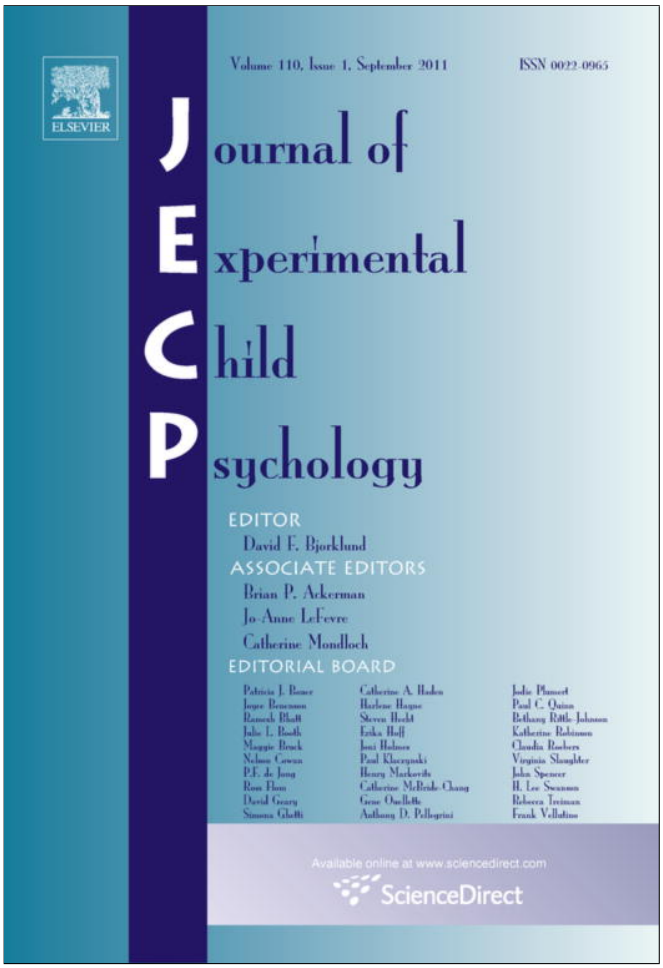

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Liking and identifying emotionally expressive music: Age and gender differences

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ABSTRACT

Adults and children 5, 8, and 11 years of age listened to short excerpts of unfamiliar music that sounded happy, scary, peaceful, or sad. Listeners initially rated how much they liked each excerpt. They subsequently made a forced-choice judgment about the emotion that each excerpt conveyed. Identification accuracy was higher for young girls than for young boys, but both genders reached adult-like levels by age 11. High-arousal emotions (happiness and fear) were better identified than low-arousal emotions (peacefulness and sadness), and this advantage was exaggerated among younger children. Whereas children of all ages preferred excerpts depicting high-arousal emotions, adults favored excerpts depicting positive emotions (happiness and peacefulness). A preference for positive emotions over negative emotions was also evident among females of all ages. As identification accuracy improved, liking for positively valenced music increased among 5- and 8-year-olds but decreased among 11-year-olds.

Introduction

Adults rate music listening as one the most important parts of their lives (Rentfrow & Gosling, 2003). Compared to preferences for specific television shows, movies, food, or clothing, music preferences are thought to reveal more about the self and others (Rentfrow & Gosling, 2003). In line with this view, knowledge of another person's music preferences increases accuracy of predictions about his or her personality (Rentfrow & Gosling, 2006). Music preferences are also known to be associated with demographic variables such as age, gender, socioeconomic status, ethnic background, and political views (North & Hargreaves, 2007a, 2007b, 2007c). Clearly, music preferences are important indicators

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of individual differences during adulthood, but when in development do these indicators become reliable?

Music preferences are known to be associated with emotional responses. Preferred musical styles tend to improve listeners' moods (Schäfer & Sedlmeier, 2009), and favorite pieces are often associated with particularly strong emotional experiences (Lamont & Webb, 2010). The degree to which unfamiliar music is liked also varies with the emotion expressed by the music, at least among adults. For example, happy-sounding music is typically given higher liking and pleasantness ratings than music that sounds sad (Hunter, Schellenberg, & Schimmack, 2008, 2010). Indeed, the preference for happy- over sad-sounding music extends over a variety of stimuli and response formats (Hunter et al., 2008, 2010; Husain, Thompson, & Schellenberg, 2002; Thompson, Schellenberg, & Husain, 2001; Vieillard et al., 2008). Exceptions to this bias are evident in some instances, such as when differences in liking between happy- and sad-sounding music disappear after listeners complete a sad mood induction (Hunter, Schellenberg, & Griffith, 2011) or a difficult task (Schellenberg, Peretz, & Vieillard, 2008). Nevertheless, a preference for happy-sounding music is the norm.

The current study examined four questions about music preferences that remain unanswered to date. The first two asked when during development the preference for happy-sounding music emerges and whether there are different trajectories for boys and girls. To the best of our knowledge, no previous study has examined whether children's music preferences vary as a function of the emotions expressed by the piece. A third question asked whether liking music based on the emotions it conveys is contingent on the ability to identify such emotions reliably. The fourth question asked whether the typical preference for happy-sounding music is specific to the actual emotion of happiness or whether it depends on more general dimensions such as arousal and valence (Russell, 1980). Happiness and sadness differ on both dimensions, with happiness being higher in arousal and more positive in valence. In other words, music cues associated with arousal, valence, or both dimensions could be responsible for the bias favoring happy- over sad-sounding music.

Our research questions were relevant to theories of distinct mechanisms for cognitive and emotional responding both in general (e.g., Zajonc, 1980) and specifically for music (Peretz & Coltheart, 2003; Peretz, Gagnon, & Bouchard, 1998). From this view, one would predict different developmental trajectories for emotional responding (i.e., liking) than for cognitive judgments (i.e., identifying an emotion conveyed by music). One might also expect developmentally inconsistent associations between liking and identification. Our goals were also relevant to distinctions between universal cues to emotion in music (e.g., tempo) and cues that are culture specific (e.g., mode) (Balkwill & Thompson, 1999). Culture-general cues should be relevant earlier in development, whereas the importance of culture-specific cues should increase with increases in age and exposure to Western music. Indeed, there is evidence of a culture-general to culture-specific developmental trend in music cognition tasks (Hannon & Trehub, 2005; Schellenberg & Trehub, 1999; Trehub, Schellenberg, & Kamenetsky, 1999). Finally, our aims were relevant to developmental theories of emotional comprehension, which point to marked improvements from 5 to 8 years of age and from 8 to 11 years of age (Pons, Harris, & de Rosnay, 2004).

One factor influencing liking for unfamiliar music is consonance. From infancy (Trainor, Tsang, & Cheung, 2002; Zentner & Kagan, 1996, 1998) to adulthood (Blood, Zatorre, Bermudez, & Evans, 1999), listeners tend to prefer consonant music over dissonant music. Developmental changes are likely to be evident, however, for factors other than consonance. We know that children's *perceptions* of emotions expressed by music are underdeveloped. For example, Terwogt and Van Grinsven (1991, Experiment 2) tested the identification of emotions in classical pieces that sounded happy, sad, angry, or fearful. Listeners included adults as well as children 5 and 10 years of age. Although recognition of happy- and sad-sounding pieces was fairly consistent across age groups, pieces that sounded angry and fearful were particularly difficult to identify and often confused among the children. This result may have stemmed from the fact that fear and anger both are high-arousal, negative-valence emotions, whereas happiness and sadness differ on both dimensions.

Children's abilities to identify emotions expressed musically also vary with the age of the children and the task. For example, 3-year-olds discriminate happy- from sad-sounding pieces (Kastner & Crowder, 1990), whereas 4-year-olds recognize happy-sounding music explicitly (Cunningham & Sterling, 1988). Some 4-year-olds can also associate emotions expressed in music with story themes (e.g., associating the scary-sounding music from *Peter and the Wolf* with the wolf; Trainor & Trehub, 1992).

Beyond 5 years of age, children begin to identify sadness, anger, and fear or threat more reliably (Dolgin & Adelson, 1990; Terwogt & Van Grinsven, 1991).

Pieces of music that express different emotions vary across many dimensions, such as tempo (fast or slow) and mode (major or minor), which are associated with listeners' arousal levels and moods, respectively (Husain et al., 2002). In one study (Dalla Bella, Peretz, Rousseau, & Gosselin, 2001), listeners who varied in age (5-year-olds, 6- to 8-year-olds, and adults) determined whether short excerpts of unfamiliar music sounded happy or sad. The excerpts included sections from happy-sounding (fast and major) and sad-sounding (slow and minor) piano pieces as well as versions that were manipulated in tempo and mode. A developmental trend revealed that the adults were influenced more by the mode manipulation, whereas the 5-year-olds were influenced more by the tempo manipulation. The 6- to 8-year-olds fell in between, influenced equally by the tempo and mode manipulations. In another study, 6- to 12-year-olds relied primarily on temporal cues when making arousal (excitement vs. calm) and valence (happiness vs. sadness) ratings of short musical pieces (Kratus, 1993).

Gender differences may also play a role in liking and identifying emotions expressed musically. Because women and girls are more accurate than men and boys at distinguishing and interpreting facial emotions (McClure, 2000), a similar female advantage might be evident for music. To date, evidence in this regard is equivocal. In one study of adults (Gagnon & Peretz, 2003), men and women provided similar ratings of perceived happiness and sadness for excerpts of music that varied in mode and tempo. In another study (Webster & Weir, 2005), women *felt* more sadness than men in response to excerpts that sounded sad, but there were no gender differences in response to excerpts that sounded happy. It is unclear whether similar gender differences would be evident with emotion perception and identification.

Findings are similarly equivocal for comparisons of boys and girls. Kratus (1993) asked 6- to 12-year-olds to listen to excerpts from Bach's *Goldberg Variations* and to indicate whether each excerpt sounded either happy or sad and either excited or calm. There were no age or gender differences, possibly because accuracy was unusually high. In another study (Giomo, 1993), 5- and 9-year-olds listened to classical pieces and rated them on three dimensions: softness–intensity, pleasantness–unpleasantness, and solemnity–triviality. There was no effect of age on accuracy, but girls' responses varied more systematically as a function of the stimulus manipulations compared with boys' responses. In some studies (Cunningham & Sterling, 1988) but not in others (Dalla Bella et al., 2001; Kastner & Crowder, 1990; Terwogt & Van Grinsven, 1991), girls identified happiness and sadness more reliably than did boys. Girls were also better than boys at identifying fear expressed musically in some instances (Terwogt & Van Grinsven, 1991) but not in others (Cunningham & Sterling, 1988; Kastner & Crowder, 1990). Different findings and differences in stimuli and tasks across studies preclude the possibility of definitive conclusions. Thus, there is a need for further research on gender differences with highly controlled and validated music stimuli.

To the best of our knowledge, the current study is the first to examine gender differences across development in *liking* for unfamiliar music as a function of the emotion expressed by the music. In one previous study (Banerjee, Greene, Krcmar, Bagdasarov, & Ruginyte, 2008), adults read synopses of movies that varied in arousal and valence and were asked to indicate how much they would like to see the actual films. Men preferred the high-arousal descriptions, whereas women preferred the positively valenced descriptions. Although parallel results may be seen in music, clearer predictions are precluded because of the change of modality and because the participants tested by Banerjee and colleagues (2008) merely read descriptions of films, whereas our participants listened to actual music.

In an effort to mitigate problems in comparing results across studies, Vieillard and colleagues (2008) created a set of short music excerpts composed in the style of background music for films (i.e., unfamiliar but not foreign-sounding). Each excerpt was designed to sound happy, scary, peaceful, or sad. These particular emotions were chosen because they differ in arousal and valence in a factorial manner (happy: high/pleasant; scary: high/unpleasant; peaceful: low/pleasant; sad: low/unpleasant), which avoids confusion that might occur between, for example, angry and scary pieces (both high/unpleasant). The stimuli were intended to be a set of prototypical emotional pieces or a musical analog to Ekman and Friesen's (1976) prototypical emotional faces. Identification accuracy in the standardization sample of adults ranged from 67% correct for peaceful-sounding excerpts to 99% for happy-sounding excerpts.

In the current study, the youngest participants were 5 years of age. Children of this age can identify emotions expressed in music with some success (Dalla Bella et al., 2001). In addition, 5-year-olds can

use child-friendly rating scales to evaluate music stimuli on a variety of dimensions, including emotion (Giomo, 1993), goodness-of-fit (Schellenberg, Adachi, Purdy, & McKinnon, 2002), and similarity/difference (Stalinski & Schellenberg, 2010). Two groups of older children (8- and 11-year-olds) allowed us to chart development through middle childhood, whereas a sample of undergraduates allowed for comparisons with adults. Previous findings indicate improvements in emotional comprehension from 5 to 8 years of age and from 8 to 11 years of age (Pons et al., 2004). A similar developmental progression among these age groups is evident in pitch perception (Stalinski & Schellenberg, 2010).

All of the listeners heard a subset of Vieillard and colleagues' (2008) stimuli and rated how much they liked each excerpt. They also made a forced-choice judgment about the emotion that each excerpt conveyed. Our goals were to examine how liking and identification accuracy change over development and whether such changes vary as a function of the arousal and/or valence of the intended emotion. As in previous research, we expected that identification accuracy would improve with age and that happiness and sadness – which differed in both arousal and valence – would be better identified than fear and peacefulness.

Because reports of a female advantage in emotion identification are limited primarily to children (Cunningham & Sterling, 1988; Giomo, 1993; Terwogt & Van Grinsven, 1991), we expected better accuracy among young girls than among young boys, with gender differences disappearing for older listeners. For liking ratings, we expected to find the usual preference for happy- versus sad-sounding pieces among our adult listeners. Because these emotions differ in both arousal and valence, it was unclear whether this bias might stem from a more general preference for high-arousal music or for music with positive valence. For children, we expected that music preferences would depend more on manipulations that influence arousal (e.g., differences in tempo) than on valence because their identification of happiness and sadness has done so in the past (Dalla Bella et al., 2001). Finally, the results of Banerjee and colleagues (2008) suggested that males and females would provide higher liking ratings for music excerpts that were high in arousal and positive in valence, respectively.

Method

Participants

The sample consisted of 120 participants with 15 males and 15 females recruited from each of four age groups: 5-year-olds (5 years 0 months to 5 years 11 months [5;0–5;11]), 8-year-olds (8;0–8;11), 11-year-olds (11;0–11;11), and adults. The children were recruited from the local community and given a small gift for participating. The adults were undergraduates enrolled in an introductory psychology class and received partial course credit. As in much past developmental research on music and emotion (e.g., Adachi, Trehub, & Abe, 2004; Cunningham & Sterling, 1988; Dolgin & Adelson, 1990; Gerardi & Gerken, 1995; Terwogt & Van Grinsven, 1991; Trainor & Trehub, 1992), participants were recruited without regard to music training.

Apparatus

Stimuli were presented using an iMac G5 while participants sat in a sound-attenuating booth. Stimulus presentation and response recording were controlled using customized software created with PsyScript 2.1 (Slavin, 2007).

Stimuli

The music excerpts (from Vieillard et al., 2008)[1] were brief and unfamiliar but not foreign-sounding. They were originally recorded in a piano timbre using MIDI (Musical Instrument Digital Interface) to ensure that extraneous performance cues were absent. Because our participants included young children, it was important to keep the testing session relatively brief. Therefore, a pilot study was used to select 20 of

[1] For full details on the composition of the pieces (copyright, Bernard Bouchard, 1998), including the scores, see Vieillard et al. (2008). The pieces are also available online at http://www.brams.umontreal.ca/plab/publications/article/96.

the original 56 excerpts, specifically those that were most consistently identified as belonging to their respective emotion category. A total of 45 undergraduates heard all 56 excerpts presented in random order. After each excerpt, they choose one of the four emotion terms (happy, scary, peaceful, or sad) that best described the emotion expressed by the music. The mean proportions correct for happy-, scary-, peaceful-, and sad-sounding excerpts were .84, .79, .69, and .75, respectively. As in Vieillard and colleagues' (2008) study, identification accuracy was highest for happy-sounding excerpts and lowest for peaceful-sounding excerpts. We subsequently selected the five best-identified excerpts from each category: happy (excerpts g01, g02, g03, g04, and g10), scary (p01, p02, p05, p06, and p09), peaceful (a01, a02, a04, a06, and a11), and sad (t01, t03, t08, t09, and t14). Mean proportion correct for these stimuli was .87, .86, .76, and .83, respectively. The average duration of the 20 excerpts was 12.8 s (SD = 2.0, range = 9–16). An analysis of variance (ANOVA) confirmed that duration did not vary systematically across the four emotion categories ($p > .10$).

Procedure

Participants were tested individually. The testing session consisted of two phases (liking and identification). Liking judgments were always collected first because even a single previous exposure to a piece of music can affect subsequent liking ratings (Peretz et al., 1998). Listeners were told during the first phase that they would hear 20 short excerpts of music and rate how much they liked each excerpt. The excerpts were presented in a different random order for each listener. A 5-point rating scale appeared after each excerpt. Scale points were labeled from 1 (*like a little*) to 5 (*like a lot*). To make the scale easier for 5-year-olds to use, each number was accompanied by a picture of an ice cream cone that grew larger from the low end of the scale to the high end.

After a brief break, listeners began the identification phase. They were told that they would hear the same excerpts again but that this time they would decide which emotion best fit the music. The excerpts were presented in a different random order. After each excerpt, the monitor displayed the four options (happiness, fear, peacefulness, and sadness). To make the task easy for children, each verbal label was accompanied by a line drawing of a face depicting the target emotion, as has been done for emotion judgments in musical contexts (Dalla Bella et al., 2001; Giomo, 1993) as well as nonmusical contexts (Pons et al., 2004). Child participants were asked to point to or verbally identify which face best matched the music. Adults made their own selection with the mouse. After the selection was made, the next excerpt was presented. No feedback was provided during either phase of the test session.

Results

Identification accuracy

Each participant had four scores measuring identification accuracy: the total number of correct responses (range = 0–5) for each emotion. Preliminary analyses compared performance with chance levels (25% correct) separately for each age group, both genders, and each of the four musical emotions. Performance was better than chance in all instances ($ps < .05$) except for two, namely, 5-year-old boys performing at chance levels with peaceful- and sad-sounding excerpts.

The principal analysis was a four-way mixed-design ANOVA with age group (four levels) and gender (two levels) as between-participants variables and with arousal (high [happiness and fear] or low [peacefulness and sadness]) and valence (positive [happiness and peacefulness] or negative [fear and sadness]) as within-participants variables. There were main effects of arousal, $F(1, 112) = 126.24$, $p < .0001$, partial $\eta^2 = .53$; age, $F(3, 112) = 35.33$, $p < .0001$, partial $\eta^2 = .49$; and gender, $F(1, 112) = 11.99$, $p < .001$, partial $\eta^2 = .10$. In general, accuracy was better for pieces that expressed high-arousal emotions ($M = 4.18$, $SD = 1.19$) rather than low-arousal emotions ($M = 3.28$, $SD = 1.42$) and for females ($M = 3.94$, $SD = 1.25$) over males ($M = 3.51$, $SD = 1.48$). The main effect of age stemmed from improvement from 5 years ($M = 2.68$, $SD = 1.58$) to 8 years ($M = 3.73$, $SD = 1.33$) and from 8 to 11 years ($M = 4.31$, $SD = 0.81$) ($ps < .05$, Tukey's HSD), after which performance reached a plateau. Adults ($M = 4.19$, $SD = 0.10$) and 11-year-olds were similarly accurate. These three main effects were

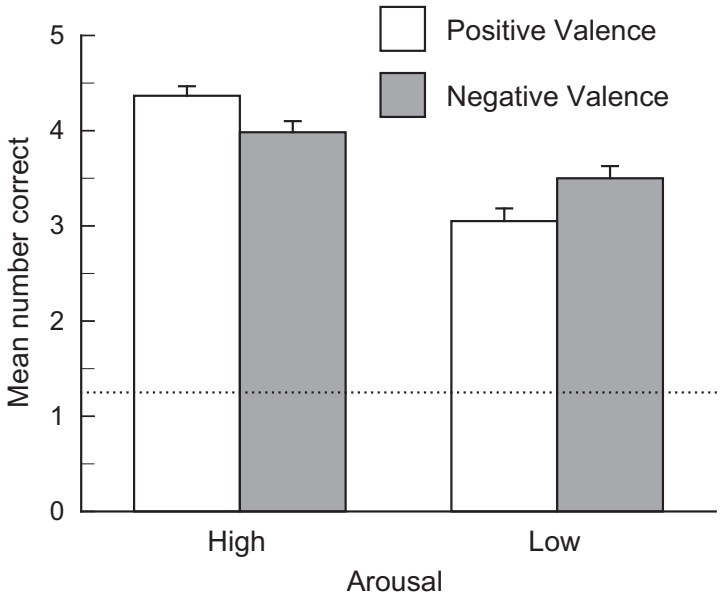

Fig. 1. Accuracy of emotion identification as a function of arousal and valence of the target emotion. Error bars are standard errors. The dashed line indicates chance level of performance.

qualified by three significant two-way interactions: between arousal and valence, $F(1, 112) = 25.12$, $p < .0001$, partial $\eta^2 = .18$ (Fig. 1); between arousal and age, $F(3, 112) = 7.11$, $p < .0005$, partial $\eta^2 = .16$ (Fig. 2); and between age and gender, $F(3, 112) = 7.06$, $p < .0005$, partial $\eta^2 = .16$ (Fig. 3). There were no significant higher order (i.e., three- or four-way) interactions.

The interaction between arousal and valence was examined further using separate ANOVAs for high- and low-arousal pieces. The effect of valence was significant in both instances. For high-arousal pieces, happiness (positive valence) was identified more accurately than fear (negative valence), $F(1, 112) = 10.14$, $p < .005$, partial $\eta^2 = .08$. By contrast, for low-arousal emotions, sadness (negative valence) was identified better than peacefulness (positive valence), $F(1, 112) = 12.10$, $p < .001$, partial $\eta^2 = .10$. Thus, as in previous research (Terwogt & Van Grinsven, 1991), happiness and sadness were relatively easy to identify. Nevertheless, the general advantage for high-arousal emotions meant that, in absolute terms, mean accuracy for scary-sounding excerpts was higher than it was for sad-sounding excerpts, contrary to predictions.

Because the other two interactions involved age, follow-up ANOVAs were conducted separately for each of the four age groups. For all groups, accuracy was better for high-arousal excerpts than for low-arousal excerpts, Fs(1, 28) = 71.50, 33.91, 29.14, and 12.72, ps < .005, partial η^2s = .72, .55, .51, and .31, for 5-, 8-, and 11-year-olds and adults, respectively. As shown in Fig. 2, the identification advantage for high-arousal excerpts compared with low-arousal excerpts decreased from 5 to 8 to 11 years of age, where it reached adult levels. A separate analysis limited to adults and 11-year-olds confirmed that there was no interaction between arousal and age ($F < 1$).

As predicted, the effect of gender was significant for 5- and 8-year-olds, Fs(1, 28) = 14.27 and 8.62, ps < .01, partial η^2s = .34 and .24, respectively, but not for 11-year-olds or adults (Fs < 1). As shown in Fig. 3, boys were less accurate than girls among the two youngest age groups, but males caught up to their female counterparts by 11 years of age. Although one might be tempted to attribute the similarity between 11-year-olds and adults to a near-ceiling effect, a robust effect of arousal for both groups points to substantial and systematic variance in response patterns.

Errors

Confusion matrices are illustrated in Table 1 separately for each age group. For the two younger age groups, excerpts with low-arousal emotions (peacefulness and sadness) were most often confused. The same confusions were evident but less common among 11-year-olds and adults. All age groups sometimes identified peaceful-sounding excerpts as happy-sounding, but confusions in the reverse

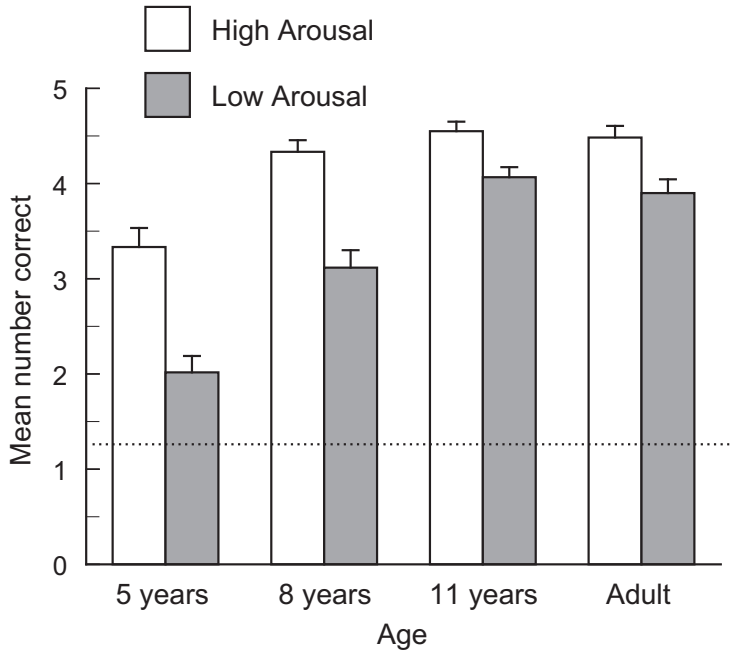

Fig. 2. Accuracy of emotion identification as a function of age of the listener and arousal of the target emotion. Error bars are standard errors. The dashed line indicates chance level of performance.

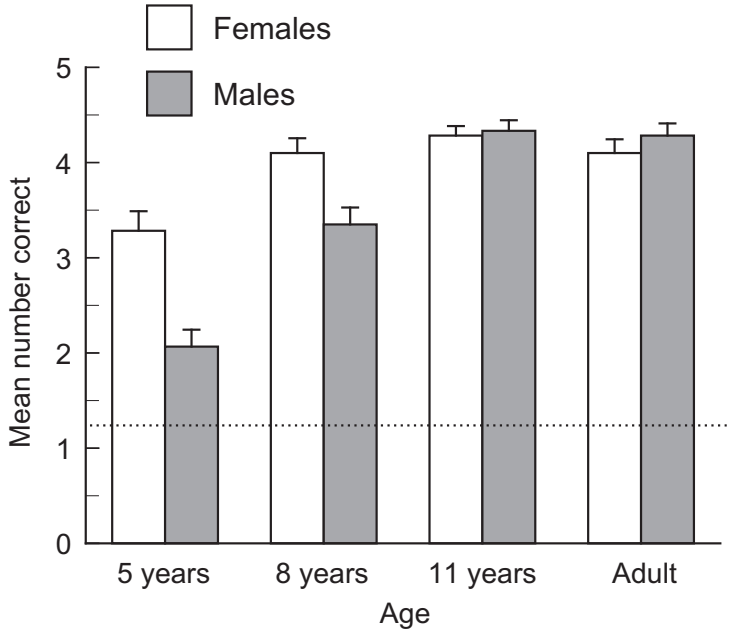

Fig. 3. Accuracy of emotion identification as a function of age and gender of the listener. Error bars are standard errors. The dashed line indicates chance level of performance.

direction were much less common. In general, then, identification of peaceful-sounding music was not as accurate as identification of the other three target emotions across age groups. Both 5-year-olds and (to a lesser extent) 8-year-olds were also somewhat unreliable at labeling sad-sounding music. This difficulty disappeared by 11 years of age.

Liking

Each participant had four liking ratings, one for each emotion, with each rating averaged over five original ratings (range = 1–5). As with identification accuracy, the principal analysis was a four-way mixed-design ANOVA. There were main effects of arousal, $F(1, 112) = 20.19$, $p < .0001$, partial

Table 1
Percentage of each response for excerpts depicting each emotion.

		Response			
Age	Music	Happy	Scary	Peaceful	Sad
5 years	Happy	**70.0**	7.3	15.3	7.3
	Scary	18.7	**63.3**	9.3	8.7
	Peaceful	26.0	7.3	**38.7**	28.0
	Sad	18.7	16.7	21.3	**43.3**
8 years	Happy	**87.3**	0.0	10.0	2.7
	Scary	6.7	**80.0**	6.7	6.7
	Peaceful	20.7	1.3	**58.0**	20.0
	Sad	5.3	12.7	18.0	**64.0**
11 years	Happy	**94.7**	0.0	5.3	0.0
	Scary	2.7	**87.3**	2.0	8.0
	Peaceful	10.0	1.3	**76.0**	12.7
	Sad	0.0	4.0	9.3	**86.7**
Adult	Happy	**94.0**	2.0	3.3	0.7
	Scary	7.3	**84.0**	6.0	2.7
	Peaceful	16.7	0.0	**70.7**	12.7
	Sad	2.0	1.3	13.3	**83.3**

Note: Correct responses are in bold.

η^2 = .15; valence, $F(1, 112) = 8.83$, $p < .005$, partial η^2 = .07; and age, $F(3, 112) = 20.01$, $p < .0001$, partial η^2 = .35. In general, liking was higher for excerpts that expressed high-arousal emotions ($M = 3.40$, $SD = 1.03$) rather than low-arousal emotions ($M = 3.09$, $SD = 0.93$) and positive emotions ($M = 3.36$, $SD = 0.95$) rather than negative emotions ($M = 3.12$, $SD = 0.95$). The main effect of age stemmed from decreases in liking between 5 years ($M = 3.77$, $SD = 0.91$) and 8 years ($M = 3.35$, $SD = 1.02$) and between 11 years ($M = 3.27$, $SD = 0.74$) and adulthood ($M = 2.59$, $SD = 0.91$) (ps < .05). Mean liking did not differ between 8 and 11 years of age. These main effects were qualified by three significant two-way interactions: between valence and gender, $F(1, 112) = 8.47$, $p < .005$, partial η^2 = .07 (Fig. 4); between valence and age, $F(3, 112) = 2.88$, $p < .05$, partial η^2 = .07 (Fig. 5); and between arousal and age, $F(3, 112) = 2.63$, $p = .05$, partial η^2 = .07 (Fig. 6). There were no significant higher order interactions.

We explored the interaction between valence and gender using separate ANOVAs for males and females. The effect of valence was significant for females, $F(1, 56) = 16.60$, $p < .0001$, partial η^2 = .23, but not for males ($F < 1$). Thus, across age groups, females but not males preferred pieces expressing positive emotions.

The interactions involving age were followed up using separate ANOVAs for each age group. There was a significant effect of valence for adults, $F(1, 28) = 18.40$, $p < .0005$, partial η^2 = .40, but not for any of the child groups (Fs < 1). By contrast, there was a significant effect of arousal for 5-, 8-, and 11-year-olds, Fs(1, 28) = 7.65, 8.32, and 14.49, ps < .01, partial η^2s = .21, .23, and .34, respectively, but not for adults ($F < 1$). Thus, children's liking was influenced by the arousal of the emotion expressed in the piece, favoring high-arousal emotions, whereas adults' liking was influenced by valence, favoring positive emotions. The marked developmental change between 11-year-olds and adults was highlighted by a separate analysis of these two age groups alone that revealed significant interactions between arousal and age and between valence and age (ps < .05). By contrast, when the three child groups were analyzed (adults excluded), neither interaction was significant (Fs < 1).

Identification accuracy and liking

Associations between accuracy and liking were examined with a general linear model. Because we were interested in whether greater accuracy would be related to more adult-like preferences, the outcome variable represented a preference for music with positive valence. Specifically, for each participant, we calculated a positivity preference score by subtracting mean liking for excerpts expressing

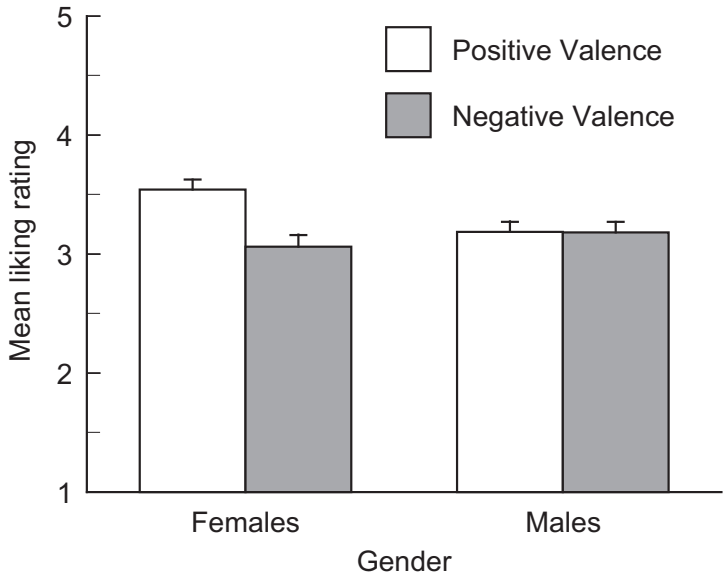

Fig. 4. Liking as a function of gender of the listener and valence of the target emotion. Error bars are standard errors.

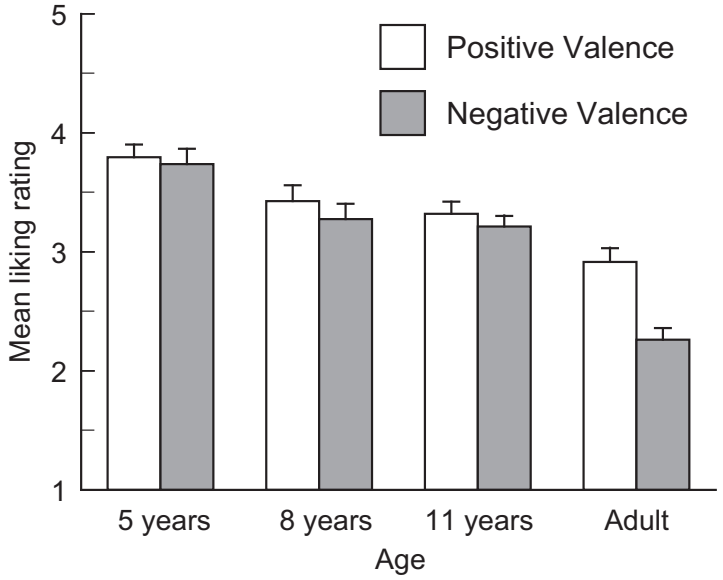

Fig. 5. Liking as a function of age of the listener and valence of the target emotion. Error bars are standard errors.

negative emotions from mean liking for excerpts expressing positive emotions. Predictor variables were age, overall accuracy (total number of correct identifications), and the interaction between age and accuracy. The model was highly significant, $F(7, 112) = 4.25$, $p < .0005$, $R^2 = .21$, with age, $F(3, 112) = 4.39$, $p < .01$, $sr^2 = .09$, and the interaction between age and accuracy, $F(3, 112) = 4.49$, $p < .01$, $sr^2 = .09$, making significant unique contributions. The effect of accuracy was not significant ($F < 1$).

We subsequently examined each age group separately, correlating identification accuracy with a preference for excerpts with positive valence. As expected, liking for excerpts with positive valence increased in tandem with identification accuracy among 5-year-olds ($r = .39$, $N = 30$, $p < .05$) and 8-year-olds ($r = .46$, $N = 30$, $p < .05$). Somewhat surprising, for 11-year-olds, liking for music with positive valence *decreased* as identification accuracy improved ($r = -.47$, $N = 30$, $p < .01$). For adults, there was no association between identification accuracy and a preference for music with positive valence ($p > .90$).

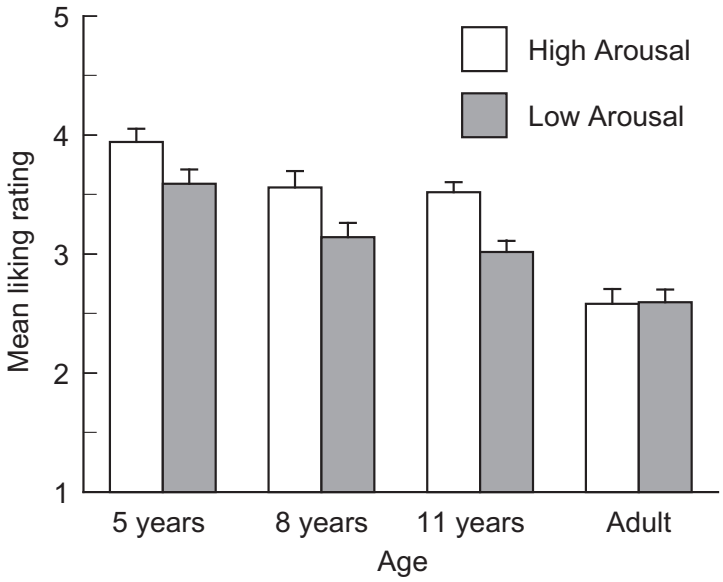

Fig. 6. Liking as a function of age of the listener and arousal of the target emotion. Error bars are standard errors.

Discussion

The goal of the current study was to examine developmental trends in affective responding to music. Participants included male and female adults and children 5, 8, and 11 years of age. The listeners were asked to rate how much they liked excerpts of unfamiliar music that sounded happy, scary, peaceful, or sad and to identify the emotions conveyed by the same excerpts.

For emotion identification, we replicated previous findings that (a) younger children are poorer than older children and adults at identifying emotions expressed musically and (b) younger children rely inordinately on musical characteristics associated with arousal (i.e., tempo). Our results extended previous findings by including fear and peacefulness in addition to happiness and sadness as target emotions and by including listeners that encompassed a large age range. Compared with 5- and 8-year-olds, the identification advantage for high-arousal emotions was smaller among 11-year-olds and adults, who were similarly accurate at identifying emotions expressed musically. Indeed, our results indicated that children reach adult-like emotion identification abilities with music by 11 years of age, at least with the four emotions we examined and the music excerpts we used. Moreover, the developmental progression from 5 to 8 to 11 years of age paralleled those that are evident when children's emotional understanding is tested in nonmusical contexts (Pons et al., 2004). Younger children's overreliance on musical cues associated with arousal, such as tempo, are likely to stem from the fact that such cues may be universal and require little to no learning, whereas cues associated with valence, such as mode, are culture specific and dependent on exposure to music. In line with this view, when adult listeners identify happiness and sadness expressed in the music from foreign cultures, they use tempo as a basis for their judgments (Balkwill & Thompson, 1999; Balkwill, Thompson, & Matsunaga, 2004).

Identification accuracy was particularly poor among 5- and 8-year-old boys, who performed worse than girls of the same age. By 11 years of age, however, the gender difference disappeared. Why did boys show a developmental lag? One possibility is that the gender difference in identification accuracy among young children stemmed from gender differences in language development. For example, girls tend to have larger vocabularies than boys (e.g., Bauer, Goldfield, & Reznick, 2002; Feldman et al., 2000; Fenson et al., 1994). Girls are also more talkative than boys (Leaper & Smith, 2004), and they exhibit advantages over boys in reading, writing, and spelling (Halpern, 2004). As a result, girls may have an advantage when linking the concepts of "peacefulness" and "fear," for example, to their perceptions of music. Alternatively, the difference in emotion identification accuracy for music could stem from gender differences in emotional sensitivity. For example, girls are better than boys at iden-

tifying the emotions associated with facial expressions (McClure, 2000), and they are more likely to be strategic about meeting their emotional needs in stressful situations by seeking comfort from a caregiver (Raver, 1996). Future research could determine whether the gender difference in the ability to identify emotions expressed by music is related primarily to gender differences in language development or emotional development, whether both variables contribute jointly to the difference we observed, and whether other variables play a role.

For liking ratings, a preference for music associated with positive valence was evident among females but not among males. This finding is consistent with the female preference for positive emotions in films reported by Banerjee and colleagues (2008). In another study that measured women's and men's behavioral and physiological responses to pictures with affective content (Bradley, Codispoti, Sabatinelli, & Lang, 2001), pictures with negative content elicited stronger negative valence ratings, a stronger startle reflex, and greater corrugator (brow) muscle activity in women than in men. The authors suggested that women exhibit stronger avoidant and defensive tendencies to stimuli with negative content. These findings have been replicated in samples of children ranging from 7 to 11 years of age (McManis, Bradley, Berg, Cuthbert, & Lang, 2001; Sharp, van Goozen, & Goodyer, 2006). In a study of emotional responses to music (Webster & Weir, 2005), women reported elevated levels of sad feelings in response to music presented with slow tempo or in minor mode. In short, heightened emotional reactivity to aesthetic stimuli with negative emotional content may explain the tendency of females to prefer music with positive content.

Whereas adult listeners liked happy- and peaceful-sounding (positive valence) music more than music that expressed sadness and fear (negative valence), their liking ratings did not distinguish between music that expressed high-arousal emotions (happiness and fear) or low-arousal emotions (sadness and peacefulness). This pattern was restricted solely to adults, with children of all ages exhibiting the exact opposite pattern, liking high-arousal music more than low-arousal music but relatively oblivious to positive or negative valence. These results are consistent with previous findings of children's reliance on tempo (an arousal cue) in emotion judgments (Dalla Bella et al., 2001; Kratus, 1993). The greater salience of arousal cues compared with valence cues for children is likely to account in large part for their arousal-based music preferences. By contrast, adults are more sensitive to mode (a valence cue) than to tempo when making emotional judgments (Dalla Bella et al., 2001), which could account for their valence-based preferences. Because effects of age and gender did not interact with liking based on valence, our results indicated that adult women were the most likely of all our participants to prefer music that expresses emotions with positive valence. Future research could attempt to replicate this finding with a larger sample of men and women and a larger set of music excerpts associated with different emotions.

Observed associations between identification accuracy and liking among our child participants were particularly provocative. Although 11-year-olds were as accurate as adults at identifying emotions expressed in music, and considerably better than 5- and 8-year-olds, their liking ratings differed from those of adults and were similar to those of younger children. Among 5- and 8-year-olds, higher accuracy was predictive of more adult-like preferences based on musical valence, as one might expect. For 11-year-olds, however, greater identification accuracy was related to a larger *discrepancy* with adult liking ratings. Theories of distinct mechanisms for emotional and cognitive responding to music (Peretz & Coltheart, 2003; Peretz et al., 1998) are consistent with our findings, specifically those showing (a) different developmental trajectories for liking and identification and (b) a developmental switch in the direction of the association between liking and identification.

At 11 years of age, children are entering adolescence, a period known to be associated with changes in music use. Music consumption generally increases during this time (North, Hargreaves, & O'Neill, 2000) as adolescents begin to use music for mood regulation (Saarikallio & Erkkila, 2007) and coping (Miranda & Claes, 2009). At the same time, adolescents are beginning to form independent identities (Erikson, 1968; see also Marcia, 1980), seeking greater autonomy from their parents (Smetana, 1988; Youniss & Smollar, 1985). Music preferences for certain genres, artists, or pieces play an important role in the move from parents to peers as the primary source of socialization (Zillman & Gan, 1997), and they serve as social glue in peer relationships (North & Hargreaves, 1999; Raviv, Bar-Tal, & Ben-Horin, 1996). In other words, developmental changes associated with the onset of adolescence may explain

the apparently contradictory result from this study that more musically mature 11-year-olds (in terms of emotion identification) had less mature preferences (or liking).

Across age groups, listeners often mistook peaceful- for sad-sounding pieces and vice versa. This association was also evident in liking ratings, with younger listeners giving similarly low liking ratings to peaceful- and sad-sounding pieces. One possibility is that there is a general difficulty in identifying low-arousal emotions in music. For example, Gabrielsson and Juslin's (1996) listeners tended to confuse pieces that sounded either sad or tender. Nevertheless, in many studies, sad-sounding pieces are among the best identified (Cunningham & Sterling, 1988; Dolgin & Adelson, 1990; Terwogt & Van Grinsven, 1991). Perhaps the inclusion of peaceful-sounding pieces disrupted listeners' perception of sad-sounding pieces. Because peaceful- and sad-sounding pieces differed primarily in valence cues (i.e., mode), it is not surprising that children would confuse them. Peaceful pieces were also often mislabeled as happy, however, despite clear differences in tempo. Even adults had difficulties with the peaceful category, for which identification accuracy was 71% correct, whereas accuracy for all other categories was 85% or higher. This mediocre level of accuracy for the best-recognized pieces implies that peacefulness may be relatively difficult to express musically compared with happiness, fear, and sadness (see Fig. 1).

Another avenue for future research would be to examine the role of exposure to music on identification accuracy and liking. Although formal training in music is unlikely to matter much (Adachi et al., 2004; Bachorik et al., 2009; Bigand, Vieillard, Madurell, Marozeau, & Dacquet, 2006), listening experience would likely play a role, with accuracy improving with increased exposure to music. The association between accuracy and liking suggests that greater exposure during childhood may lead to more adult-like preferences, at least until early adolescence. It would also be interesting to examine developmental changes in the association between perceiving and feeling emotions. Among adults, there is a general tendency for perceived and felt emotions to vary in tandem (Hunter et al., 2010; Kallinen & Ravaja, 2006). It is unknown whether children exhibit the same pattern. When they identify the emotion conveyed incorrectly, it would be particularly interesting to determine whether their actual emotional response is more in line with the intended emotion or the identified emotion. For example, a piece intended to sound scary but identified as happy could evoke feelings of either happiness (i.e., the perceived emotion) or fear (i.e., the composer's intended emotion).

In sum, five major findings emerged from this study. First, children's identification of emotion in unfamiliar music was worse for emotions that are low in arousal rather than high in arousal. Second, boys were less accurate than girls at identifying emotions in music during early childhood, but this gender difference disappeared by 11 years of age, when children were as good as adults. Third, children tended to prefer high-arousal emotions in music regardless of valence, whereas adults preferred positive-valence emotions in music regardless of arousal. Fourth, the preference for positively valenced emotions expressed musically was evident among females but not among males. Fifth, associations between liking and identification accuracy were inconsistent across development.

Our original question asked when during development music preferences become reliable predictors of individual differences. Our results indicated that although 11-year-olds are adult-like at identifying emotions expressed musically, their emotion-based preferences do not become adult-like until later in life. Further explorations of the development of music preferences will help to further our understanding of individual differences in responding to music and how such differences are related more generally to social and emotional development.

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