

Liking for happy- and sad-sounding music: Effects of exposure

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We examined liking for happy- and sad-sounding music as a function of exposure, which varied both in quantity (number of exposures) and in quality (focused or incidental listening). Liking ratings were higher for happy than for sad music after focused listening, but similar after incidental listening. In the incidental condition, liking ratings increased linearly as a function of exposure. In the focused condition, liking ratings were an inverted U-shaped function of exposure, with initial increases in liking (after 2 exposures) followed by decreases (after 8 or 32 exposures). The results documented that: (1) sad music is liked as much as happy music in some instances; (2) frequency of exposure causes both familiarity (positive) and over-familiarity (negative) effects; and (3) effects of exposure on liking differ for focused and incidental listening.

Music is found in every known culture and it is ubiquitous within cultures as well. In modern Western society, we hear music incidentally in many different contexts, such as when we eat in a restaurant or go out to buy groceries. We also choose to listen to music in the car, at home, and at concerts. Nonetheless, the study of musical preferences—what we like, what we choose to hear—is in its infancy. This is a peculiar state of affairs because listeners' tastes in music are central to their identity (Rentfrow & Gosling, 2003). In fact, our musical preferences allow us to convey much about our personalities to others, just as others' musical tastes tell us much about who they are (Rentfrow & Gosling, 2006). We know relatively little, however, about *how* we come to like a particular piece of music or a particular musical

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style (e.g., classical, heavy metal, reggae). In the present study, we examined liking for music among a large sample of undergraduates. We were particularly interested in the effect of exposure on liking for music with pre-existing emotional status (i.e., happy- or sad-sounding).

Music is often said to be the language of the emotions (e.g., Mithen, 2005). Two emotions that music portrays relatively easily are happiness and sadness (Gabrielsson & Juslin, 1996; Krumhansl, 1997). The perception of happiness and sadness in music is influenced by many variables that function in a rich and interactive manner (e.g., Gabrielsson & Lindström, 2001; Schellenberg, Krysciak, & Campbell, 2000). Nonetheless, in Western music, pieces that are perceived to sound happy typically have a fast tempo and are composed in a major mode. By contrast, sad-sounding music is usually slow and minor. *Tempo* refers to the speed of a musical piece (measured in beats per minute), whereas *mode* refers to the underlying key upon which a piece is based (major or minor). Western music has 12 major and 12 minor keys (A major, A minor, A# major, A# minor, B major, B minor, and so on). Researchers established several years ago that listeners readily use cues from tempo (Gundlach, 1935; Hevner, 1937; Rigg, 1937, 1940) and from mode (Hevner, 1935; Rigg, 1937, 1939; Scherer & Oshinsky, 1977) to identify whether a musical piece sounds happy or sad. Recent evidence is consistent with these earlier findings (Dalla Bella, Peretz, Rousseau, & Gosselin, 2001; Gagnon & Peretz, 2003; Gerardi & Gerken, 1995; Gregory, Worrall, & Sarge, 1996; Hunter, Schellenberg, & Schimmack, in press; Peretz, Gagnon, & Bouchard, 1998a; Webster & Weir, 2005).

As one might expect, listeners typically *prefer* happy- to sad-sounding music. For example, after listening to classical music, enjoyment ratings are higher for an up-tempo piece written in a major key compared to a slow-tempo piece in a minor key (Thompson, Schellenberg, & Husain, 2001). When listeners hear different versions of the same piece that vary in tempo (fast or slow) and mode (major or minor), liking ratings are highest for the fast-major version (Husain, Thompson, & Schellenberg, 2002). Preferences for happy-sounding pieces (i.e., fast tempo and major key) extend to music from a wide variety of genres (e.g., jazz, alternative, rock; Hunter et al., in press), and to listeners with brain damage (Gosselin et al., 2005).

Why, then, do we often choose to listen to sad-sounding music? Clearly, many sad-sounding pieces are also beautiful works of art from an aesthetic standpoint (Schubert, 1996). As such, appreciating sad music might be similar to watching a film about a sad subject matter, or looking at a visual work of art that portrays a negative image. In the present investigation, we sought to further our understanding of the appeal of sad-sounding music by testing whether the usual preference for happy-sounding music might be altered systematically by previous experience.

Music preferences are also influenced by familiarity. Liking for unfamiliar pieces typically increases as a function of exposure (e.g., Heingartner & Hall, 1974; Meyer, 1903; Peretz, Gaudreau, & Bonnel, 1998b; Verveer, Barry, & Bousfield, 1933), as does liking for visual art (e.g., Cutting, 2003). More provocatively, *mere exposure* (Zajonc, 1980)—even when listeners have no explicit memory for previously encountered stimuli—also increases liking for music and music-like stimuli (Johnson, Kim, & Risse, 1985; Szpunar, Schellenberg, & Pliner, 2004; Thompson, Balkwill, & Vernescu, 2000; Wilson, 1979). Phenomenological experience tells us, however, that *increases* in liking as a function of exposure cannot be the whole story. Listeners often satiate, or come to dislike, music they have heard repeatedly.

Szpunar et al. (2004) documented satiation effects for music in the laboratory. When their participants were required to listen attentively to musical excerpts (in the *focused* listening condition), initial increases in liking that followed a moderate number of exposures (i.e., 2 or 8 exposures) turned into decreases after 32 exposures. Interestingly, this inverted U-shaped function was evident only after an ecologically valid listening experience—one that involved identifying the lead instrument in excerpts from recordings of classical music. When listeners were asked to count the number of tones in sequences of random, isochronous piano tones (i.e., non-musical stimuli and orienting task), liking did not vary as a function of previous exposure. Moreover, when the stimuli were presented quietly in the background (in the *incidental* listening condition), liking ratings increased monotonically as a function of exposure, as did recognition, and there was no evidence of satiation even after 32 exposures.

How do researchers account for effects of exposure on liking? One account (Zajonc, 2001) is based on classical conditioning but its current formulation is on *subliminally* presented visual stimuli (e.g., Monahan, Murphy, & Zajonc, 2000) and therefore of limited relevance to everyday musical experiences. Another account, the *perceptual fluency/attributional model* (Bornstein, 1989, 1992; Bornstein & D'Agostino, 1994), holds that (1) previously encountered stimuli are processed fluently (i.e., rapidly and efficiently; Jacoby, 1983), and (2) when participants are asked to judge how much they like a particular stimulus, perceptual fluency is misattributed as a favourable disposition toward the stimulus. Because this view is based on misinterpreting ease-of-processing as liking, such effects are less likely as explicit memory for the stimulus increases and perceivers realise that their perceptual fluency is a consequence of familiarity. A related view (Reber, Schwarz, & Winkielman, 2004; Reber, Winkielman, & Schwarz, 1998; Winkielman, Schwarz, Fazendeiro, & Reber, 2003) holds that “processing fluency is itself hedonically marked” (Reber et al., 2004, p. 365). In other words, processing fluency that arises from previous exposure leads directly to positive affective responding without any misattribution. As with the

traditional fluency view, however, positive aesthetic evaluations are said to be less likely when perceivers are aware that their fluency can be attributed to previous exposure (see Van den Burgh & Vrana, 1998). In short, both fluency perspectives account for mere-exposure effects but they cannot account for increases in liking that are accompanied by increases in explicit memory (Peretz et al., 1998b; Szpunar et al., 2004). Listeners often remember *and* like familiar pieces of music.

An alternative view is provided by the *two-factor model* (Berlyne, 1970, 1971, 1974; Stang, 1974), which focuses explicitly on exposure and liking rather than recognition. Berlyne's model is actually "a heuristically useful, but loosely organised, set of ideas about psychological principles hypothetically involved in aesthetics and art" rather than a formal theory (Konecni, 1996, p. 131). He considered liking to be a function of the "arousal potential" of a stimulus, which should be neither too great nor too small. Liking increases initially with exposure as the arousal potential of a stimulus decreases and the perceiver realises that a novel, potentially threatening stimulus is benign (in line with Zajonc, 2001, and his account of subliminal stimuli). These *increases* in liking work in combination with a second factor based on over-familiarity or boredom (and further decreases in arousal potential), which accounts for *decreases* in liking that accompany prolonged exposure. In other words, the two-factor model posits that liking will often be an inverted U-shaped function of exposure, with initial increases followed by decreases. The peak in liking and the onset of satiation vary depending on stimulus complexity (more complex = more arousal potential; Orr & Ohlsson, 2001) and attention. The peak occurs after relatively few exposures for simple stimuli and/or focused attending, but much later (if at all) with more complex stimuli and incidental exposure. Expertise also plays a role, with experts such as professional artists or musicians more likely to attend to multiple stimulus dimensions (Orr & Ohlsson, 2005). Accordingly, the arousal potential of a complex stimulus is likely to decrease as the expertise of the perceiver increases.

Processing fluency provides a good account of response patterns to music-like stimuli that are impoverished and aesthetically neutral (e.g., random tone sequences). Focused exposure leads to accurate recognition but not to increases in liking, whereas incidental exposure leads to increases in liking in the absence of explicit memory (Szpunar et al., 2004, Experiment 1). In fact, there is abundant empirical evidence of liking in the absence of explicit memory for impoverished and neutral stimuli presented in either visual or auditory modalities (Barchas & Perlaki, 1986; Bonanno & Stillings, 1986; Bornstein, Leone, & Galley, 1987; Kunst-Wilson & Zajonc, 1980; Mandler, Nakamura, & Van Zandt, 1987; Murphy, Monahan, & Zajonc, 1995; Seamon, Brody, & Kauff, 1983; Seamon, Marsh, & Brody, 1984; Seamon et al., 1995; Thompson et al., 2000).

When the stimuli are rich and aesthetically pleasing, however, the two-factor model appears to provide a better account of response patterns. With only a few focused exposures to real music, increases in liking are accompanied by increases in recognition (Peretz et al., 1998b). Additional focused listening leads to increases in recognition, but liking ratings follow an inverted U-shaped function, with positive effects of familiarity superseded by boredom as the number of exposures increases (Szpunar et al., 2004, Experiment 2). By contrast, for music heard in the background (i.e., incidental listening), multiple exposures lead to liking ratings that increase in tandem with recognition (Szpunar et al., 2004, Experiment 2), presumably because the exposure process (i.e., decreasing arousal potential) is slower when the perceiver's attention is diverted. To date, evidence of an interaction between quantity (frequency of exposure) and quality (focused or incidental) of the listening experience on liking for real music comes primarily from a single report (Szpunar et al., 2004; but see also Tan, Spackman, & Peaslee, 2006). Although the findings with impoverished and neutral stimuli are interesting theoretically, response patterns to real music are more relevant to the formation of music preferences in everyday life.

In the present investigation, we examined liking as a function of exposure for excerpts of music taken from the classical repertoire. Listeners heard happy- and sad-sounding excerpts with varying exposure frequencies. The exposure phase involved focused or incidental listening. If ecological validity and aesthetic merit are crucial stimulus parameters, then response patterns should be similar for the happy- and sad-sounding pieces because all of the stimuli were real pieces of complex music that have stood the test of time. Accordingly, for focused listeners, we predicted monotonic increases in recognition as a function of exposure to happy- and sad-sounding music, but a curvilinear pattern for liking ratings (increases followed by decreases). For incidental listeners, we expected to find increases in liking as a function of exposure, and that such increases would be accompanied by increases in recognition.

We also expected that listeners would, in general, provide higher liking ratings for happy- over sad-sounding music, as they have in previous research. Nonetheless, because the incidental listeners were required to complete a demanding and relatively lengthy (approximately 25 minutes) distractor task during the exposure phase, the usual bias favouring happy-sounding music might be exaggerated or attenuated for this group of participants. On the one hand, after a boring task, these listeners might exhibit an even greater preference for arousing (happy) music. On the other hand, sad music might increase in appeal because it would be congruent with the listeners' negative mood. Moreover, if listeners were to become fatigued or agitated, slow-tempo, sad-sounding music, which is known to lower arousal levels (Balch & Lewis, 1996; Husain et al., 2002; Krumhansl, 1997;

Thompson et al., 2001), might increase in appeal relative to arousing and happy-sounding music. Accordingly, the typical preference for happy-sounding music would be attenuated or eliminated. In any event, we predicted that response patterns for happy- and sad-sounding music would be *similar* as a function of *quantity* of exposure (number of exposures), but *different* as a function of *quality* of exposure (focused or incidental listening).

METHOD

Participants

Listeners were 108 undergraduates recruited from two large Canadian universities (Toronto and Montréal). Recruitment in Montréal was limited to fluent English–French bilinguals (French is the language of instruction) so that the method was identical across campuses. Assignment to the focused and incidental conditions was counterbalanced across campuses. Listeners received partial course credit or token remuneration for participating. On average, the students had 1.9 years of private music lessons, but the distribution was positively skewed ($SD = 3.2$ years, range = 0–12). The median and mode were 0 years of lessons, and more than three-quarters (76%) had a maximum of 2 years.

Stimuli

The stimuli were 18 of the 32 musical excerpts from the corpus formed by Peretz et al. (1998a; see also Dalla Bella et al., 2001; Gosselin et al., 2006; Peretz, Blood, Penhune, & Zatorre, 2001). Peretz et al. selected excerpts from pieces from the Baroque, Classical, Romantic, and Impressionist periods, based on the criterion that 16 sounded unequivocally happy and 16 sounded unequivocally sad. The happy-sounding excerpts had a relatively fast tempo and were composed in major mode, whereas the sad-sounding excerpts were relatively slow and in minor mode. Some of the pieces were originally written for orchestra or for instruments other than piano, but all of them were transcribed for piano with MIDI (Musical Instrument Digital Interface) software, using the exact pitch and duration values from the original scores and identical amplitude for each tone. Consequently, although the excerpts were more complex and aesthetically pleasing than the neutral and impoverished stimuli that researchers typically use, the piano “performances” sounded slightly mechanical. Nonetheless, in previous studies, adult nonmusicians judged the emotional valence of the excerpts in line with the selection criterion. Specifically, on a 10-point bipolar scale (1 = *sad*, 10 = *happy*), the happy and sad pieces received average ratings of 8.7 and 3.6 (Peretz et al., 1998a), and of 7.7 and 3.3 (Dalla Bella et al., 2001),

respectively. Even children as young as 5 years of age successfully classified the excerpts appropriately as happy or sad (Dalla Bella et al., 2001).

From the original set of 32, we chose 9 happy-sounding and 9 sad-sounding excerpts that were the least likely to be familiar to college students (see Appendix). None of the present participants reported being familiar with any of our chosen excerpts, and even the first author (with 10 years of formal music lessons) was unfamiliar with all of them. Because each excerpt was selected to make sense musically (i.e., comprising a complete phrase or musical idea), they varied in duration from 7.4 to 23.8 s ($M = 14.5$, $SD = 5.1$). The happy and sad excerpts were matched in terms of number of beats per excerpt (happy: $M = 19.9$, $SD = 7.0$, sad: $M = 19.8$, $SD = 4.7$), but the sad excerpts ($M = 17.4$ s, $SD = 3.9$ s) were longer than the happy excerpts ($M = 11.7$ s, $SD = 4.6$ s) because of their slower tempo.

As in Szpunar et al. (2004), the stimulus for the distractor task in the incidental condition was excerpted from the beginning of a narrated story written by Stephen King (1996). King is best known as a writer of horror novels. This particular excerpt was somewhat disjointed and eerie in tone, but the distractor task (see below) prevented detailed processing of its semantic content. All stimuli were saved as CD-quality digital sound files.

Apparatus

Listeners wore high-quality stereophonic headphones while sitting in front of a Macintosh computer in a quiet room. Customised software created with RealBasic was used to present the stimuli and to collect responses.

Procedure

Listeners were tested individually. Following Szpunar et al. (2004), there was an initial exposure (listening) phase followed by second and third phases that required liking and memory ratings, respectively. In the exposure phase, 3 happy and 3 sad pieces were selected randomly for each listener. The pieces were then assigned randomly to one of three exposure frequencies, so that there were 32 presentations of one happy- and of one sad-sounding piece, 8 presentations of another happy and another sad piece, and 2 presentations of the two remaining pieces (one happy, one sad). The 84 stimulus presentations were presented in random order, constrained so that the same piece was never presented twice in a row.

Half of the listeners were assigned to the focused condition, the other half to the incidental condition. To ensure that listeners in the focused condition listened attentively to each presentation, they were required to identify whether each piece sounded happy or sad. As with the instrument-identification task used by Szpunar et al. (2004) and the familiarity judgements used by Peretz et al. (1998b), the emotion-identification task

was considered to be musically relevant and to encourage holistic processing of the stimuli (unlike counting tones). Because the listening phase included many repeated pieces, we informed listeners that we were also interested in their perception of the pieces' durations, their ability to respond *immediately* after each piece ended, and whether response latencies might decrease with repeated exposures.

The goal of the incidental condition was to create a listening experience in which music was overheard in the background but the listener's attention was diverted elsewhere. To that end, we used an extremely effortful dichotic-listening task. Participants were required to track a narrated story in their right ear, pressing one key on the keyboard every time they heard the word *the*, and another key every time they heard the word *and*. They were also asked to count the total number of times they heard the word *but*. The musical pieces were presented in their left ear, with consecutive pieces separated by 1 s of silence. The music was audible but presented at greatly reduced amplitude compared to the story (story sound file normalised to 100% of maximum amplitude, music normalised to 2%), which was presented at the same amplitude (a comfortable volume) as the musical pieces in the focused condition, and as the pieces in the subsequent (liking and memory) phases.

The liking phase had 12 pieces presented in random order, including the 6 pieces from the exposure phase as well as an additional 6 pieces (3 happy, 3 sad) selected randomly from the 12 that were not presented earlier. Listeners rated how much they liked each piece by clicking the mouse on a 7-point scale (1 = *not at all*, 7 = *extremely*). The memory phase included all 18 pieces presented in random order. Listeners used an identical 7-point scale to rate how confident they were that each piece was presented in the initial exposure phase.

Data analysis

Each listener had 8 liking ratings and 10 recognition ratings. The 8 liking ratings included one for each of the 6 pieces (3 happy, 3 sad) heard during the exposure phase, as well as two baseline ratings averaged separately for the 3 happy and 3 sad pieces that were introduced in the liking phase (no prior exposure). The 10 recognition ratings included one for each of the 6 pieces heard during the exposure phase, two additional ratings that were averaged separately for the 3 happy and 3 sad pieces that were introduced in the liking phase (1 previous exposure but not in the exposure phase), and two baseline ratings averaged separately for the 3 happy and 3 sad pieces that were introduced in the recognition phase (no prior exposure). The main analyses were three-way, mixed-design analyses of variance (ANOVAs), with Frequency of Exposure (four levels for liking ratings, five levels for

recognition ratings) and Emotion (happy or sad) as within-subjects variables, and Listening Condition (focused or incidental) as a between-subjects variable. The Huyhn–Feldt correction was used for possible violations of the sphericity assumption. All tests were two-tailed with $\alpha = .05$. Exact p -values are reported, accurate to three decimal places.

RESULTS

Liking ratings

The ANOVA revealed a main effect of emotion, $F(1, 106) = 10.22, p = .002$. In general, happy-sounding pieces were liked more than sad-sounding pieces, but this effect was qualified by a two-way interaction between emotion and listening condition, $F(1, 106) = 4.30, p = .041$. As illustrated in Figure 1, happy pieces were rated higher than sad pieces after focused listening, $F(1, 53) = 11.80, p = .001$, but not after incidental listening, $F < 1$. Alternative follow-up analyses confirmed that liking for sad-sounding pieces was higher after incidental compared to focused listening, $F(1, 106) = 4.61, p = .034$, whereas liking for happy-sounding pieces did not vary as a function of listening condition, $F < 1$. Thus, the incidental-listening experience led to an increase in the appeal of the sad-sounding music, which eliminated the typical preference for happy- over sad-sounding music. Moreover, the lack of a three-way interaction, $F < 1$, indicated that the observed two-way interaction was independent of number of exposures and therefore indistinguishable between novel and familiar excerpts.

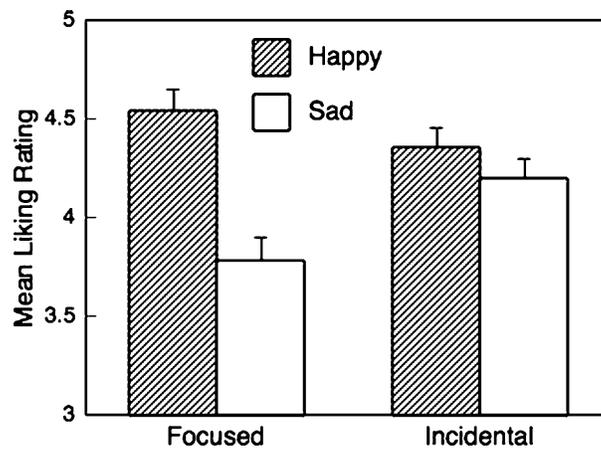


Figure 1. Liking ratings as a function of listening condition and the emotional status of the musical excerpts. Error bars are standard errors.

The main effect of frequency of exposure was not significant, but number of exposures interacted with listening condition, $F(3, 318) = 8.67, p < .001$. As shown in Figure 2, ratings from listeners in the focused condition were an inverted U-shaped function of exposure, with initial increases in liking relative to baseline for pieces heard twice, $t(53) = 2.14, p = .037$, a return to baseline levels for pieces heard 8 times, and ratings that were lower than baseline for pieces heard 32 times, $t(53) = 3.01, p = .004$. A quadratic trend confirmed that this curvilinear function was statistically reliable, $F(1, 53) = 12.58, p < .001$. Because the peak in liking was off-centre (at 2 exposures), there was also a negative linear trend, $F(1, 53) = 12.60, p < .001$.

For listeners in the incidental condition, ratings increased slowly but monotonically as a function of exposure. Accordingly, the linear trend was reliable, $F(1, 53) = 4.26, p = .046$, but the quadratic trend was not, $F < 1$. Only the ratings for pieces heard 32 times were significantly higher than baseline, $t(53) = 2.34, p = .023$. There was no cubic trend for either group of listeners and there were no other main effects or interactions, $F_s < 1$. Whereas differential responding to happy- and sad-sounding excerpts was independent of exposure frequency, differences in liking as a function of exposure were independent of the emotional status of the excerpts.

Recognition ratings

An ANOVA on recognition ratings revealed significant main effects of listening condition, $F(1, 106) = 4.91, p = .029$, and exposure frequency, $F(4, 424) = 309.77, p < .001$. In general, listeners in the focused condition

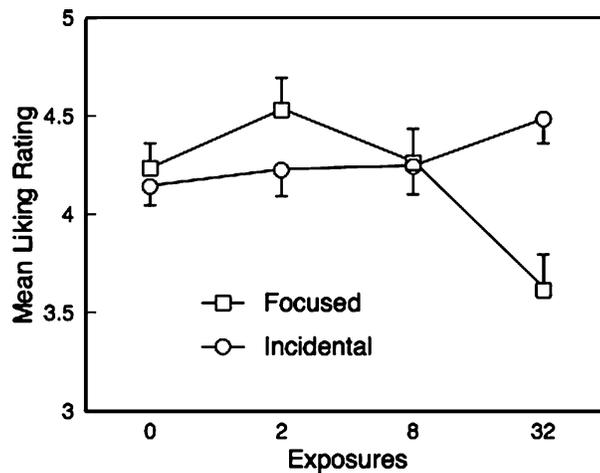


Figure 2. Liking ratings as a function of listening condition and number of previous exposures. Error bars are standard errors.

provided higher memory ratings than their counterparts in the incidental condition, and recognition ratings increased monotonically as a function of exposure frequency. Both of these main effects were qualified by significant two-way interactions involving listening condition.

An interaction between listening condition and emotion, $F(1, 106) = 4.42$, $p = .038$, indicated that happy-sounding pieces received lower recognition ratings than sad-sounding pieces among listeners in the incidental condition, $F(1, 53) = 5.01$, $p = .029$, but there was no effect of emotion among listeners in the focused condition, $F < 1$ (see Figure 3). As shown in the figure, the interaction stemmed solely from relatively low recognition ratings for happy-sounding pieces among listeners in the incidental condition. As with the observed interaction for liking ratings, the interaction between listening condition and emotion was independent of the number of exposures (i.e., no three-way interaction, $F < 1$).

There was also a significant two-way interaction between listening condition and number of exposures, $F(4, 424) = 78.89$, $p < .001$. As one would expect, recognition ratings varied more dramatically in the focused condition, $F(4, 212) = 451.00$, $p < .001$, than in the incidental condition, $F(4, 212) = 43.61$, $p < .001$. As shown in Table 1, listeners in the focused condition were more certain that they had heard pieces that were actually presented in the exposure phase, and more accurate about pieces they had not heard as well. For both groups, recognition ratings were above baseline levels at each exposure frequency, even for those that were introduced in the liking phase (false recognition), $ps < .001$. The lack of a three-way interaction (noted above) confirms that differential recognition effects

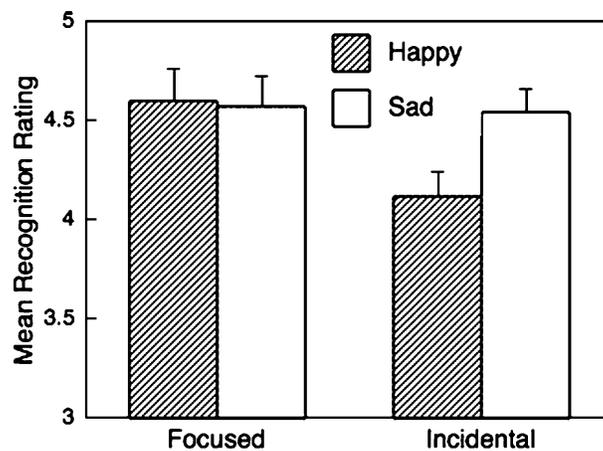


Figure 3. Recognition ratings as a function of listening condition and the emotional status of the musical excerpts. Error bars are standard errors.

TABLE 1
 Mean recognition ratings (with standard deviations in parentheses) as a function of listening condition and number of presentations in the exposure phase

Number of exposures	Condition		<i>t</i> (106)	<i>p</i> -value
	Focused	Incidental		
0	1.42 (0.58)	2.61 (1.14)	-8.71	<.001
1*	2.46 (1.19)	4.38 (1.40)	-9.79	<.001
2	5.41 (2.05)	4.61 (2.09)	2.85	.005
8	6.69 (0.96)	4.72 (2.04)	8.92	<.001
32	6.94 (0.33)	5.31 (1.81)	8.85	<.001

Notes: *Previous exposure was in the liking phase. The difference between the focused and incidental listening conditions was significant at each exposure frequency.

due to the quality and quantity of exposure were identical for happy- and sad-sounding pieces.

DISCUSSION

We examined liking for musical excerpts as a function of the emotional status of the music, frequency of exposure, and type of exposure. The musical excerpts were either happy or sad sounding, they were presented from 0 to 32 times, and the listening experience was either focused or incidental. Each of the experimental manipulations influenced responding in different ways. Liking for happy- compared to sad-sounding music was influenced by the quality of the listening experience but not by the number of exposures. By contrast, effects of the number of exposures on liking interacted with the listening experience but not with the emotional status of the musical excerpts.

One of our principal goals was to improve our understanding about why listeners often choose to listen to sad-sounding music. The results replicated previous findings that listeners generally prefer happy- over sad-sounding music (Gosselin et al., 2005; Hunter et al., in press; Husain et al., 2002; Thompson et al., 2001). Nonetheless, we also found that this preference was attenuated greatly (and eliminated statistically) after participants completed a demanding distractor task (see Figure 1). To the best of our knowledge, these response patterns provide the first laboratory demonstration of increases in liking for sad-sounding music relative to happy-sounding music.

In principle, the emotion-identification task for the focused listeners could have influenced their subsequent liking ratings, such that they provided higher ratings for stimuli they had previously identified as happy rather than sad sounding. In other reports with no prior identification task

(Gosselin et al., 2005; Hunter et al., in press; Husain et al., 2002; Thompson et al., 2001), however, listeners preferred happy- over sad-sounding music, and we have no reason to believe that the present listeners would differ in this regard. Indeed, the observed interaction between listening condition and emotional status stemmed from relatively high levels of liking for sad-sounding music among the incidental listeners (see Figure 1). This finding is consistent with two alternative hypotheses that could be tested in future research. One involves mood congruency and the proposal that listeners in a negative mood demonstrate enhanced liking for music with negative (sad) affect. The other suggests that the appeal of sad music is linked with its calming effects, most likely its association with reductions in arousal levels. As noted, two distinguishing characteristics of sad-sounding music are its slow tempo and minor mode. There is evidence that tempo influences arousal levels (i.e., high or low levels of energy) but not mood (i.e., positive or negative valence), whereas mode influences mood but not arousal (Husain et al., 2002). Although tempo and mode co-varied perfectly in the present study, future research could seek to determine whether liking for sad-sounding music is better predicted by slow tempo and its association with reductions in arousal, or by minor mode and its association with negative mood.

The recognition ratings provide additional insight into differences and similarities in responding to happy- and sad-sounding musical excerpts. For listeners in the incidental condition, *increases* in liking for *sad*-sounding excerpts were accompanied by *decreases* in recognition for *happy*-sounding excerpts. Nonetheless, for both liking and recognition ratings, differential responding based on the emotional status of the excerpts was independent of exposure frequency. Indeed, the recognition and liking effects for incidental listeners may not be linked causally. Rather, the recognition effects could be a consequence of the fact that the happy-sounding excerpts had a faster tempo than the sad excerpts and therefore more events per unit of time, such that they were extremely difficult to process while listeners completed the demanding distractor task. For example, responding to one of three target words (*the*, *and*, or *but*) in the attended ear (right ear: narrated story) would have led to a relatively large gap of processing in the unattended ear (left ear: music). As a result, the happy-sounding excerpts may have been largely undifferentiated by listeners. In other words, a third factor (i.e., the demanding distractor task in the incidental condition) may have given rise to relatively low recognition ratings for the happy-sounding excerpts (due to poor processing) and to relatively high liking ratings for the sad excerpts (due to fatigue or negative affect).

Our second major goal was to examine liking for real music as a function of the number of previous exposures and whether the listening experience was focused or incidental. The emotional status of the excerpts proved to

have no effect in this regard. For listeners in the incidental condition, liking increased monotonically as a function of exposure. For listeners in the focused condition, liking ratings increased after 2 exposures relative to baseline, but decreased back to baseline after 8 exposures. Further decreases in liking after 32 exposures led to liking ratings that were actually *lower* than baseline. Typically, in studies that include multiple exposures to stimuli, the peak in the liking-exposure function occurs at around 9 exposures (Bornstein, 1989). Indeed, in previous research with identical exposure frequencies to those used in the present study (Szpunar et al., 2004), liking for 15 s excerpts of classical music (selected without regard to emotional status) among the focused listeners increased from baseline to 8 exposures, but decreased back to baseline levels after 32 exposures.

How can we explain the difference in response patterns between the two studies? One possibility is that the difference was a consequence of the orienting task in the focused-listening conditions—choosing one of two emotions expressed by the music in the present study, compared to identifying the lead instrument from a set of six different instruments in the study by Szpunar et al. (2004). Another possibility is that the pre-existing emotional status of the present musical excerpts accelerated the liking function, possibly because the familiarity of the emotional cues reduced the arousal potential of the otherwise novel stimuli. Yet another possibility is that the relatively rapid onset of satiation stemmed from the familiar musical cues that characterise happy- and sad-sounding music *and* the simple task of identifying the particular emotion. From this perspective, the ease with which the musical excerpts could be matched with their corresponding emotion accelerated effects of familiarity as well as over-familiarity. It is also possible that Szpunar et al.'s excerpts from commercial recordings were more complex and interesting than our MIDI-generated excerpts, with more arousal potential, and, consequently, a decelerated inverted U-shaped liking function.

An important contribution of the present findings is their relevance to theories of exposure and liking. The perceptual fluency/attributional model (Bornstein, 1989, 1992; Bornstein & D'Agostino, 1994) does not account for the robust satiation effects we observed for listeners in the focused condition. By contrast, the hedonically marked account (Reber et al., 1998, 2004; Winkielman et al., 2003) allows for satiation and marked reductions in aesthetic pleasure when the source of the fluency (i.e., repeated presentations in this case) is obvious. Nonetheless, both fluency perspectives posit that *increases* in recognition will be accompanied by *decreases* in liking (see also Van den Burgh & Vrana, 1998), yet we observed *increases* in liking in the focused condition (from 0 to 2 exposures) and in the incidental condition (monotonically from 0 to 32 exposures) that were accompanied by *increases* in recognition. When our two groups of listeners are considered jointly (see Table 1 and Figure 2), liking ratings increased in tandem with recognition

ratings until recognition reached a mean of approximately 5.5 on a 7-point scale, after which liking decreased. Up to a point, then, increases in liking for music were accompanied by marked increases in recognition memory.

The two-factor model (Berlyne, 1970, 1971, 1974; Stang, 1974) provides a good account of our listeners' liking ratings. From this perspective, the arousal potential of novel musical excerpts for the focused listeners would have decreased with the first two exposures, making them more appealing. With additional exposures and further reductions in arousal potential, listeners presumably became bored with the excerpts and rated them increasingly unfavourably. For incidental listeners, their diverted attention and the reduced amplitude of the music would have slowed down reductions in arousal potential, such that the excerpts became more likeable with increased exposure, and arousal potential was never reduced to the point at which boredom would begin. Despite the two-factor model's success at explaining the current set of liking ratings, it is underdeveloped with respect to associations between liking and memory. As such, it does not speak to larger issues of associations between cognition and emotion.

Alternative accounts of processing fluency (e.g., Kelley & Rhodes, 2002; Whittlesea & Williams, 1998, 2000) are similarly limited by focusing solely on familiarity and recognition rather than on liking and affective responding. For example, Whittlesea and Williams' "discrepancy-attribution hypothesis" suggests that recognition or a feeling of familiarity arises from a discrepancy between *expected* and *experienced* fluency. A stimulus is recognised or perceived to be familiar when it is processed more fluently than the perceiver expects. If we extend this hypothesis to include associations between fluency and affective responding, it can be used to explain the response patterns we observed. For listeners in the incidental condition, elevated liking and recognition ratings may have arisen as a consequence of unexpected fluency, which increased with additional exposures. For focused listeners, better-than-expected processing fluency could explain increases in liking and recognition for excerpts that were heard twice in the exposure phase. Presumably, for excerpts that were heard many (8 or 32) times and subsequently very well recognised, there would be little or no discrepancy between expected and experienced fluency, and liking decreased accordingly.

In much of past research, the stimuli have been neutral with respect to aesthetic appeal and emotional status. In many instances, liking for neutral stimuli increased as a function of a small number of previous exposures yet perceivers could not consciously recognise the previously exposed stimuli (Barchas & Perlaki, 1986; Bonanno & Stillings, 1986; Bornstein et al., 1987; Kunst-Wilson & Zajonc, 1980; Mandler et al., 1987; Murphy et al., 1995; Seamon et al., 1983, 1984, 1995; Thompson et al., 2000). Processing fluency provides an elegant account of these response patterns and of the

independence between implicit memory (as evidenced by increases in liking) and explicit memory. Although findings with highly controlled and impoverished stimuli are important to models of cognition and emotion, the question of liking for complex, aesthetically pleasing, and ecologically valid stimuli is at least as relevant to everyday experience in general, and to the formation of musical preferences in particular. Our results indicate that liking and recognition of real music co-vary, positively at times and negatively at others. The two-factor model provides a good account of liking response patterns but it says nothing about the complex interplay between memory and liking. By contrast, fluency accounts either ignore affective responding or they predict relatively simplistic negative associations between liking and memory. When our findings are considered jointly with past results from studies with neutral stimuli, they highlight the need for researchers to develop a model that can account for neutral as well as for aesthetically pleasing stimuli, for a few as well as many exposures, for attentive as well as inattentive exposure, and for liking as well as memory.

In sum, the present report is important for shedding light on the appeal of aesthetically-pleasing stimuli with negative valence, for replicating the response patterns reported by Szpunar et al. (2004), for extending those results to pieces of music with pre-existing emotional status, and for improving our knowledge of the formation of music preferences, which are central to daily life in general and to issues of identity and personality in particular (Rentfrow & Gosling, 2003, 2006). Our participants' experience of listening to music in a laboratory setting may appear to belie our claims of ecological validity, yet much of everyday exposure to music is involuntary, such as when we hear music in a shopping mall, on an airplane, or during a television commercial. The broader issue of exposure effects on aesthetic preferences is undoubtedly complex and influenced by nuances in context. Indeed, many questions about exposure and emotional responding to music and art remain to be answered by future research. These include: (1) how responses are influenced by musical expertise and listeners' pre-existing preferences for one genre over another; (2) whether the observed response patterns extend to different, more unusual types of music (e.g., atonal music, music from a foreign culture) or to other art forms with (e.g., video and film) or without (e.g., painting and sculpture) temporal organisation; (3) how lyrics and vocal qualities affect liking for music; and (4) how effects of exposure are influenced by social and cultural determinants such as gender, ethnicity, and education.

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APPENDIX
The musical excerpts used as stimuli

<i>Composer</i>	<i>Piece</i>	<i>Measures^a</i>	<i>Emotion</i>
Beethoven	Piano Concerto No. 4 (3rd movement)	191–200(2)	Happy
Handel	Utrecht's Te Deum	5–14(1)	Happy
Mozart	Piano Concerto No. 23 (3rd movement)	1–8	Happy
Mozart	Piano Concerto No. 27 (3rd movement)	1–8	Happy
Mozart	Die Zauberflöte (Act 1 No. 2 Papageno's Aria)	18(2)–24(2)	Happy
Saint-Saëns	Carnaval des Animaux (La volière)	1–9(2)	Happy
Schumann	Kinderszenen Op 15 No. 9	1–9	Happy
Verdi	Rigoletto (Act 1 No. 4)	69–73	Happy
Verdi	La Traviata (Brindisi)	1–15(1)	Happy
Bach	Passionsmusik nach dem evangelisten Matthäus	1–5(2)	Sad
Chopin	Nocturne Op 9 No. 1	0–4(1)	Sad
Chopin	Nocturne Op 27 No. 1	2(2)–6(3)	Sad
Chopin	Nocturne Op 48 No. 1	1–4(1)	Sad
Grieg	Peer Gynt Suite No. 2 (Solvieg's lied)	13(4)–17(3)	Sad
Mahler	Symphony No. 5 (3rd movement)	12(4)–16(3)	Sad
Mozart	Piano Concerto No. 23 (2nd movement)	1–3	Sad
Rodrigo	Concerto de Aranjuez (Adagio)	1–4(4)	Sad
Schubert	String Quartet No. 14 (2nd movement)	1–4	Sad

^aThe numbers indicate the starting and ending measures for each excerpt. The parenthetical numbers indicate the beat numbers for excerpts that began or ended in the middle of a measure. For example, the first excerpt started at the beginning of the 191st measure and ended at the second beat of the 200th measure.