Individual Differences in Music-Perceived Emotions: The Influence of Externally Oriented Thinking

Liila Taruffi
Freie Universität Berlin, Berlin, Germany

Rory Allen, John Downing, & Pamela Heaton
Goldsmiths, London, United Kingdom

Previous music and emotion research suggests that individual differences in empathy, alexithymia, personality traits, and musical expertise might play a role in music-perceived emotions. In this study, we investigated the relationship between these individual characteristics and the ability of participants to recognize five basic emotions (happiness, sadness, tenderness, fear, and anger) conveyed by validated excerpts of film music. One hundred and twenty participants were recruited through an online platform and completed an emotion recognition task as well as the IRI (Interpersonal Reactivity Index), TAS-20 (Toronto Alexithymia Scale), BFI (Big Five Inventory), and Gold-MSI (Goldsmiths Musical Sophistication Index). While participants recognized the emotions depicted by the music at levels that were better than chance, their performance accuracy was negatively associated with the *externally oriented thinking* subscale from the TAS-20. Our results suggest that alexithymia, previously linked to a deficit in perception of facial and vocal expressions of emotion, is also associated with difficulties in perception of emotions conveyed by music.

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It has long been debated whether, and to what extent, music expresses emotions that are effectively understood across cultures (e.g., Balkwill & Thompson, 1999; Thompson & Balkwill, 2010). A landmark study by Fritz and colleagues (2009) showed that people from a native African population called Mafa, naive to Western music, were able to recognize the three "basic" emotions of happiness, sadness, and fear conveyed by Western music. Their findings strongly suggest that music-perceived emotions (i.e., the emotions depicted by the music) are not culturally determined, but universal across human cultures. This idea is supported by a number of studies that showed that even young children are able to recognize basic emotions represented by music, including happiness and sadness (Cunningham & Sterling, 1988; Dalla Bella, Peretz, Rousseau, & Gosselin, 2001; Kastner & Crowder, 1990; Nawrot, 2003), anger (Cunningham & Sterling, 1988; Heaton, Allen, Williams, Cummins, & Happé, 2008; Kastner & Crowder, 1990; Nawrot, 2003), and fear (Cunningham & Sterling, 1988; Heaton et al., 2008; Nawrot, 2003). However, questions remain about the extent that this ability is influenced by listener characteristics. If such individual differences exist across the typical population (meaning that we are not all the same at recognizing emotions in music), it follows that the "universal" tendency to perceive musical emotions can be modulated by individual factors.

Preliminary evidence for individual differences in music-perceived emotions comes from research on facial and verbal expressions of basic emotions. Although healthy individuals generally perform well in recognizing basic emotion expressed in faces and voices, it has also been shown that there are considerable and stable individual differences in the accuracy of people's judgments (e.g., Bowles et al., 2009; Ekman & Oster, 1979; Matthews et al., 2015; Miura, 1993; Palermo, O'Connor, Davis, Irons, & McKone, 2013). With regard to facial expression, the perception of emotional faces and pictures can be altered by temporary moods in an affect-congruent fashion (Bouhuys, Bloem, & Groothuis, 1995; Isen & Shalker, 1982). For example, Bouhuys and colleagues (1995) demonstrated that induced sad mood leads to an increased perception of sadness in ambiguous emotional expressions. Furthermore, there is some evidence for sex differences, with female children and adults being more sensitive to nonverbal emotion cues than male children and adults (e.g., Allgood & Heaton, 2015; Briton & Hall, 1995). With regard to verbal expression, research suggests that younger participants are more sensitive to emotional voices than older participants (Allen & Brosgole, 1993; Brosgole & Weisman, 1995; Kiss & Ennis, 2001; Orbelo, Grim, Talbott, & Ross, 2005; Paulmann, Pell, & Kotz, 2008).

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Further preliminary proof that individual differences can influence perception of musically expressed emotions arises from music research investigating felt emotions (i.e., emotions evoked in response to the music). A few studies have shown that listener characteristics consistently influence the individual's personal emotional experience and enjoyment of sad music. For instance, trait empathy (Taruffi & Koelsch, 2014; Vuoskoski & Eerola, 2012; Vuoskoski, Thompson, McIlwain, & Eerola, 2012) and the personality trait of *openness to experience* (Vuoskoski et al., 2012) are associated with the enjoyment of sad music and the susceptibility to music-evoked sadness. Similarly, the enjoyment of sad music is positively associated with individual differences in *musical empathy* and *absorption* (Garrido & Schubert, 2011, 2013), and is negatively associated with *emotional stability* (Taruffi & Koelsch, 2014). As perceived and felt emotions are intrinsically connected (Gabrielsson, 2002), it is likely that such individual factors may impact both types of musical responses. Moreover, the so-called "paradox of sad music" perfectly illustrates the existence of individual differences in the perception of sad music (Garrido & Schubert, 2011, 2013; Huron, 2011; Taruffi & Koelsch, 2014). Many listeners describe the sadness conveyed by music as pleasant (positive emotions associated with sad music include nostalgia, peacefulness, wonder, tenderness, and transcendence; Taruffi & Koelsch, 2014), while others perceive it as negatively valenced.

To sum up, although previous studies have provided substantial evidence for the role of individual differences in music-evoked emotions, research has yet to identify the individual characteristics influencing the perception of emotional expressions in music. Importantly, emotion perception may draw on more general mechanisms of emotional sensitivity, which are necessary for adequate social functioning. For instance, alexithymia – a personality trait characterized by a reduced ability to translate internal emotional experiences into precise, explicit verbal form, common in autism spectrum disorder (Allen & Heaton, 2010; Nemiah, Freyberger, & Sifneos, 1976) - is linked to deficits in perception of facial and vocal expressions of emotions (Heaton et al., 2012; Jessimer & Markham, 1997; Lane et al., 1996; Parker, Bagby, Taylor, Endler, & Schmitz, 1993; Prkachin, Casey, & Prkachin, 2009). Thus, investigating whether also the perception of musical emotions is altered in alexithymia can shed light on the nature of the mechanisms involved in emotion perception. Furthermore, the ability to correctly identify and communicate emotions depicted by music is a relevant aspect of music performance (Juslin & Laukka, 2003), and, for the listener, emotion recognition may lead to deeper understanding as well as greater aesthetic appreciation of the music (Goodman, 1968). Therefore, it is important to understand how emotions are decoded through music, and to identify which factors influence this decoding process. As a contribution to this field of research, we examined the relationship between the perception of musical emotions and individual differences in empathy, alexithymia, personality traits, and musical expertise. Such characteristics were chosen over other plausible candidates, like mood, because they are strongly implicated in the recognition of musical emotions, as the following review illustrates.

Empathy is defined as an individual affective response to the observed, imagined, or inferred experiences of others, involving both perspective-taking capabilities or tendencies, and emotional reactivity (Singer & Lamm, 2009). Apart from the literature on negative music-evoked emotions, to date only one study has directly examined the relationship between trait empathy and music-perceived emotions (Wöllner, 2012). In this study, a string quartet performance was video recorded, and the members of the quartet were asked to rate their expressive musical intentions during the performance. Independent observers were asked to evaluate the musicians' expressive intentions, and observers with higher affective and overall empathy scores performed better than observers with lower scores on these measures. In line with this finding, Resnicow and colleagues (2004) found a significant positive correlation between emotional intelligence (a construct involving empathy) and correct identification of emotions in music, suggesting that the correct decoding of emotions in music is an important aspect of emotional intelligence.

Several studies have highlighted an association between empathic deficits and alexithymia (Guttman & Laporte, 2000; Jonason & Krause, 2013; Moriguchi et al., 2007; Silani et al., 2008). Conscious understanding of one's own emotions is linked to the understanding of another individual's feelings (Singer et al., 2004), and it is unsurprising that alexithymia correlates with empathic deficits. Alexithymia is found not only in psychiatric and psychosomatic patients but also among general healthy people (Taylor & Bagby, 2004). In the general population, alexithymia is associated with a broad range of sociodemographic variables such as poor education (Kokkonen et al., 2001), low income (Kokkonen et al., 2001), increasing age (Mattila, Salminen, Nummi, & Joukamaa, 2006), and low health-related quality of life. Moreover, alexithymia is usually higher in men than in women (Kokkonen et al., 2001; Mattila et al., 2006; Salminen, Saarijärvi, Äärelä, Toikka, & Kauhanen, 1999). As mentioned above, several studies have shown that individuals with high levels of alexithymia are significantly less able to recognize facial expressions of emotions (Jessimer & Markham, 1997; Lane et al., 1996; Parker et al., 1993; Prkachin et al., 2009) and vocal expressions of emotion (Heaton et al., 2012) than those with low levels of alexithymia. This suggests that alexithymia involves a deficit in interpreting external as well as internal emotion cues. In addition, this deficit appears to be linked specifically to negative emotions (Parker et al., 1993; Parker, Prkachin, & Prkachin, 2005). For example, Prkachin and colleagues (2009) found that students with high alexithymia scores experienced difficulties in detecting facial expressions of sadness, anger, and fear. With regard to the music domain, Allen, Davis, and Hill (2013) compared a group of high-functioning adults on the autism spectrum with a group of matched controls on verbal and physiological measures of musical responsiveness. Following exposure to musical excerpts, the participants were presented with a check-list of words related to emotions, feelings, and sensations, and were asked to tick words that described the way the music made them feel. Individuals with autism obtained significantly lower scores than typical individuals. However, when the participants' alexithymia scores were included as a mediator variable the group difference was no longer significant. On the measure of physiological responsiveness to music, the groups did not significantly differ, indicating that the visceral impact of the music was similar. Nevertheless, the results from the study clearly indicate that alexithymia was responsible for the autistic participants' relative inability to articulate the emotional experience induced by the music.

Individual differences in the ability to perceive musical expressions of emotions may also depend on personality traits. In particular, personality traits can lead to emotion-specific biases. For instance, Vuoskoski and Eerola (2011) found a positive association between trait *neuroticism* and sadness ratings (given after the exposure to musical stimuli depicting basic emotions) as well as a negative association between trait *extraversion* and sadness ratings, thus suggesting that personality traits modulate perceived emotions in a trait-congruent fashion (see also Rusting, 1998). In other terms, *neuroticism* would lead to a general scale-use bias towards negative emotions, while *extraversion* would lead to a positive emotion bias. However, the sample size was relatively small in the study ($N = 67$), and further research should try to replicate the findings with a larger population.

Because perception of emotion in music partly relies on the processing of musical and acoustic features (Juslin & Västfjäll, 2008), musical expertise may influence performance accuracy in the recognition of musical emotions. For instance, musical abilities (e.g., tonal encoding of pitch) may constitute an advantage in a musical emotion recognition task. However, conflicting findings emerge from research on music and emotion. While some studies have provided evidence for a role of musical expertise in emotion perception (Bigand, Vieillard, Madurell, Marozeau, & Dacquet, 2005), several studies have failed to reveal a difference in the way musicians and nonmusicians process musical structure (for a review, see Bigand & Poulin-Charronnat, 2006). Given these conflicting results, more research is needed to clarify whether musical expertise can contribute to the recognition of emotions in music.

The aim of the current study was to test whether individual differences in empathy, alexithymia, personality traits, and musical expertise influence the listeners' sensitivity to music-perceived emotions. To address this question we measured short-term emotion perception of validated musical stimuli conveying happiness, sadness, tenderness, fear, and anger. While studies of music and emotion often use Western classical music (e.g., Krumhansl, 1997; Mitterschiffthaler, Fu, Dalton, Andrew, & Williams, 2007), we aimed to increase ecological validity by employing film music as our stimulus material. To measure individual differences we administered the Interpersonal Reactivity Index (IRI: Davis, 1980), the Toronto Alexithymia Scale (TAS-20: Bagby, Parker, & Taylor, 1994), the Big Five Inventory (BFI: John & Srivastava, 1999), and the Goldsmiths Musical Sophistication Index (Gold-MSI: Müllensiefen, Gingras, Musil, & Stewart, 2014).

We tested two experimental hypotheses. First, we expected that participants who obtained high scores on empathy and musical expertise and low scores on alexithymia would perform at high levels on the musical emotion recognition (MER) task. Second, we expected that personality traits would modulate perceived emotions in a trait-congruent fashion. Our aim in testing the second hypothesis was to extend the findings of Vuoskoski and Eerola (2011), by investigating the influence of personality traits in the recognition of musical emotions in a larger sample of participants.

Method

PARTICIPANTS

One hundred and twenty subjects (73 female), aged 19-72 ($M = 30.37$, $SD = 9.49$), took part in the study. The sample was composed mainly of students (49.3%). Around half of the participants had obtained postgraduate degrees (46.7%). The majority of the participants were Italian (45.8%), followed by English (20.8%). Among the remaining participants, 21% grew up in Europe, 5% in the United States, 2.5% in Australia, 2.5% in South America, and 2.4% in Asia. The participants' favorite musical genres fell into the following categories: 65% rock and pop, 20.8% classical music, 8.4% folk and ethnic music, and 5.8% jazz. Additionally, 26.7% of the participants could not play any musical instrument and did not sing.

Participants were recruited through fliers posted around the University campus as well as through advertisements on student mailing lists. Participation was voluntary and completely anonymous, all participants provided informed consent, and no financial compensation was offered. The study was conducted according to the Declaration of Helsinki and approved by the ethics committee of Goldsmiths Department of Psychology. The privacy of participants was ensured and their data were anonymized.

MATERIALS

The test battery included a MER task plus the following four questionnaires: IRI, TAS-20, BFI, and Gold-MSI. Descriptive statistics for each of the used instruments are displayed in Table 1.

The IRI comprises 28 items divided in four subscales, which measure the following related aspects of empathy: *perspective-taking*, *fantasy*, *empathic concern*, and *personal distress*. The items were scored on a 5-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree*).

The TAS-20 comprises 20 items and yields a general score plus three subscores corresponding to three factors, labeled respectively as: *difficulty in identifying feelings*, *difficulty in describing feelings*, and *externally oriented thinking*. The items were scored on a 5-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree*).

The BFI comprises 44 items, scored on a 5-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree*). The questionnaire assesses the following five personality dimensions: *extraversion*, *agreeableness*, *conscientiousness*, *neuroticism*, and *openness to experience*.

The Gold-MSI measures individual differences in musical sophistication. It includes the following five factors: *active engagement*, *perceptual abilities*, *musical training*, *singing abilities*, and *emotion*. For the scope of the present study, we assessed only the factor of *musical training* (i.e., the amount of formal music training received), which comprises seven items, scored on a 7-point Likert scale (1 = *completely disagree* and 7 = *completely agree*).

The musical stimuli used in the MER task aimed to convey the five basic emotions of happiness, sadness, tenderness, fear, and anger. These emotions were selected because they represent common emotional responses to music and have been widely investigated in previous studies of musical emotion recognition (Juslin & Sloboda, 2010; Juslin & Västfjäll, 2008). The stimulus material was created and validated by Eerola and Vuoskoski (2011). In the present study, 50 musical excerpts from film soundtracks (10 for each emotion) were randomly allocated to five audio blocks of 10 excerpts. Each stimulus was approximately 15 s long. The 10 musical excerpts for each emotion comprised five "high" and five "moderate" examples of that specific

TABLE 1. *Descriptive Statistics*

	Study Sample (N = 120)			Normative Data		
	M	*SD*	Range	*M*	*SD*	Range
TAS-20 Total	46.58	10.98	21-78	45.57	11.35	20-100
Difficulty in Identifying Feelings	17.97	6.27	7-34	14.38	5.21	7-35
Difficulty in Describing Feelings	12.93	4.93	5-23	12.50	4.20	5-25
Externally Oriented Thinking	15.68	3.88	8-26	18.70	4.72	8-40
Musical Training	33.68	16.58	9-49	26.52	11.44	7-49
Perspective-taking	19.43	4.20	4-27	17.37	4.78	0-28
Fantasy	20.30	4.64	5-28	17.24	5.38	0-28
Empathic Concern	20.99	4.06	9-28	20.35	4.02	0-28
Personal Distress	12.73	5.23	0-27	10.87	4.78	0-28
Extraversion	3.43	0.75	1.13-5	3.28	0.90	1-5
Agreeableness	3.77	0.59	2-5	3.67	0.69	1-5
Conscientiousness	3.55	0.61	2.22-5	3.63	0.72	1-5
Neuroticism	3.06	0.77	1-4.88	3.22	0.84	1-5
Openness to Experience	4.12	0.53	2.2-5	3.94	0.67	1-5

Note. Normative data are from Parker et al., 2003 (TAS-20), Müllensiefen et al., 2014 (Gold-MSI), Davis, 1980 (IRI), and Srivastava et al., 2003 (BFI).

emotion. The "high emotion" excerpts were clearer and easier to interpreter, while the "moderate emotion" ones were more ambiguous and difficult to identify.

PROCEDURE

A website containing the questionnaires and the MER task was set up. A description of the study and its aims was presented in the home page of the website. Participants were instructed to complete the experiment individually and in a quiet environment. They were instructed to begin by providing general information (i.e., age, gender, occupation, education, nationality, and favorite musical genre), before completing the questionnaires and the musical task. Presentation of each questionnaire was followed by an audio block (in total five blocks presented in a random order). After listening to each musical excerpt, participants were asked to select one of the five emotions shown on the screen (i.e., happiness, sadness, tenderness, fear, and anger). The instructions made a clear distinction between felt and perceived emotions and participants were explicitly asked to report the latter ("You are now going to listen to a group of 10 musical excerpts. After listening to each excerpt, please match it to one of the five emotions shown on the screen, according to which emotion you think the music aimed to convey rather than how the music made you feel"). Following the completion of each audio block and questionnaire, the participants had the option of taking a break and completing the rest of the experiment later. However, they were not allowed to access and change responses that they had already submitted. This procedure aimed to guard against fatigue effects, potentially resulting from the design (repeated measures) and the length of the experiment (between 35 and 45 min, depending on the participant's speed). A menu displayed on the right side of the screen recorded the individual progress through the experiment.

Results

MER TASK

We measured the performance accuracy on the MER task by calculating the sum of the correct answers across the entire stimulus set for each participant ("MER total score") as well as within the subset of stimuli corresponding to each specific emotion. The MER total score ranged from 28 to 45 ($M = 35.78$, $SD = 3.95$).

First, we conducted a single sample *t*-test to verify that the MER total score was significantly greater than chance level, $t(119) = 71.36$, $p < .001$. Then, we compared the numbers of correct answers given for the "high emotion" ($M = 19.97$, $SD = 2.33$) with the "moderate emotion" excerpts ($M = 15.81$, $SD = 2.49$) in a paired samples *t*-test. As expected, participants recognized the "high emotion" excerpts better than the "moderate emotion" ones with this difference being significant, $t(119) = 16.50$, $p < .001$.

Second, we carried out five repeated-measures ANOVAs (one for each target emotion) with emotion category (five levels) as within-subjects factor, to investigate whether there was any significant difference between the number of correct answers given for each emotion category. As the Kolmogorov-Smirnov test revealed that scores deviated from a normal distribution, we transformed the data with reverse score followed by log transformations. The results revealed significant main effects for all target emotion categories: happiness, $F(1.97, 233.99) = 1437.30$, $p < .001$, $\eta^2_p = .92$; sadness, $F(1.78, 211.15) = 661.92$, $p < .001$, $\eta^2_p = .85$; tenderness, $F(1.79, 213.45) = 599.33$, $p < .001$, $\eta^2_p = .83$; fear, $F(2.17, 257.95) = 864.19$, $p < .001$, $\eta^2_p = .88$; and anger, $F(1.19, 142.64) = 529.67$, $p < .001$, $\eta^2_p = .82$ (all reported degrees of freedom were Greenhouse-Geisser adjusted for deviance from sphericity). Bonferroni pairwise comparisons showed that the mean correct ratings for the target emotions were significantly greater than the mean correct ratings for other emotions. Figure 1 illustrates this pattern and shows the mean correct ratings for each target emotion.

Third, a confusion matrix (Table 2) was computed to summarize the amount of error and the confusion patterns emerging from the MER task. Overall, the error rate was low (0.29, 29% of all predictions). Table 2 shows that the highest amount of total error per emotion category occurred in the case of anger (see also Figure 1). In particular, angry music was mistaken for fearful music (440 out of 475 total incorrect predictions). Moreover, the category (target emotion) with the lowest amount of total error was happiness (254 total incorrect predictions). By contrast, listeners frequently confused sadness with tenderness (211 predictions) and vice versa (187 predictions).

INDIVIDUAL CHARACTERISTICS INFLUENCING PERFORMANCE ON THE MER TASK

Data were further analyzed in two ways to investigate the main hypotheses that individual characteristics influence the perception of musical emotions. First, an exploratory correlation analysis of the subscale scores with the correct answers given for the "high emotion" and the "moderate emotion" excerpts was conducted to see if overall patterns could be identified. Second, a regression model based on the identified patterns was performed.

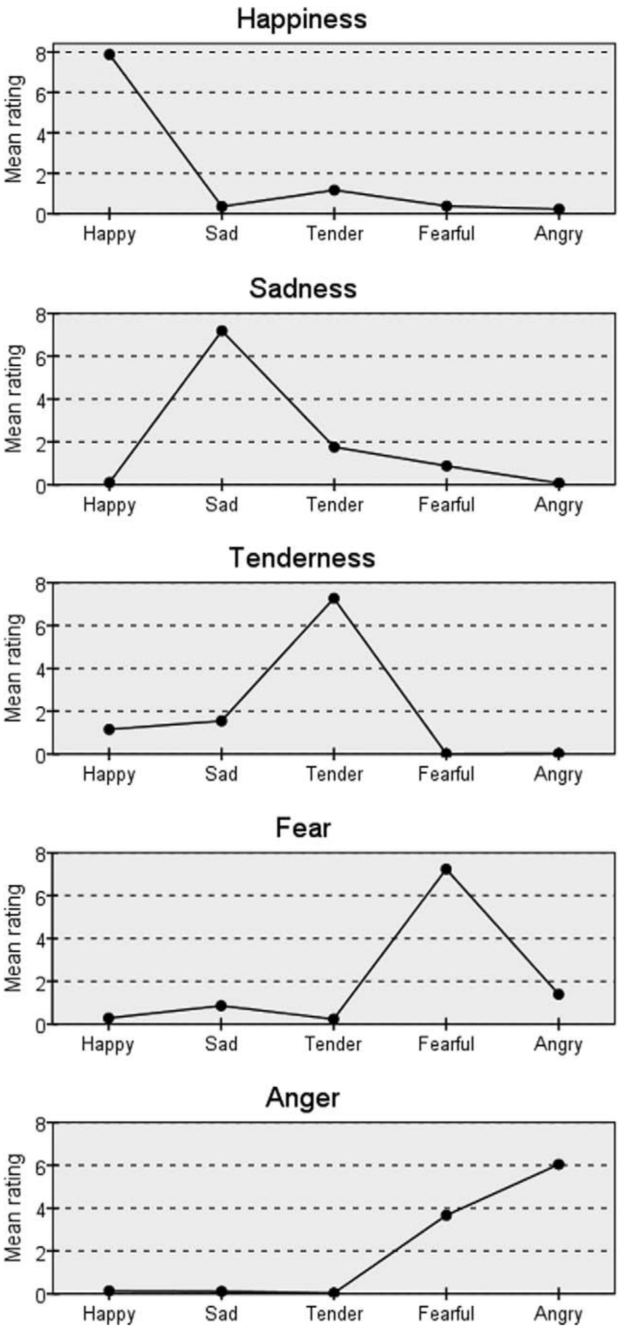

FIGURE 1. Mean correct ratings of five basic emotions and musical excerpts representing these target emotions.

After correcting for multiple tests using the False Discovery Rate (FDR: Benjamini & Hochberg, 1995), only two significant correlations emerged. The subscale of alexithymia named *externally oriented thinking* correlated negatively with the correct score for the "high emotion" excerpts, $r(119) = -.28$, $p = .002$; among the BFI factors, trait *conscientiousness* correlated positively with the correct score for the "high emotion" excerpts, $r(119) = .26$, $p = .004$. Consequently, the p values relative to the correlations between *externally oriented thinking*, as well as *conscientiousness,* and MER score for individual emotions were explored, giving an alpha value with FDR correction of .05/5 = .01. *Externally oriented thinking* was significantly associated, in a negative fashion, with correct ratings for sadness, $r(119) = -.25$, $p = .006$. Furthermore, we detected a significant positive correlation between *musical training* and correct ratings for anger, $r(119) = .25$, $p = .006$. Table 3 reports the results of this correlation analysis (the complete correlation matrix is available in the Appendix). Consequently, *externally oriented thinking, conscientiousness,* and *musical training* were used as predictors in a standard multiple regression analysis with MER total score as dependent variable. As shown in Table 4, only *externally oriented thinking* made a significant contribution to MER total score ($\beta = .21$, $p < .05$), accounting for 8.2% of the variance (R^2).

As an alternative approach, we examined the relationship between individual characteristics and emotion ratings for groups of extreme scorers. The extreme scorers method can be used to increase the statistical power to detect an effect by focusing exclusively at those participants who are highly representative of a specific trait (Preacher, Rucker, MacCallum, & Nicewander, 2005). Extreme scorers on each scale were those individuals scoring in the upper tertiles. We calculated the percentage of extreme scorers exhibiting high accuracy rates (>5 correct answers out of 10) in the recognition of the five basic emotions presented in the experimental task. Results are shown in Table 5. First of all, the average highest and lowest percentages of extreme scorers with high accuracy rates belong respectively to the categories of happiness and anger, in line with the error analysis, indicating that happiness was the easiest emotion to detect while anger the most difficult one. Furthermore, the percentage of extreme scorers on *externally oriented thinking* with high accuracy rates for sad stimuli (78%) was lower compared with the percentages of extreme scorers on other scales. Moreover, 80.5% of extreme scorers on *musical training* provided high accuracy rates for stimuli conveying anger. This percentage was the highest for anger stimuli among the other groups of extreme scorers. Both these results corroborate the findings of the correlation and regression analyses. Interestingly, a relatively low percentage of extreme scorers on *musical training* (78%) exhibited high accuracy rates for sad stimuli, suggesting that this was the most difficult emotion category to detect for

TABLE 2. *Error Analysis: Confusion Matrix for the MER Task*

	Target Emotion				
Emotion	Happiness	Sadness	Tenderness	Fear	Anger
Happiness	**946 (15.77)**	12 (0.20)	137 (2.28)	34 (0.57)	17 (0.28)
Sadness	42 (0.70)	**862 (14.37)**	187 (3.12)	103 (1.72)	14 (0.23)
Tenderness	140 (2.33)	211 (3.52)	**872 (14.53)**	28 (0.47)	4 (0.07)
Fear	45 (0.75)	105 (1.75)	2 (0.03)	**868 (14.47)**	440 (7.33)
Anger	27 (0.45)	9 (0.15)	3 (0.05)	167 (2.78)	**725 (12.08)**
Total Error	254 (4.23)	337 (5.62)	329 (5.48)	332 (5.54)	475 (7.91)

Note. Values are numbers of errors (with % in brackets). Correct predictions are in bold. Target emotions denote the five emotion conditions employed in this study. The matrix shows a total of 1727 errors and 4273 correct predictions.

TABLE 3. *Pearson Correlations between Individual Characteristics and Performance Accuracy in the MER Task*

	MER CORRECT SCORE						
Factor	Happiness	Sadness	Tenderness	Fear	Anger	HE ex.	ME ex.
C	.03	.06	.21*	.13	.05	.26**	.00
EOT	−.02	−.25**	−.19*	−.04	−.17	−.28**	−.08
MT	−.09	−.05	.13	.03	.25**	.19*	.02

Note. * $p < .05$, ** $p < .01$. C = *conscientiousness*; EOT = *externally oriented thinking*; HE ex. = "high emotion" excerpts; MT = *musical training*; ME ex. = "moderate emotion" excerpts.

TABLE 4. *Predictors for Standard Multiple Regression Model of the MER Total Score*

	B	*SE*	β	T	*p*
Constant	34.98	2.63		13.30	< .001
C	0.89	0.57	.14	1.55	.12
EOT*	−0.21	0.09	.21	2.34	.02
MT	0.03	0.02	.12	1.36	.18

Note. $R^2 = .08$. *B* denotes unstandardized regression coefficient. *SE* denotes standard error of *B*. β denotes the standardized regression coefficient. * denotes significant predictor. C = *conscientiousness*; EOT = *externally oriented thinking*; MT = *musical training*.

this group of listeners. Also, extreme scorers on *personal distress* (78.6%) showed the same trend in regard to sadness, while a high percentage of extreme scorers on *fantasy* (95.3%) provided high accuracy rates for this emotion category. Finally, the percentage of extreme scorers on *neuroticism* (94.9%) with high accuracy rates for sad stimuli was also relatively high.

Discussion

The aim of the present study was to examine the relationship between individual differences and perception of musical emotions. Through an online interface, a sample of 120 participants completed an emotion recognition task as well as four questionnaires assessing empathy, alexithymia, personality, and musical expertise.

Participants successfully recognized the emotions conveyed by the music well above chance level, although the emotion categories of fear and anger were frequently confused, especially when anger was the target emotion. This pattern of confusion has been identified by previous research (Eerola & Vuoskoski, 2011) and indicates that these two emotion categories cannot be easily disentangled in the music domain. According to Russell's two-dimensional model of emotion (1980), arousal and valence often overlap in expressions of anger and fear (however, please notice that in three-dimensional models of emotion anger and fear are distinguished by tension and energy; see Schimmack & Grob, 2000) and future studies should evaluate differences and similarities in the acoustic and musical features of angry and fearful music. Moreover, it would be valuable for future studies to examine whether the confusion of anger with fear occurs across different musical genres. For example, it is possible that heavy metal music communicates the emotion of anger more clearly than other musical genres, and consequently the confusion of anger with fear might be minimal. In the present study, a secondary source of error was reported for the emotion categories of sadness and tenderness. Both sadness and tenderness are characterized by low arousal and share a number of

TABLE 5. *Percentages of Extreme Scorers with High Accuracy Rates in the Recognition of Basic Emotions*

		Emotion Category					
Factor	*N*	Happiness	Sadness	Tenderness	Fear	Anger	*M*
TAS-20							
DIF	41	**95.1**%	**90.2**%	**95.1**%	85.4%	61%	85.4%
DDF	41	**97.6**%	85.4%	**92.7**%	**92.7**%	63.4%	86.4%
EOT	41	**95.1**%	78%	82.9%	80.5%	63.4%	79.9%
Gold-MSI							
MT	41	90.2%	78%	**87.8**%	87.8%	**80.5**%	84.9%
IRI							
PT	36	**97.2**%	**88.9**%	86.1%	**94.4**%	**69.4**%	87.2%
EC	37	**94.6**%	**89.2**%	83.8%	**97.3**%	**78.4**%	88.7%
FT	43	93%	**95.3**%	**88.4**%	88.4%	**74.4**%	87.9%
PD	42	90.5%	78.6%	**88.1**%	**95.2**%	66.7%	83.8%
BIG-5							
E	40	**95**%	**92.5**%	80%	87.5%	60%	83%
A	39	92.3%	79.9%	76.9%	87.2%	66.7%	80.6%
C	40	92.5%	82.5%	**90**%	**92.5**%	65%	84.5%
N	39	**94.9**%	**94.9**%	**89.7**%	79.5%	**69.2**%	85.6%
O	41	85.4%	82.9%	85.4%	85.4%	**70.7**%	81.9%
M		93.3%	85.9%	86.7%	88.7%	68.4%	

Note. Percentages above the average per emotion category are in bold. The last row shows average per emotion category and the last column average per individual factor. A = *agreeableness*; C = *conscientiousness*; DDF = *difficulty in describing feelings*; DIF = *difficulty in identifying feelings*; E = *extraversion*; EC = *empathic concern*; EOT = *externally oriented thinking*; FT = *fantasy*; MT = *musical training*; N = *neuroticism*; O = *openness to experience*; PD = *personal distress*; PT = *perspective-taking.*

important features such as slow tempo, low pitch, legato articulation, and slow tone attacks (Juslin, 2001; Juslin & Laukka, 2004). Furthermore, in everyday life sadness is experienced as a negatively valenced emotion, while tenderness has a positive valence. In the music domain however, sadness, as well as tenderness, is often perceived and experienced as a pleasant emotion (Kawakami, Furukawa, Katahira, & Okanoya, 2013; Taruffi & Koelsch, 2014). Interestingly, the recognition of anger was less successful in comparison to the other emotion categories. This finding is consistent across the error analysis for the MER task, the ANOVAs, and the extreme scorers analysis. Compared with other basic emotions (e.g., happiness or sadness), anger is less commonly evoked by music (Juslin & Laukka, 2004; Zentner, Grandjean, & Scherer, 2008). While anger may be expressed in heavy metal or punk music, none of the participants in the current study expressed a liking for these types of music. Moreover, the analysis of the data from the extreme scorers showed that individuals with high levels of *musical training* were the most accurate in identifying angry excerpts. This may then suggest that relatively poor recognition of angry music, observed in the majority of participants, results from a lack of exposure to this emotion in music and can be counterbalanced by musical expertise.

Our first experimental hypothesis stated that participants with high scores on empathy and musical expertise and low scores on alexithymia would perform at high levels on the MER task. The results of the exploratory correlation analysis revealed a negative association between the MER total score and *externally oriented thinking* as well as a positive association between the correct ratings for anger and *musical training*. These findings are consistent with our predictions about musical expertise and alexithymia (*externally oriented thinking* is a primary factor of alexithymia). Furthermore, the correlation analysis pointed to a diminished ability to detect sadness in participants who score high on *externally oriented thinking*. This finding, which was confirmed by the extreme scorers analysis, is in line with the results from a previous study showing an association between *externally oriented thinking* and difficulties in identifying facial expressions of anger, sadness, and fear in a sample of students (Prkachin et al., 2009).

The results of the regression analysis indicated that *externally oriented thinking* was the only individual characteristic significantly influencing performance on the MER task, accounting for 8.2% of the variance. Moreover, the relationship between the recognition of musical emotions and *externally oriented thinking* was negative, meaning that *externally oriented thinking* is a negative predictor of the overall MER correct score. *Externally oriented thinking* describes a cognitive style that is concrete, utilitarian, and focused on external details of everyday life, rather than personal thoughts and feelings or other aspects of a person's inner experience (Parker, Taylor, & Bagby, 2003). *Externally oriented thinking* is positively associated with primary psychopathy, emotional detachment, low tenderness, and lack of empathy (Lander, Lutz-Zois, Rye, & Goodnight, 2012). Unlike the other two factors of alexithymia, high scorers on *externally oriented thinking* show reduced physiological reactivity in response to sad movies (Davydov, Luminet, & Zech, 2013). Results from the present study highlight that *externally oriented thinking* leads to a perceptual negative bias towards musical stimuli depicting sadness. Experimental stimuli conveying sadness, such as film clips or musical excerpts, can trigger rumination and/or spontaneous cognition, which are characterized by a shift of attention from the external environment to "internal" thoughts (Luminet, Bouts, Delie, Manstead, & Rimé, 2000; Luminet, Rimé, Bagby, & Taylor, 2004; Lumley & Bazydlo, 2000; Taruffi, Pehrs, Skouras, & Koelsch, 2017); in this sense, *externally oriented thinking* may distract attention from "internal" thoughts by inhibiting arousal changes associated with inwardly directed cognition (Davydov et al., 2013). Thus, on the one hand an *externally oriented* cognitive style can protect against experiencing negative feelings by avoiding unpleasant stimuli, while on the other hand it may favor long-term dysfunctional psychosomatic outcomes by depriving individuals from positive stress experiences (i.e., stress that enhances one's functioning and is resolved through coping; Davydov et al., 2013).

With regard to trait empathy, we initially detected two positive correlations between the MER score and the subscales of *empathic concern* and *fantasy.* This finding is consistent with previous studies of music-evoked emotions revealing a positive correlation between sadness ratings and *fantasy* (Taruffi & Koelsch, 2014; Vuoskoski et al., 2012). However, after correcting for multiple tests, the correlations were no longer significant. Therefore, in contrast to the results of Wöllner (2012), neither empathy nor any of its subscales was associated with better recognition of emotion in music. This discrepancy is probably due to the fact that Wöllner's experimental paradigm differed from the one employed in the current study. Wöllner made use of audio and video recordings of a performance from a string quartet, in which musical intentions were also expressed through facial and bodily expressions and movements. Moreover, empathy was not assessed by the IRI, but by the Questionnaire of Cognitive and Affective Empathy (QCAE: Reniers, Corcoran, Drake, Shryane, & Völlm, 2011), which yields a different structure of factors to the measure used in the present study. Importantly, significant results were only related to empathy's affective factor and to the part of the musical composition "characterized by a high degree of expressiveness, which was also present in the musicians' actions" (Wöllner, 2012, p. 220). It is therefore plausible to suggest that differences in affective empathy may play a decisive role in the perception of musical emotions, when the emotional information is delivered by both visual and auditory modalities (for example, in the settings of a live performance). Empathic skills are indeed a crucial factor in the ability to correctly perceive changes in emotional states depicted by facial expressions and bodily gestures (Hooker, Verosky, Germine, Knight, & D'Esposito, 2010). According to embodied simulation theories, the perception of a facial emotional expression triggers the simulation of a corresponding affective state in the observer, and favors access to specific emotional concepts (Gallese, 2005; Goldman & Sripada, 2005; Niedenthal, 2007).

Our second hypothesis, stating that personality traits would modulate perceived emotions in a trait-congruent fashion, was not fully supported by the study, despite the results of the extreme scorers analysis are consistent with previous work suggesting that *neuroticism*, but not *extraversion*, is associated with sadness ratings (Vuoskoski & Eerola, 2011). Although we used the same stimulus materials as those employed by Vuoskoski and Eerola (2011), we opted for a forced-choice measure of perceived emotions rather than ratings on continuous scales (as in Vuoskoski & Eerola, 2011), and this choice might have led to the inconsistency of results with regard to *extraversion*. Interestingly, the present study also points to a novel finding: *conscientiousness* correlated with the correct score for the "high emotion" excerpts, in a trait-congruent fashion. *Conscientiousness* is a personality trait characterized by a tendency to be organized, careful, and efficient. This trait may therefore have favored good performance on the MER task.

Our results showed that a tendency towards externally oriented cognition, which is a feature of alexithymia, can predict low performance on a MER task. The present study therefore provides preliminary evidence suggesting that alexithymic difficulties in recognition of emotional expressions in the visual and language domains (Heaton et al., 2012; Lane et al., 1996; Parker et al., 1993; Prkachin et al., 2009) generalize to music. It is important for further research to verify this suggestion by testing directly the perception of emotions represented by music in an alexithymic sample.

Nevertheless, on the basis of our data we cannot exclude the following alternative interpretation: the results from the correlation and regression analyses, rather than pointing to a perceptual deficit in emotional processing of musical stimuli in individuals with tendencies to alexithymia, might instead suggest that *externally oriented thinking* involves a conscious decision not to explore one's own emotions and those of others, and may be an autonomous factor, independent from alexithymia (Meins, Harris-Waller, & Lloyd, 2008). According to this interpretation, participants with high scores on *externally oriented thinking* performed worse on the MER task because of their tendency to avoid processing of emotional information. Future studies could test whether *externally oriented thinking* is an independent construct from alexithymia, for example, by taking into consideration the other factors of the TAS-20 (i.e., *difficulty in identifying feelings* and *difficulty in describing feelings*).

Although the results of the correlation and regression analyses were corroborated by the extreme scorers analysis, the overall magnitude of the correlation coefficients and the explained variance were small ($r < .3$ and $R^2 = .08$). Thus, our findings require independent replication to evaluate their robustness. On the other hand, it should be noted that the problem of weak associations is rather common in correlational studies of music and personality traits, which usually report smaller correlations when compared with the standards used in other psychological research (e.g., Ladinig & Schellenberg, 2012; Vuoskoski & Eerola, 2011). This may be due to a wide variety of factors that play a confounding role. For example, mood and musical preference can interact with personality traits, and in turn affect recognition of musical emotions (Vuoskoski & Eerola, 2011). Furthermore, self-reported *externally oriented thinking* scores were slightly lower in the current study than have been previously reported for the general population (see Table 1), and consequently may have impacted our results.

Another limitation of the present study lies in the measure used for the assessment of alexithymia, the TAS-20. Although the TAS-20 is the most common and reliable self-report measure to assess alexithymia in the general population, it has also been subject to criticism (Kooiman, Spinhoven, & Trijsburg, 2002; Leising, Grande, & Faber, 2009; Lumley, 2000). Thus, it is important for further studies to replicate our results using other self-report questionnaires, for example the more elaborated 40-item Bermond-Vorst Alexithymia Questionnaire (BVAQ: Vorst & Bermond, 2001). This scale is known to provide a comprehensive operationalization of alexithymia. Furthermore, alexithymia can be subdivided into two subsidiary concepts, namely type I and II (Berthoz & Hill, 2005). Type I is associated with the phenomenon of individuals who do not experience strong emotions at any conscious level (Berthoz & Hill). Type II describes people who are aware of their emotional experience but do not have the corresponding cognitions (Berthoz & Hill). The factor structure of the BVAQ (five factors) enables researchers to distinguish the presence (or the absence) of type I alexithymia (i.e., the "affective" dimension), while the TAS-20 simply measures the strength of type II alexithymia (i.e., the "cognitive" dimension).

Despite the methodological limitations highlighted above, our study provides the first empirical evidence showing that *externally oriented thinking*, a characteristic of alexithymia, significantly influences the recognition of musical emotions. Importantly, our results suggest that the impact of alexithymia is not restricted to the processing of emotion-laden information in the visual and language domains, but also extends to music. The findings further highlight the importance of collecting alexithymia data for future studies of music-perceived emotions.

Author Note

Correspondence concerning this article should be addressed to Liila Taruffi, Department of Educational Sciences & Psychology, Freie Universität Berlin, Habelschwerdter Alle 45, 14195 Berlin, Germany. E-mail: liilataruffi@zedat.fu-berlin.de

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Appendix

Complete Correlation Matrix

Factor	Happiness	Sadness	Tenderness	Fear	Anger	HE ex.	ME ex.	Tot. MER
TAS-20								
DIF	−.09	.13	.08	.02	−.02	−.02	.11	.06
DDF	.10	−.03	.12	.08	−.07	−.04	.17	.10
EOT	−.02	−.25**	−.19*	−.04	−.17	−.28**	−.08	−.21*
Gold-MSI								
MT	−.09	−.05	.13	.03	.25**	.19*	.02	.13
IRI								
PT	−.08	−.02	.06	.13	.11	.15	−.01	.08
EC	.00	.04	−.01	.04	.19*	.18*	.00	.11
FT	−.18	.20*	.12	−.03	.19*	.12	.02	.08
PD	−.04	.08	.11	.06	.02	.09	.08	.10
BIG-5								
E	−.08	.12	−.16	.00	.05	.06	−.15	−.06
A	.02	−.13	−.09	.14	−.01	.10	−.12	−.02
C	.03	.06	.21*	.13	.05	.26**	.00	.16
N	.03	.14	.02	−.13	.11	−.04	.17	.08
O	−.13	.17*	.04	.09	.16	.19*	−.01	.10

Note. * $p < .05$, ** $p < .01$. A = *agreeableness*; C = *conscientiousness*; DDF = *difficulty in describing feelings*; DIF = *difficulty in identifying feelings*; E = *extraversion*; EC = *empathic concern*; EOT = *externally oriented thinking*; FT = *fantasy*; HE ex. = "high emotion" excerpts; ME ex. = "moderate emotion" excerpts; MT = *musical training*; N = *neuroticism*; O = *openness to experience*; PD = *personal distress;* PT = *perspective-taking;* Tot. MER = MER total score.