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Chapter 15

MUSIC: THE LANGUAGE OF EMOTION

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ABSTRACT

Music has a universal appeal that is often attributed to its ability to make us feel a certain way, and to change how we are currently feeling. In fact, music is often said to be the language of emotion. Although the body of research on music and emotions has grown rapidly over the past two decades, many issues remain the subject of debate. How is emotion conveyed through musical features? Do listeners actually experience emotions in response to music, or are they simply perceiving emotions? Which particular emotions does music convey? What factors influence whether we like a particular piece of music? Can research on music and emotions inform us about emotions in general? How do experience and learning affect the perception of musical emotions? In this chapter, we provide an overview of research that addresses these and other related questions, with an emphasis on recent findings.

1. INTRODUCTION

People listen to music because of the way it makes them feel, and because it can change how they are currently feeling (Juslin & Laukka, 2004; Lonsdale & North, 2011). Indeed, many people consider music to be the language of emotion because it has the power to move us to tears of sorrow or joy. Music is also used widely as a therapeutic tool to improve physical, mental, and emotional health and wellbeing (MacDonald, Kreutz, & Mitchell, 2012); it is an integral part of significant life events such as ritual ceremonies, weddings, and funerals; and it promotes infants' emotional attachment to their caregivers (Dissanayake, 2000; Trainor, 1996; Trehub & Trainor, 1998).

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In the past two decades, research on links between music and emotion has become increasingly common. The present chapter provides a summary of the most important topics in the field, focusing primarily on recent publications. More thorough reviews can be found in several chapters and books dedicated to the topic (e.g., Gabrielsson, 2009; Hunter & Schellenberg, 2010; Juslin, 2009a, 2009b, 2011; Juslin & Sloboda, 2001, 2010; Koelsch, 2010; Trainor & Schmidt, 2003). Increasing scholarly interest in associations between music and emotion has the potential to reveal why music is so appealing to listeners regardless of age, gender, and culture, and why music is such a fundamental and universal human behavior.

How does music convey emotions? In section 2, we discuss musical cues that are associated with specific emotions. We begin by identifying domain-general acoustic cues that are used to express emotions in music as well as in speech. We go on to discuss cues to emotion that are specific to particular musical cultures. Despite nearly universal agreement that music is capable of conveying emotions, some scholars doubt that music actually induces emotional responses, arguing instead that musical emotions are perceived but not felt. In section 3, we discuss the available evidence concerning whether listeners actually feel emotions in response to music.

Others propose that listeners respond emotionally to music, but that music-induced emotions differ from everyday emotions such as happiness, fear, anger, and sadness. In section 4, we explore the types of emotions that music induces, including an examination of particularly strong and positive responses to music (i.e., chills, section 4.1), as well as a discussion of the most fundamental emotional response to music—liking or disliking—and a look at why individuals like music that conveys sadness, a negative emotion (section 4.2). Section 5 examines what research on music and emotions reveals about the structure of emotions in general. Finally, section 6 discusses the impact of different types of experience on the perception of musical emotions, including the effects of informal music-listening experiences (section 6.1), the perception of emotion in music from foreign cultures (section 6.2), and the effects of formal music lessons (section 6.3).

2. Musical Cues to Emotion

One major focus of research on music and emotion examines how particular emotions are conveyed through musical features. Music varies on a number of different dimensions, from basic acoustic aspects to more complex features that are specific to music. For example, music uses domain-general cues such as loudness, average pitch level (e.g., high like a flute or low like a tuba), timbre (i.e., what makes a flute and a clarinet sound different), and tempo (how fast or slow the musical beat is, similar to speech rate). Music also varies on dimensions that have no counterparts with speech or other aspects of audition. For example, Western music varies in *mode*, which refers to particular patterns of pitch relations. Historically, the most common mode in Western music is the major mode, the collection of pitches used in songs such as *Twinkle Twinkle Little Star*, *Joy to the World*, and The Beatles' *Hey Jude*. The minor mode is also common, used in songs like *The Cat Came Back*, *We Three Kings*, and Madonna's *Hung Up*.

In the component-process theory of emotion, Scherer (1985) proposes that different emotions activate the sympathetic nervous system, which in turn affects vocal musculature and production. More specifically, happiness, disgust, sadness, fear, and anger influence basic acoustic aspects of the human voice such as mean fundamental frequency, intensity (loudness), and speech rate. A meta-analysis conducted by Juslin and Laukka (2003) confirmed that a number of basic acoustic cues to emotion are common to the expression of emotion in both speech and music. For example, faster rates of speaking and faster tempi in music are associated with high-arousal emotions such as happiness and anger, whereas slow speech rate and tempo are markers of low-arousal emotions such as sadness and tenderness. Other arousal-related associations are observed for intensity/loudness (loud = high arousal, soft = low arousal) and voice quality or timbre (sharp-sounding with more high-frequency energy = high arousal, dull-sounding with less high-frequency energy = low arousal). Acoustic features that distinguish positively from negatively valenced emotions are based on regularity in terms of intensity, frequency, and duration, with positive emotions more regular than negative emotions. Other research confirms that tempo is a particularly important cue to emotion in music (e.g., Gagnon & Peretz, 2003; Hevner, 1935, 1936, 1937; Juslin, 1997b; Juslin & Lindström, 2010), and that low pitch levels are predictive of a reduction in felt pleasantness, particularly among women (Jacquet, Danuser, & Gomez, 2012). Among men, low pitch also predicts an increase in arousal levels (Jacquet et al., 2012). Presumably, low pitch is associated with threatening behavior. More generally, these findings suggest that emotions expressed in music often mimic the way that emotions are expressed in speech.

Some cues to emotions expressed musically, however, have no parallels with speech (Juslin & Laukka, 2003). For example, articulation provides a cue to arousal, such that *staccato* (i.e., short note durations with spaces of silence in between successive notes, or choppy sounding) is associated with high-arousal emotions, whereas *legato* (i.e., longer note durations with no silence between successive notes, or smooth sounding) is associated with low-arousal emotions. Mode is also a particularly strong cue to valence, with major mode associated with positive emotions (especially happiness) and minor mode associated with negative emotions (especially sadness; Gagnon & Peretz, 2003; Hevner, 1935, 1936, 1937; see Gabrielsson & Juslin, 2003 and Juslin & Laukka, 2004 for reviews). Particularly strong emotional responses often coincide with specific musical features (Sloboda, 1991). For example, tears occur most often during melodic appoggiaturas (i.e., when an unexpected, non-stable note on a strong beat is followed by a stable note), whereas chills (or thrills) are elicited commonly by unexpected harmonic progressions.

The various ways in which music communicates emotion are complex. Cues to musical emotions are probabilistic rather than deterministic (Juslin, 1997a; Juslin & Laukka, 2003), and listeners rely on configurations of musical cues to perceive emotion. Different cues also interact in their influence on emotion judgments (Juslin & Lindström, 2010; Schellenberg, Krysciak, & Campbell, 2000), and some particular cues are more important for some musical emotions than for others (Juslin & Lindström, 2010).

Finally, culture-specific cues, such as mode in Western music, must be learned. Many years ago, Meyer (1956) argued that expectations provide the basis for the perception of emotion and meaning in music. He suggested that the interplay between tension and relaxation, produced by unexpected and expected musical events, respectively, gives rise to emotional expression. Huron (2006) later built on these ideas in his Imagination-Tension-Prediction-Response-Appraisal (ITPRA) theory. Importantly, these theories suggest that structures common to a listener's musical culture must be learned—either explicitly or implicitly—in order to experience these types of expectations, which implies that the perception of emotion in music depends partly on culturally formed musical knowledge. In section 6 of the present chapter, we discuss the effects of informal and formal experience on the perception of musical emotions.

3. Do Listeners Actually Experience Emotions in Response to Music?

One debate in research on music and emotion centers on whether music can *induce* emotions in listeners in addition to simply *conveying* emotion. The *cognitivist* position (e.g., Kivy, 1980, 1990, 2001; Konečni, 2008; Meyer, 1956) maintains that music does not induce emotions because true emotional responding requires cognitive appraisal. Rather, music is evaluated in terms of simple liking or disliking without inducing more specific emotions such as happiness or sadness. Clearly, scary-sounding music does not induce fear of the actual piece of music in the same way that a large, approaching predatory animal would itself be the object of fear.

By contrast, the *emotivist* position (e.g., Goldstein, 1980; Sloboda, 1991) assumes that cognitive appraisals are not necessary for emotion induction, and that music is capable of eliciting true and specific emotions in listeners. Juslin and Västfjäll (2008) proposed six mechanisms—other than cognitive appraisal—by which music induces emotions in listeners: (1) *brain stem reflexes* occur when a sudden loud or unexpected sound causes a startle response, (2) *evaluative conditioning* arises when a piece of music is associated with an emotional event or object, (3) *emotional contagion* occurs when the emotion expressed by the music becomes internalized, (4) *visual imagery* evoked by music may have emotional connotations, (5) music may remind the listener of *episodic memories*—memories from an individual's past—that are emotionally charged, and (6) the fulfillment or violation of *musical expectancies* induces emotions. Other mechanisms include *exposure*, when liking for a piece of music increases with familiarity but decreases with over-exposure (Moors & Kuppens, 2008; Schellenberg, 2008), *semantic associations* evoked by music that have emotional undertones (Fritz & Koelsch, 2008), and *rhythmic entrainment* to a musical beat (or meter) that influences physical responses such as heart rate and other changes in arousal level that are associated with emotional responding (Agostino, Peryer, & Meck, 2008; Alcorta, Sosis, & Finkel, 2008; Bharucha & Curtis, 2008; Madison, 2008; Scherer & Zentner, 2008).

Evidence consistent with the view that music actually induces emotions comes from a variety of sources. Simply asking listeners to report their emotional reactions to music is the most common and direct source. Self-reports reveal that listeners experience particularly strong emotions in response to music, especially positive emotions such as happiness, joy, elation, and even euphoria or ecstasy (Gabrielsson, 2001). Juslin and Laukka (2004) conducted a questionnaire study that included both open-ended and multiple-choice questions. All of their participants claimed that they actually experience (rather than just perceive) emotions in response to music, at least in some instances. Again, the most commonly reported emotions were positive (e.g., happy, relaxed, moved), and motivations for listening to music frequently involved emotional states (e.g., "to express, release, and influence emotions"). Self-report methods have been criticized, however, because listeners may find it difficult to remember specific emotional responses to music, or because they may confuse perceived and felt emotions when they are required to describe these responses retrospectively.

To overcome the problem of asking participants to remember their emotional responses to music, Juslin, Liljeström, Västfjäll, Barradas, and Silva (2008) conducted an experience-sampling study of emotional reactions in everyday life when music was present or absent. The participants were provided with small computers that beeped at different times throughout the day, with each beep prompting them to provide information about their situation and emotional state. When music was present (approximately 1/3 of the time), listeners reported that it tended to influence their emotional state, usually in a positive direction. Comparisons between situations with or without music revealed that positive emotions were more common when music was present, whereas negative emotions were more common when music was absent. Although the experience-sampling method assumes that (1) individuals are aware of their emotional states, (2) they can report these accurately, and (3) they can distinguish felt from perceived emotions, these findings provide highly suggestive evidence that music does in fact induce emotions in listeners, and that it does so frequently in everyday life.

Additional evidence in support of the emotivist position comes from studies of physiological responses during music listening that are known to be markers of emotional responding (see Hodges, 2010 for a review). Emotionally evocative music causes changes in heart rate, blood pressure, skin conductance, body temperature, and respiration that differ from measurements taken during listening to non-emotional music (e.g., Rickard, 2004) or sitting in silence (e.g., Khalfa, Peretz, Blondin, & Manon, 2002; Krumhansl, 1997; Nyklíček, Thayer, & Van Doornen, 1997). One problem with physiological responses is that they cannot differentiate clearly between different felt emotions. Rather, physiological responses are better measures of activation levels (i.e., arousal) than they are of positive or negative responding (i.e., valence; Khalfa et al., 2002; Nyklíček et al., 1997). Moreover, physiological responses such as respiratory rate tend to become synchronized with tempo (i.e., the speed of the beat or pulse) of the music (Etzel, Johnsen, Dickerson, Tranel, & Adolphs, 2006). Although faster tempo is associated with increased levels of arousal (Husain, Thompson, & Schellenberg, 2002), in principle tempo could influence physiological responses that are independent of felt emotions. In at least one study, however, differences in physiological responses to happy- and sad-sounding music could not be explained solely by manipulations of tempo or rhythm (Khalfa, Roy, Rainville, Dalla Bella, & Peretz, 2008).

Although most physiological measures are better indicators of arousal than of valence, expressive behaviours such as smiling and brow furrowing appear to differentiate between positive and negative emotions. For example, when facial electromyography is used to measure activity of the zygomatic (smiling), corrugator (brow furrowing), and orbicularis oculi (eye closing) muscles, both zygomatic and corrugator activity differentiate listening to positively compared to negatively valenced music, independently of arousal (Witvliet & Vrana, 2007). Specifically, pleasant-sounding music produces more smiling, whereas unpleasant-sounding music produces more brow furrowing. By contrast, orbicularis oculi activity and heart rate are associated primarily with arousal. In a study that collected self-report data in combination with physiological measures and expressive motor behaviors (Lundqvist, Carlsson, Hilmersson & Juslin, 2009), happy-sounding music elicited higher ratings of felt happiness compared to sad-sounding music, as well as lower ratings of felt sadness, more smiling, greater skin conductance, and lower finger temperature. Convergence across measures suggests strongly that listeners are experiencing emotions in response to music, rather than simply perceiving the emotions music conveys.

Emotionally evocative music also activates brain regions that are involved in emotion and reward processing, including limbic and paralimbic areas (see Koelsch, 2010; Peretz, 2010 for reviews). Specifically, changes in activity have been reported in the amygdala, hippocampus, ventral striatum (including the nucleus accumbens, the so-called pleasure centre of the brain), parahippocampal gyrus, orbitofrontal cortex, temporal poles, ventral tegmental area, insula, and anterior cingulate cortex (e.g., Blood & Zatorre, 2001; Blood, Zatorre, Bermudez, & Evans, 1999; Brown, Martinez, & Parsons, 2004; Koelsch, Fritz, Cramon, Müller, & Friederici, 2006; Menon & Levitin, 2005; Mitterschiffthaler, Fu, Dalton, Andrew, & Williams, 2007; Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011; Trost, Ethofer, Zentner, & Vuilleumier, 2012). Such changes in activity have been observed in response to happy- compared to sad-sounding music (Mitterschiffthaler et al., 2007), to consonant or pleasant-sounding music compared to dissonant or unpleasant-sounding music (Blood et al., 1999; Koelsch et al., 2006; Menon & Levitin, 2005), to unfamiliar but well-liked music (Brown et al., 2004), and to intensely positive musical experiences (i.e., chills; Blood & Zatorre, 2001; Salimpoor et al., 2011).

One goal of future research could be to identify which brain structures are involved in particular emotional responses instead of simply distinguishing between positive or negative responding. In one instance, the left striatum and insula were activated during positive, high-arousal emotions, whereas the right striatum and orbitofrontal cortex were activated during positive, low-arousal emotions (Trost et al., 2012). As with the physiological measures, then, the neurological measures are more successful at measuring changes in arousal than in valence.

Although the available evidence indicates that music evokes emotional responding in listeners, it should be noted that musical emotions are usually more strongly perceived than felt (Evans & Schubert, 2008; Hunter, Schellenberg, & Schimmack, 2010; Schubert 2007a, 2007b; Zentner, Grandjean, & Scherer, 2008; for a discussion see Gabrielsson, 2002). Thus, even if listeners are capable of perceiving the intended emotion, they may not always experience the same emotion. In line with this view, Hunter et al. (2010) reported that felt emotions in response to music are mediated by perceived emotions. In other words, when listeners respond emotionally to music, they typically do so after perceiving the conveyed emotion. Moreover, although perceived and felt emotions tend to be highly associated, they are not identical (Evans & Schubert, 2008; Hunter et al., 2010; Kallinen & Ravaja, 2006), and the emotion conveyed by music may differ quantitatively and qualitatively from the emotion that is felt. For example, several studies have found that fear and anger are often confused in perception studies (Gabrielsson & Juslin, 1996; Krumhansl, 1997; Terwogt & van Grinsven, 1991), perhaps because listeners confuse the conveyed emotion of anger with the felt emotion of fear.

In sum, there is ample evidence that music has the capacity to induce emotions in listeners, who report experiencing emotions while they listen to music, and who exhibit physiological, behavioral, and neuropsychological reactions that are markers of emotional responding. Nevertheless, further research could clarify several issues. First, the physiological, behavioral, and neuropsychological correlates of particular emotions remain underspecified, and it is poorly understood which responses reflect the induction of a specific emotion (e.g., joy) rather than, for example, the simple experience of pleasure or liking, the listener's arousal level, or the influence of a musical dimension (e.g., fast tempo) that is not necessarily accompanied by emotional responding. Second, responses should be compared across contexts in which emotions are actually felt or only perceived. A more nuanced understanding of emotional responding to music could help to clarify the nature of particularly complex responses, such as when listeners respond positively to sad-sounding music.

4. WHICH EMOTIONS DOES MUSIC INDUCE?

A related debate centers on the nature of emotions that music evokes. Some researchers (e.g., Konečni, 2008; Scherer, 2004; Zentner et al., 2008) claim that music induces *aesthetic* emotions, such as feelings of wonder, transcendence, nostalgia, power, and tension, which differ from everyday or *utilitarian* emotions, such as happiness, sadness, anger, and fear. Scherer (2004) argues that the major difference between these two classes of emotions is that utilitarian emotions involve goal-relevant and coping-related cognitive appraisals, whereas aesthetic emotions involve subjective pleasure in response to the physical qualities of the stimulus itself. In other words, aesthetic emotions lack direct personal relevance insofar as they do not motivate adaptive action tendencies such as fleeing during the experience of fear.

Zentner et al. (2008) conducted a series of self-report studies designed to examine the most common emotions that are experienced (as opposed to perceived) during music listening. Factor-analytic approaches uncovered nine dimensions: wonder, transcendence, tenderness, nostalgia, peacefulness, power, joyful activation, tension, and sadness. Notably, these "music-specific" emotions differed markedly from basic or discrete emotions (e.g., interest, joy, surprise, sadness, anger, disgust, contempt, fear, shame, and guilt). Moreover, the music-specific approach provided a better account of variance in listeners' self-reports compared to models of discrete emotions or a commonly used model of emotions that relies on two bipolar dimensions (i.e., high to low arousal, positive to negative valence).

Nevertheless, the conclusion that musical emotions are domain-specific may be premature. Although individuals with a variety of music preferences (i.e., classical, jazz, pop/rock, Latin American, techno) were included in Zentner et al.'s (2008) initial samples, the samples used to test the nine-factor model were comprised largely of listeners who preferred classical music. This sampling bias is problematic because emotions that were experienced in response to music differed according to the genre of music that listeners preferred. For example, feelings of amazement (part of the dimension termed *wonder*) and peacefulness were frequent only among fans of classical music. In general, emotions that music induces may depend largely on the particular genre (e.g., anger in heavy metal music, sadness in blues, joy in upbeat pop; for preliminary evidence see Eerola, 2011). Individual differences in personality are also associated with preferences for specific musical genres (e.g., Rentfrow, Goldberg, & Zilca, 2011; Rentfrow & Gosling, 2003, 2006; Zweigenhaft, 2008) precisely because different genres express and induce different emotions. Individuals who prefer pop, rap, and dance music tend to be high in extraversion (Rawlings & Ciancarelli, 1997; Rentfrow & Gosling, 2003), and extraversion is associated with the propensity to experience positive affect (e.g., Costa & McCrae, 1980; McCrae & Costa, 1991). Thus, extraverts may seek out music that is high in arousal and positive in valence. In short, firm conclusions about emotions evoked frequently by music require representative samples of the general population rather than restricted groups of individuals who prefer one particular genre.

In Juslin et al.'s (2008) experience-sampling study, college students were asked about their current emotional state using a predetermined set of 14 emotion terms that included basic (utilitarian) as well as aesthetic emotions. Negative basic emotions such as shame/guilt and disgust/contempt were almost never experienced in response to music, but they were experienced rarely in nonmusical contexts as well. In any event, listeners experienced basic emotions in response to music in addition to aesthetic emotions. Importantly, positive emotions such as calm/contentment, happiness/elation, and nostalgia/longing tended to be experienced more frequently in musical contexts, whereas negative emotions such as boredom/indifference, anger/irritation, and anxiety/fear tended to be experienced more frequently in nonmusical contexts. In other words, music may induce a wide variety of basic *and* aesthetic emotions, and music's widespread appeal may be related to the fact that such emotions are typically positive.

4.1. Chills

Music-induced chills (or thrills; Goldstein, 1980) are perhaps the strongest emotional responses to music. Chills refer to a tingling sensation or shivers, usually felt in the back of the neck or upper back and sometimes accompanied by piloerection (goosebumps). In Goldstein's (1980) study, about half of the sample claimed to experience chills in response to music, although subsequent research indicated that chills may be more common among musicians than nonmusicians (Sloboda, 1991). The tendency to experience chills is also a marker of openness-to-experience (McCrae, 2007; Silvia & Nusbaum, 2011), a personality trait associated with aesthetic appreciation and intellectual curiosity. Although chills can be elicited by a variety of stimuli (e.g., pictures or art, non-musical sounds or speech, tactile stimulation, gustatory stimulation, imagination or memories), chills in response to music tend to be experienced as especially pleasant (Goldstein, 1980; Grewe, Katzur, Kopiez, & Altenmüller, 2010). Huron (2006) argues that chills occur when a surprising stimulus is initially and automatically perceived as a potential threat, which leads to piloerection similar to what is experienced in contexts that evoke a fight response. When a musical stimulus is subsequently appraised as nonthreatening, pleasure arises.

Among musicians, chills tend to coincide with particular musical features, specifically unexpected harmonies (Sloboda, 1991). When nonmusicians *and* musicians are studied, chills often coincide with unexpected musical events or sudden musical changes, including unexpected harmonies as well as sudden changes in loudness, shifts between solo instrument and orchestral textures, and sustained high pitches (e.g., Grewe, Nagel, Kopiez, & Altenmüller, 2007; Guhn, Hamm, & Zentner, 2007; Panksepp, 1995). On a more global level, slow-tempo pieces are more likely than fast-tempo pieces to elicit chills (Guhn et al., 2007), and chills are more likely to occur in response to emotionally evocative music compared to relaxing or arousing music, or to emotionally evocative films (Rickard, 2004).

Chills tend to coincide most reliably with increases in skin conductance (e.g., Craig, 2005; Grewe et al., 2010; Grewe, Kopiez, & Altenmüller, 2009; Guhn et al. 2007; Rickard, 2004; Salimpoor et al., 2011; Salimpoor, Benovoy, Longo, Cooperstock, & Zatorre, 2009; but see Blood & Zatorre, 2001), although there is also evidence of increases in heart rate and respiration rate, and of decreases in temperature and amplitude of blood-volume pulse (e.g., Blood & Zatorre, 2001; Grewe et al., 2009; Guhn et al., 2007; Salimpoor et al., 2011, 2009). The subjective experience of chills coincides with increased activity in the ventral striatum and dorsomedial midbrain, as well as with decreases in the amygdala, hippocampus, and ventromedial prefrontal cortex (Blood & Zatorre, 2001). In short, intensely pleasurable musical experiences are associated with brain circuitry involved in reward and emotion processing.

Salimpoor et al. (2011) used PET, fMRI, and physiological measures to examine the role of dopamine in experiences of chills, as well as the time course of associated changes in brain activity. The participants were individuals who reported experiencing chills often and consistently in response to music. Music-induced chills coincided with dopamine release in the ventral and dorsal striatum, specifically in the right nucleus accumbens and the right caudate. Activity in the nucleus accumbens was highest during the actual chill experience, whereas activity in the caudate was highest during the anticipatory period leading up to the chill. Furthermore, self-reports of chill intensity and degree of pleasure were correlated with dopamine release in the nucleus accumbens. Because subjective pleasure continued to correlate positively with striatum activity when instances that included chills were excluded from the analyses, chills are not necessary for activation of critical brain areas. Rather, music-induced chills are indicators of intensely pleasant emotional responses, which recruit the brain's pleasure centers.

4.2. Liking Music

Most of the research on music and emotions has examined perceptions and feelings of happiness, sadness, and other specific emotions. A more basic response to music is simply whether listeners like it or not. In other words, emotional responding to music occurs on two levels: one concerning the specific emotion music conveys and/or evokes such as happiness or sadness, the other relating to the listener's evaluation (Hunter & Schellenberg, 2010). Evaluations occur in response to individual pieces of music as well as to entire genres. Most of the research concerning evaluative responses examines preferences for specific genres of music (e.g., classical, alternative, jazz) and how these are related to other individual-difference variables (for a review see Rentfrow & McDonald, 2010). Our focus here is on liking unfamiliar *pieces* of music. In studies of liking unfamiliar pieces, the influence of pre-existing genre preferences can be minimized by including music stimuli from a wide variety of genres, or by using stimuli from a single genre. The issue of liking music has important ramifications for music cognition because listeners remember music they like better than music they dislike or respond to neutrally (Stalinski & Schellenberg, 2012).

One variable that plays an important role is familiarity. Listeners often like music they have heard before. Listeners also grow to dislike music they have heard repeatedly, or too often in a short timeframe. Such increases and decreases in liking music as a function of exposure were documented by Szpunar, Schellenberg, and Pliner (2004). In an initial exposure phase, their listeners heard six different excerpts, each from a recording of a different concerto (i.e., an orchestral piece with a lead instrument). The excerpts were heard twice, eight times, or 32 times, with two excerpts assigned to each exposure frequency. To ensure that participants listened to each presentation of each excerpt, they were asked to identify the lead instrument (e.g., piano, violin, and so on). In the next phase, they heard 12 excerpts (6 from the exposure phase, 6 new) and made liking judgments. Liking was higher for excerpts heard 8 times compared to those heard twice in the exposure phase, and for excerpts heard twice compared to novel excerpts. Excerpts heard 32 times were liked no better than novel excerpts. Because the different excerpts were assigned randomly to the different exposure frequencies, differences in inherent likeability did not affect the results. Another group of listeners was tested similarly except that during the exposure phase, they heard the excerpts presented softly in one ear while they listened closely to a narrated story in the other ear. These listeners showed monotonic increases in liking as a function of exposure frequency. In other words, decreases in liking for music as a consequence of over-exposure were evident only when listeners were required to listen intently to the music.

In a follow-up study (Hunter & Schellenberg, 2011), participants were tested identically in the focused-listening condition, but they also completed a questionnaire measuring individual differences on the "big five" personality dimensions. As in Szpunar et al. (2004), the same inverted-U shaped function was evident for listeners in general: increases in liking up to 8 exposures but decreases from 8 to 32 exposures. Tests of interactions with personality revealed that openness-to-experience moderated the association between liking and exposure frequency. Although listeners who scored low on openness showed the same response pattern as in the earlier study, listeners who scored high on openness liked novel excerpts equally to those they heard twice, followed by a monotonic decrease in liking with additional exposures. More generally, high-openness listeners showed elevated levels of liking novel music and a steeper decline in liking as a function of over-exposure.

In another study (Schellenberg, Peretz, & Vieillard, 2008), the music excerpts were obviously happy- or sad-sounding pieces of MIDI-generated piano music heard 0, 2, 8, or 32 times. As in Szpunar et al. (2004), exposure occurred during either focused or incidental listening, but listeners in the focused condition were required to identify whether each excerpt sounded happy or sad. For them, liking was again an inverted-U shaped function of exposure frequency, but liking peaked at 2 rather than 8 exposures, either because of the orienting task (identification of emotion vs lead-instrument) or the stimuli (MIDI-generated piano timbre vs real orchestras). As in the earlier study, liking increased monotonically as a function of exposure for listeners who heard the excerpts incidentally. A novel finding indicated that although the happy-sounding excerpts were preferred over the sad-sounding excerpts in the liking phase for focused listeners, this bias disappeared for listeners in the incidental condition.

When children are asked to rate how much they like music that expresses different emotions, they prefer pieces that express high-arousal emotions (happiness or fear) over those that express low-arousal emotions (peacefulness or sadness) while ignoring the distinction between positive (happiness and peacefulness) and negative (fear and sadness) valence (Hunter, Schellenberg, & Stalinski, 2011). Adults show the exact opposite pattern, preferring music that expresses positive rather than negative valence, while ignoring differences in arousal.

As noted, listening to music tends to evoke positive emotions more frequently than negative emotions (e.g., Gabrielsson, 2001; Juslin & Laukka, 2004; Juslin et al., 2008). It is also well documented that listeners tend to *prefer* happy- over sad-sounding music (Hunter, Schellenberg, & Schimmack, 2008; Husain et al., 2002; Khalfa et al., 2008; Ladinig & Schellenberg, 2012; Schellenberg et al., 2008; Thompson, Schellenberg, & Husain, 2001; Vieillard et al., 2008). Nevertheless, people often choose to listen to sad-sounding music (e.g., Zentner et al., 2008), which they obviously enjoy (e.g., Garrido & Schubert, 2011; Kreutz, Ott, Teichmann, Osawa, & Vaitl, 2008; Vuoskoski & Eerola, 2012; Vuoskoski, Thompson, McIlwain, & Eerola, 2012). Because sadness is a negative emotional state, these findings beg the question of why people would want to listen to sad-sounding music.

The cognitivist perspective holds that listeners only perceive sadness but do not in fact experience the emotion while listening to sad-sounding music (Kivy, 1989; Konečni, 2008), which leaves them free to enjoy the music without any negative affect. A related proposal (Garrido & Schubert, 2011; Schubert, 1996) suggests that displeasure is inhibited in aesthetic contexts. According to this view, negative emotions conveyed by music may induce emotion but it is experienced as positive rather than negative. Listeners claim that music actually induces sadness at times (e.g., Juslin & Laukka, 2004; Juslin, Liljeström, Laukka, Västfjäll, & Lundqvist, 2011; Juslin et al., 2008; Vuoskoski et al., 2012), however, with converging evidence from measures of expressive behavior (e.g., Witvliet & Vrana, 2007) and neuroimaging studies (e.g., Mitterschiffthaler et al., 2007; Trost et al., 2012). Sad-sounding music has also been shown to produce "depressive realism", a state in which individuals rate their skills and traits in a more realistic manner than the positive bias that is usually present in non-depressive states (Brown & Mankowski, 1993). In one experiment, sad-sounding music was liked whereas scary-sounding music was disliked (Vuoskoski et al., 2012), which provides additional evidence that displeasure is experienced in response to music, contrary to Schubert's (1996) proposal.

Vuoskoski and Eerola (2012) examined whether sadness could be induced by sad-sounding music using indirect behavioral measures of emotional responding. One measure was a picture-judgment task in which participants rated ambiguous facial expressions on a number of affective dimensions. Sad-sounding music that participants selected (which tended to evoke sad autobiographical memories) induced sad feelings as indicated by heightened perception of sadness in the ambiguous faces, an affect-congruent bias that is also evident in nonmusical domains (Bouhuys, Bloem, & Groothuis, 1995; Parrott & Sabini, 1990). Experimenter-selected neutral music did not produce such biases, and only participants who scored high on an empathy scale showed signs of increased sadness in response to experimenter-selected, sad-sounding music. These results are in line with proposals that episodic memories play an important role in music-induced sadness, and that some individuals experience such sadness through an emotional-contagion mechanism (Juslin & Västfjäll, 2008).

Other research reveals that individuals with particular personality traits are more likely than other individuals to experience sadness and to enjoy sad-sounding music. For example, agreeableness and neuroticism are associated positively with sad responding to music; agreeableness is also associated positively with intensity of emotional responding (Ladinig & Schellenberg, 2012). Liking sad-sounding music tends to decrease among those who score high on extraversion (Ladinig & Schellenberg, 2012), but it increases among those who score high on openness-to-experience (Ladinig & Schellenberg, 2012; Vuoskoski et al., 2012), empathy (Garrido & Schubert, 2011; Vuoskoski et al., 2012), and absorption (i.e., the tendency to become deeply focused and engaged in mental imagery; Garrido & Schubert, 2011; Kreutz et al., 2008). Aesthetic sensitivity is one facet of openness-to-experience (Costa

& McCrae, 1992), whereas absorption is associated with involvement in the arts (Wild, Kuiken, & Schopflocher, 1995), both of which implicate aesthetic appreciation in the enjoyment of sad-sounding music. In addition, empathic individuals may be more likely to experience intense emotions conveyed by music, and the intensity of listeners' emotional response to a musical piece is associated positively with liking it (Ladinig & Schellenberg, 2012; Vuoskoski et al., 2012). Thus, individuals who are most likely to experience actual sadness in response to sad-sounding music may also tend to enjoy it the most.

Situational factors also play a role in liking sad-sounding music. When the typical preference for happy-sounding music was eliminated after participants completed a long and arduous task in the Schellenberg et al. (2008) study, the authors provided two possible explanations: (1) the task induced a negative mood in listeners, who therefore appreciated listening to mood-congruent music, or (2) sad-sounding music had a calming effect on the fatigued listeners. In a follow-up experiment, sad mood was induced by having participants describe feelings that they experienced in response to emotionally evocative pictures (Hunter, Schellenberg, & Griffith, 2011). This manipulation eliminated the preference for happy-sounding music, a finding consistent with the hypothesis that sad-sounding music is appreciated when listeners are in a mood-congruent (sad) mood. Another important situational factor involves the listening context. After repeated presentation of different pieces of happy-sounding music, music that conveys sadness evokes more intense feelings and it is appreciated more (Schellenberg, Corrigall, Ladinig, & Huron, 2012).

Huron (2011) proposes a neurochemical explanation—as yet untested empirically—for why sad-sounding music can be experienced as enjoyable. He argues that music induces sadness through a number of different mechanisms, including empathy (e.g., identifying with and feeling the emotions of the composer or performer that are conveyed through musical features), learned associations between particular musical features and emotions, and cognitive ruminations about sad life events that are triggered by sad-sounding music. Thus, according to Huron, genuine sadness is evoked by music. Because the peptide hormone *prolactin* is released during states of sadness (Turner et al., 2002), and because this hormone is thought to induce feelings of comfort, consolation, and tranquility, Huron proposes that the enjoyable effects of sad-sounding music are a consequence of the positive effects of prolactin. He argues that the brain is "tricked" into thinking it is experiencing true psychic pain, as in an unfulfilled life goal. In this way, sad-sounding music's effect on prolactin is akin to the way that opiates mimic endorphin release, producing pleasure.

Enjoyment of sad-sounding music may also be a consequence of the fact that music is relatively unique in its ability to evoke paradoxical feelings. For example, sad-sounding music is enjoyed significantly more than recalling sad events (Vuoskoski & Eerola, 2012). In other words, sad-sounding music may induce *mixed* emotions in listeners rather than negative emotions alone.

In line with this view, sad-sounding music induces sadness but also positive emotions such as nostalgia, peacefulness, and wonder (Vuoskoski et al., 2012). Furthermore, Eerola and Vuoskoski (2011) found that sad but not happy perceived emotion was correlated with ratings of beauty (see also Gabrielsson & Lindström, 1993). Thus, one reason why people like sad-sounding music is that they simultaneously experience positive emotions on the evaluative level, as well as negative emotions on the emotional-response level.

5. Musical Emotion Research and the Structure of Emotions

Evidence for mixed emotional responding to music has implications for structural models of emotion. The *circumplex model* (Russell, 1980, 2003; Russell & Carroll, 1999), used widely in research on music and emotion, proposes that different emotions can be mapped in two dimensions: arousal (low to high) and valence (negative to positive). Happiness, for example, is described as having higher than average arousal and positive valence, whereas sadness has low arousal and negative valence. One assumption of this model is that negative and positive valence lay at opposite ends of the same continuum and therefore cannot be felt at the same time. This assumption is closely related to the use of particular measurement techniques, such as bipolar scales that designate one end as negative and the other as positive. Bipolar scales allow for neutral feelings but prevent participants from reporting both positive and negative emotions. By contrast, the *evaluative space model* (Cacioppo & Berntson, 1994) proposes that positive and negative valence are activated independently rather than reciprocally, at least in some circumstances. In line with this view, studies have shown that mixed emotions occur in many non-musical situations (e.g., Diener & Iran-Nejad, 1986; Larsen, McGraw, & Cacioppo, 2001: Larsen, McGraw, Mellers, & Cacioppo, 2004; Larsen, Norris, McGraw, Hawkley, & Cacioppo, 2009; Schimmack, 2001).

Music may be an ideal stimulus to evoke mixed feelings because it has different dimensions that can vary independently. For example, in the case of tempo, fast tempi are associated with happiness whereas slow tempi are associated with sadness. In the case of mode, major modes are associated with happiness whereas minor modes are associated with sadness. Thus, unambiguously happy-sounding music is major and fast, whereas sad-sounding music is minor and slow. But what about pieces of music with conflicting emotional cues, such as many pieces of dance music from recent years that tend to be fast and minor (Schellenberg & von Scheve, 2012)?

Evidence of mixed feelings can be found when each emotion is measured on a separate unipolar scale ranging from *none at all* to *extremely*. This is the approach taken in a series of studies that asked whether listeners feel and perceive mixed emotions when they hear music with conflicting cues to happiness and sadness (Hunter et al., 2008, 2010; Ladinig & Schellenberg, 2012). The general approach was to vary tempo and mode in a factorial design, such that the music stimuli had consistent cues to happiness (fast and major), consistent cues to sadness (slow and minor), or inconsistent cues (fast and minor or slow and major). Happiness and sadness were measured separately in response to each piece. As one would expect, perceived and felt happiness was highest in response to the fast and major pieces, lowest for slow and minor pieces, and intermediate for pieces with inconsistent cues. Sadness ratings showed the opposite pattern. A novel finding indicated that simultaneous happy *and* sad responding was greater in response to music with conflicting cues than for music that sounded clearly happy or sad. These patterns were evident whether the music stimuli were highly controlled pieces manipulated with MIDI (Hunter et al., 2010), or excerpts from actual recordings (Hunter et al., 2008; Ladinig & Schellenberg, 2012).

Subsequent research tested whether happiness and sadness are actually felt simultaneously rather than rapidly in succession (Larsen & Stastny, 2011). While listening to the excerpts used in earlier studies (Hunter et al., 2008; Ladinig & Schellenberg, 2012), participants pressed one button when they felt sad, and another button when they felt happy. Although mixed emotions were relatively rare, they occurred simultaneously rather than in an alternating fashion. Moreover, Damasio et al. (2000) reported that emotional states of happiness and sadness were associated with qualitatively different patterns of brain activation, which implies that the neural substrates underlying these emotions differ and can therefore be activated independently (or at the same time). In sum, research on music and emotions has contributed to the debate among emotion researchers concerning whether valence should be measured on one or two dimensions, with the evidence siding firmly on the two-dimensional approach, which allows for mixed feelings.

6. Influences of Informal and Formal Music Experience

Exposure to music can be informal or formal. *Informal* experience refers to simple exposure that occurs when people hear music in everyday life. Virtually all individuals with normal hearing have informal musical experience that they acquire through passive music listening, which can be focused (e.g., listening to music through headphones, attending a concert) or incidental (i.e., music heard in the background while doing something else). By contrast, *formal* experience is acquired by taking music lessons and studying music theory, such that musically trained individuals acquire explicit knowledge about musical scales, harmony, and other structural features of music.

Effects of informal exposure are typically examined developmentally. With increases in age, children have more music-listening experiences, which are accompanied by the development of general cognitive and perceptual skills (e.g., memory, attention) that play a role in children's responses when they are tested in the laboratory. Informal exposure to music can also be examined cross-culturally. Because musical systems differ across cultures, individuals from different cultures have different music-listening experiences. Finally, effects of music lessons are typically studied by comparing individuals with or without formal training in music.

6.1. Informal Experience and Development

Listening experiences shape children's capacity to perceive and experience musical emotions. As noted, the perception and induction of such emotions depends on listeners' sensitivity to the structural aspects of music (Meyer, 1956; Huron, 2006). Because these structural aspects differ across cultures and it takes many years to become fully enculturated, one might predict a long developmental trajectory (Hannon & Trainor, 2007). As we will see, however, infants and young children perceive musical emotions, although their responses depend on different cues to emotion than those that are important for older listeners. To date, studies have focused almost exclusively on children's ability to identify the emotions expressed by music, rather than on their actual emotional responses. Moreover, research has tended to examine the perception of basic emotions such as happiness and sadness, rather than aesthetic emotions such as wonder and awe.

It is well known that parents speak and sing to their infants in a manner that it is more musical than adult-directed speech and singing by using higher overall pitch, exaggerated pitch contours, and a slower rate (e.g., Fernald, 1991; Papoušek, 1992; Trainor, Clark, Huntley, & Adams, 1997). Communication of emotion and the promotion of infant-parent bonding appear to be central to this infant-directed mode of communicating (Dissanayake, 2000; Trainor, 1996; Trehub & Trainor, 1998), with infants preferring infant- over adult-directed speech and singing (Cooper & Aslin, 1990; Trainor, 1996; Werker & McLeod, 1989). Moreover, the emotional tone of infant-directed singing affects infants' behavior. Whereas lullabies cause them to focus on themselves as if preparing to sleep, playsongs cause them to attend closely to their caregiver (Rock, Trainor, & Addison, 1999). Although 5- to 9-month-olds associate happy-sounding music with a happy face, they do not appear to associate sad-sounding music with a sad face (Nawrot, 2003), possibly because of a general tendency to avoid displays of sadness.

Other research suggests that instrumental music influences infants' arousal level without inducing positive or negative valence. For example, although EEG reveals lateralization in brain activity among adult listeners in response to joyful- compared to sad- and fearful-sounding musical excerpts (Schmidt & Trainor, 2001), these effects are absent in infant listeners (Schmidt, Trainor & Santesso, 2003). Rather, brain-activation patterns suggest that music heightens arousal in 3-month-olds, has little effect for 6- to 9-month-olds, and lowers arousal in 12-month-olds. Future research could attempt to verify whether infants experience variations in valence in response to music in addition to variations in arousal.

Even though preschoolers can identify emotions conveyed by music in certain situations, the perception of emotions conveyed musically develops with age. Young children rely primarily on basic acoustic cues that are common to both vocal and musical expression of emotion. For example, 4- and 5-year-olds use tempo as a cue to emotion, associating a fast tempo with happiness and a slow tempo with sadness (Dalla Bella, Peretz, Rousseau, & Gosselin, 2001; Mote, 2011). Such associations are more reliable when the music is vocal rather than instrumental (Dolgin & Adelson, 1990). There is also a gender difference among 5- and 8-year-olds in the ability to identify emotions expressed musically, with girls outperforming boys (Hunter et al., 2011).

When children are asked to convey emotions by singing, they tend to use basic acoustic cues that are shared with vocally expressed emotions. For example, 4- to 12-year-olds use tempo (fast = happy, slow = sad), loudness (loud = happy, soft = sad), and pitch (high = happy, low = sad; e.g., Adachi & Trehub, 1998). Although children also tend to convey emotion through their facial expressions while they sing, both adults and 6- to 10-year-old children are more successful at perceiving children's intended emotion from auditory cues than from visual cues (Adachi & Trehub, 2000). By 8 to 10 years of age, children are *better* than adults at perceiving the intended emotion of same-age children's sung performances (Adachi & Trehub, 2000; Adachi, Trehub, & Abe, 2004). Perhaps adults perform relatively poorly on this task because they cannot help but attend to culture-specific cues in addition to culture-general cues, even though such cues are absent or unreliable in children's singing.

As children age and acquire more exposure to their culture's music, they become increasingly sensitive to the emotional connotations of culture-specific cues. For example, 6- to 8-year-olds associate the major mode with happiness and the minor mode with sadness, but younger children fail to do so (Dalla Bella et al., 2001; Gerardi & Gerken, 1995; Gregory, Worrall, & Sarge, 1996; but see Kastner & Crowder, 1990 for evidence of an earlier emergence). Nevertheless, although 6- to 12-year-old children make use of culture-specific cues such as mode, they rely more heavily on temporal cues (which are not specific to Western music) when making judgments of happiness/sadness and of excitement/calmness (Kratus, 1993).

Specifically, rhythmic activity (i.e., the amount of activity regardless of the tempo; greater activity is associated with both happiness and excitement), meter (i.e., duple meter is associated with calmness, triple meter with excitement), and note articulation (i.e., staccato notes are associated with happiness, legato notes with sadness) are significant predictors of children's emotional judgments. In short, the temporal organization of music provides especially useful cues to emotions for children. Even when children have learned to associate particular features of their culture's music with specific emotions, universal cues to emotion often continue to take precedence.

In real music, emotion is expressed simultaneously through a variety of cues. When real music is used as stimuli, even 4-year-olds identify happiness expressed by melodies (Dolgin & Adelson, 1990) or excerpts from orchestral pieces (e.g., Cunningham & Sterling, 1988; Terwogt & van Grinsven, 1991). In an indirect test of children's emotion perception, Ziv and Goshen (2006) played a fast-major melody, a slow-minor melody, or no music while 5- to 6-year-olds listened to an emotionally neutral story. Because the emotion expressed by the music influenced children's interpretation of the emotional tone of the story, the results provide converging evidence that children have an implicit understanding of emotions expressed musically. Successful emotional identification, however, depends on the particular emotion that is examined. When researchers test the identification of happy-, sad-, angry-, and scary-sounding music, children and even adults often confuse fear and anger (e.g., Dolgin & Adelson, 1990; Terwogt & van Grinsven, 1991; Robazza, Macaluso, & D'Urso, 1994). Findings that children identify facial displays of happiness earlier in development compared to other emotions (e.g., Gao & Maurer, 2009, 2010), suggest that happiness is easy to identify across modalities.

In general, happiness and sadness may be better identified than anger and fear because of their uniqueness in terms of arousal and valence. Of the four emotions, happiness is the only one with positive valence, sadness is the only low-arousal emotion, whereas fear *and* anger are both high-arousal emotions with negative valence.

When Hunter et al. (2011) tested 5-, 8- and 11-year-olds' identification of four emotions with arousal and valence crossed in a factorial manner, children better identified high-arousal emotions (happiness or fear) than low-arousal emotions (peacefulness or sadness). Children are also easily influenced by conflicting emotions expressed by the semantic content of lyrics, failing to ignore the words when asked to judge the emotion conveyed by a singer's voice (Morton & Trehub, 2007).

The study of the development of sensitivity to emotions expressed musically leaves us with many unanswered questions that could be addressed in future research. For example, when and how do children actually experience emotions in response to music? Do young children experience complex aesthetic emotions, such as awe or wonder to certain musical pieces, and can they perceive and/or feel mixed musical emotions? And how does children's developing knowledge of musical structure affect their perception of musical emotions?

6.2. Informal Experience and Culture

The music of other cultures can sound strange, especially if it uses different tonal systems, metrical structures, and timbres. One might therefore expect music's expressed emotion to be lost on listeners raised in a different musical culture. Listeners are surprisingly accurate, however, at identifying the intended emotion conveyed in foreign, unfamiliar music. Balkwill and Thompson (1999) proposed the *cue redundancy model* to explain this phenomenon, suggesting that performers use both culture-specific cues as well as basic acoustic cues to express emotions in the music they play. Because no musical enculturation is required to decode basic acoustic cues, unfamiliar listeners are often able to perceive the intended emotional message in foreign music.

In one cross-cultural study, North American listeners could successfully identify happiness, sadness, and anger in Hindustani (Indian) ragas, but they had trouble identifying peacefulness (Balkwill & Thompson, 1999). A follow-up study confirmed that Japanese listeners perceive happiness, sadness, and anger in familiar music (traditional Japanese and Western music) as well as in unfamiliar music (Hindustani ragas; Balkwill, Thompson, & Matsunaga, 2004). Japanese adults and 8- to 10-year-old children can also identify whether Canadian 8- to 10-year-olds are trying to express happiness or sadness in their singing, with children actually outperforming adults on this task (Adachi et al., 2004). There is also remarkable agreement about the emotions expressed in traditional Greek music between foreign (Italian and British) and native (Greek) listeners, especially for particular emotions (Zacharopoulou & Kyriakidou, 2009). Specifically, happiness, sadness, and anger are more easily identified than fear. Even the Mafa tribe of Cameroon—with little or no exposure to Western music—can identify happiness, sadness, and fear expressed in Western music at above-chance levels (Fritz et al., 2009). Thus, listeners often perceive the intended emotion conveyed by music from a foreign culture by relying on general acoustic cues that are used across cultures.

6.3. Formal Music Training

Formal music training does not have a strong effect on the perception of emotion in music. For example, Hevner (1935) found that individuals who scored high on a measure of musical talent were only slightly better at associating major and minor modes with positive and negative affective terms, respectively. More recent results confirm that music training has little influence on the perception of emotion in music (Bigand, Vieillard, Madurell, Marozeau, & Dacquet, 2005; Ramos, Bueno, & Bigand, 2011; Robazza et al., 1994; Terwogt & van Grinsven, 1991). These results may not be surprising in light of the fact that much of emotion perception in music can be decoded from basic acoustic cues that are also present in vocal expressions of emotion. The effect of music training on decoding emotions in speech prosody is also inconsistent (Lima & Castro, 2011b; Thompson, Schellenberg, & Husain, 2004; Trimmer & Cuddy, 2008). Moreover, even though music training is associated with cognitive abilities (for a review see Schellenberg & Weiss, 2013), it has little or no association with emotional intelligence in adulthood (Resnicow, Salovey, & Repp, 2004; Schellenberg, 2011; Trimmer & Cuddy, 2008) or childhood (Schellenberg & Mankarious, 2012).

Some studies, however, have found a positive association between music training and the perception of emotions expressed musically, both in children (Yong & McBride-Chang, 2007) and adults (Lima & Castro, 2011a). One possibility is that effects of training are more likely to be evident in the perception of *subtle* musical emotions (Sloboda, 1985). In line with this view, compared to untrained listeners, musically trained individuals show higher liking for music that expresses mixed emotions (Ladinig & Schellenberg, 2012). Future research could examine further the effects of training on the perception of aesthetic compared to basic emotions, or on the perception of emotions in music with ambiguous cues.

CONCLUSION

The available evidence reveals that music is capable of conveying as well as inducing a wide range of emotions in listeners, including basic emotions (e.g., happiness and sadness) as well as more complex aesthetic emotions (e.g., wonder, transcendence, nostalgia). Music also evokes particularly strong and positive emotional responses such as chills, and it can elicit mixed emotional responding, including simultaneous perceptions and feelings of happiness and sadness, and positive evaluations of sad-sounding music. To communicate emotion, music often borrows cues from vocal expression of emotion, particularly temporal cues such as tempo. Other cues to emotion, such as mode, are culture-specific. Young children make use of basic acoustic cues in order to decode musical emotions, and they learn to use culture-specific cues as they gain more exposure to music. Basic acoustic cues are also used to decode emotions expressed in music from a foreign and unfamiliar culture. In fact, musical emotions tend to be understood readily by almost everyone whether or not they have formal training in music. The universality of emotional responding to music is consistent with the claim that music is the language of emotion.

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