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BRIEF REPORT

It's A Bittersweet Symphony: Simultaneously Mixed Emotional Responses to Music With Conflicting Cues

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Some evidence indicates that emotional reactions to music can be organized along a bipolar valence dimension ranging from pleasant states (e.g., happiness) to unpleasant states (e.g., sadness), but songs can contain some cues that elicit happiness (e.g., fast tempos) and others that elicit sadness (e.g., minor modes). Some models of emotion contend that valence is a basic building block of emotional experience, which implies that songs with conflicting cues cannot make people feel happy and sad at the same time. Other models contend that positivity and negativity are separable in experience, which implies that music with conflicting cues might elicit simultaneously mixed emotions of happiness and sadness. Hunter, Schellenberg, and Schimmack (2008) tested these possibilities by having subjects report their happiness and sadness after listening to music with conflicting cues (e.g., fast songs in minor modes) and consistent cues (e.g., fast songs in major modes). Results indicated that music with conflicting cues elicited mixed emotions, but it remains unclear whether subjects simultaneously felt happy and sad or merely vacillated between happiness and sadness. To examine these possibilities, we had subjects press one button whenever they felt happy and another button whenever they felt sad as they listened to songs with conflicting and consistent cues. Results revealed that subjects spent more time simultaneously pressing both buttons during songs with conflicting, as opposed to consistent, cues. These findings indicate that songs with conflicting cues can simultaneously elicit happiness and sadness and that positivity and negativity are separable in experience.

Keywords: mixed emotions, music, happiness, sadness, bittersweet

Despite having no apparent adaptive significance (Hauser & McDermott, 2003), music can elicit such disparate emotions as joy, pride, agitation, serenity, and wonder (Zentner, Grandjean, & Scherer, 2008). One way to make sense of this disparate array of emotions is to organize them into some finite, parsimonious number of dimensions (e.g., Bigand, Vieillard, Madurell, Marozeau, & Dacquet, 2005). The challenge then becomes identifying what those dimensions are. Our goal is to shed light on the structure of emotional reactions to music by investigating whether certain types of music can elicit simultaneously mixed emotions (i.e., opposite-valence emotions) of happiness and sadness.

Theoretical Perspectives

Bigand et al. (2005) investigated the structure of emotional reactions to music by asking subjects to sort 27 pieces of Western classical music into groups of pieces that made them experience similar emotions. Multidimensional scaling of the resulting co-occurrence matrix revealed that the 27 pieces' emotional signatures fell in a circular pattern within a two-dimensional space. One dimension was a bipolar valence dimension: some songs elicited positive emotions (e.g., happiness) and others elicited negative emotions (e.g., sadness). The second dimension was an orthogonal arousal dimension: some songs elicited highly arousing emotions (e.g., fear) and others elicited more sedate emotions (e.g., serenity).

Bigand et al.'s (2005) results extend a long tradition of theory and research indicating that valence and arousal represent basic building blocks not only of emotional reactions to music in particular (e.g., Wedin, 1972), but of emotional experience in general (Bain, 1859; L. F. Barrett, 2006; Wundt, 1896; Russell, 1980). Though parsimonious, the notion that the bipolar valence dimension is a basic building block of emotional reactions may not fully capture the complexity of emotional reactions to music. Consider the finding that music can elicit nostalgia (Janata, Tomic, & Rakowski, 2007; Zentner et al., 2008), which has bittersweet pleasant and unpleasant aspects (Wildschut, Sedikides, Arndt, & Routledge, 2006). The only way to map songs that elicit such bittersweet emotions onto the bipolar valence dimension would be to place them near the middle of the dimension, which would make them indistinguishable from songs that elicit neither positive nor negative (i.e., neutral) emotions.

Another theoretical approach to the structure of emotional experience may help distinguish songs that elicit mixed emotions from those that elicit neutral emotions. This approach extends as

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far back as Socrates (Plato, trans. 1975), Hume (1739/2000), and Ebbinghaus (1902; cited in Wolgemuth, 1919) and has culminated in Cacioppo and Berntson's (1994) evaluative space model, which holds that the positive and negative substrates underlying the bipolar valence dimension are separable. In addition to making sense of the finding that music can elicit nostalgia, the evaluative space model allows for the possibility that a song can elicit mixed emotions of happiness and sadness at the same time. In contrast, if valence is a basic building block of emotional experience, happiness and sadness should be mutually exclusive (Russell & Carroll, 1999; see also, Bain, 1859). Thus, the question of whether music can make people feel happy and sad at the same time can shed light on the structure of emotional reactions to music.

Available Evidence

Some evidence indicates that music can elicit mixed emotions of happiness and sadness. In one study, college students indicated that listening to the pop songs from their youth that made them nostalgic also made them feel mixed emotions of happiness and sadness (F. S. Barrett et al., 2010). In other studies, Hunter, Schellenberg, and Schimmack (2008, 2010) had subjects listen to songs that varied in terms of *tempo*, which refers to number of beats per minute, and *mode*, which refers to different patterns of pitch changes. Whereas fast tempos and major modes elicit happiness, slow tempos and minor modes elicit sadness (e.g., Webster & Weir, 2005). Hunter et al.'s goal was to investigate emotional reactions to songs with conflicting cues (i.e., fast songs in minor modes; slow songs in major modes). After each song, Hunter et al. asked subjects to rate both how happy they felt and how sad they felt. Consistent with the contention that people can feel happy and sad at the same time, subjects indicated that music with conflicting cues elicited more mixed emotions than music with consistent cues. In addition, slow songs in minor modes elicited substantial levels of mixed emotions, perhaps because slow songs in minor modes, like fast songs in major modes, contain other enjoyable properties found in virtually all music, such as rhythm, melody, and consonance (Huron, 2006).

There is an alternative interpretation for evidence that nostalgic songs and songs with conflicting cues can elicit mixed emotions of happiness and sadness. Emotions can change quickly (Ekman, 1992) and emotions elicited by music may change especially quickly because music is a dynamic, ever-changing stimulus (e.g., Krumhansl, 1997). Moreover, ambivalent states can be unpleasant (Cacioppo & Berntson, 1994), particularly for individuals in western cultures (e.g., Goetz, Spencer-Rodgers, & Peng, 2008). This raises the possibility that subjects simply vacillated between happiness and sadness during nostalgic songs and songs with conflicting cues and then, when prompted, reported summaries of their emotions rather than how they were feeling at that very moment (F. S. Barrett et al., 2010; L. F. Barrett & Bliss-Moreau, 2009; Larsen, McGraw, Mellers, & Cacioppo, 2004). If subjects merely vacillated between happiness and sadness, there is little need to conclude that positivity and negativity are separable in the experience of emotional reactions to music. Rather, it would make sense to retain the more parsimonious notion that valence is a basic building block of emotional reactions to music.

The Current Research

We examined the structure of emotional reactions to music by providing a stronger test of whether music with conflicting cues leads people to experience simultaneously mixed emotions of happiness and sadness. We did so by collecting continuous online measures of happiness and sadness, rather than static retrospective measures, while subjects listened to music with consistent and conflicting cues. Specifically, we asked them to complete Larsen et al.'s (2004) button press measures. The button press measures allow subjects to make continuous online ratings of emotion by pressing the left button of a computer mouse whenever they feel happy, the right button whenever they feel sad, neither button if they feel neither happy nor sad, and both buttons if they feel both happy and sad simultaneously. If positivity and negativity are separable in experience, Hunter et al.'s (2008, 2010) results make it plausible that (a) music with conflicting cues would elicit more simultaneously mixed emotions than music with consistent cues, and (b) slow songs in minor modes would also elicit substantial levels of simultaneously mixed emotions.

Method

Subjects

Subjects were 21 introductory psychology students (10 men; 48%) who were compensated with course credit.

Materials

Subjects listened to Hunter et al.'s (2008) 30-s instrumental musical clips. The 48 clips came from a variety of genres and comprised 12 fast songs in major modes (e.g., Glen Miller's *In the Mood*), 12 slow songs in major modes (e.g., Beethoven's *6th Symphony*), 12 fast songs in minor modes (e.g., Yann Tiersen's *La Noyee*), and 12 slow songs in minor modes (e.g., The Cure's *Last Dance*). For a complete list, see Hunter et al., (2008). Subjects listened to the songs over headphones while sitting at computers.

Procedure

The experimenter greeted subjects and, to disguise our interest in mixed emotions, told them that they would complete an experiment involving memory for music. To substantiate the cover story, the experimenter emphasized that it was important for subjects to pay attention to each clip because they would be asked to listen to a second series of clips and indicate which ones had been played during the initial series. (There was no second series.) The experimenter then told subjects that emotions can affect memory, so it was important to know how they felt during each song. In order to keep track of their emotions during each clip, subjects were asked to complete Larsen et al.'s (2004) button press measures by pressing the left button of a computer mouse whenever they felt happy, the right button whenever they felt sad, neither button if they felt neither happy nor sad, and both buttons if they felt both happy and sad simultaneously. Each subject then completed the button press measures while listening to the 48 songs in unique random orders.

Results

Happiness and Sadness

We expected to replicate prior evidence that fast songs and songs in major modes elicit more happiness than slow music and music in minor modes, respectively, but less sadness (e.g., Hunter et al., 2008). To examine the patterns of emotions evoked by the songs, we calculated the proportion of time that subjects reported happiness and the proportion of time they spent reporting sadness while listening to the four types of music (see Figure 1). Note that these values do not represent how long it took subjects to report a given emotion (i.e., latencies). Rather, they represent how long people reported that emotion.

We submitted the happiness and sadness data to separate 2 (tempo: fast, slow) × 2 (mode: major, minor) within-subjects ANOVAs. As expected, both ANOVAs revealed main effects of tempo. Subjects spent more time reporting happiness during fast songs ($M = 47.4\%$, $SD = 25.2\%$) than slow songs ($M = 36.1\%$, $SD = 24.5\%$), $F(1, 20) = 31.86$, $p < .001$, partial $\eta^2 = .61$, but spent less time reporting sadness during fast songs ($M = 15.8\%$, $SD = 11.5\%$) than slow songs ($M = 26.2\%$, $SD = 13.5\%$), $F(1, 20) = 67.08$, $p < .001$, partial $\eta^2 = .77$. As expected, both ANOVAs also revealed main effects of mode. Subjects spent more time reporting happiness during songs in major modes ($M = 55.6\%$, $SD = 29.4\%$) than minor modes ($M = 27.9\%$, $SD = 22.8\%$), $F(1, 20) = 41.58$, $p < .001$, partial $\eta^2 = .68$, but less time reporting sadness during songs in major modes ($M = 8.0\%$, $SD = 6.2\%$) than minor modes ($M = 33.9\%$, $SD = 19.4\%$), $F(1, 20) = 62.15$, $p < .001$, partial $\eta^2 = .76$. In addition, the ANOVA on the sadness data revealed a tempo x mode interaction, $F(1, 20) = 18.74$, $p < .001$, partial $\eta^2 = .48$. Fast songs elicited less sadness than slow songs regardless of mode, but the effect of tempo was stronger for songs in minor modes, $t(20) = 6.68$, $p < .001$, $d = 1.48$, than for songs in major modes, $t(20) = 2.16$, $p = .04$, $d = 0.47$. Taken together, our findings replicate past research on the effects of mode and tempo on happiness and sadness (e.g., Hunter et al., 2008).

Mixed Emotions

Following Larsen et al. (2004), we operationalized the duration of mixed emotions as the amount of time that subjects spent pressing the happy and sad buttons at the same time. These data, which are shown in Figure 2, indicate that people did not report mixed emotions very often. In fact, the average subject spent only 4.9% ($SD = 6.0\%$) of the time reporting mixed emotions. Nonetheless, with the caveat that it is obviously impossible for subjects to spend < 0% of time reporting mixed emotions, this value is significantly > 0%, $t(20) = 3.73$, $p < .001$.

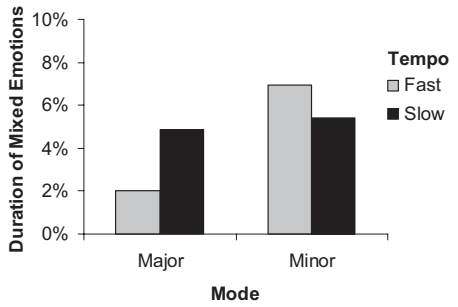

Figure 2. Proportion of time that subjects spent reporting simultaneously mixed emotions (i.e., pressing the happy and sad buttons at the same time) as a function of mode and tempo.

Figure 2 suggests that people spent more time reporting mixed emotions during songs with conflicting cues, as opposed to consistent cues. To investigate this possibility, we submitted the duration of mixed emotions data to a 2 (tempo: fast, slow) × 2 (mode: major, minor) within-subjects ANOVA. The ANOVA revealed a main effect of mode, such that subjects spent more time reporting mixed emotions during songs in minor modes ($M = 6.2\%$, $SD = 8.5\%$) than major modes ($M = 3.5\%$, $SD = 4.1\%$), $F(1, 20) = 4.78$, $p = .04$, partial $\eta^2 = .19$. More important, there was a significant tempo x mode interaction, $F(1, 20) = 5.69$, $p = .03$, partial $\eta^2 = .22$, such that subjects spent more time reporting mixed emotions during songs with conflicting cues ($M = 5.8\%$; $SD = 7.3\%$) than consistent cues ($M = 3.9\%$, $SD = 5.1\%$). One follow-up t test indicated that subjects spent more time reporting mixed emotions in response to slow songs in major modes ($M = 4.9\%$, $SD = 5.9\%$) than fast songs in major modes ($M = 2.0\%$, $SD = 3.3\%$), $t(20) = 2.08$, $p = .05$, $d = 0.45$. Replicating the results of Hunter et al. (2008, 2010), a second t test indicated that subjects did not spend significantly more time reporting simultaneously mixed emotions during fast music in minor modes ($M = 7.0\%$, $SD = 10.9\%$) than during slow music in minor modes ($M = 5.4\%$, $SD = 7.1\%$), $t(20) = 1.18$, $p = .25$, $d = 0.26$.

The duration of mixed emotions data indicate that people spent more time experiencing mixed emotions during songs with con-

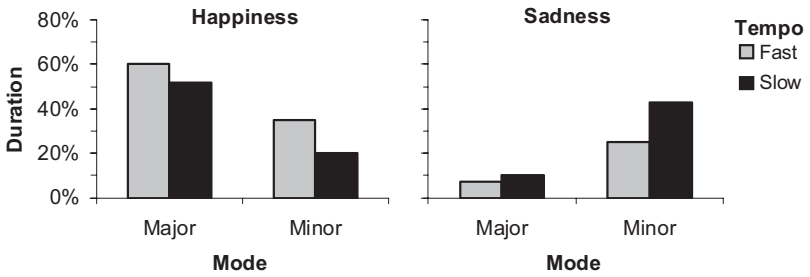

Figure 1. Proportion of time that subjects spent reporting happiness (i.e., pressing the happy button; left panel) and sadness (i.e., pressing the sad button; right panel) as a function of mode and tempo.

flicting cues, but it is possible that subjects only briefly and unintentionally pressed both buttons at the same time during songs with conflicting cues as they vacillated between feelings of happiness and sadness (see Larsen et al., 2004). The finding that reports of mixed emotions had a median duration of 1.8 s suggests otherwise. Nonetheless, fully 43% (i.e., 105 out of 244) of the reports of mixed emotions were < 1 s, so we conducted additional analyses after removing those reports that were < 1 s (see Larsen & McGraw, 2011). A 2 (tempo: fast, slow) $\times$ 2 (mode: major, minor) within-subjects ANOVA indicated that removing the brief reports had no influence on the statistical significance or magnitude of the tempo x mode interaction, $F(1, 20) = 5.64$, $p = .03$, partial $\eta^2 = .22$. Some reports of mixed emotions presumably were unintentional, but these results indicate that subjects spent more time intentionally reporting mixed emotions during songs with conflicting cues than during songs with consistent cues.

Discussion

Hunter et al. (2008, 2010) found that subjects reported more mixed emotions after listening to songs with conflicting cues (e.g., slow songs in major modes) than after listening to songs with consistent cues (e.g., fast songs in major modes). Because emotional reactions to music can be fleeting (Krumhansl, 1997), drawing firm conclusions about whether songs with conflicting cues lead people to vacillate between happiness and sadness or to experience simultaneously mixed emotions requires measuring happiness and sadness *while*, rather than *after*, subjects listen to such music. We measured happiness and sadness while subjects listened to music by asking them to press one button whenever they felt happy and another button whenever they felt sad. Results indicated that subjects spent more time reporting simultaneously mixed emotions (i.e., simultaneously pressing both buttons) during songs with conflicting cues than during songs with consistent cues.

These results shed light on the structure of emotional reactions to music and the structure of emotion more generally. The finding that feelings of happiness and sadness were nearly always mutually exclusive is consistent with evidence that it is useful to characterize emotional reactions to music as falling along a bipolar valence dimension (e.g., Bigand et al., 2005). It is also consistent with Cacioppo and Berntson's (1994) contention that ambivalent states tend to be infrequent and unstable. Yet reports of happiness and sadness were not always mutually exclusive: the average subject spent nearly 5% of the time reporting simultaneously mixed emotions. It is unlikely that these reports of mixed emotions were erroneous (e.g., due to inattention), because they did not occur at random during the series of songs. To the contrary, people systematically spent more time reporting mixed emotions during songs with conflicting, as opposed to consistent, cues. Taken together with evidence that people report more intense mixed emotions after listening to songs with conflicting cues (Hunter et al., 2008) and nostalgic songs (F. S. Barrett et al., 2010), our findings indicate that emotional reactions to music cannot always be organized along a bipolar valence dimension. In so doing, our data shed light on the age-old question of the nature of valence. Specifically, our findings are inconsistent with the contention that valence is a basic building block of emotional experience (e.g., Bain, 1859; L. F. Barrett, 2006), but consistent with the competing contention that positivity and negativity are separable in experience (e.g., Ebbinghaus, 1902; Cacioppo & Berntson, 1994).

Remaining Questions

One possibility is that subjects used the button press measures to report their perceptions of whether the songs expressed happiness and sadness rather than their actual experience of happiness and sadness (see Konečni, 2008). This is an important point because theories that preclude the experience of mixed emotions need not preclude people from perceiving stimuli as having ambivalent pleasant and unpleasant aspects (Russell, 2003). Some evidence indicates that people can distinguish between their perceptions of whether music expresses emotion and their own emotional reactions to the music. Hunter et al. (2010) asked subjects to listen to 32 30-s pieces composed by Bach that varied in mode and tempo. For the median subject, the correlation between one's perceptions of the extent to which a song expressed mixed emotions of happiness and sadness and one's own experience of mixed emotions of happiness and sadness was only .55. Moreover, as one would expect, perceptions of mixed emotions mediated the effect of conflicting cues on the experience of mixed emotions. In contrast, the experience of mixed emotions did not mediate the effect of conflicting cues on perceptions of mixed emotions. Thus, people's ratings of their emotional reactions to music are distinct from, but systematically related to, their ratings of the emotions expressed by the music.

Our findings indicate that music with conflicting cues can elicit mixed emotions, but our use of closed-ended measures makes it difficult to definitively conclude that they elicited mixed emotions of happiness and sadness in particular. It is possible that people pressed the happy button to report positive emotions other than happiness and the sad button to report negative emotions other than sadness. Larsen and McGraw (2011) addressed this possibility in their studies of emotional reactions to bittersweet film scenes. Subjects in studies involving the button press measures spent more time reporting simultaneously mixed emotions (i.e., pressing both the happy and sad buttons) during bittersweet scenes from the tragicomic film *Life Is Beautiful* than during control scenes from that film. Subjects in subsequent studies were asked to describe their emotions in response to open-ended questions (e.g., "How do you feel right now?"). These subjects were more likely to spontaneously report mixed emotions of happiness and sadness after watching the bittersweet scenes, which provided convergent validity for evidence from the button press studies that the bittersweet scenes elicit simultaneously mixed emotions of happiness and sadness. Future studies with open-ended measures will be necessary to clarify whether music with conflicting cues elicit mixed emotions of happiness and sadness. Of course, open-ended measures will be less sensitive to the time course of emotional reactions than closed-ended measures like the current study's button press measures.

Final Thoughts

Our discussion of the strengths and limitations of open- and closed-ended measures of emotion highlights the fact that no single set of measures can capture the complexity of emotional reactions to music or other evocative events. As noted by Sir

Arthur Eddington (1939; see Cacioppo & Berntson, 1994), scientists who cast nets with 2 mesh into the sea may catch many fish, but none of them will be smaller than 2. The fish in the nets can yield great insight about the various fish in the sea, but it would be unwise to conclude that the sea contains no fish smaller than 2-in. Similarly, measures that constrain listeners to rate their emotions on bipolar scales ranging from happiness to sadness have yielded great insight into emotional reactions to music (e.g., Schubert, 2010), but our results indicate that it would be unwise to conclude from listeners' ratings that music cannot make people feel both happy and sad at the same time.

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