analysed separately, $F\text{s}(1, 19) = 12.43$ and 17.25, in Experiments 1 and 2, respectively, $p\text{s} < .005$.

In additional analyses, we divided participants into two groups based on the number of times their happy and sad ratings summed to 5, 6, or 7. Virtually identical patterns were evident. In short, observed patterns of mixed happy and sad responding cannot be attributed to participants who may have misinterpreted our unipolar scales as bipolar.

median $r = -.17$) and pleasantness (30 of 40 listeners, median $r = -.14$), ps $< .005$, and positively with sadness (30 of 40 listeners, median $r = .35$) and unpleasantness (36 of 40 listeners, median $r = .47$), ps $< .0005$. Mixed ratings of pleasant and unpleasant feelings also had a small, positive association with mixed ratings of happiness and sadness (27 of 40 listeners, median $r = .12$), $p < .01$, but the overlap in variance for the typical listener was only 1%.

Means for mixed pleasant and unpleasant feelings are illustrated in Figure 2 (lower). An ANOVA revealed that mixed pleasant and unpleasant feelings were higher in general for music with slow rather than fast tempi, $F(1, 39) = 22.22$, $p < .0001$. There was no effect of mode and no interaction between tempo and mode. Thus, in line with our predictions and in contrast to mixed happy and sad feelings, mixed pleasant and unpleasant feelings were not significantly higher for excerpts with conflicting musical cues. Rather, ambivalent (pleasant *and* unpleasant) responding was simply elevated in response to slow music.

EXPERIMENT 2

Experiment 2 addressed further the concern of response artefacts by asking participants to report their semantically opposite feelings with a single rating made on a two-dimensional grid (Larsen et al., 2007). We used two grids: one for happiness and sadness, and one for pleasantness and unpleasantness. The grid format makes it salient to participants that responses to happiness are not required to be opposite to those for sadness. In fact, a bipolar interpretation requires participants to respond only on the upper-left/bottom-right diagonal of the grid. Moreover, from a bipolar view, off-diagonal responses (e.g., 3 on the sadness axis, 0 on the happiness axis) are non-sensical (e.g., feeling neutral but extremely sad). In direct support of the unipolar but two-dimensional nature of the grid, Larsen et al. (2007) demonstrated that the grid performs as well as a two-step format, which asks first whether a feeling is present, with affirmative responses followed by an intensity rating (Reisenzein, 1995; Russell & Carroll, 1999; Schimmack & Diener, 1997).

Method

Participants. Another 40 undergraduates (28 women, 12 men) were recruited as in Experiment 1. They had an average of 4.3 years of music lessons ($SD = 5.0$; range = 0–16 years), but the distribution was again skewed positively and the majority (75%) had 2 years of lessons or less.

Apparatus and stimuli. The apparatus and stimuli were identical to those in Experiment 1.

Procedure. The procedure was identical to that of Experiment 1 except that ratings were made on 2 two-dimensional response grids. The axes of the first grid were labelled "Happy" (abscissa) and "Sad" (ordinate). Those of the second grid were labelled "Pleasant" (abscissa) and "Unpleasant" (ordinate). The values on each axis ranged from 0 to 6. Participants were instructed to click on the point in the two-dimensional space that indicated the desired value on both axes. In other words, happy and sad ratings were made simultaneously, as were pleasant and unpleasant ratings. Once again, we emphasised to participants that they should choose zero if they did *not* feel one of the emotions labelled on the grid.

Results and discussion

The data were analysed as in Experiment 1.

Pure feelings. Pairwise correlations among ratings of pure feelings (calculated separately for each listener) revealed that each correlation was consistently different from 0, $p\text{s} < .0001$. Medians are reported in Table 1 (lower). The associations were identical to those from Experiment 1. Happy and sad feelings were negatively correlated (39 of 40 listeners), as were pleasant and unpleasant feelings (40 of 40). Positive associations were also evident between happy and pleasant feelings (40 of 40 listeners), and between sad and unpleasant feelings (36 of 40). As predicted, associations tended to be larger in the former case (median of 44% variance in common) than in the latter (27% variance in common), $p < .0001$.

Mean ratings are illustrated in Figure 3. As in Experiment 1, main effects of tempo confirmed that fast tempi increased feelings of happiness and pleasantness, $F\text{s}(1, 39) = 285.14$ and 65.18, respectively, $p\text{s} < .0001$, whereas slow tempi made listeners feel relatively sad and unpleasant, $F\text{s}(1, 39) = 264.34$ and 75.97, respectively, $p\text{s} < .0001$. Main effects of mode confirmed again that major modes led to higher happy and pleasant feelings, $F\text{s}(1, 39) = 122.30$ and 67.69, respectively, $p\text{s} < .0001$, while minor modes elevated sad and unpleasant feelings, $F\text{s}(1, 39) = 82.12$ and 58.83, respectively, $p\text{s} < .0001$.

The main effects were qualified by significant interactions between mode and tempo, both for sadness, $F(1, 39) = 10.67$, $p < .01$, and for unpleasantness, $F(1, 39) = 4.34$, $p < .01$. Although minor modes evoked more sadness than major modes for music at fast tempi, $t(39) = 5.16$, $p < .0001$, the effect was exaggerated at slow tempi, $t(39) = 9.26$, $p < .0001$. Similarly, minor modes evoked higher unpleasant feelings than major modes at fast tempi, $t(39) = 5.56$, $p < .0001$, with the effect exaggerated at slow tempi, $t(39) = 6.96$, $p < .0001$. As before, music evoked particularly high levels of negative affect (sadness and unpleasantness) when it had consistent sad cues.

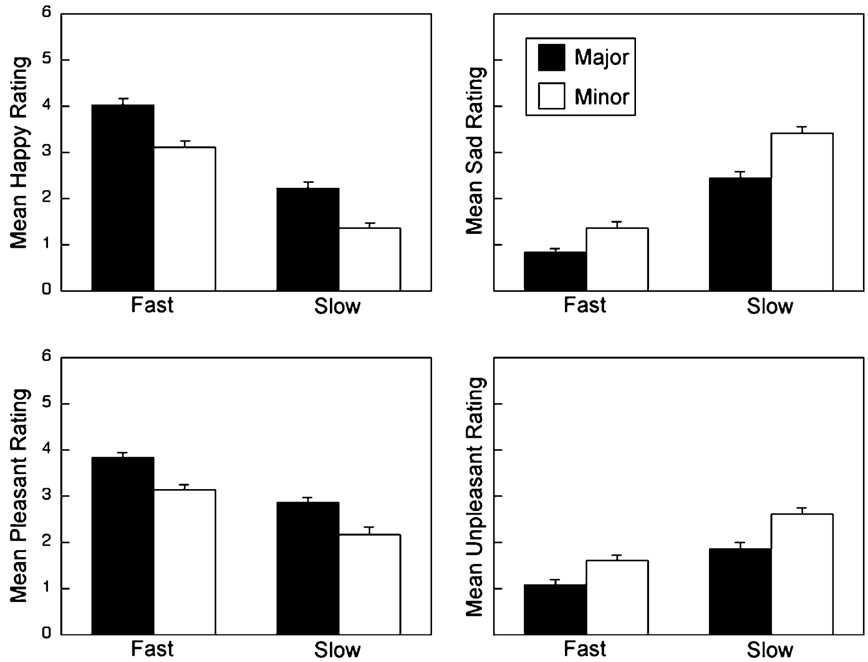

Figure 3. Mean ratings on happy (upper left), sad (upper right), pleasant (lower left), and unpleasant (lower right) scales in Experiment 2. Error bars are standard errors.

Nonetheless, unpleasant feelings in the slow–minor condition ($M = 2.60$) were not significantly higher than pleasant ratings ($M = 2.16$), which again points to ambivalence toward sad sounding music.

Mixed feelings. As in Experiment 1, mixed happy and sad feelings were correlated consistently and positively with sad feelings (39 of 40 listeners, median $r = .34$), $p < .0001$, but not with the other three pure feelings. Descriptive statistics for mixed ratings are illustrated in Figure 4 (upper). As in Experiment 1, a main effect of tempo indicated that slow tempi evoked relatively high levels of mixed happy and sad feelings, $F(1, 39) = 22.83$, $p < .0001$. The main effect of mode was not significant, but the effect of tempo was qualified by the predicted interaction between mode and tempo, $F(1, 39) = 39.81$, $p < .0001$. Music with conflicting cues (fast–minor and slow–major) evoked higher mixed happy and sad feelings ($M = 1.20$) than music with consistent cues (fast–major and slow–minor, $M = 0.86$). More specifically, minor mode caused greater mixed feelings at fast tempi, $t(39) = 3.91$, $p < .001$, whereas major mode caused greater mixed feelings at slow tempi, $t(39) = 5.04$, $p < .0001$. As in Experiment 1, however, mixed scores for slow–minor music (consistent sad cues) were similar in magnitude to those

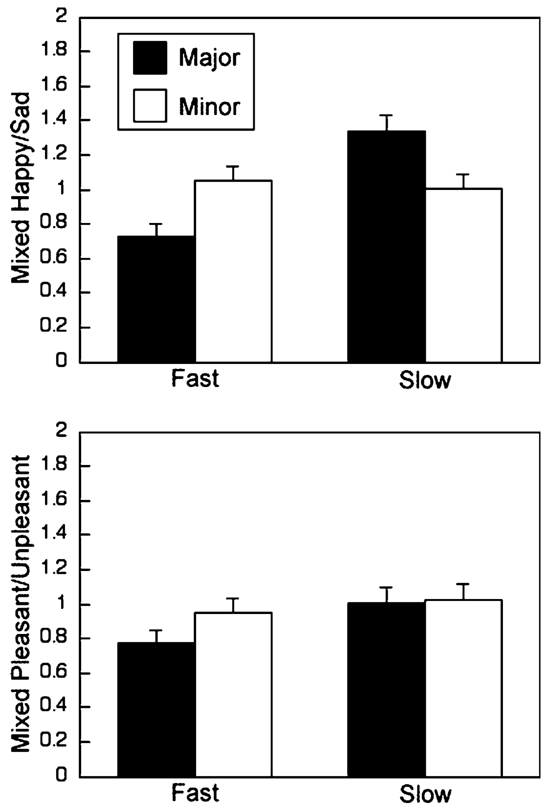

Figure 4. Mean mixed happy–sad (upper) and pleasant–unpleasant (lower) ratings in Experiment 2. Error bars are standard errors. A score of 0 means no mixed responding.

for fast–minor music (inconsistent cues). Although Experiment 2 used a relatively unambiguous response format, it is still an empirical question whether participants used the grid correctly (Russell & Carroll, 1999; Schimmack, 2001). Thus, we again examined whether reports of mixed feelings may have been inflated by bipolar interpretations of the scales. As in Experiment 1, mixed feelings in response to mixed cues were not a consequence of participants who may have interpreted the happy and sad rating scales as bipolar rather than unipolar (see Footnote 1).

Correlations between mixed pleasant and unpleasant feelings and the four pure feelings revealed small but consistent negative associations with happiness (28 of 40 listeners, median $r = -.10$), $p = .005$, and positive associations with sadness (31 of 40, median $r = .21$) and unpleasantness (37 of 40, median $r = .36$), ps $< .005$. Mixed pleasant and unpleasant feelings also tended to be associated positively with mixed happy and sad feelings

(37 of 40 listeners, median $r = .32$), $p < .0001$. Nonetheless, for the typical listener the overlap in variance between the two measures of mixed feelings was only 10%. An ANOVA revealed that greater mixed pleasant and unpleasant feelings were evident for minor over major modes, $F(1, 39) = 5.22$, $p < .05$, and for slow over fast tempi, $F(1, 39) = 7.09$, $p < .05$. As in Experiment 1, there was no interaction between mode and tempo. Rather, ambivalence in terms of pleasant and unpleasant feelings was elevated for sad-sounding excerpts.

Sequential versus simultaneous ratings. We combined the data sets from Experiments 1 and 2 to test further whether the change in response format affected mixed responding. The data were analysed with an ANOVA that had Mode (major, minor) and Tempo (fast, slow) as within-subjects variables, and Response Format (sequential, simultaneous) as a between-subjects variable. Mixed happy and sad ratings were higher for simultaneous (Experiment 2, $M = 1.03$) than for sequential (Experiment 1, $M = 0.68$) responding $F(1, 78) = 12.51$, $p < .001$, but response format did not interact with any other variable or combination of variables. Similarly, mixed pleasant and unpleasant ratings were higher for simultaneous ($M = 0.94$) than for sequential ($M = 0.54$) responding, $F(1, 78) = 15.25$, $p < .001$, but response format did not interact with any other variables. In sum, responding on the grid led to higher mixed feelings in general, but response patterns were otherwise identical across experiments. Presumably, the two-dimensional response space made it less likely for participants to record a response of 0 (by clicking the mouse on one of the axes) than when they used unipolar scales sequentially, although the mean sad rating for fast–major music in Experiment 2 was still less than 1.

GENERAL DISCUSSION

Our principal goal was to test whether mixed happy and sad responding would be particularly likely after listening to music with conflicting happy and sad affective cues. In contrast to previous research (with one exception: Dibben, 2004), ours was the first to allow positive and negative responses to music to vary independently. Results from two experiments provided support for our main hypothesis. In Experiment 1, participants listened to excerpts from instrumental recordings. Mixed happy and sad feelings were stronger after listening to music with inconsistent rather than consistent cues to happiness and sadness. The results of Experiment 2 paralleled those of Experiment 1 and confirmed that response patterns were not simply an artefact of using separate unipolar scales. Our findings are notable for at least three reasons: (1) They confirm that "opposite" feelings, such as happiness and sadness, can be co-activated; (2) They indicate that music can be used to elicit mixed happy and sad responding in predictable ways; and (3) They show that although opposite feelings can be activated simultaneously, they are not completely independent.

In both experiments, fast tempi and major modes were associated with higher happy ratings, whereas slow tempi and minor modes were associated with higher sad ratings. These findings are consistent with previous research on the affective characteristics of fast and slow tempi (Gagnon & Peretz, 2003; Gundlach, 1935; Hevner, 1937; Peretz et al., 1998a; Rigg, 1937) and of major and minor modes (Gagnon & Peretz, 2003; Gerardi & Gerken, 1995; Gregory et al., 1996; Hevner, 1935; Peretz et al., 1998a; Rigg, 1937, 1939; Scherer & Orshinsky, 1977). In several instances, interactions between tempo and mode indicated that consistent affective cues led to higher ratings of negative affect than one would predict from a simple additive combination of the tempo and mode main effects. Evidence of these interactions is not surprising because when tempo and mode cues were inconsistent, one was a cue for the semantically opposite emotion. More importantly, treating happiness and sadness as separate dimensions did not have any impact on associations that have been reported previously with bipolar measures.

Our findings demonstrate that music, like stimuli in other domains (Larsen et al., 2001, 2004; Schimmack, 2001), evokes semantically opposite feelings simultaneously, which is inconsistent with predictions from bipolar models of affect (Russell & Carroll, 1999), but in line with predictions from models that allow positive and negative affect to vary independently (e.g., the evaluative space model; Cacioppo & Berntson, 1994). The results are novel and important because they confirm that music can induce mixed feelings quickly (the excerpts were 30 s) and predictably (when the affective cues of the music conflict). Russell and Carroll (1999) proposed that mixed feelings arise only when individuals are feeling particularly emotional toward a target stimulus, or when they are feeling conflict or indecision. Our results indicate, however, that brief excerpts of music can evoke mixed feelings readily in controlled laboratory contexts. Indeed, if mixed affective cues make the experience richer and more interesting or enjoyable for the music listener, mixed affective responding to music may actually be the norm rather than the exception. Composers are likely to be aware of the aesthetic appeal of ambiguous cues, even if this knowledge is implicit rather than explicit.

Two alternative but not mutually exclusive explanations focus on the object-directedness of affective responses. From these perspectives, mixed feelings may stem from cognitive ambivalence, or they may reflect alternating (rather than simultaneous) positive and negative feelings. The first explanation suggests that mixed emotional responding arose from participants' cognitive awareness of positive and negative characteristics of the stimulus, rather than actual mixed feelings. The second explanation argues that participants shifted their attention between positive and negative aspects of the stimulus, which led to alternating positive and negative feelings. In the present study, mixed feelings were induced through music, and it is extremely unlikely, although not impossible, that listeners were alternating their attention between the tempo and the mode of the musical excerpts. Untrained and moderately trained listeners might indeed focus their attention more on the drums than the harmony (or vice versa) for a given excerpt, but they would not have the analytic skills to match specific variables with specific characteristics (e.g., tempo with drums, mode with harmony), and then go on to link specific levels of these variables with specific feelings (e.g., fast tempo with happiness, minor mode with sadness). Rather, their responses are much more likely to be spontaneous and emotional, with little or no explicit cognitive mediation. We do not doubt that implicit learning of musical conventions and their associations with emotions influenced listeners' emotional reactions and thus their responses. In our view, however, the present results are more easily and parsimoniously explained as a consequence of simultaneous positive and negative feelings.

Our listeners tended to find music they rated as happy as also pleasant, whereas music they rated as sad was deemed to be unpleasant. In both experiments, participants rated fast, major-key excerpts as relatively pleasant, whereas slow, minor-key excerpts were considered relatively unpleasant. In addition, happy and sad ratings were correlated positively with pleasant and unpleasant ratings, respectively. Why, then, do people choose to listen to sad music, which they seem to dislike and experience as unpleasant? With familiar music, simple exposure would be important, as it is with visual art (Cutting, 2003, 2006) and visual stimulus materials (Kunst-Wilson & Zajonc, 1980; Zajonc, 1968). People tend to enjoy music more if they have heard it before (Peretz, Gaudreau, & Bonnel, 1998b; Szpunar, Schellenberg, & Pliner, 2004). In the present series of experiments, however, the musical excerpts were selected to be unfamiliar for the vast majority of our listeners.

One possibility is that music, in general, is a relatively pleasant stimulus because of its aesthetic appeal regardless of its affective content. Thus, sad music would be by nature "mixed" because it has both negative (sadness) and positive (aesthetic appeal) components. In line with this view, mixed feelings were elevated for stimuli with sad cues (particularly for slow tempo), and sad feelings were correlated with mixed feelings. Moreover, associations between sadness and unpleasantness were smaller than associations between happiness and pleasantness, and mean pleasant and unpleasant ratings did not differ for the saddest sounding (slow–minor) music. In other words, the experimental procedures may have evoked mixed feelings in two distinct ways. In the intended way, mixed musical cues to happiness and sadness from the tempo and mode manipulations led to mixed happy and sad responding. In another, largely unintended way, sad but enjoyable music led to very general mixed positive and negative responding. Mixed feelings may also have stemmed from a combination of relatively happy feelings when participants entered the experiment, and relatively sad feelings induced by some of the sad sounding music, leading to positive and negative co-activation (Schimmack, 2001). Future research could examine whether pre-existing feelings and emotional states moderate or interact with music-induced feelings. For listeners who are feeling sad, music with mixed affective cues might be particularly appealing because the sad cue (e.g., slow tempo) seems to acknowledge how they feel, while the happy cue (e.g., major mode) makes their feelings of sadness less painful by eliciting concurrent pleasure.

Turning now to the issue of independence between opposite emotions, the findings revealed that happy and sad ratings were negatively correlated (as were pleasant and unpleasant ratings). At first glance, these correlations might imply that happy and sad rating scales were measuring the same bipolar happy–sad dimension. But the bipolar perspective actually posits that when one feels happiness, one does not feel sadness, and vice versa (Diener & Iran-Nejad, 1986; Russell & Carroll, 1999; Schimmack, 2001). Thus, when ratings are greater than zero for one feeling (e.g., happiness), they should approximate zero on the other (e.g., sadness). These types of response patterns would lead to correlations that could vary in magnitude from very weak to very strong, depending on the stimulus set (Schimmack, 2001). In other words, correlations are not particularly useful at distinguishing between bipolar and two-dimensional models. Nonetheless, negative correlations confirmed that ratings of "opposite" feelings in the present investigation tended to be activated reciprocally. Consequently, they were never high concurrently, as demonstrated by relatively low MIN scores. At the same time, the MIN ratings used in the present study provided clear evidence of mixed feelings and at least partial independence between positive and negative responding, as they have in previous studies (Larsen et al., 2004; Schimmack, 2001). These response patterns are in line with Schimmack's (2001) view that the activation of one affective response mitigates but does not eliminate activation of its "opposite" response.

Russell and Carroll (1999) expressed concerns about the use of unipolar scales, their potential for ambiguity, and the possibility that reports of mixed feelings are a consequence of ambiguous response formats. We investigated this possibility (see Footnote 1) and found no evidence in line with their view. Rather, mixed feelings in response to music with mixed cues were evident among participants who obviously treated the scales as unipolar. Although Russell and Carroll claimed that unipolar scales are unambiguous only when they require a two-step response (e.g., Step 1: Do you feel happy? Step 2: If yes, how happy?), other studies show that a single rating is functionally equivalent when participants are properly instructed about the nature of the response format (Schimmack, 2001, 2005; Schimmack & Diener, 1997). In the present investigation, we provided clear instructions before listeners began to make their ratings.

In sum, our results confirm that listening to music elicits mixed feelings and that it does so to a greater degree when the affective cues of the music conflict. In fact, music may be an ideal stimulus to elicit mixed happy and sad feelings. Several aspects of music that elicit affective responding lie along bipolar dimensions (e.g., tempo, mode) that vary independently, which allow composers to write music that suggests conflicting affective states. Moreover, pleasant but sad sounding music may in general evoke mixed responding for listeners. Although co-activation of positive and negative affect might be infrequent in response to mundane events, it could be relatively common in response to music. Future research could examine other stimulus contexts—musical and otherwise—that are likely to elicit mixed affective responding. The study of aesthetically pleasing works of art that portray negative events could be particularly fruitful in this regard.

Our results also raise the possibility of reconciling bipolar and two-dimensional models of affective valence. Bipolarity may be a viable model of affective experiences for single stimulus dimensions or appraisals (see Reisenzein, 1992). In the present context, both tempo and mode had bipolar effects on happiness and sadness. In general, then, single-event outcomes may be appraised as positive or negative (e.g., winning a prize is positive and elicits happiness, not sadness). In everyday life, however, many stimuli are complex and many events are associated with more than one outcome. Our demonstration of mixed feelings indicates that the affect system responds separately to each dimension and does not integrate affective information across dimensions. This separability across dimensions may allow people to use their affective experiences to evaluate the consequences of multiple but different event outcomes. In other words, folk psychology may be correct to consider *happy* and *sad* as bipolar opposites while allowing for *ambivalence* (i.e., mixed feelings) at the same time. Whereas bipolarity characterises responses to a single stimulus dimensions, mixed feelings appear to be elicited by complex stimuli with multiple but conflicting affective cues.

Manuscript received July 2006
Revised manuscript received 12 February 2007
Manuscript accepted 10 April 2007
First published online 12 September 2007

REFERENCES

Arnold, M. B. (1960). *Emotion and personality: Vol. 1. Psychological aspects.* New York: Columbia University Press.

Balkwill, L.-L., & Thompson, W. F. (1999). A cross-cultural investigation of the perception of emotion in music: Psychophysical and cultural cues. *Music Perception*, *17*, 43–64.

Balkwill, L.-L., Thompson, W. F., & Matsunaga, R. (2004). Recognition of emotion in Japanese, Western, and Hindustani music by Japanese listeners. *Japanese Psychological Research*, *46*, 337–349.

Cacioppo, J. T., & Berntson, G. G. (1994). Relationship between attitudes and evaluative space: A critical review, with emphasis on the separability of positive and negative substrates. *Psychological Bulletin*, *115*, 401–423.

Clore, G. L., Ortony, A., & Foss, M. A. (1987). The psychological foundations of the affective lexicon. *Journal of Personality and Social Psychology*, *53*, 751–766.

Crowder, R. G. (1984). Perception of the major/minor distinction: I. Historical and theoretical foundations. *Psychomusicology*, *4*, 3–12.

Cunningham, J. G., & Sterling, R. S. (1988). Developmental change in the understanding of affective meaning in music. *Motivation and Emotion*, *12*, 399–413.

Cutting, J. E. (2003). Gustave Caillebotte, French Impressionism, and mere exposure. *Psychonomic Bulletin & Review*, *10*, 319–343.

Cutting, J. E. (2006). *Impressionism and its canon*. Lanham, MD: University Press of America.

Dalla Bella, S., Peretz, I., Rousseau, L., & Gosselin, N. (2001). A developmental study of the affective value of tempo and mode in music. *Cognition*, *80*, B1–B10.

Dibben, N. (2004). The role of peripheral feedback in emotional experience with music. *Music Perception*, *22*, 79–115.

Diener, E., & Iran-Nejad, A. (1986). The relationship in experience between various types of affect. *Journal of Personality and Social Psychology*, *50*, 1031–1038.

Frijda, N. H. (1993). Moods, emotion episodes, and emotions. In M. Lewis & J. M. Haviland (Eds.), *Handbook of emotions* (pp. 381–403). New York: Guilford Press.

Gagnon, L., & Peretz, I. (2003). Mode and tempo relative contributions to "happy–sad" judgments in equitone melodies. *Cognition and Emotion*, *17*, 25–40.

Gerardi, G. M., & Gerken, L. (1995). The development of affective response to modality and melodic contour. *Music Perception*, *12*, 279–290.

Gregory, A., Worall, L., & Sarge, A. (1996). The development of emotional responses to music in young children. *Motivation and Emotion*, *20*, 341–349.

Gundlach, R. H. (1935). Factors determining the characterization of musical phrases. *American Journal of Psychology*, *47*, 624–643.

Hemenover, S. H., & Schimmack, U. (2007). That's disgusting! . . . , But very amusing: Mixed feelings of amusement and disgust. *Cognition and Emotion, 21*, 1102–1113.

Hevner, K. (1935). The affective character of the major and minor modes in music. *American Journal of Psychology*, *47*, 103–118.

Hevner, K. (1937). The affective value of pitch and tempo in music. *American Journal of Psychology*, *49*, 621–630.

Husain, G., Thompson, W. F., & Schellenberg, E. G. (2002). Effects of musical tempo and mode on arousal, mood, and spatial abilities. *Music Perception*, *20*, 151–171.

Juslin, P. N. (1997). Emotional communication in music performance: A functionalist perspective and some data. *Music Perception*, *14*, 383–418.

Kaplan, K. J. (1972). On the ambivalence–indifference problem in attitude theory and measurement. *Psychological Bulletin*, *77*, 361–372.

Kastner, M. P., & Crowder, R. G. (1990). Perception of the major/minor distinction: IV. Emotional connotations in young children. *Music Perception*, *8*, 189–202.

Kellogg, C. E. (1915). Alternation and inference of feelings. *Psychology Monographs*, *18*, 1–94.

Krumhansl, C. L. (1997). An exploratory study of musical emotions and psychophysiology. *Canadian Journal of Experimental Psychology*, *51*, 336–353.

Kunst-Wilson, W. R., & Zajonc, R. B. (1980). Affective discrimination of stimuli that cannot be recognized. *Science*, *207*, 557–558.

Larsen, J. T., McGraw, A. P., & Cacioppo, J. T. (2001). Can people feel happy and sad at the same time? *Journal of Personality and Social Psychology*, *81*, 684–696.

Larsen, J. T., McGraw, A. P., Mellers, B. A., & Cacioppo, J. T. (2004). The agony of victory and thrill of defeat: Mixed emotional reactions to disappointing wins and relieving losses. *Psychological Science*, *15*, 325–330.

Larsen, J. T., Norris, C. J., & Cacioppo, J. T. (2007). *The evaluative space grid: A single-item measure of positive and negative reactions.* Manuscript submitted for publication.

Ortony, A., Clore, G. L., & Collins, A. (1988). *The cognitive structure of emotions.* Cambridge, UK: Cambridge University Press.

Peretz, I., Gagnon, L., & Bouchard, B. (1998a). Music and emotion: Perceptual determinants, immediacy, and isolation after brain damage. *Cognition*, *8*, 111–141.

Peretz, I., Gaudreau, D., & Bonnel, A. M. (1998b). Exposure effects on music preferences and recognition. *Memory & Cognition*, *15*, 379–388.

Peretz, I., & Zatorre, R. J. (2005). Brain organization for music processing. *Annual Review of Psychology*, *56*, 89–114.

Reisenzein, R. (1992). A structuralist reconstruction of Wundt's three-dimensional theory of emotion. In H. Westmeyer (Ed.), *The structuralist program in psychology: Foundations and applications* (pp. 141–189). Ashland, OH: Hogrefe & Huber.

Reisenzein, R. (1994). Pleasure-arousal theory and the intensity of emotions. *Journal of Personality & Social Psychology*, *67*, 525–539.

Reisenzein, R. (1995). On Oatley and Johnson-Laird's theory of emotion and hierarchical structures in the affective lexicon. *Cognition and Emotion*, *9*, 383–416.

Reisenzein, R., & Schönpflug, W. (1992). Stumpf's cognitive-evaluative theory of emotion. *American Psychologist*, *47*, 34–45.

Rigg, M. (1937). An experiment to determine how accurately college students can interpret intended meaning of musical compositions. *Journal of Experimental Psychology*, *21*, 223–229.

Rigg, M. (1939). What features of a musical phrase have emotional suggestiveness? *Bulletin of the Oklahoma Agricultural and Mechanical College*, *36*, 1–38.

Rigg, M. (1940). Speed as a determiner of musical mood. *Journal of Experimental Psychology*, *27*, 566–571.

Robazza, C., Macaluso, C., & D'Urso, V. (1994). Emotional reactions to music by gender, age, and expertise. *Perceptual and Motor Skills*, *79*, 939–944.

Russell, J. A., & Carroll, J. M. (1999). On the bipolarity of positive and negative affect. *Psychological Bulletin*, *125*, 3–30.

Schellenberg, E. G., Nakata, T., Hunter, P. G., & Tamoto, S. (2007). Exposure to music and cognitive performance: Tests of children and adults. *Psychology of Music*, *35*, 5–19.

Scherer, K. R., & Oshinsky, J. S. (1977). Cue utilization in emotion attribution from auditory stimuli. *Motivation and Emotion*, *1*, 331–346.

Schimmack, U. (2001). Pleasure, displeasure, and mixed feelings: Are semantic opposites mutually exclusive? *Cognition and Emotion*, *15*, 81–97.

Schimmack, U. (2005). Response latencies of pleasure and displeasure ratings: Further evidence for mixed feelings. *Cognition and Emotion*, *19*, 671–691.

Schimmack, U., & Colcombe, S. (in press). Eliciting mixed feelings with the paired-picture paradigm: A tribute to Kellogg (1915). *Cognition and Emotion*.

Schimmack, U., & Crites, S. L. (2005). The structure of affect. In D. Alberacin, B. T. Johnson, & M. P. Zanna (Eds.), *The handbook of attitudes* (pp. 397–435). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Schimmack, U., & Diener, E. (1997). Affect intensity: Separating intensity and frequency in repeatedly measured affect. *Journal of Personality and Social Psychology*, *73*, 1313–1329.

Schimmack, U., & Hartmann, K. (1997). Individual differences in the memory representation of emotional episodes: Exploring the cognitive processes in repression. *Journal of Personality and Social Psychology*, *73*, 1064–1079.

Sloboda, J. A. (1992). Empirical studies of emotional response to music. In M. R. Jones & S. Holleran (Eds.), *Cognitive bases of musical communication* (pp. 33–46). Washington, DC: American Psychological Association.

Szpunar, K. K., Schellenberg, E. G., & Pliner, P. (2004). Liking and memory for musical stimuli as a function of exposure. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, *30*, 370–381.

Terwogt, M. M., & Van Grinsven, F. (1991). Musical expression of moodstates. *Psychology of Music*, *19*, 99–109.

Thompson, W. F., Schellenberg, E. G., & Husain, G. (2001). Arousal, mood, and the Mozart effect. *Psychological Science*, *12*, 248–251.

Västfjäll, D. (2001/2002). Emotion induction through music: A review of the musical mood induction procedure. *Musicae Scientiae, Special Issue*, 173–211.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Developmental and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070.

Webster, G. D., & Weir, C. G. (2005). Perceptions of emotion in music: Interactive effects of mode, texture, and tempo. *Motivation and Emotion*, *29*, 19–39.

Wedin, L. (1972). A multidimensional study of perceptual-emotional qualities in music. *Scandinavian Journal of Psychology*, *13*, 241–257.

Wundt, W. (1896). *Grundrisse der psychologie* [Outlines of psychology]. Leipzig, Germany: Engelmann.

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology Monographs*, *9*(2, Pt. 2), 1–27.

APPENDIX

Recordings from which stimuli were excerpted in Experiments 1 and 2

Tempo	*Mode*	*Title*	*Artist/Composer*	*Album*	*Start time*
Fast	Major	Loyin Loyin	Babatunde Olatunji	Best of Both Worlds: The Rykodisk World Music Sampler	0:24
Fast	Minor	Sera	Ali Farka Toure with Ry Cooder	Talking Timbuktu	0:29
Fast	Major	Santiago	Zafra	Caliente: Musica Cubana	0:04
Fast	Minor	El monte	Zafra	Caliente: Musica Cubana	0:04
Fast	Major	Etude in G major	Chopin	Classikon: Chopin: Mazurkas—Waltzes—Scherzi—Polonaise No. 6—Ballade No. 1	0:01
Fast	Minor	Valse n 14 in E minor	Chopin	Classikon: Chopin: Mazurkas—Waltzes—Scherzi—Polonaise No. 6—Ballade No. 1	0:08
Fast	Major	Lukey	Great Big Sea	Up	1:25
Fast	Minor	Billy Peddle	Great Big Sea	Up	0:13
Fast	Major	Concerto for Piano and Orchestra No. 2 in F major, 1st movement	Shostakovich	Concerto For Piano and Trumpet No .1, Piano Concerto No. 2, Trio No. 2	0:33
Fast	Minor	Concerto for Piano and Trumpet No. 1 in C minor, 1st movement	Shostakovich	Concerto For Piano and Trumpet No .1, Piano Concerto No. 2, Trio No. 2	2:43
Fast	Major	Land of …	St. Germain	Tourist	0:57
Fast	Minor	Latin Note	St. Germain	Tourist	0:15
Fast	Major	6th Symphony, 1st movement	Beethoven	On A Classical Note: Beethoven Symphony No. 5, Symphony No. 6—"Pastoral"	3:08
Slow	Major	6th Symphony, 2nd movement	Beethoven	On A Classical Note: Beethoven Symphony No. 5, Symphony No. 6—"Pastoral"	1:12
Fast	Major	The Legend Spreads	James Horner	Braveheart *Soundtrack*	0:10
Slow	Major	Main Title	James Horner	Braveheart *Soundtrack*	0:18
Fast	Major	In The Mood	Glenn Miller	His Greatest Hits & Finest Performances	0:00
Slow	Major	Moonlight Serenade	Glenn Miller	His Greatest Hits & Finest Performances	0:00

APPENDIX (*Continued*)

Tempo	*Mode*	*Title*	*Artist/Composer*	*Album*	*Start time*
Fast	Major	Concerto (Sinfonia) in D Major 1st movement	Vivaldi	Famous Concerti for Two Trumpets, Oboe, Violins, Cello, Mandolins	0:01
Slow	Major	Cello Concerto in G major 2nd movement	Vivaldi	Famous Concerti for Two Trumpets, Oboe, Violins, Cello, Mandolins	0:37
Fast	Major	Friday I'm in Love	The Cure	Wish	0:00
Slow	Major	A Letter to Elise	The Cure	Wish	0:01
Fast	Major	(Manifest)	The Weakerthans	Reconstruction Site	1:08
Slow	Major	(Past-Due)	The Weakerthans	Reconstruction Site	1:15
Slow	Minor	Le Moulin	Yann Tiersen	Amelie Soundtrack	0:29
Fast	Minor	La Noyee	Yann Tiersen	Amelie Soundtrack	0:08
Slow	Minor	I Remember Clifford	Benny Golson	Sunday Morning Jazz	0:23
Fast	Minor	Body and Soul	Chet Baker	Jazz After Dark	2:14
Slow	Minor	Rabbit in your Headlights (3D Mix Reverse Light)	UNKLE	Rabbit In Your Headlights	6:24
Fast	Minor	Organ Donor	DJ Shadow	Psyence Fiction	0:11
Slow	Minor	Like Spinning Plates	Radiohead	I Might be Wrong/Live Recordings	3:02
Fast	Minor	There There	Radiohead	Hail to the Thief	0:12
Slow	Minor	Tanguera 1	Silvanan Deluigi	Tanguera: Woman in Tango	0:13
Fast	Minor	Quien hubera dicho	Silvanan Deluigi	Tanguera: Woman in Tango	1:54
Slow	Minor	Icicle	Tori Amos	Under the Pink	0:18
Fast	Minor	Cornflake Girl	Tori Amos	Under the Pink	2:25
Slow	Minor	Herzlich tut mich Verlangen	Bach	Great Organ Works	0:00
Slow	Major	Wachet auf, ruft uns die Stimme	Bach	Great Organ Works	0:00
Slow	Minor	Fake Plastic Trees	Christopher O'Riley	True Love Waits	0:04
Slow	Major	Exit Music (For a Film)	Christopher O'Riley	True Love Waits	0:52
Slow	Minor	Last Dance	The Cure	Disintegration	0:00
Slow	Major	Plainsong	The Cure	Disintegration	1:29
Slow	Minor	Piano Concerto 23 in A, Adagio	Mozart	Mozart for Meditation	0:53

APPENDIX (*Continued*)

Tempo	*Mode*	*Title*	*Artist/Composer*	*Album*	*Start time*
Slow	Major	Concerto for Flute and Harp in C	Mozart	Mozart for Meditation	0:38
Slow	Minor	Untitled 5	Sigur Ros	()	1:04
Slow	Major	Untitled 4	Sigur Ros	()	0:48
Slow	Minor	Weather Storm	Massive Attack	Protection	0:09
Slow	Major	Protection	Massive Attack	Protection	5:31