THE MALLEABILITY OF MUSIC PREFERENCES:
EFFECTS OF INDIVIDUAL DIFFERENCES AND THE LISTENING CONTEXT

By

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Abstract

Despite the ubiquity of music and its importance to one’s identity, there has been limited research on individual differences in music preferences. The aim of this dissertation was to examine how music preferences vary across individual differences in stable traits (e.g., gender, personality) and states (e.g., mood) over three studies. The focus of Study 1 was on the influence of the listener’s mood on emotion-based music preferences. The typical preference for happy- over sad-sounding music was found to be mood-dependent, evident after happy and neutral but not sad mood inductions. When the music was emotionally ambiguous (i.e., with cues to both happiness and sadness), happy listeners liked the music more than other listeners, whereas sad listeners perceived it to be more sad-sounding.

Study 2 examined how emotion-based music preferences develop. Adults and children 5, 8, and 11 years of age listened to short pieces expressing emotions that varied in arousal and valence: happiness (high, positive), scariness (high, negative), peacefulness (low, positive), or sadness (low, negative). Adults preferred pieces with a positive valence (happy and peaceful), whereas children preferred excerpts depicting high-arousal emotions (happy and scary).
Identification accuracy was predictive of a positive-valence bias among 5- and 8-year-olds. A number of other findings related to accuracy and gender differences were also evident.

Study 3 examined whether personality differences affect the influence of exposure on liking. Undergraduates completed the Big Five Inventory and provided liking ratings for novel music excerpts as well as for excerpts they heard 2, 8, or 32 times. Higher scores on Openness-to-Experience were related to greater liking for novel excerpts and more rapid satiation. In sum, these three studies highlight that music preferences vary as a function of individual differences and the listening context.
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Table of Contents

General Abstract .................................................. ii

List of Tables ................................................................ vii

List of Figures ................................................................ viii

List of Appendices ...................................................... ix

Opening Comments .................................................... 1

Study 1: Mood effects on liking for emotionally evocative music

Abstract ..................................................................... 5

Introduction ................................................................ 6

Experiment 1

Method ..................................................................... 9

Results and Discussion .............................................. 11

Experiment 2

Method ..................................................................... 14

Results and Discussion .............................................. 14

General Discussion ................................................... 16

Study 2: The development of music preferences

Abstract ..................................................................... 20

Introduction ................................................................ 21

Method ..................................................................... 27

Results ..................................................................... 29

Discussion .................................................................. 39

Study 3: Effects of Personality and Frequency of Exposure on Liking for Music
List of Tables

Table 1. Percentage of Each Response for Excerpts Depicting each Emotion 34

Table 2. Liking for music excerpts as a function of number of exposures 55
List of Figures

Figure 1. Ratings of liking (upper panel) and perceived emotion (lower panel) for happy- and sad-sounding music as a function of mood induction (Experiment 1). .......................................................... 13

Figure 2. Ratings of liking (upper panel) and perceived emotion (lower panel) for ambiguous-sounding music as a function of mood induction (Experiment 2). ........................................... 16

Figure 3. Mean identification accuracy and standard errors as a function of arousal and valence of the target emotion. .................................................................................................................. 31

Figure 4. Mean identification accuracy and standard errors as a function of age of the participant and arousal of the target emotion. ................................................................................................... 32

Figure 5. Mean identification accuracy and standard errors as a function of age and gender of the participant. .......................................................................................................................... 33

Figure 6. Mean liking ratings and standard errors as a function of gender of the participant and valence of the target emotion. .................................................................................................. 36

Figure 7. Mean liking ratings and standard errors as a function of age of the participant and valence of the target emotion. .................................................................................................. 37

Figure 8. Mean liking ratings and standard errors as a function of age of the participant and arousal of the target emotion. ........................................................................................................ 38

Figure 9. Liking for music excerpts as a function of number of exposures. .................................................................................................................. 54

Figure 10. Liking for music excerpts as a function of number of exposures and whether participants were high or low on Openness-to-Experience. .................................................. 56

Figure 11. Number of participants who exhibited each response style, calculated separately for participants who were high or low on Openness-to-Experience. .................................................. 57
List of Appendices

Appendix A: Pieces from which stimuli were excerpted in Study 1  81
Appendix B: Example of a happy picture used in Study 1  82
Appendix C: Example of a neutral picture used in Study 1  83
Appendix D: Example of a sad picture used in Study 1  84
Appendix E: Visual analogue liking scale used in Study 2  85
Appendix F: Line drawings of emotional faces used in Study 2  86
Appendix G: Pieces from which stimuli were excerpted in Study 3  87
Opening Comments

Music is a remarkably ubiquitous aspect of human culture. Across cultures, exposure to music begins in infancy with maternal singing (e.g., Trehub & Schellenberg, 1995; Trehub & Trainor, 1998). In the formative years of adolescence, music preferences are considered to be the strongest marker of identity (Rentfrow & Gosling, 2003). Questions of why music is important, what motivates people to listen to music, and why people like music have motivated much research. Broad theoretical approaches focus on the evolutionary purpose of music, with some scholars suggesting that music confers a selective advantage—by facilitating emotional communication (Juslin 2001), synchronicity and social cohesion (Brown, 2000), or attracting a mate (Darwin, 1871; Miller, 2000)—and others arguing that music is a mere by-product of other auditory preferences, akin to “auditory cheesecake” (Pinker, 1997). Music, of course, is not uniform, and other approaches have examined variations in liking for different music genres and pieces. Significant effects have emerged regarding the emotion expressed by the music and the listener’s degree of familiarity with a particular piece. These studies typically focus on responses averaged across heterogeneous groups of listeners. There are good reasons, however, to expect that responses would vary as a function of individual differences, including those that are relatively stable over time as well as those that are more transitory. The present dissertation examines whether liking for music is associated with the listeners’ age, stable individual differences (e.g., gender, personality), and contextual factors (e.g., mood).

A large body of literature links musical characteristics such as tempo and mode with the perception of emotions expressed in music (for a review, see Gabrielsson & Juslin, 2003). Far fewer studies have explored preferences for emotions expressed in music, with the notable exception of findings pointing to a reliable and robust preference among listeners for happy-
over sad-sounding music. This finding has been replicated using different stimuli (from short compositions to excerpts from commercial recordings), and multiple measures, including self-report ratings (of liking or pleasantness), facial muscle activity, and frontal electroencephalographic asymmetry (Hunter, Schellenberg, & Schimmack, 2008, 2010; Schmidt & Trainor, 2001; Thompson, Schellenberg, & Husain, 2001; Vieillard et al., 2008; Witvliet & Vrana, 2007). Nevertheless, there is much anecdotal evidence of people who listen to and prefer sad-sounding music (e.g., the blues, goth). Why would anyone listen to sad music if it makes them feel sad? A potential answer comes from one study (Schellenberg, Peretz, & Vieillard, 2008), which found that the happy-preference disappeared among listeners who had completed a demanding cognitive task. The authors suggested that the negative mood generated by the task influenced their listeners’ preferences.

A related question asks how preferences for emotionally evocative music develop. Is a preference for positive emotion (in music or more generally) innate, or does it develop with age? There is little evidence that children’s preferences vary as a function of age, but few studies have addressed this question directly. Adults typically find dissonant music to be unpleasant (Blood, Zatorre, Bermudez, & Evans, 1999; Stemmler, Heldman, Pauls, & Scherer, 2001), and even infants as young as 2 to 4 months of age show a preference for consonance over dissonance (Trainor, Tsang, & Cheung, 2002; Zentner & Kagan, 1996, 1998). Beyond dissonance, research on children’s musical preferences is relatively scarce. Nonetheless, because children’s perception of musically expressed emotions is under-developed (e.g., Terwogt & Van Grinsven, 1988), there could also be age-related differences in preferences for emotionally evocative music.
Familiarity is well-established as a factor that influences preferences for one stimulus over another. Increases in liking with frequency of exposure have been documented many times (see Bornstein, 1989), and this association extends to musical stimuli (e.g., Meyer, 1903; Moore & Gilliland, 1924; Mull, 1957; Peretz, Gaudreau, & Bonnel, 1998). Although the effect is consistent with anecdotal evidence that music becomes popular as it is played more often on the radio (Jakobovits, 1966), there is an equal amount of anecdotal evidence of disliking for music that is overplayed. Detrimental effects of over-exposure on liking have been documented experimentally with visual (e.g., Zajonc, Shaver, Tavris, & Van Kreveld, 1972) and musical stimuli (Schellenberg et al., 2008; Szpunar, Schellenberg, & Pliner, 2004). Nonetheless, individual differences may moderate or mediate the association between exposure and liking. For example, some people are able to listen to one song repeatedly, whereas others quickly move on, craving something new. In line with this view, although Zajonc et al. (1972) found a general inverted-U shaped association between liking for paintings and frequency of exposure, only 36% of their participants did, in fact, exhibit this association. A slightly smaller proportion (32%) had a linear decrease in liking as a function of exposure, whereas linear increases and upright-U relationships were evident in 19% and 13% of participants, respectively. To the best of our knowledge, no one has examined whether personality dimensions might help to explain individual differences in the association between exposure and liking.

The goal of the present dissertation is to examine these sorts of questions in a series of experiments. Study 1 focuses on the role of mood in emotion-based music preferences. Study 2 explores the development of emotion-based music preferences and their association with the ability to identify emotions expressed music. Study 3 examines whether personality factors can
explain inter-individual variability in the association between liking for music and frequency of exposure.
Study 1

Abstract

We examined emotional responses to music after mood induction. On each trial, listeners heard a 30-s musical excerpt and rated how much they liked it, whether it sounded happy or sad, and how familiar it was. When the excerpts sounded unambiguously happy or sad (Experiment 1), the typical preference for happy-sounding music was eliminated after inducing a sad mood. When the excerpts sounded ambiguous with respect to happiness and sadness (Experiment 2), listeners perceived more sadness after inducing a sad mood. Sad moods had no influence on familiarity ratings (Experiments 1 and 2). These findings imply that “misery loves company.” Listeners in a sad mood fail to show the typical preference for happy-sounding music, and they perceive more sadness in music that is ambiguous with respect to mood.
Mood effects on liking for emotionally evocative music.

Music can express a range of emotions, from the joy of a Mozart sonata or Joan Jett’s *I Love Rock ‘n’ Roll* to the despair of a Shostakovich string quartet or The Beatles’ *Yesterday*. Moreover, listeners’ emotional responses typically parallel the emotions portrayed by the music (e.g., Hunter et al., 2008, 2010). In fact, music is particularly effective at inducing positive or negative moods in the laboratory (Västfjäll, 2002), and musically induced moods have notable effects on cognitive abilities (e.g., Thompson et al., 2001). Outside of the laboratory, the issue of negative emotional responses to music presents a conundrum for emotion researchers. If sad-sounding music elicits negative feelings, why would anyone choose to listen to it?

As one might expect, theories of emotion consider sadness to be an unpleasant state. For example, the *circumplex model* (Russell, 1980) describes emotions in terms of valence and arousal, with sadness at the negative end of the valence dimension. Appraisal theories (e.g., Smith, Haynes, Lazarus, & Pope, 1993) consider sadness to result from appraising an event as goal-incongruent and low in coping potential. In line with these views, listeners consistently provide more favourable ratings of musical pieces that sound happy rather than sad (Study 2; Hunter et al., 2008, 2010; Thompson et al., 2001; for a review see Hunter & Schellenberg, 2010). Sad-sounding music also elicits a right-sided frontal asymmetry in brain activation (Schmidt & Trainor, 2001), which is an indicator of avoidant tendencies (Harmon-Jones & Seligman, 2001). Nonetheless, responses to sad-sounding music are not entirely negative (Schubert, 2007). For example, when listeners are asked to rate positive and negative affective responses separately, they report elevated levels on both scales (i.e., ambivalence) after listening to sad-sounding music, but they report only positive affect after listening to happy-sounding music (Hunter et al., 2008, 2010).
Although the prevailing view is that positive and negative emotions are associated with approach and avoidance, respectively (Davidson, 1998), the situation is actually more complex. For example, anger is sometimes associated with approach tendencies (Carver & Harmon-Jones, 2009), eliciting greater activity in the left than in the right frontal cortex (Harmon-Jones & Seligman, 2001). Anger can also be associated with withdrawal, however, such as when there is social pressure to suppress negative feelings (Zinner, Brodish, Devine, & Harmon-Jones, 2008). Similarly, although sadness is normally associated with avoidance, choosing to listen to sad-sounding music obviously indicates approach.

The nature of affective responses to music is a contentious issue. So-called “emotivists” claim that music elicits true emotions (e.g., Juslin & Västfjäll, 2008), whereas “cognitivists” suggest that responses to music are purely aesthetic and rarely, or never, emotional (Konečni, 2008). Others argue that responses to music are true emotions but that they differ from those experienced in everyday life (Scherer, 2004). For example, feelings of transcendence are reported commonly in response to music and other aesthetic events but infrequent otherwise (Zentner, Grandjean, & Scherer, 2008). Emotional responses to music and other aesthetic stimuli also differ from everyday emotions because they involve two distinct and independent levels—one relating to emotions portrayed by the music or artwork, the other involving an evaluative component (Hunter et al., 2008, 2010). In other words, perceivers can like or dislike works of art whether they portray positive or negative emotions.

Regardless of one’s theoretical perspective, music that sounds sad tends to receive lower liking ratings than music that sounds happy (Hunter et al., 2010) and it has negative effects on arousal levels, moods, and cognitive performance (e.g., Thompson et al., 2001). One possibility is that liking for sad-sounding music varies with the listening context. In a recent study
(Schellenberg et al., 2008), listeners made liking ratings for happy- or sad-sounding music. One group of participants made such judgments after a lengthy (25 min) and difficult task that involved monitoring a narrated story. They were required to press one key when they heard the word *and*, another key when they heard the word *the*, and to tally all instances of the word *but*. The typical preference for happy-sounding music was absent among these listeners. The authors provided two hypotheses (not mutually exclusive) to explain this result. One suggested that the monitoring task elicited high levels of negative arousal, and the sad-sounding music (with a slow tempo) reduced arousal levels (e.g., Thompson et al., 2001), leading to greater liking ratings. The other was based on mood congruency: Preferences for sad-sounding music increased because listeners were in a negative mood state.

Nonmusical mood-congruency effects are seen reliably when the outcome variables comprise tests of memory or attention. For instance, mood facilitates memory for mood-congruent information (Isen, Shalker, Clark, & Karp, 1978). Although a bias favoring memory for positively valenced stimuli is the norm, induced sadness or clinical depression may switch the bias in favour of negative information (Matt, Vazquez, & Campbell, 1992). Similarly, dysphoria is related to increased attention to negative words and visual images (Isaacowitz, Toner, Goren, & Wilson, 2008; Koster, De Raedt, Goeleven, Franck & Crombez, 2005).

Mood-congruent memory effects are also seen for music. Positive and negative moods lead to enhanced recognition of previously heard major-key (happy-sounding) and minor-key (sad-sounding) melodies, respectively (Houston & Haddock, 2007). If mood-congruent effects with music extend to attention and perception, such effects are most likely to be evident for ambiguous-sounding music. There are multiple cues to emotion in music, among the strongest of which are tempo and mode (for a review see Hunter & Schellenberg, 2010). Fast tempi and
major mode suggest happiness, whereas slow tempi and minor mode suggest sadness. When these cues align, listeners perceive relatively pure happiness (fast-major) or sadness (slow-minor) in the music. When they conflict (i.e., fast-minor or slow-major), however, listeners perceive mixed happiness and sadness (Hunter et al., 2010). The listener’s mood may make one cue more salient than the other in these instances, with happy listeners attending to the fast tempo or major mode, and sad listeners focusing on the slow tempo or minor mode.

In the present study, we tested two mood-congruency hypotheses. In Experiment 1, we tested whether happy, neutral, and sad moods influence liking for happy- and sad-sounding music. After a mood induction, listeners heard either a happy- or a sad-sounding musical excerpt. Experiment 2 was identical except that the music sounded ambiguous with respect to happiness and sadness in order to examine whether listeners attend selectively to the cue that matches their mood. In both experiments, listeners provided a liking rating on each trial. They also rated how happy or sad and how familiar each excerpt sounded. We had two predictions of mood congruency, or that “misery loves company”. One was that the typical bias for happy-sounding music would disappear when listeners were in a sad mood (Experiment 1). The other was that the perception of sadness in emotionally ambiguous music (neither happy- nor sad-sounding) would be elevated for sad listeners (Experiment 2). Familiarity judgments served as a control measure and were not expected to vary as a function of sad mood in either experiment.

Experiment 1

Method

Participants. Forty-eight undergraduates were recruited without regard to music training from an introductory course in psychology. The students received partial course credit for participating in the study.
**Stimuli and Apparatus.** Hunter et al.’s (2008) stimuli were 48 30-s excerpts from commercial recordings of a variety of musical styles. We used a subset of these, specifically the six excerpts that received the highest happy and sad ratings (three each; see Appendix A). The happy-sounding excerpts had a fast tempo and were in major mode, whereas the sad-sounding excerpts were slow and minor.

The 36 pictures used in the mood inductions were collected from internet sources using the Google image search. Happy pictures depicted people in happy situations (e.g., birthdays, amusement parks), cute children and animals, and pleasant locations (e.g., the beach; see Appendix B). Neutral pictures depicted objects (e.g., a box), and places (e.g., an apartment building; see Appendix C). Sad pictures depicted sad situations (e.g., a funeral, war), grieving mothers or children, war-torn villages, pollution, and injured animals (see Appendix D). The screen size and resolution of each picture was adjusted so that each appeared to be roughly the same size without any apparent reduction in picture quality. Pilot testing confirmed that the 12 “happy” and 12 “sad” pictures received elevated ratings of happy and sad feelings, respectively, and that the 12 “neutral” pictures did not elicit either happy or sad feelings. Captions were added (e.g., “Death of a Friend”) to emphasize the positive, neutral, or negative affect of the pictures.

Except for the written responses to the pictures, testing was computer controlled on an iMac with customized software written in PsyScript version 2.1 (Slavin, 2007).

**Procedure.** Participants were tested individually. They were told that they would be seeing pictures, listening to music, making ratings of both, and that they would be asked to write a short reflective statement about some of the pictures. The different mood inductions were blocked, with the happy block first, the neutral block second, and the sad block last for
half of the participants, and the opposite order (sad-neutral-happy) for the other half. Within each block, there were two separate mood inductions, each followed by a music-listening trial. These trials consisted of one happy- and one sad-sounding music excerpt selected randomly but with no excerpts repeated across blocks.

During each mood induction, participants saw a series of six pictures intended to elicit happy, neutral, or sad feelings. Each picture was displayed on the monitor for 15 s followed by a seven-point (0-6) bipolar sad-happy rating scale with the question, “How did the picture make you FEEL?” Participants then chose one of the six pictures about which to write a reflective statement with pen and paper. They were asked to write three or four sentences indicating how they felt about the image, memories that were evoked, or simply a few descriptive sentences.

Participants then heard a happy- or sad-sounding musical excerpt. They were asked: (1) “How much did you LIKE the music?” (2) “How happy or sad did the music SOUND?” and (3) “How familiar did the music SOUND?” Responses were recorded on seven-point scales. Differences among questions were emphasized by the use of upper-case letters, as shown.

Results and Discussion

Mood induction. Each participant had three mood scores, with each score averaged over 12 original feeling ratings that were made in response to the happy, neutral, or sad pictures. A one-way repeated-measures Analysis of Variance (ANOVA) confirmed that the mood induction was highly effective, $F(2, 94) = 484.16, p < .0001, \eta_p^2 = .91$. Happy pictures made participants feel happier than neutral pictures, $t(47) = 14.91, p < .0001$, which, in turn, made participants feel happier than sad pictures, $t(47) = 22.60, p < .0001$.

Liking. Each participant had six liking ratings, one after each of the three mood inductions for both a happy- and a sad-sounding musical excerpt. Descriptive statistics are
illustrated in Figure 1 (upper panel). A two-way repeated-measures ANOVA revealed a main effect of musical emotion, $F(1, 47) = 15.40$, $p < .0005$, $\eta_p^2 = .25$. In general, listeners exhibited the typical preference for happy- over sad-sounding music. This main effect was qualified, however, by an interaction between induced mood and musical emotion, $F(2, 94) = 3.18$, $p < .05$, $\eta_p^2 = .06$. As predicted, listeners exhibited a preference for happy- over sad-sounding music after the happy, $t(47) = 2.02$, $p < .05$, and neutral, $t(47) = 4.35$, $p < .0001$, mood inductions, but not after the sad mood induction, $p > .4$. As shown in the figure, for listeners in a sad mood, absolute levels of liking for happy- and sad-sounding music were virtually identical.

**Perceived Emotion.** Each listener also had six ratings of perceived emotion. Descriptive statistics are illustrated in Figure 1 (lower panel). A two-way repeated-measures ANOVA yielded no main effect of induced mood on perceived emotion, and no interaction between mood and musical emotion, $Fs < 1$. A main effect of musical emotion confirmed simply that listeners thought that the happy-sounding music sounded happier than the sad-sounding music, $F(1, 47) = 138.06$, $p < .0001$, $\eta_p^2 = .75$.

**Familiarity.** Each listener’s six familiarity ratings were examined identically. There was no main effect of induced mood on familiarity judgments, $p > .2$, and no interaction between induced mood and musical emotion, $F < 1$. Rather, happy-sounding excerpts were deemed to sound more familiar than sad-sounding excerpts, $F(1, 47) = 37.98$, $p < .0001$, $\eta_p^2 = .45$. This finding is consistent with others indicating that participants tend to provide higher familiarity ratings for positively rather than negatively valenced pictures (Cacioppo, Bush, & Tassinary, 1992) and music (Witvliet & Vrana, 2007).
Figure 1. Ratings of liking (upper panel) and perceived emotion (lower panel) for happy- and sad-sounding music as a function of mood induction (Experiment 1). Higher ratings correspond to greater liking (upper) and more perceived happiness but less sadness (lower). Error bars are standard errors.
Experiment 2

Method

Participants. Fifty-four undergraduates were recruited as in Experiment 1.

Stimuli and Apparatus. The stimuli and apparatus were identical to Experiment 1 except that the six 30-s musical excerpts were those from Hunter et al. (2008) that evoked the highest levels of mixed (happy and sad) feelings (see Appendix A). Three of these had a fast tempo and were in minor mode; the other three were slow and major.

Procedure. Identical to Experiment 1, except that after each of the three mood inductions, listeners heard two ambiguous-sounding musical excerpts selected randomly from a set of six but with no repetitions. These six excerpts had conflicting cues to happiness and sadness, specifically fast tempo and minor mode for three, and slow tempo and major mode for the other three.

Results and Discussion

The data were analyzed as in Experiment 1 except that there was no independent variable for musical emotion because all of the musical excerpts sounded ambiguous with respect to happiness and sadness.

Mood induction. The mood-induction procedure was again highly effective, $F(2, 106) = 758.35, p < .0001, \eta^2_p = .93$. Happy pictures evoked more sadness than neutral pictures, $t(53) = 21.16, p < .0001$, which evoked more sadness than sad pictures, $t(53) = 23.85, p < .0001$.

Liking. A one-way repeated-measures ANOVA examined liking ratings for ambiguous-sounding music after happy, neutral, or sad mood inductions. Liking varied as a function of the mood induction, $F(2, 106) = 5.29, p < .01, \eta^2_p = .09$ (Figure 2, upper panel). Liking was elevated after the happy mood induction compared to the neutral, $t(53) = 2.07, p < .05$, and sad,
$t(53) = 3.21, p < .005$, mood inductions, which did not differ, $p > .2$. This result is consistent with the well established finding that feeling happy and liking are often two markers of the same construct: positive affect (e.g., Fredrickson & Losada, 2005).

**Perceived emotion.** Perceived emotion ratings also varied as a function of the mood induction, $F(2, 106) = 6.52, p < .005, \eta^2_p = .11$ (Figure 2, lower panel). As predicted, ratings were lower (more perceived sadness) after the sad mood induction than after the happy, $t(53) = 2.89, p < .01$, or neutral, $t(53) = 3.18, p < .005$, mood induction, which did not differ, $p > .8$. In other words, the perception of sadness conveyed by emotionally ambiguous music was elevated among listeners who were feeling sad. Perceived sadness after the sad mood induction did not vary between fast-minor and slow-major excerpts, $F < 1$.

**Familiarity.** Induced mood had no effect on familiarity judgments, $F < 1$.

**General Discussion**

After inducing happy, neutral, or sad moods, we compared reactions to happy- and sad-sounding music (Experiment 1) and to ambiguous-sounding music (Experiment 2). Although happy music was preferred to sad music after a happy or neutral mood induction, this preference disappeared after a sad mood induction. Sad moods also increased the perception of sadness in music when the music was not clearly happy- or sad-sounding. In short, the results provided support for both of our “misery-loves-company” hypotheses.

Whereas Schellenberg et al. (2008) eliminated the typical preference for happy-sounding music after an arduous and lengthy task, our findings allowed us to attribute the effect to sad mood. Previous findings indicate that music liking is increased when there is a match between listeners’ perception of emotions conveyed by the music and their responses to it (Schubert, 2007). The present findings reveal that music liking is also enhanced when feelings unrelated to
Figure 2. Ratings of liking (upper panel) and perceived emotion (lower panel) for ambiguous-sounding music as a function of mood induction (Experiment 2). Higher ratings correspond to greater liking (upper) and more perceived happiness but less sadness (lower). Error bars are standard errors.
music match the emotion conveyed by music heard subsequently. Our findings do not preclude the possibility that listeners sometimes prefer sad-sounding music for other reasons, such as its arousal-reducing properties or because of idiosyncratic personality or contextual factors. In future research, physiological measures may be useful for determining the role of arousal reduction. One could also examine whether sad-sounding music is liked by listeners for whom sadness is chronic (e.g., those with depression or dysthymia) rather than transient.

Our findings also extend mood-congruency effects to perceiving emotion in music. In Experiment 1, when the emotion cues in the musical excerpts clearly suggested happiness or sadness, there was no effect of mood on perception. In Experiment 2, however, cues to happiness and sadness were in conflict, and mood influenced perceptions. Sad listeners gave higher ratings of perceived sadness, presumably because they selectively attended more to the “sad” cue in the music (slow tempo or minor mode). By contrast, listeners in a happy or neutral mood perceived less sadness and more happiness in the music, which implies that they attended more to the “happy” cue (fast tempo or major key). This interpretation is consistent with positive and negative biases in memory (Matt et al., 1992) and attention (Koster et al., 2005) for non-depressed and depressed individuals, respectively. The preference for happy-sounding music after a neutral mood induction is also consistent with typical positive biases in perception. Neutral mood appears to involve a default positivity bias, which explains the preference for happy-sounding music seen in previous studies with no induced moods (e.g., Hunter et al., 2008).

Our original question asked why people listen to sad music if it makes them feel sad. Our results indicate that sad moods make sad-sounding music more appealing, yet it is still unknown whether this is in spite of additional sad feelings elicited by the music, or whether
music did not give rise to such feelings despite abundant evidence of effects of sad-sounding music on mood (Västfjäll, 2002). Siemer (2005, Experiment 2) demonstrated that musically induced moods tend to accompanied by mood-congruent cognitions. Perhaps listeners in an initially happy or neutral mood found sad-sounding music to be unpleasant because it elicited sad thoughts. By contrast, listeners in a sad mood would already be thinking sad thoughts, so the effect of the music on their cognitions would be moot.

An alternative perspective suggests that sadness derived from aesthetic experiences does not carry the same negative affective weight as sadness elicited under everyday circumstances. For example, when Goldstein (2009) compared sadness in response to personal events or fictional narratives, both stimuli elicited sadness but only personal events elicited anxiety as well. The author suggested that fiction acts as a safe environment in which to experience negative emotions. Music may provide a similar safe environment. This hypothesis is consistent with Scherer’s (2004) proposal that emotions induced by aesthetic sources differ from those aroused in everyday situations because the latter involves a goal-relevant appraisal whereas the former does not. For example, sadness felt when receiving a bad test grade is unpleasant because it is inconsistent with one’s achievement goals, whereas sadness evoked when listening to Yesterday is not unpleasant because the song is goal-irrelevant.

In the present study, however, listeners in happy and neutral moods found sad-sounding music to be relatively unpleasant. Some research suggests that there are different styles of music listening (Kreutz, Schubert, & Mitchell, 2008). Whereas music systemizers tend to focus on music as an object, music empathizers process music as emotional communication. For systemizers, sad cognitions may not arise when listening to sad-sounding music because they are attending to its aesthetic merits rather than the emotion expressed. If so, the effects in the
present study may have been driven by music empathizers in the sample. Future studies could test whether systemizers are resistant to negative mood effects of sad-sounding music.

Our results motivate several other hypotheses that could be tested in future research. For example, researchers could examine directly whether the appeal of sad-sounding music increases when the music does not elicit negative thoughts or anxiety, and whether liking for sad-sounding music is mediated by increased attention and deeper processing. Our results have practical applications for music therapy among depressed patients and, more generally, for modulating one’s own moods. They also suggest new avenues of research such as whether the findings would extend beyond music. If so, the general tendency to avoid stimuli associated with sadness may be attenuated for those who are feeling sad. Indeed, sad mood may be one route to the pleasure of sadness in aesthetic experiences.
Study 2

Abstract

Adults and children 5, 8, and 11 years of age listened to excerpts of music that sounded happy, scary, peaceful, or sad. They rated how much they liked each excerpt and made a forced-choice judgment about the emotion each excerpt conveyed. Identification accuracy was better for young girls than boys but both genders reached adult-like levels by the age of 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 favoured excerpts depicting positive emotions (happiness and peacefulness). Across age groups, only females preferred positive emotions. As identification accuracy improved, liking for positively valenced music increased among 5- and 8-year-olds but decreased among 11-year-olds.
The development of music preferences

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, they believe that their music preferences reveal more about themselves 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, b, c). Clearly, music preferences are important indicators of individual differences in adulthood, but when in development do these indicators become reliable?

Music preferences are closely associated with emotional responses. Preferred musical styles tend to improve listeners’ moods (Schäfer & Sedlmeier, 2009) and favourite pieces are often associated with particularly strong emotional experiences (Lamont & Webb, 2010). Music preferences also vary 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 et al., 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 et al., 2001; Vieillard, et al., 2008). There is also evidence that listening to sad-sounding music activates a right-sided frontal asymmetry in EEG activity (Schmidt & Trainor, 2001), which is a marker of avoidance motivation. 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 very
difficult cognitive task (Schellenberg et al., 2008), or after a sad mood induction (Study 1). Nevertheless, among adults a preference for happy-sounding music is the norm.

The present study examined three questions about music preferences that remain unanswered to date. First, when in development does the preference for happy-sounding music emerge, and are there 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 second question asked whether preferences for music based on the emotions it conveys are contingent on the ability to identify such emotions reliably. The third 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 higher in arousal and more positive in valence. In other words, musical cues associated with arousal, valence, or both dimensions could be responsible for the bias favouring happy-over sad-sounding music.

Music plays a role in the lives of children from the day they are born (or earlier, see Parncutt, 2006 for a review). For example, maternal singing to infants is ubiquitous across cultures (Trehub & Schellenberg, 1995). Compared to adult-directed singing, infant-directed singing tends to have a higher pitch, a slower tempo, and a heightened emotional tone (Trainor, Clark, Huntley, & Adams, 1997; Trehub, Unyk, et al., 1997). Singing to infants promotes bonding between the caregiver and the infant, and it allows caregivers to communicate emotion to their infant, to regulate their infant’s mood, and to lull the infant to sleep (Nakata & Trehub, 2004; Schenfield, Trehub, & Nakata, 2003; Trainor, 1996; Trehub & Trainor, 1998; Trehub, Unyk, & Trainor, 1993a, b). The efficacy of infant-directed singing is supported by evidence
showing that adults can identify whether infants are listening to a playsong or a lullaby by watching a silent video of their reactions (Rock, Trainor, & Addison, 1999). The musical characteristics of infant-directed speech also help to explain why infants prefer it over adult-directed speech (Cooper & Aslin, 1990; Fernald, 1989; Fernald & Kuhl, 1987; Werker & McLeod, 1989).

In adulthood, listeners tend to dislike dissonant music, which activates brain regions associated with processing negative stimuli (e.g., the parahippocampal gyrus; Blood et al., 1999). Infants show a similar preference for consonance over dissonance, even at 2 to 4 months of age (Trainor et al., 2002; Zentner & Kagan, 1996, 1998). In fact, this preference may be innate and universal because it is also evident in isolated non-Western cultures (e.g., the Mafa tribe in Cameroon; Fritz et al., 2009). It may also be unique to humans because other primates (i.e., Tamarin monkeys) do not show a similar bias (McDermott & Hauser, 2004).

Beyond dissonance, we know little about children’s music preferences. Nonetheless, there are reasons to expect that they would differ from those of adults. For example, children’s perceptions of emotions expressed by music are less refined than those of adults. Terwogt and Van Grinsven (1991, Experiment 2) tested the identification of emotion 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 are both high-arousal, negative-valence emotions, whereas happiness and sadness differ on both dimensions.
Children’s abilities to identify emotions expressed by music vary not only with the emotion of the piece, but also with the age of the child 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 the age of 5, children begin to identify sadness, anger, and fear or threat more reliably (Dolgin & Adelson, 1990; Terwogt & VanGrinsven, 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), emotion identification was tested in four groups of listeners: 3- to 4-year-olds, 5-year olds, 6- to 8-year-olds, and adults. The task involved using a bipolar happy-sad scale to rate the emotion expressed in short excerpts of music. Listeners heard the original versions as well as versions that were manipulated in tempo and mode. A clear developmental trend revealed that adults’ ratings were influenced more by the mode manipulation, whereas 5-year-olds were influenced more by the tempo manipulation. Six- to 9-year-olds were affected equally by the tempo and mode manipulations, and thus fell in between. (The youngest children performed at chance levels.) These response patterns are partly consistent with results from an earlier study, in which older children (6- to 12-year-olds) relied primarily on temporal cues when making arousal (excitement versus calm) and valence (happiness versus sadness) ratings of short musical pieces (Kratus, 1993).
Even among adults, identification of emotions expressed musically are not perfectly consistent. Gabrielsson and Juslin (1996) found that adults were better at identifying some emotions (i.e., happiness, sadness, and anger) than others (e.g., solemnity). Their listeners also tended to confuse specific emotions such as sadness and tenderness. The stimuli differed from those used in other studies, however, with the different emotions determined by performance cues (i.e., the way the pieces were played) rather than different musical pieces. Accuracy may have been better if there were cues in the actual pieces (e.g., differences in mode).

Few studies have examined gender differences in the perception of emotion in music and the available findings are equivocal. One study (Gagnon & Peretz, 2003) found no gender difference in adults’ ratings of perceived happiness and sadness for excerpts that varied in mode and tempo. Another study (Webster & Weir, 2005) reported that women felt more sadness than men in response to excerpts that were in a minor mode or played at a slow tempo, but there were no gender differences in response to excerpts in a major mode or at a fast tempo. Because the authors tested only felt emotions, it is unclear whether similar gender differences would be evident with emotion 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 happy or sad, and excited or calm. There were no differences between boys and girls or across ages, possibly because accuracy in this particular study 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 to those of boys. In some
studies (Cunningham & Sterling, 1988) but not in others (Dalla Bella et al., 2001; Kastner & Crowder, 1990; Terwogt & VanGrivensen, 1991), girls identified happiness and sadness more reliably than boys. Girls were also better than boys at identifying fear expressed musically in some instances (Terwogt & VanGrivensen, 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. Clearly, further research on gender differences is needed with highly controlled and validated stimuli.

In an effort to mitigate problems in comparing results across studies, Vieillard et al. (2008) created a set of short musical excerpts 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. Although identification accuracy in the standardization sample was very high for happy-sounding excerpts (99%), it was substantially lower for peaceful-sounding excerpts (67%).

To the best of our knowledge, the present study is the first to examine gender differences across development in liking for music as a function of the emotion expressed by the music. In one previous study (Banerjee, Greene, Krcmar, Bagdasarov, & Ruginyte, 1998), 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 in Banerjee et al. (1998) merely read descriptions of films, whereas our participants listened to actual music.

The present participants were adults and 5-, 8-, and 11-year-old children who listened to a subset of Vieillard et al.’s (2008) stimuli. Each age group had an equal number of males and females. The listeners rated how much they liked each excerpt. They also made a forced-choice judgment about the emotion 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 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 the 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 music with positive valence. For children, we expected that music preferences would depend more on manipulations that influence arousal (e.g., tempo changes) rather than valence, as their identification of happiness and sadness has in the past (Dalla Bella et al., 2001). Finally, the results of Banerjee et al. (1998) suggested that males and females, respectively, would provide higher liking ratings for musical excerpts that were high in arousal and positive in valence.

Method
Participants

The sample comprised 120 participants with 30 from each of four age groups: 5-year-olds, 8-year-olds, 11-year-olds, and adults. In each group, there were 15 males and 15 females. 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 who participated for partial course credit.

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

Because our participants included young children, it was important to keep the testing session relatively brief. Accordingly, a pilot study was used to select a subset of the 56 excerpts from Vieillard et al. (2008), specifically the 20 that were the most consistently identified as sounding happy (excerpts g01, g02, g03, g04, g10), scary (p01, p02, p05, p06, p09), peaceful (a01, a02, a04, a06, a11), or sad (t01, t03, t08, t09, t14). The pieces are available online at: http://www.brams.umontreal.ca/plab/publications/article/96. We tested 45 undergraduates individually. They heard all 56 excerpts presented in random order. After each excerpt, they choose one of the four emotion terms (happy, scary, peaceful, sad) that best described the emotion expressed by the music. Mean proportion correct for happy-, scary-, peaceful, and sad-sounding excerpts was .84, .79, .69, and .75, respectively. As with the sample tested by Vieillard et al., identification accuracy was highest for happy-sounding excerpts and lowest for peaceful-sounding excerpts. The five best-identified excerpts from each category were used as
stimuli in the present study. Mean proportion correct for these stimuli was .87, .86, .76, and .83 for happy-, scary-, peaceful-, and sad-sounding excerpts, respectively.

Procedure

Participants were tested individually in a sound-attenuating booth. The testing session consisted of two phases. In an initial liking phase, listeners were told that they would hear 20 short excerpts of music and rate how much they liked each excerpt. The excerpts were presented in random order. A 5-point rating scale appeared after each excerpt. Scale points were labelled from 1 (Like a LITTLE) to 5 (Like a LOT) and were accompanied by pictures of an ice cream cone that grew larger from the low end of the scale to the high end (see Appendix E). After a brief break, listeners began the identification phase. They were told that they would hear the same excerpts again, but this time they would decide which emotion best fit the music. The excerpts were presented in a new random order. After each excerpt, the monitor displayed the four options (happiness, fear, peacefulness, and sadness) with each verbal label accompanied by a line drawing of a face depicting the target emotion (see Appendix F). Child participants were asked to point or to identify verbally which face best matched the music, whereas adults made their own selection with the mouse. After the selection was made, the next excerpt was presented. No feedback was provided in 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, \( p < .05 \), with two
exceptions. Five-year-old boys performed 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-subjects variables, and arousal (high: happiness and fear, or low: peacefulness and sadness) and valence (positive: happiness and peacefulness, or negative: fear and sadness) as within-subjects variables. There were main effects of arousal, $F(1, 112) = 126.24, p < .0001, \eta^2_p = .53$, age, $F(3, 112) = 35.33, p < .0001, \eta^2_p = .49$, and gender, $F(1, 112) = 11.99, p < .001, \eta^2_p = .10$. In general, accuracy was better for pieces that expressed high- ($M = 4.18, SD = 1.19$) rather than low- ($M = 3.28, SD = 1.42$) arousal emotions, 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 ($M = 2.68, SD = 1.58$) to 8 ($M = 3.73, SD = 1.33$) years and from 8 to 11 ($M = 4.31, SD = 0.81$) years of age, $ps < .05$ (Tukey 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 qualified by three significant two-way interactions: between arousal and valence, $F(1, 112) = 25.12, p < .0001, \eta^2_p = .18$ (Figure 3), arousal and age, $F(3, 112) = 7.11, p < .0005, \eta^2_p = .16$ (Figure 4), and age and gender, $F(3, 112) = 7.06, p < .0005, \eta^2_p = .16$ (Figure 5). There were no 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), $F(1, 112) = 10.14, p < .005$. By contrast, for low-arousal emotions, sadness (negative valence) was identified better than peacefulness (positive valence), $F(1, 112) = 12.10, p < .001$. Because there was no three-way interaction involving age, these response
patterns were similar across age groups. In short, as in previous research (Terwogt & VanGrivensen, 1991), happiness and sadness were relatively easy to identify.

![Bar graph showing mean identification accuracy and standard errors as a function of arousal and valence of the target emotion.]

**Figure 3.** Mean identification accuracy and standard errors as a function of arousal and valence of the target emotion.

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 than for low-arousal excerpts, $F$s(1, 28) = 71.50, 33.91, 29.14, and 12.72, $ps < .005$, for 5-, 8-, and 11-year-olds, and adults, respectively. As shown in Figure 4, the identification advantage for high- compared to low-arousal excerpts decreased from age 5 to age 8 to age 11, where it
reached adult levels. A separate analysis limited to the adults and 11-year-olds confirmed that there was no interaction between arousal and age, $F < 1$.

\[ \text{Figure 4. Mean identification accuracy and standard errors as a function of age of the participant and arousal of the target emotion.} \]

The effect of gender was significant for 5- and 8-year-olds, $F_s(1, 28) = 14.27$ and 8.62, respectively, $p_s < .01$, but not 11-year-olds or adults, $F_s < 1$. As shown in Figure 5, boys were less accurate than girls among the two youngest age groups, but males caught up to their female counterparts by the age of 11.
Figure 5. Mean identification accuracy and standard errors as a function of age and gender of the participant.

Errors. Confusion matrices are illustrated in Table 1 separately for each age group. For the two younger age groups, excerpts with low-valence 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 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. Five-year-olds and to a lesser extent 8-year-olds were also
somewhat unreliable at labelling sad-sounding music. This difficulty disappeared by the age of 11.

Table 1. *Percentage of Each Response for Excerpts Depicting each Emotion.*

<table>
<thead>
<tr>
<th>Age</th>
<th>Music</th>
<th>Happy</th>
<th>Scary</th>
<th>Peaceful</th>
<th>Sad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Five</td>
<td>Happy</td>
<td>70.0</td>
<td>7.3</td>
<td>15.3</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>Scary</td>
<td>18.7</td>
<td>63.3</td>
<td>9.3</td>
<td>8.7</td>
</tr>
<tr>
<td></td>
<td>Peaceful</td>
<td>26.0</td>
<td>7.3</td>
<td>38.7</td>
<td>28.0</td>
</tr>
<tr>
<td></td>
<td>Sad</td>
<td>18.7</td>
<td>16.7</td>
<td>21.3</td>
<td>43.3</td>
</tr>
<tr>
<td>Eight</td>
<td>Happy</td>
<td>87.3</td>
<td>0.0</td>
<td>10.0</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>Scary</td>
<td>6.7</td>
<td>80.0</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>Peaceful</td>
<td>20.7</td>
<td>1.3</td>
<td>58.0</td>
<td>20.0</td>
</tr>
<tr>
<td></td>
<td>Sad</td>
<td>5.3</td>
<td>12.7</td>
<td>18.0</td>
<td>64.0</td>
</tr>
<tr>
<td>Eleven</td>
<td>Happy</td>
<td>94.7</td>
<td>0.0</td>
<td>5.3</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Scary</td>
<td>2.7</td>
<td>87.3</td>
<td>2.0</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>Peaceful</td>
<td>10.0</td>
<td>1.3</td>
<td>76.0</td>
<td>12.7</td>
</tr>
<tr>
<td></td>
<td>Sad</td>
<td>0.0</td>
<td>4.0</td>
<td>9.3</td>
<td>86.7</td>
</tr>
<tr>
<td>Adult</td>
<td>Happy</td>
<td>94.0</td>
<td>2.0</td>
<td>3.3</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Scary</td>
<td>7.3</td>
<td>84.0</td>
<td>6.0</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>Peaceful</td>
<td>16.7</td>
<td>0.0</td>
<td>70.7</td>
<td>12.7</td>
</tr>
<tr>
<td></td>
<td>Sad</td>
<td>2.0</td>
<td>1.3</td>
<td>13.3</td>
<td>83.3</td>
</tr>
</tbody>
</table>

*Liking*

Each participant had four liking ratings, one for each emotion, with each rating averaged over five original ratings. As with identification accuracy, the principal analysis was a four-way
mixed-design ANOVA, with age group and gender as between-subjects variables, and arousal and valence as within-subjects variables. There were main effects of arousal, $F(1, 112) = 20.19, p < .0001, \eta^2_p = .15$, valence, $F(1, 112) = 8.83, p < .005, \eta^2_p = .07$, and age, $F(3, 112) = 20.01, p < .0001, \eta^2_p = .35$. In general, liking was higher for excerpts that expressed high- ($M = 2.40, SD = .84$) rather than low- ($M = 2.09, SD = .80$) arousal emotions, and positive ($M = 2.39, SD = .81$) rather than negative ($M = 2.12, SD = .91$) emotions. The main effect of age stemmed from decreases in liking between the ages of 5 ($M = 2.77, SD = .67$) and 8 ($M = 2.35, SD = .64$), and between the age of 11 ($M = 2.27, SD = .48$) and adulthood ($M = 1.59, SD = .56$), $ps < .05$ (Tukey HSD). Mean liking did not differ between the ages of 8 and 11. These main effects were qualified by three significant two-way interactions: between valence and gender, $F(1, 112) = 8.47, p < .005, \eta^2_p = .07$ (Figure 6), valence and age, $F(3, 112) = 2.88, p < .05, \eta^2_p = .07$ (Figure 7), and arousal and age, $F(3, 112) = 2.63, p = .05, \eta^2_p = .07$ (Figure 8). There were no higher-order (i.e., three- or four-way) interactions.

We explored the interaction between valence and gender using separate ANOVAs for males and females. The effect of valence was significant for females, $F(1, 56) = 16.60, p < .0001$, but not for males, $F < 1$. Thus, females but not males generally preferred pieces expressing positive emotions. Because there was no three-way interaction with age, this gender difference was similar across age groups.

The interactions involving age were followed up using separate ANOVAs for each age group. There was a significant effect of valence for the adults, $F(1, 28) = 18.40, p < .0005$, but not for any of the child groups, $Fs < 1$. By contrast, there was a significant effect of arousal for the 5-, 8-, and 11-year-olds, $Fs(1, 28) = 7.65, 8.32, 14.49$, respectively, $ps < .01$, but not for the adults, $F < 1$. In general, children's liking was influenced by the arousal of the emotion.
expressed in the piece, favouring high-arousal emotions, whereas adults’ liking was influenced by valence, favouring positive emotions. The marked developmental change between 11-year-olds and adults was highlighted by a separate analysis of these two age groups alone, which revealed significant interactions between arousal and age and between valence and age, $ps < .05$. 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 using an Analysis of Covariance (ANCOVA). Because we were interested in whether greater accuracy would be
related to more adult-like preferences, the dependent 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 negative emotions from mean liking for excerpts expressing positive emotions. Age served as the independent variable and overall accuracy (total number of correct identifications) as the covariate. The ANCOVA revealed a significant effect of age, $F(3, 112) = 4.39, p < .001, \eta^2 = .11$, which was qualified by an interaction between age and accuracy, $F(3, 112) = 4.49, p < .001, \eta^2 = .11$. The main effect of accuracy was not significant, $F < 1$. 

*Figure 7.* Mean liking ratings and standard errors as a function of age of the participant and valence of the target emotion.
Figure 8. Mean liking ratings and standard errors as a function of age of the participant and arousal of the target emotion.

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 surprisingly, 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, $p > .9$. 
Discussion

The goal of the present 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 music that sounded happy, scary, peaceful, or sad, and to identify the emotion conveyed by the same excerpts.

For emotion identification, we replicated previous findings that happiness and sadness are relatively easy to identify, that younger children are poorer than older children and adults at identifying emotions expressed musically, and that younger children rely inordinately on musical characteristics associated with arousal (i.e., tempo). Our results extended previous findings by including anger and peacefulness in addition to happiness and sadness as target emotions, and by including listeners that encompassed a large age range. Compared to 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 age 11, at least with the four emotions we examined and the music excerpts we used. Younger children’s over-reliance 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 age 11, 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 stems 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). Although parents tend to talk more to daughters than to sons (Leaper, Anderson, & Sanders, 1998), the gender difference in vocabulary persists when differences in linguistic input are held constant (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). Girls are also more talkative than boys (Leaper & Smith, 2004), and they exhibit advantages over boys in reading, writing, and spelling (Halpern, 2004). 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 identifying 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 care-giver (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, or whether both variables contribute jointly to the difference we observed.

For liking ratings, we found a preference for music associated with positive valence among females but not among males, a gender difference that was evident across development. This finding is consistent with the female preference for positive emotions in films reported by Banerjee et al. (2008). In another study that measured women’s and men’s behavioural and physiological responses to pictures with affective content (Bradley, Codispoti, Sabatinelli, &
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 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. Future research could determine the extent to which emotional responses play a role in music preferences and whether this association accounts for emotion-based preferences in other domains.

Whereas adult listeners liked happy- (positive valence, high arousal) and peaceful- (positive valence, low arousal) sounding music more than music that expressed sadness (negative valence, low arousal) or fear (negative valence, high arousal), their liking ratings did not distinguish between music that expressed high-arousal (happiness or fear) or low-arousal (sadness or peacefulness) emotions. This pattern was restricted solely to adults, with children of all ages exhibiting the exact opposite pattern, liking high- more than low-arousal music but failing to make a distinction between music with 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 to 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) relative to tempo when making emotional judgments (Dalla Bella et al., 2001), which could account for
their valence-based music preference. 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 of 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 adults and were similar to those of younger children. Among the 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.

Eleven-year-olds 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, 1974; see also Marcia, 1980), seeking greater autonomy from their parents (Smetana, 1988; Youniss & Smollar, 1985). Music preferences 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). Indeed, children of this age are often rebels with a cause.

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 identifying low-arousal emotions in music. For example, Gabrielsson and Juslin’s (1996) listeners tended to confuse pieces that were performed to sound either sad or tender. Nevertheless, in many studies, sad-sounding pieces are among the best-identified (Cunningham & Sterling, 1988; Dolgin & Adelson, 1990; Terwogt & VanGrinsven, 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. Nevertheless, peaceful pieces were also often mislabelled as “happy” despite clear differences in tempo. Even adults had difficulties with the peaceful category, for which identification accuracy was around 70% correct, whereas accuracy for all other categories was greater than 80%. Similarly poor accuracy for “peacefulness” has been shown in adults previously (Gosselin et al., 2005). This mediocre level of accuracy for the top-five recognized pieces implies that peacefulness may be relatively difficult to express musically compared with happiness, fear, and sadness.

Future research could also examine the role of exposure to music or music lessons on identification accuracy and liking. Accuracy should improve with greater exposure to music, and the association between accuracy and liking suggests that greater exposure in 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 remains unknown whether children would exhibit the same pattern. When they identify the emotion conveyed incorrectly, it would be particularly interesting to determine whether their emotion response is more in line with the intended 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, four major findings emerged from this study. First, children's identification of emotion in music was worse for emotions that are low rather than high in arousal. Second, males were less accurate at identifying emotions in music early in childhood, but this difference disappeared by the age of 11. 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. These findings open the way for future research to explore gender differences and the development of (1) emotion-based music preferences, (2) the ability to identify emotions expressed by music, and (3) associations between preferences and identification accuracy. Exploring the developmental 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 (e.g., North & Hargreaves, 2007a, b, c; Rentfrow & Gosling, 2003) and emotional (e.g., Hunter et al., 2008, 2010; Lamont & Webb, 2010; Schafer & Sedlmeier, 2009) development.
Study 3

Abstract

Liking for a stimulus often increases with initial exposure but decreases with over-exposure. Re-analyses of previous findings revealed marked differences among individual participants who heard music at different exposure frequencies. In fact, fewer than half exhibited the inverted-U shaped pattern that was evident for listeners as a group. We examined whether the dimension of personality called Openness-to-Experience is associated with individual differences in liking for music as a function of frequency of exposure. Undergraduates completed the Big Five Inventory and provided liking ratings for novel music excerpts as well as for excerpts they heard 2, 8, or 32 times. As a group, liking ratings varied as an inverted-U shaped function of exposure. Number of exposures interacted with Openness-to-Experience but not with any of the other four personality dimensions. Higher levels of Openness-to-Experience were associated with higher liking ratings for novel pieces but lower ratings for over-exposed pieces. Although an inverted-U shaped response pattern was relatively common among all listeners, increases in liking as a function of exposure were also common for those who were low in Openness-to-Experience, whereas decreases were the most common response pattern among those who were high in Openness-to-Experience.
Interactive Effects of Personality and Frequency of Exposure on Liking for Music

It is common to begin liking a song after hearing it a few times. When the same song is heard too often, it is also common to begin disliking it. Indeed, this rise and fall in liking for music as a function of exposure has been documented in the consumption of popular music (Jakobovits, 1966). The first effect—increases in liking after initial exposure—is also a well-documented psychological phenomenon. Zajonc (1968) demonstrated that simple exposure is sufficient to enhance liking for a neutral stimulus even when participants cannot explicitly remember it. This mere exposure effect has been replicated many times, primarily with visual stimuli (see Bornstein, 1989 for a review), although increases in liking as a consequence of exposure are also evident for music (e.g., Meyer, 1903; Moore & Gilliland, 1924; Mull, 1957; Peretz, Gaudreau, & Bonnel, 1998; Schellenberg et al., 2008; Szpunar et al., 2004). Decreases in liking as a consequence of over-exposure have also been documented with visual stimuli (Zajonc et al., 1972) as well as with music (Schellenberg et al., 2008; Szpunar et al., 2004).

Two models have been proposed to account for changes in liking as a function of exposure. Berlyne (1970) proposed the two-factor model, which was further developed by Stang (1974). The model posits that liking varies with arousal potential. A particular stimulus tends to be disliked if its arousal potential is too high or too low, but liked otherwise. More importantly, the arousal potential of a stimulus varies with its familiarity. A novel stimulus has a high arousal potential because it is a possible threat. The first factor stems from exposure with benign consequences, which reduces the threat of the stimulus, lowering its arousal potential to a more optimal level and generating a more positive affective response (Kalat & Rozin, 1973; Zajonc, 1968). The second factor explains satiety or boredom. Specifically, over-exposure leads to further reductions in arousal potential below optimum levels, and thus, to decreases in liking.
Bornstein’s (1992; Bornstein & D’Agostino, 1994) *perceptual fluency/attribution model* suggests that exposure to a stimulus increases processing fluency (i.e., speed and efficiency) for the stimulus. When the perceiver has no explicit memory for the stimulus, fluency is misattributed as liking for it. After many exposures, the perceiver becomes aware of the source of fluency and no longer attributes it to liking. In a similar approach, Reber, Schwarz, and Wikelman (2004) propose that unexpected fluency is inherently pleasant, which explains preferences for symmetrical faces and prototypicality in addition to effects of familiarity. When the perceiver has explicit memory for the stimulus, fluency is expected and no longer pleasurable. In many instances, however, people often remember *and* like familiar stimuli such as music (Peretz et al., 1998; Szpunar et al., 2004; Schellenberg et al., 2008). Similar findings are evident in other domains, such as when participants consciously remember and like visual stimuli (e.g., polygons or photographs of faces; Newell & Shanks, 2007). Moreover, fluency explanations do not explicitly address disliking for over-exposed stimuli. Nevertheless, some aspects of the fluency models may work in concert with the two-factor model. For example, reductions in the arousal potential of a stimulus may be mediated by increased fluency.

Szpunar et al. (2004) examined effects of exposure on liking for music. They varied stimulus complexity (from random tone sequences to excerpts from recordings) and the listening context. *Focused* listeners completed an orienting task that required them to listen intently to each presentation, whereas *incidental* listeners completed a distractor task while the music was presented quietly in the background. For focused listeners who heard real music, liking increased monotonically from zero to two to eight exposures, when it reached a peak; liking decreased to baseline levels for music heard 32 times. By contrast, incidental listening to
simple and complex stimuli led to linear increases in liking as a function of exposure, whereas liking for simple stimuli among focused listeners was independent of exposure.

In a follow-up study (Schellenberg et al., 2008), the music stimuli were computer-generated and clearly happy- or sad-sounding. Once again, incidental listening led to linear increases in liking from 0 to 32 exposures, whereas focused listening gave rise to an inverted-U shaped function. In contrast to Szpunar et al. (2004), liking peaked at two rather than eight exposures. With more than two exposures, there were monotonic decreases in liking. The authors suggested that the stimuli sounded simple because they were computer-generated, and somewhat familiar because they had obvious cues to happiness (major key, fast tempo) or sadness (minor key, slow tempo; see Hunter & Schellenberg, 2010). The orienting task likely played an additional role. Focused listeners in Szpunar et al. counted the number of tones in short sequences or identified the lead instrument in orchestral music excerpts, whereas the focused group in Schellenberg et al. identified whether the excerpts sounded happy or sad.

In short, increases and decreases in liking as a function of exposure are moderated by stimulus complexity and the exposure context. Individual differences are also likely to moderate the effect. In Zajonc et al. (1972, Experiment 1), although responses for the sample as a whole followed an inverted-U shaped function, this pattern was evident for only 36% of the participants. A slightly smaller proportion (32%) had decreases in liking with exposure, whereas increases and upright-U associations were seen in 19% and 13% of participants, respectively. The present study provided a more detailed examination of individual differences in associations between liking and exposure, and the factors that contribute to these differences. First, though, we sought additional evidence of individual differences in the association between liking and exposure.
Re-analyses of previously reported data

We reanalyzed the data from the focused-listening conditions of Szpunar et al. (2004, Experiment 2) and Schellenberg et al. (2008). Following Zajonc et al. (1972), we examined mean liking for low, medium, and high exposure frequencies in order to derive a three-point pattern for each participant. The participants in Szpunar et al. and Schellenberg et al. had four levels of exposure (i.e., 0, 2, 8, and 32 exposures). To make response patterns comparable to Zajonc et al., we averaged the two moderate exposure levels (2 and 8) and compared them to liking ratings for novel stimuli (0 exposures) and those with a high number of exposures (32). Inverted-U and upright-U associations were defined as patterns in which mean liking for the moderate exposure level was highest and lowest, respectively. Participants with increases had the lowest mean liking at 0 exposures and highest liking at 32 exposures, with liking at moderate (2 and 8) exposures falling in between, whereas participants with decreases exhibited the opposite pattern.

For listeners tested by Szpunar et al. (2004), the inverted-U response pattern was the most common (45%), followed by increases (35%), decreases (10%), and an upright-U pattern (10%). Response patterns for listeners tested by Schellenberg et al. (2008) were distributed more evenly. The inverted-U pattern was again the most common (29%), followed by an upright-U pattern (25%), decreases (23%), and increases (22%). Both re-analyses suggested that averaging liking ratings across participants may conceal individual differences that modify the association between liking and exposure. Although the modal response pattern was indeed an inverted-U in both instances, fewer than half of the individual participants actually exhibited this pattern of responding.

Aim
We sought to determine whether personality differences moderate the association between liking for music and frequency of exposure. Big five models of personality (e.g., Costa & McCrae, 1992; Goldberg, 1993) explain individual differences with five broad dimensions: Agreeableness, Conscientiousness, Emotional Stability (or Neuroticism), Extroversion, and Openness-to-Experience. Some of these dimensions are known to be associated with preferences for particular genres of music. For example, two studies that measured liking for many different music genres—one with adults (Rentfrow & Gosling, 2003) and another with adolescents (Delsing, Ter Bogt, Engels, & Meeus, 2008)—used principal components analysis to reduce the number of genres to four broad dimensions: Elite (e.g., jazz, classical), Rock (e.g., rock, metal), Urban (e.g., hip-hop, soul), and Conventional (e.g., pop). Both studies tested for associations between personality scores and liking scores on each of the four music dimensions. Higher levels of Extroversion and Agreeableness predicted increased liking for Urban and Conventional music. Emotional Stability was correlated positively with liking Elite music among adults, but negatively among adolescents. Both studies also found a positive association between Openness-to-Experience and liking Elite and Rock music. For the adults, relatively low scores on Openness were also predictive of liking Conventional music.

We were particularly interested in the dimension of Openness-to-Experience and whether it would moderate the association between liking for music and frequency of exposure. Higher levels of Openness are associated with a greater appreciation of novelty and a greater comfort with ambiguity (McRae, 2007; McRae & Costa, 1997). Thus, participants who exhibit high or low levels on this personality dimension may have an attenuated or augmented effect of novelty on arousal, respectively. In other words, participants who are high in Openness should respond more favourably to novel stimuli, whereas participants who are less open should be
particularly wary of novelty. These hypothesized differences in liking responses should also be associated with rate on onset of satiety, because Openness involves “a recurrent need to enlarge and examine experience” (McRae & Costa, 1997, p. 826).

Thus, we predicted that higher scores on Openness-to-Experience would be associated with greater liking for novel pieces and reduced liking for pieces that are over-exposed, as well as a shifted (earlier) peak in liking compared to those who score lower on Openness. We had no reason to expect that any other personality dimension would moderate the association between exposure and liking. In other words, these other dimensions of personality served as control measures. Our method was identical to the focused-listening condition from Szpunar et al. (2004, Experiment 2), including their stimuli (orchestral excerpts) and their instrument-identification task. Participants also completed the Big Five Inventory (BFI; Benet-Martínez & John, 1998; John, Donahue, & Kentle, 1991), a commonly used 44-item measure of the big five personality dimensions.

Method

Participants

Participants were 79 undergraduates (52 women, 27 men). They were recruited without regard to music training from an introductory psychology class and received partial course credit for participating.

Apparatus and stimuli

The stimuli were presented at a comfortable volume over high-quality headphones. Stimulus presentation and response recording were controlled by software written with PsyScope (Cohen, MacWhinney, Flatt, & Provost, 1993) installed on an iMac computer. The stimuli were identical to those used in Szpunar et al. (2004). They consisted of 18 15-s excerpts
taken from commercial recordings of orchestral music (see Appendix G). The excerpts were
drawn primarily from concerti from the Baroque, Classical, and Romantic periods. Each excerpt
had a clearly identifiable lead instrument. There were equal numbers (i.e., three) of excerpts
with cello, flute, horn, oboe, piano, or violin as the lead instrument.

Procedure

Each participant was tested individually in a quiet room. The experiment consisted of an
initial exposure phase followed by a liking phase. The exposure phase consisted of 84 trials in
which participants heard an excerpt then identified the lead instrument. Choices were made by
clicking on one of six buttons. Prior to the exposure phase, participants were familiarized with
each of the six instruments. The 84 presentations in this phase comprised six different
excerpts—each with a different lead instrument—presented 2, 8, or 32 times, with two excerpts
presented at each frequency and assignment of excerpts to frequencies determined randomly for
each participant. The order of excerpts was also randomized separately for each participant but
constrained so that there were no repetitions.

In the liking phase, participants heard the six excerpts from the exposure phase as well
as six novel excerpts selected randomly from the remaining 12 but constrained so that each
novel excerpt had a different lead instrument. The 12 excerpts were presented in random order.
After hearing each excerpt, participants rated how much they liked it on a seven-point rating
scale. Participants subsequently completed the BFI.

Results

Listeners had four liking scores. Their baseline score (0 exposures) was an average of
the six original liking ratings they made for novel excerpts. Their three other liking scores were
for excerpts that were heard 2, 8, or 32 times in the exposure phase. Each of these scores was
averaged over two original ratings. An initial one-way repeated-measure analysis of variance (ANOVA) was used to test whether the present data replicated the results of Szpunar et al. (2004). Descriptive statistics are illustrated in Figure 9. Liking varied with exposure frequency, $F(3, 234) = 5.59, p < .005, \eta_p^2 = .07$. A quadratic trend confirmed that an inverted-U shaped function was evident, $F(1, 78) = 16.92, p < .0001, \eta_p^2 = .18$. Linear and cubic trends were not significant, $ps > .05$. As in Szpunar et al., liking ratings peaked at eight exposures. When participants were classified according to response style (as in the re-analyses reported above), 37%, 28%, 19%, and 16% showed an inverted-U pattern, decreases, increases, and an upright-U pattern, respectively. Thus, as in previous research, the association between liking for music and number of exposures varied across individuals.

Correlations among the five personality variables were small and none was statistically significant after correcting for multiple (i.e., 10) tests. The highest correlation ($r = .26$) was between Conscientiousness and Openness-to-Experience. We used a median split to divide participants into low- and high-scoring groups for each of the five personality dimensions. We then analyzed liking ratings with five separate mixed-design ANOVAs (one for each personality dimension), with personality (high or low) as a between-subjects variable and number of exposures (0, 2, 8, or 32) as a within-subjects variable. The results from each analysis are presented in Table 2. Response patterns were consistent with our predictions. In each analysis, liking varied as a function of exposure frequency. Only for Openness-to-Experience, however, was there an interaction between personality and exposure frequency (Figure 10).
Follow-up analyses examined liking ratings separately for participants who were low or high in Openness-to-Experience. For those who were low in Openness, liking varied as a function of exposure frequency, $F(3, 111) = 2.78$, $p < .05$, $\eta_p^2 = .07$, and the quadratic trend was significant, $F(1, 37) = 9.93$, $p < .005$, $\eta_p^2 = .21$, but the linear and cubic trends were not, $F$s < 1. As shown in Figure 9, liking ratings for these participants followed a classic inverted-U shaped pattern with a peak at eight exposures. Liking also varied as a function of exposures for participants who were high in Openness, $F(3, 120) = 6.60$, $p < .0005$, partial $\eta^2 = .14$. For these participants, however, a negative linear trend was evident, $F(1, 40) = 10.46$, $p < .005$, $\eta_p^2 = .21$, as well as a smaller quadratic trend, $F(1, 40) = 7.07$, $p < .05$, $\eta_p^2 = .15$. Liking peaked for
Table 2: Results from ANOVAs testing effects of personality and exposure frequency on liking for music.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Personaliy Main Effect</th>
<th>Exposure Main Effect</th>
<th>Personality X Exposure Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$F(1, 77)$</td>
<td>$p$</td>
<td>$F(3, 231)$</td>
</tr>
<tr>
<td>Openness</td>
<td>1.80</td>
<td>n.s.</td>
<td>5.64</td>
</tr>
<tr>
<td>Extroversion</td>
<td>3.94</td>
<td>n.s.</td>
<td>5.16</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>&lt; 1</td>
<td>n.s.</td>
<td>5.47</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>1.10</td>
<td>n.s.</td>
<td>5.47</td>
</tr>
<tr>
<td>Emotional Stability</td>
<td>1.49</td>
<td>n.s.</td>
<td>5.54</td>
</tr>
</tbody>
</table>

excerpts heard twice in the exposure phase, although these ratings were virtually identical to those for novel excerpts.

Additional analyses examined differences in liking between participants who were low or high in Openness-to-Experience separately for each exposure frequency. As predicted, compared to their counterparts who were low in Openness, participants who were high in Openness responded *more* favourably to the novel music excerpts, $t(77) = 2.09$, $p < .05$, but *less* favourably to the excerpts heard 32 times, $t(77) = 2.15$, $p < .05$. The two groups did not differ in liking for excerpts they heard two or eight times.
Figure 10. Liking for music excerpts as a function of number of exposures and whether participants were high or low on Openness-to-Experience. Error bars are standard errors.

The final analysis tested for an association between individual response style (inverted-U, upright-U, increases, and decreases) and whether or not participants scored low or high in Openness-to-Experience (Figure 11). A chi-square test of independence confirmed that the two variables were not independent, $\chi^2(3, N = 69) = 10.99, p < .05, \text{Cramer’s } V = .40$. As shown in the figure, although several participants in both groups exhibited an inverted-U shaped response pattern, many participants who were low in Openness exhibited increases in liking for music as a function of exposure, whereas the modal response pattern for participants who were high in Openness was a decrease in liking.
Figure 11. Number of participants who exhibited each response style, calculated separately for participants who were high or low on Openness-to-Experience.

Discussion

The goal of the present study was to examine whether the personality dimension of Openness-to-Experience moderated the effect of exposure on liking for music. Increases in liking are typically evident after a moderate number of exposures followed by decreases after many exposures. We first presented a re-analysis of previously collected data (Schellenberg et al., 2008; Szpunar et al., 2004), which revealed substantial individual differences in response patterns. In a new experiment, listeners rated how much they liked music they had previously heard 0, 2, 8, or 32 times. Of the big five dimensions of personality, only Openness-to-Experience interacted with exposure. Participants who were low in Openness exhibited the
inverted-U shaped pattern when considered as a group, although many individuals showed simple increases in liking as a function of exposure. By contrast, high levels of Openness were associated with increased levels of liking for novel pieces and decreased liking for overly familiar pieces, and the most common response pattern was a linear decrease in liking.

Because listeners who were high on Openness provided liking ratings for novel pieces that were already at or near peak levels, they showed little or no sign of neophobia. From the perspective of the two-factor model, this greater comfort with ambiguity would be accounted for by a lower arousal potential generated by novelty, such that novel music excerpts generated levels of arousal potential that were at or near optimum levels. Consequently, arousal potential fell below optimum after relatively few exposures, which, in turn, caused liking to decrease. By contrast, listeners who were low on Openness exhibited evidence of discomfort with ambiguity, or neophobia, needing eight exposures to reach optimum liking. By 32 exposures, though, liking decreased for them as well.

Another possible explanation for our results comes from the findings of a study that examined why people listen to music (Chamorro-Premuzic & Furnham, 2007). Participants’ self-reports were used to identify three styles of music listening. The first was an emotion-focused style; these listeners used music to manipulate their mood. The second was an intellectual style, such that listeners focused on the music itself, perhaps judging the artistry of the performance or the composition. Finally, a background-listening style indicated that music was played typically while the listener’s attention was focused on another task. Openness-to-Experience was predictive of an intellectual listening style. This finding suggests that the present listeners who were high in Openness may have paid more attention to the music they heard, which would then have become familiar more quickly. Although this perspective predicts a relatively early peak in
liking and more rapid satiety, it cannot explain greater liking for completely novel stimuli that we observed among participants who were high in Openness.

Another possibility is that high-scorers on Openness were more familiar, in general, with classical music. Classical pieces, then, even if novel, would sound more familiar because they came from a familiar genre. Indeed, a correlation between Openness and a preference for Elite genres, which includes classical music, has been reported among adults (Rentfrow & Gosling, 2003) and adolescents (Delsing et al., 2008). From this perspective, one might expect higher levels of liking in general for those who were familiar with classical music. In the present study, however, there was no difference in overall liking between groups (i.e., no main effect of Openness). In fact, peak levels of liking were higher for the low-Openness group. Nevertheless, future research could measure familiarity with the music genre of the stimuli as well as personality variables in order to test the hypothesis that pre-existing levels of familiarity are accounting for some of the effects we observed.

Our results do not speak directly to whether the two-factor or fluency models best account for effects of exposure on liking for music. Both an intellectual listening style and an initial familiarity with classical music could lead to attenuated neophobia and/or higher fluency. Only the two-factor model, however, accounts for decreases in liking as a consequence of over-exposure. Moreover, fluency models propose that greater liking is evident when the participant is unaware of the source of fluency (Bornstein & D’Agostino, 1992) or when fluency is unexpected (Reber et al., 2004). In the case of intellectual listening, greater attention would presumably lead to greater memory for the piece and, consequently, greater awareness of previous exposure. In the case of familiarity with classical music, listeners would recognize novel excerpts as nonetheless belonging to a familiar genre.
Our findings shed some light on associations between personality and genre preferences that have been reported previously (Delsing et al., 2008; Rentfrow & Gosling, 2003). Both studies reported that Openness-to-Experience was related positively to liking for relatively non-mainstream music genres. Delsing et al. attributed this finding to a desire for variety and unconventionality among individuals who are high in Openness. Moreover, when they examined longitudinal changes in preferences, they found that Openness was related to decreases in liking over time for Conventional music, and to a relatively slow increase in liking for Urban music. Considering the ubiquity of Conventional and Urban music in mainstream media, the results of the present study raise the possibility that those who are high in Openness might tire of an entire genre of music over time, perhaps driving them to seek out less familiar musical styles. Although it seems probable that these individuals would be prone to dislike specific over-exposed pieces (e.g., Pachelbel’s Canon) or artists (e.g., U2), it is unclear whether satiety would occur at the level of a music genre. Rather, individuals who are high in Openness may tend to show greater liking for less-common pieces (e.g., Sigur Rós’s Gobbledygook) or artists (e.g., M.I.A., Broken Social Scene) who can still be classified as belonging to popular genres.

Our findings highlight individual differences in the association between liking music and number of exposures for only one of the big five personality dimensions: Openness-to-Experience. Future research may reveal that other personality constructs also lead to interactions between exposure and liking for music. Sensation Seeking is a definite possibility, because it involves a desire for novelty and complexity as well as a willingness to take risks (Zuckerman, 1979). Future research could also attempt to replicate the present results with music taken from completely unfamiliar musical styles, such as music from a foreign culture. The use of
unfamiliar music would help to tease apart effects of fluency and attenuated neophobia. Music from a foreign and unfamiliar culture should sound novel to all participants such that individual differences in fluency would be negligible. Thus, relatively high levels of liking for novel pieces among participants who are high in Openness could be attributed directly to attenuated neophobia. A third direction for future research could be to test the arousal-mediation hypothesis directly by measuring arousal levels. The present results suggest that Openness-to-Experience would be negatively associated with arousal levels when listeners are exposed to unfamiliar music.

In sum, the present findings reveal that liking for novel classical music varies in an interactive manner as a function of personality and number of exposures. They also raise questions about whether similar findings would be evident with a different style of music, whether other personality constructs would moderate the association between liking and exposure to music, and which theoretical model or models best describe liking for music that is heard a few times or many times.
Concluding Remarks

Music is a cultural product that has strong ties to personal identities (e.g., Rentfrow & Gosling, 2003; Delsing et al., 2008) and emotions (see Hunter & Schellenberg, 2010), yet our understanding of how music preferences relate to personal and contextual factors remains incomplete. Previous research has examined preferences for musical genres and for emotions expressed in music, but these factors are typically examined in isolation. The findings reveal general tendencies for listeners to prefer music that is familiar (e.g., Peretz et al., 1998) or happy-sounding (e.g., Hunter et al., 2010). These results are at odds, however, with anecdotal evidence of listeners liking unfamiliar or sad-sounding pieces. When individual differences have been examined, they are associated with preferences for particular genres of music (e.g., Rentfrow & Gosling, 2003), which represent very broad and relatively uninformative categories. The research in the present dissertation sought to fill some gaps in our knowledge by considering the influence of context and individual differences on liking for pieces of music that varied in expressed emotion or familiarity.

The present results highlight the importance of considering individual differences when examining music preferences. Consideration of gender, age, mood, and personality revealed several distinctions related to the typical preference for happy- over sad-sounding music (e.g., Hunter et al., 2008; Schmidt & Trainor, 2001; Witvliet & Vrana, 2007). First, this preference was dependent on the listener’s mood (Study 1). More specifically, listeners in a sad mood did not show the preference for happy-sounding music. Because most participants are likely to come to a psychology laboratory in a neutral or relatively happy mood, a preference for happy-sounding music is the norm even though many people regularly choose to listen to sad-sounding music.
Children were also found to have a preference for happy- over sad-sounding music, but subtle developmental differences emerged (Study 2). Children had a more general preference for music expressing high-arousal emotions (i.e., happy- and scary-sounding pieces), whereas adults preferred music expressing positive emotions (i.e., happy- and peaceful-sounding pieces). A gender difference also emerged, with females, but not males showing a positive-valence preference across ages. Further, listeners’ ability to identify emotions expressed musically was associated with their liking responses, such that young children (aged 5 and 8 years) who were more accurate tended to show more adult-like music preferences.

The principal finding of Study 3 was that personality moderates the association between liking and frequency of exposure. Listeners who were high in Openness-to-Experience showed a lack of neophobia for unfamiliar music. They also satiated faster than those who were low on this dimension. This finding is best explained as a function of arousal potential, in line with the two-factor theory (Berlyne, 1970; Stang, 1974). According to the theory, liking peaks when arousal is at optimum levels (i.e., neither too high nor too low). This arousal response to novel stimuli appears to vary with Openness. Novel stimuli appear to elicit optimum levels of arousal in those who are high in Openness but greater-than-optimum arousal among those who are low on this dimension.

The present findings also indicate that affect plays an important role in music preferences. Some authors suggest that preferences are determined by cognitive factors such as aesthetic judgement (Konečni, 2008) and perceptual fluency (Reber et al., 2004). Nevertheless, listeners in happy or neutral moods showed a preference for happy- over sad-sounding music (Study 1), which suggests that they had a relatively unpleasant affective response to sad-sounding music. Moreover, it is difficult to explain why adults and children had music
preferences organized along different affective dimensions without considering their affective reactions. It would be a strange coincidence if they actually found music to be more aesthetically pleasing when it expressed emotions that were positive in valence or high in arousal, respectively. Finally, arousal levels—part of emotional responding—also play a role in the effect of exposure on liking. Explanations based solely on perceptual fluency are unable to account for liking for novel pieces seen among listeners who are high in Openness-to-Experience. For all of the above findings, it is more parsimonious to conclude that listeners responded affectively to music.

The present findings also have implications for areas outside of music psychology. To date, there has been limited research on affective preferences for non-music stimuli. Influences of mood and individual differences could be investigated in the context of other aesthetic stimuli, in order to determine whether the findings observed in the present dissertation are specific to music, or whether they apply across stimulus types. In addition, non-music studies have not attempted to account for individual differences in the association between liking and frequency of exposure, even though such differences were first reported with respect to visual stimuli (Zajonc et al., 1972). Presumably, perceivers who are high in Openness-to-Experience should show lower neophobia across domains, such that they respond relatively favourably to novel visual as well as auditory stimuli.

The present findings also have practical implications for music education and music therapy that could be studied in future research. For music education, the delayed development of emotion identification among boys implies that young boys might benefit from extra music instruction or exposure at these ages. For music therapy, although it seems like sad-sounding music would worsen one’s mood, sad listeners find this music to be relatively pleasurable.
Thus, sad-sounding music may have a place in therapy for those with mood disorders such as dysthymia or depression. For chronically sad individuals, sad-sounding music may even play a cathartic role.

Like most research, the present set of studies addressed existing questions while raising many additional questions. For example, personality was investigated in relation to the effect of exposure on liking, but it may also play a role in preferences for musically expressed-emotions or other musical factors. Indeed, emotion-based music preferences may be related to preferences for musical genres, as some genres are stereotypically related to certain emotions (e.g., pop with happiness, heavy metal with anger). Because personality is related to genre preferences, preferred emotions may provide a mediating factor. For example, extraverts may prefer high-arousal emotions expressed in music. Similarly, because arousal potential appears to play a role in the effect of frequency of exposure on liking, it is possible that the arousal level of the emotion expressed in the music could mediate this association. For example, would pieces expressing high-arousal emotions require more exposures for listeners to warm up to them? In addition, two theories of listening style (Chamorro-Premuzic & Furnham, 2007; Kreutz et al., 2008) were cited as potential explanations for the present findings. Both differentiate between intellectual/systemizing and emotion-focused/empathizing listening styles. These concepts may be useful in understanding individual differences in music perception and responding to music. Finally, little is known about children’s affective responses to music. Because their perception and preferences for expressed emotion differ from those of adults, so too might they differ in felt emotion. If so, mood might affect their music preferences in ways that differ from those seen in adulthood.
In sum, it is clear that there are strong influences of gender, age, mood, and personality on music preferences, which may be masked by findings based on reactions to stimulus characteristics among groups of heterogeneous participants. Examining these differences can help to resolve apparent discrepancies between studies (e.g., differences in the effect of exposure on liking) or between laboratory research and anecdotal evidence (e.g., liking for sad-sounding music). Moreover, this approach contributes to our understanding of how music preferences form, and how they relate to personal identity. The importance people ascribe to music and music’s cultural ubiquity confirm that furthering our understanding of liking for music is a worthwhile goal for psychologists to pursue in future research.
References


Scherer, K. R. (2004). Which emotions can be induced by music? What are the underlying mechanisms? And how can we measure them? *Journal of New Music Research, 33*, 239-251.


http://www.psych.lancs.ac.uk/software/psyScript.html


cognitions: Attributions, appraisals, and their relation to emotion. Journal of Personality
and Social Psychology, 65, 916-929.

81, 1014-1025.

stimuli as a function of exposure. Journal of Experimental Psychology: Learning,
Memory, and Cognition, 30, 370-381.


Trainor, L., & Trehub, S. E. (1992). A comparison of infants' and adults' sensitivity to Western
musical structure. Journal of Experimental Psychology: Human Perception and
Performance, 18, 394-402


### Appendix A

**Pieces from Which Stimuli Were Excerpted in Study 1**

<table>
<thead>
<tr>
<th>Emotion</th>
<th>Artist/Composer</th>
<th>Title</th>
<th>Album</th>
</tr>
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<tbody>
<tr>
<td>Happy</td>
<td>Babatunde Olatunji</td>
<td>Loyin Loyin</td>
<td>Best of Both Worlds…</td>
</tr>
<tr>
<td>Happy</td>
<td>Glenn Miller</td>
<td>In the Mood</td>
<td>His Greatest Hits…</td>
</tr>
<tr>
<td>Happy</td>
<td>Zafra</td>
<td>Santiago</td>
<td>Caliente: Musica Cubana</td>
</tr>
<tr>
<td>Sad</td>
<td>Christopher O’Riley</td>
<td>Exit Music (For a Film)</td>
<td>True Love Waits</td>
</tr>
<tr>
<td>Sad</td>
<td>Radiohead</td>
<td>Like Spinning Plates</td>
<td>I Might be Wrong…</td>
</tr>
<tr>
<td>Sad</td>
<td>Massive Attack</td>
<td>Weather Storm</td>
<td>Protection</td>
</tr>
<tr>
<td>Ambiguous</td>
<td>The Cure</td>
<td>A Letter to Elise</td>
<td>Wish</td>
</tr>
<tr>
<td>Ambiguous</td>
<td>The Cure</td>
<td>Last Dance</td>
<td>Disintegration</td>
</tr>
<tr>
<td>Ambiguous</td>
<td>Glenn Miller</td>
<td>Moonlight Serenade</td>
<td>His Greatest Hits…</td>
</tr>
<tr>
<td>Ambiguous</td>
<td>Silvanan Deluigi</td>
<td>Quien hubera dicho</td>
<td>Tanguera: Woman in Tango</td>
</tr>
<tr>
<td>Ambiguous</td>
<td>Vivaldi</td>
<td>Cello Conc. in G maj. 2</td>
<td>Famous Concerti…</td>
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<tr>
<td>Ambiguous</td>
<td>Yann Tiersen</td>
<td>La Noyee</td>
<td>Amelie Soundtrack</td>
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</tbody>
</table>
Appendix B

Delicious and Messy
Appendix C

Blue Pen
Appendix D

Injured Turtle
Appendix E

Like a LITTLE

Like a LOT
Appendix F

HAPPY

SAD

PEACEFUL

SCARY
Appendix G

Pieces from Which Stimuli Were Excerpted in Study 3

<table>
<thead>
<tr>
<th>Composers</th>
<th>Pieces</th>
</tr>
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<tbody>
<tr>
<td>Bach</td>
<td>Brandenburg Concerto No. 1 in F</td>
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<tr>
<td>Bach</td>
<td>Concerto in A for Oboe</td>
</tr>
<tr>
<td>Bach</td>
<td>Flute Concerto in E Minor</td>
</tr>
<tr>
<td>Beethoven</td>
<td>Piano Concerto No. 1 in C Major, Op. 15</td>
</tr>
<tr>
<td>Beethoven</td>
<td>Violin Concerto in D, Op. 61</td>
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<tr>
<td>Fauré</td>
<td>En Priere for Flute and Orchestra</td>
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<tr>
<td>Fauré</td>
<td>Pavane for Flute and Orchestra</td>
</tr>
<tr>
<td>Handel</td>
<td>Oboe Concerto No. 1 in B Flat</td>
</tr>
<tr>
<td>Haydn</td>
<td>Cello Concerto No. 1 in C</td>
</tr>
<tr>
<td>Haydn</td>
<td>Cello Concerto No. 2 in D</td>
</tr>
<tr>
<td>Mozart</td>
<td>Horn Concerto No. 1 in D, K. 412</td>
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<tr>
<td>Mozart</td>
<td>Horn Concerto No. 3 in E Flat, K. 447</td>
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<tr>
<td>Schubert</td>
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<td>Schubert</td>
<td>String Quartet No. 13 in A Minor, D804</td>
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<tr>
<td>Tchaikovsky</td>
<td>Piano Concerto No. 2 in D Minor, Op. 23</td>
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<td>Tchaikovsky</td>
<td>Piano Concerto No. 3 in E Flat, Op. 75</td>
</tr>
<tr>
<td>Vivaldi</td>
<td>Cello Concerto in G Major</td>
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<tr>
<td>Vivaldi</td>
<td>Oboe Concerto in C Major</td>
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</tbody>
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