

A Cross-cultural Study on Music Emotion Recognition
between Chinese and Western Contexts:
Sensitivity, Psychoacoustic Features, and Individual
Differences

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March 2024

Abstract

The expression and perception of emotional expressions in music have been investigated in cross-cultural contexts, revealing both universality and culture-specificity in the recognition of musically expressed emotions by listeners of different cultural backgrounds. However, the complex nature of cross-cultural studies leads to many related issues remaining unexplored, and there are still many cultures that have rarely been touched upon with respect to cross-cultural music emotion recognition. Therefore, this thesis aims to further explore this topic by investigating the recognition of Chinese traditional and Western classical music among Chinese and Western listeners. To achieve this, three empirical studies were conducted.

The first study aimed to test the previously observed in-group advantage for recognising emotions expressed in culturally familiar music, as well as cultural differences in associated psychoacoustic features. Results from the first study revealed cultural disparities in psychoacoustic features in terms of number, degree, and type. Contrary to previous findings, the expected in-group advantage in recognising emotions expressed in music from one's own culture was not established. Instead, a cultural advantage in recognising specific emotions, regardless of the cultural origin of the music, was observed. These findings were replicated in the second study, which further focused on exploring potential moderators in the relationship between cultural background and music emotion recognition. The results indicated the moderating roles of negative affect, familiarity, and preferences for the Reflective and Complex musical genre dimension. To further elucidate the cultural differences in recognition sensitivity and associated psychoacoustic features observed in the previous two studies, the third study explored how personality traits and cognitive styles may predict these cultural differences. I found evidence supporting the mediating effect of Neuroticism on the relationship between cultural background and the recognition of emotions in music. Additionally, cultural differences in associated psychoacoustic features were found to be related to differences in empathising cognitive styles. Overall, this research challenges some previously established findings in the field of cross-cultural music emotion recognition and contributes to the understanding of cultural differences in music emotion recognition by examining how individual differences can explain the observed cultural distinctions.

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Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

I designed all the empirical studies and collected the data under the supervision of Prof. Hauke Egermann. I conducted the initial analysis and wrote the first draft of the thesis. The thesis was subsequently revised based on Prof. Hauke Egermann's feedback on the first study (Chapters 4 and 5) and Dr. Katherine O'Neill's feedback on the rest of the thesis.

Publications and Presentations

The publications and presentations are listed alongside their corresponding chapters in the thesis: Publications and presentations

Chapter

Peer-reviewed journal article

Lyu, M., & Egermann, H. (in press). A cross-cultural study in Chinese and Western music: Cultural advantages in recognition of emotions. *Psychology of Music*.

Pilot Studies & Study 1
(Chapter 4 & 5)

Peer-reviewed conferences contributions

Lyu, M., O'Neil, K. & Egermann, H. (2024, July 3-6). *Exploring the mediating roles of personality traits and cognitive styles on the relationship between cultural background and music emotion recognition* [Paper presentation]. The 12th Triennial Conference of the European Society for the Cognitive Sciences of Music, York, United Kingdom.

Study 3
(Chapter 7)

Lyu, M., O'Neil, K. & Egermann, H. (2024, July 3-6). *Cross-cultural music emotion recognition: Exploring the emotion-specific advantage and the moderating influences of individual differences* [Paper presentation]. The 12th Triennial Conference of the European Society for the Cognitive Sciences of Music, York, United Kingdom.

Study 2
(Chapter 6)

Lyu, M., O'Neil, K. & Egermann, H. (2024, June 8-10). *The mediating effects of personality traits and cognitive styles on the relationship between cultural background and music emotion recognition* [Poster presentation]. The 17th International Conference of Students of Systematic Musicology (SysMus24), Jyväskylä, Finland.

Study 3
(Chapter 7)

Lyu, M., O'Neil, K. & Egermann, H. (2024, June 8-10). *Exploring the in-group advantage in emotion recognition in culturally-familiar music and the moderating influences of individual differences* [Paper presentation]. The 17th International Conference of Students of Systematic Musicology (SysMus24), Jyväskylä, Finland.

Study 2
(Chapter 6)

Lyu, M. & Egermann, H. (2023, October 18-20). *Exploring cross-cultural music emotion recognition and its correlation with acoustic features between Chinese and Western contexts* [Paper Presentation]. The 16th International Conference of Students of Systematic Musicology (SysMus23), Sheffield, United Kingdom.

Pilot Studies & Study 1
(Chapter 4 & 5)

Lyu, M., & Egermann, H. (2023, Sep 14-16). *Cross-Cultural Emotion Recognition: A Comparative Study of Chinese Traditional and Western Classical Music Among Chinese and*

Pilot Studies & Study 1
(Chapter 4 & 5)

Western Listeners [Paper presentation]. GAPS2 - Global Arts and Psychology Seminar "Creativity in music and the arts", York, United Kingdom.

Lyu, M., & Egermann, H. (2023, August 24-28). A Cross-cultural study between Chinese and Western contexts: Emotion recognition in music and the effects of acoustic features. In T. Minoru, S. Makiko, I. Shimpei, M. Toshie, O. Masahiro, & S. Haruka (Eds.), *The e-proceedings of the 17th International Conference on Music Perception and Cognition and the 7th Conference of the Asia-Pacific Society for the Cognitive Sciences of Music*.

Pilot Studies & Study 1
(Chapter 4 & 5)

Other conference contributions

Lyu, M., & Egermann, H. (2023, March 22). *A cross-cultural study between Chinese and Western contexts: Emotion recognition in music and the effects of the acoustic features* [Paper Presentation]. Music Postgraduate Forum, School of Arts and Creative Technologies, University of York, York, United Kingdom.

Pilot Studies & Study 1
(Chapter 4 & 5)

Acknowledgements

With the submission of this thesis, I would like to take this opportunity to express my gratitude to those who have provided me with help, care, and love, supporting me to reach this point.

I am thankful for Hauke Egermann, who brought me into the PhD journey and helped me overcome the initial difficulties faced as a young researcher. I owe immense gratitude to Katherine O'Neill for her guidance, companionship, and encouragement throughout the completion of this thesis. I am also grateful to Graham Welch, who years ago, established the bridge from Music Education to Music Psychology for me with patience and provided continuous care and encouragement. The invaluable exchange of ideas, thoughts, and advice among my fellow friends in the York Music Psychology Group is deeply appreciated. I also value the Music Education Teaching Team for enabling me to preserve a significant portion of my identity as a music educator and instilling in me a sense of belonging. My dear friend, Jinqiao Zhang, took the first step to extend her kindness and friendship towards me, providing vital support and companionship during the most challenging period of my PhD amidst the COVID-19 pandemic. I am also grateful to my study fellow and friend, Menglian Zhang, whose company has helped me through numerous difficult moments during my PhD and life.

Lastly, the biggest thanks go to my parents, who gave me life to experience all the beauty in the world. I always feel proud to have been born and raised in a family where I have received tons of love and support, without which I could not have become who I am today and come this far.

Chapter 1. General Introduction

1.1 Overview of the Thesis

Music has been suggested to have the ability to communicate emotions (Izen et al., 2023; Thormählen, 2022). The capacity of music to convey emotional expression has been conceived as a prerequisite for listeners' appreciation of it (Fritz et al., 2009). Previous cross-cultural studies have revealed both universality and culture-specificity in the way listeners from diverse cultures process the same emotional expressions in music (Balkwill, 2006; Balkwill et al., 2004; Balkwill & Thompson, 1999; Fritz et al., 2009; Thompson & Balkwill, 2010). Due to the complex nature of cross-cultural studies, the results of the exploration of emotion recognition in music have shown both consistency and controversy, as well as both similarities and differences across different studies. For example, some studies have found universal recognition of musically expressed emotions (e.g., Fritz et al., 2009), although there may be an in-group advantage in recognition for individuals whose cultural background is close to or the same as the culture of the music (Balkwill & Thompson, 1999; Fritz, 2013). Counter to this, it has also been suggested that cross-cultural recognition of emotions may not always be possible (Davies, 2011). Additionally, there are still some issues yet to be fully interpreted and understood, such as the associated psychoacoustic features, and many cultures have not been thoroughly explored in the investigation of cross-cultural music emotion recognition. Therefore, in this PhD thesis, attention was focused on a pair of music cultures that are still rarely studied together concerning cross-cultural music emotion recognition. The further aims were to identify the relationship between cultural background and listeners' recognition of emotions expressed in music and interpret the observed cultural differences between Chinese and Western listeners.

This thesis consists of 11 chapters. The first three chapters provide a general introduction to the core theme (Chapter 1), a literature review on recent empirical evidence and theoretical reflections related to the focus points of this research (Chapter 2), and an overview of the research methodology (Chapter 3). The following four chapters delve into the details of the pilot studies (Chapter 4) and the three main studies (Chapter 5, 6, and 7). The remaining chapters include a general discussion of the main findings (Chapter 8), a consideration of general limitations (Chapter 9), implications for future research (Chapter

10), and, finally, a general conclusion (Chapter 11). The following sub-sections serve as extended abstracts for each empirical study in this thesis.

1.1.1 Study 1: Exploratory study on music emotion recognition and associated psychoacoustic features between Chinese and Western contexts

Background: Previous studies have suggested both universality and cultural specificity in music emotion recognition. Basic emotions could be recognised across cultures, however, there may be an in-group advantage if the music and the listeners stem from the same culture. Emotion perception in music could be based on a combination of universal and cultural cues, which might influence listeners differently across cultures. Similar to Western music, Chinese music is often appreciated by its emotional expressivity in Chinese culture. However, there is still rare research on comparing Chinese music and Western music in the cross-cultural perception of musical emotions.

Aims: The first purpose of the study was to examine whether in-group advantage of music emotion recognition, which has been found in many previous studies, can be replicated in the Chinese and Western contexts. The second purpose was to investigate how psychoacoustic cues are associated with the perception of musical emotions in Chinese and Western listeners.

Method: Two hundred seventy-eight Chinese (69 males, 98 musicians, $M = 25$ years) and 136 Westerners (54 males, 68 musicians, $M = 35$ years) participated in an online study via Qualtrics. After completing a demographic questionnaire, participants were required to listen to 18 Chinese and Western music excerpts, which were presented randomly and intended to express happiness, sadness, peacefulness, anger, and fear. Participants were instructed to indicate to which degree they thought the music expressed the five emotions on continuous scales ranging from 1 to 5.

Results: The repeated measures ANOVAs revealed that regardless of the cultural origin of the music, Chinese participants seemed to be more sensitive than Western participants to the perception of happiness and sadness, while Western participants seemed to be better at identifying fear. By extracting the acoustic features via the MIR Toolbox 1.8.1 and conducting mixed linear regressions, it was also found that the type, number, and degree of psychoacoustic features correlated with emotion recognition differed across cultures.

Conclusions: In-group advantage in the cross-cultural music emotion recognition was not well substantiated in this study, as different cultural groups seemed to generally demonstrate better performance in recognising specific emotions. In addition, differences in the quantity and quality of psychoacoustic cues associated with emotion recognition across cultures were shown. Based on relevant literature, the above findings could be related to the differences in the personality traits or cognitive styles among a particular culture, and thus subsequent study exploring these assumptions was suggested to be conducted.

1.1.2 Study 2: Moderators of the relationship between cultural background and music emotion recognition

Background: Regarding the recognition of musically expressed emotions, previous studies have demonstrated an in-group advantage for listeners whose cultural background is the same or close to the music (Balkwill & Thompson, 1999). However, recent evidence highlights a cultural advantage in specific emotions instead of an overall in-group advantage (Lyu & Eggermann, in press). Previous studies on music and emotion have suggested the influence of individual differences on the recognition of emotions in music. However, these factors are often not adequately considered in the investigation of this issue in a cross-cultural context, despite suggestions that cultural differences need to be interpreted with consideration of individual differences (Juslin et al., 2016).

Aims: The first purpose of this study was to investigate whether the previously found emotion-specific advantage for different cultures can be replicated. The second purpose was to explore moderating factors in the relationship between cultural background and music emotion recognition, including gender, musical expertise, current mood, familiarity and preference for specific musical stimuli, and general preferences for musical genres.

Method: Data collected from 246 Chinese and 225 Westerners, were analysed. Participants were asked to listen to 18 previously tested Chinese and Western music stimuli, and rate the degree to which they thought the music expressed each of the five target emotions (happiness, sadness, peacefulness, anger, and fear), and their familiarity and preference for the music stimuli, on continuous scales ranging from 1 to 5. Participants also completed the International Positive and Negative Affect Schedule Short Form, and the Short Test of Music Preferences.

Results: Repeated measures ANOVA showed a cultural advantage for the Western participants in the recognition of fear in both Chinese and Western music, partially aligning with previous findings. Additionally, there was little gender difference, but there was an evident advantage for professional musicians compared to non- and amateur musicians. Correlation analysis showed that familiarity and preference were both associated with the recognition of musically expressed emotions. Further moderation analysis also indicated the moderating effects of negative affect and preferences for musical genres on emotion recognition sensitivity.

Conclusions: Similar to the previous study, an overall in-group advantage was not established but a cultural advantage for the Western listeners in the recognition of fear was observed. The moderating effects of the tested factors on the recognition of musically expressed emotions highlight the importance of considering individual differences in cross-cultural studies on music emotion recognition.

1.1.3 Study 3: The influences of personality traits and cognitive styles on cross-cultural music emotion recognition

Background: Cross-cultural research on music emotion recognition has revealed both universality and cultural specificity (Balkwill & Thompson, 1999). It has been suggested that cultural differences in emotion processing in music could be interpreted with consideration of individual differences (Juslin et al., 2016). However, there have been limited studies empirically investigating this.

Aims: This study aimed to explore whether and how individual differences in personality traits and cognitive styles mediate the relationship between cultural background and the recognition of musically expressed emotions, and on the psychoacoustic features associated with music emotion recognition.

Method: Data collected from 204 Chinese (36 males; 38 professional musicians) and 214 Westerners (89 males; 43 professional musicians), were analysed in this study. Participants were asked to listen to 18 previously tested Chinese and Western music stimuli, and rate the degree to which they thought the music expressed each of the five target emotions (happiness, sadness, peacefulness, anger, and fear), on continuous scales ranging from 1 to 5. Personality traits and cognitive styles were measured using the Big Five Inventory, the

Analysis-Holism Scale, and the 10-item short forms of the Empathy Quotient and Systemising Quotient-Revised.

Results: The mediation analysis revealed the indirect effect of cultural background on the recognition of fear in Chinese music, and the recognition of happiness, sadness, and fear in Western music. Additionally, these observed indirect effects were all through Neuroticism. Both empathising and systemising did not mediate the relationship between cultural background and emotion recognition sensitivity. Furthermore, the regression analysis for all types of cognitive styles only indicated a cultural difference in the empathising cognitive style, and the subsequent mediation analysis revealed the mediating effect of it on the relationship between cultural background and the association between emotion recognition sensitivity and associated psychoacoustic features.

Conclusions: This study indicated the mediating effect of Neuroticism on the relationship between cultural background and the recognition of emotions in music. This could be attributed to the positive correlation between Neuroticism and Sensory Processing Sensitivity, which is a personality trait that describes sensitivity to environmental stimuli and is related to empathy. The previously hypothesised association between cultural differences in holistic-analytic cognitive styles and cultural differences in emotion recognition was not confirmed. However, cultural differences in associated psychoacoustic features were found to be related to cultural differences in the empathising cognitive style. These findings suggest the need to consider personality traits and cognitive styles for interpreting cultural differences in the recognition of emotions in music.

1.2 Original Contribution to Knowledge of the Field

This thesis explores the recognition of musically expressed emotions and the associated psychoacoustic features. Additionally, it investigates potential modulatory factors in the relationship between cultural background and music emotion recognition and psychoacoustic features, with a view to contributing to the field of cross-cultural music emotion recognition. This thesis focuses on the relatively seldom compared music cultures of Chinese traditional and Western classical music to examine the in-group advantage in cross-cultural music emotion recognition. It delves into cultural differences in music emotion recognition and the associated psychoacoustic features, both of which are central focuses in this research field. A

cultural advantage in recognising specific musically expressed emotions was found, rather than the previously hypothesised in-group advantage. More innovatively, this thesis also stands as the first to explore the potential moderators and the mediating roles of personality traits and cognitive styles in the relationship between cultural background and music emotion recognition. These explorations contribute to a more rigorous identification of the impact of cultural background on the recognition of emotion expressed in music. They also aid in better interpreting the factors that contribute to the observed cultural differences in emotion recognition in music and associated psychoacoustic features at the individual level.

Chapter 2. Literature Review

Each of the study-based chapters of this thesis (Chapter 5, 6, and 7) contain a briefly summarised literature review that has informed the specific methods and research questions addressed in each. Theoretical rationales and a general literature review underpin the whole thesis will be introduced in this chapter.

2.1 Distinguishing Emotion from Relevant Confounding Terminologies

Terminological confusion within the field of music and emotion, where terms such as *affect*, *emotion*, *mood*, and *feeling* are often used interchangeably or inconsistently (Juslin & Sloboda, 2010; Marin & Bhattacharya, 2011), has led to difficulties in communication and integration. This issue cannot be neglected before delving into an exploration of any phenomenon that these terms describe or determine. Thus, this thesis begins from here with a brief clarification of the fundamental terminology involved. *Affect*, the superordinate category, is conceptualised as an “umbrella term” encompassing a broader spectrum of affective phenomena, evaluating valence (positive or negative) and states such as emotion, mood, and preference (Juslin & Sloboda, 2010; Niven, 2013). The focus of this thesis *Emotion*, is an intricate and diverse phenomenon marked by strong, often fleeting emotional experiences caused by specific stimuli or cognitive assessments, lasting from minutes to hours (Juslin & Sloboda, 2010). Emotion is a complex set of processes associated with action readiness, which is essential for the way living organisms engage with the world. It has developed from simple preparations for movement in all creatures to purposeful actions in birds and mammals (Frijda, 2016). For instance, emotions such as anger and fear are thought to have evolved in response to life-threatening situations, triggering “fight or flight” behaviours, as observed in *Drosophila* (Gu et al., 2019; Kravitz & Fernandez, 2015). According to Juslin and Laukka (2004), emotions can be understood as short-lived but intense responses to changes in the environment that are relevant to goals and involve several components, including cognitive appraisal, subjective feeling, physiological arousal, emotional expression, action tendency, and emotion regulation. In contrast to immediate

emotions, *Mood* refers to affective states that are more prolonged but less intense, lack synchronisation, and do not require a specific object, typically lasting from hours to days (Bottemanne et al., 2022; Juslin & Sloboda, 2010). Moods are characterised by either a positive or negative valence (Tyng et al., 2017). *Feeling*, as mentioned above, is a component of emotions and refers to the subjective experience of emotions, typically measured through self-reports (Juslin & Sloboda, 2010). Physiological assessments (Ciuk et al., 2015; Sacrey et al., 2021; Zhang et al., 2019), which measure objective manifestations in behaviour and body or brain physiology, are also used as indirect indicators of these inner experiences (Ledoux & Hofmann, 2018).

It should be clear that in the three empirical studies of this thesis, I focused on listeners' instant perceptions of emotions expressed through music. For this, I used the term “emotions” throughout this thesis, consistently referring to the affective content conveyed through music.

2.2 Emotion Perception and Emotion Induction

In the previous studies on music and emotion, the conceptual distinction between perception and induction of emotions is constantly highlighted (Marin & Bhattacharya, 2011). This is due to their different underlying mechanisms and measurements, and the finding that emotions perceived in music may not always be congruent with emotions induced by music (Gabrielsson, 2001; Juslin, 2012; Juslin & Laukka, 2004; Juslin & Västfjäll, 2008b).

“Perception is the process by which we recognise what is represented by the information provided by our sense organs” (Martin et al., 2013, p. 186). Accordingly, emotion perception is defined as instances where listeners perceive or recognise emotions in music without necessarily feeling them (Juslin & Västfjäll, 2008b). For example, listeners may perceive or recognise a piece of music as sad without actually experiencing sadness. In contrast, emotion induction refers to instances where music induces or evokes an emotion in listeners, meaning that listeners feel the emotion (Juslin & Sloboda, 2010). It should be noted that this thesis focuses on emotion recognition by investigating perceived emotions. Although emotion recognition and emotion perception are often used interchangeably (e.g. Juslin et al., 2016) as they both involve measuring perceived emotions, a nuanced difference exists in that the former necessitates further consideration of the issue—*matching* (Juslin, 1997b). Specifically, emotion recognition not only looks at how a musical stimulus is perceived

emotionally (e.g., to which degree the music conveys emotions such as happiness or sadness) but also is interested in whether the emotion perceived aligns with the emotion the music conveys (Vieillard et al., 2008).

Using 16 adjectives from the arousal and valence axes (e.g., Lang, 1995), and the negative activation and positive activation that represent a 45° rotation from them (Watson & Tellegen, 1985), Kallinen and Ravaja (2006) found that the perceived emotions were generally the same as the felt emotions in music. However, there were also some differences. For instance, felt emotions were stronger than perceived emotions related to positive valence but weaker in relation to arousal, positive activation, and negative activation. Positive activation axis extends from high-arousal positive emotion to low-arousal negative emotion, and negative activation axis extends from high-arousal negative emotion to low-arousal positive emotion (Watson & Tellegen, 1985). Furthermore, a notable distinction emerged between the perceived and experienced emotions, with fearful music being perceived as negative and relatively high on the negative activation dimension, while in the subjective experience, the identical music was perceived as relatively positive and did not evoke any negative activation. This phenomenon, explained by previous researchers, may be related to the specific underlying mechanism involved (Juslin, 2012; Juslin & Västfjäll, 2008b). For example, emotional contagion, by definition, entails the transmission and experience of the same emotion, while this is not necessarily true for episodic memory. For instance, a piece of music expressing a “happy” emotion might trigger a “sad” episodic memory. Additionally, another domain-specific finding that could be useful in explaining this phenomenon is the enjoyment of negative emotions in the field of music. Researchers have elucidated that sad music can be perceived as more tragic, yet the actual experience entails it being more romantic and blithe, and less tragic than initially perceived for the same music (Kawakami et al., 2013). This paradoxical phenomenon of enjoyable music-evoked sadness has been proposed to be positively correlated with prolactin concentrations (Huron, 2011), and may be attributed to a combination of biological, psychosocial, and cultural factors, as discussed in an integrative review by Eerola et al. (2018). A similar phenomenon is also reflected in the more frequent perception than actual experience of sadness and dysphoria in music (Zentner et al., 2008).

Overall, these findings indicate that emotion perception or recognition may not always align with emotion induction. This suggests a need for researchers to explicitly

communicate to participants in empirical studies whether they are tasked with rating in terms of the emotion they perceive or recognise, as opposed to the emotion they actually feel.

2.3 Emotions in Music

Appraisal-based and non-appraisal emotions (utilitarian and aesthetic emotions), the prevalence of musical and non-musical emotions, and everyday life and music-specific emotions constitute three closely connected discussion points related to emotions in music that need to be addressed for the focus of this thesis on emotion recognition in music. Despite some expository overlaps, I organised them into separate sub-sections to enhance the focus on each aspect.

2.3.1 Appraisal-based emotions and non-appraisal emotions

Scherer and Zentner (2008a) suggested that music can elicit both aesthetic emotions and utilitarian ones, which distinguish each other in terms of appraisal mechanisms. The latter is appraisal-based, goal-congruent, and action-oriented, comprising certain basic emotions, such as fear and sadness, that are related to adaptation to situations or the maintenance of well-being. In contrast, the former emerges based on appraisal mechanisms other than cognitive and goal-oriented ones (Juslin & Västfjäll, 2008a; Scherer, 2004a). Scherer and Zentner (2008b) claimed that aesthetic emotions are more frequently triggered by music than utilitarian emotions, precisely suggesting the uniqueness of musically evoked emotions. Conversely, Juslin and Västfjäll (2008a) asserted that the differentiation between most musically related emotions and most musically irrelevant emotions was rooted in the absence of reliance on cognitive appraisals. Scherer and Zentner (2008b) cautioned that blurring the boundaries between aesthetic and utilitarian emotions might pose a risk of overreliance on dimensional and discrete emotion models, considering that musically induced emotions are noted to be more nuanced than what these general emotion models capture. However, Juslin and Västfjäll (2008a) expressed scepticism regarding the reliability of the musical emotion scale developed by Scherer and Zentner, in terms of its “bottom-up” and theory-less fashion. The mechanism of cognitive appraisal (e.g., one appraises the situation as “dangerous”) has been revealed as the most commonly discussed underlying mechanism in the general field of

emotion theories, outside the domain of music. However, as Juslin (2013a, p. 239) pointed out, “the problem is that music as such rarely has implications for life goals”. In light of this, whether cognitive appraisal is rarely or mostly the cause of musically induced emotions further involves follow-up issues concerning the prevalence of musical emotions and the distinctions between music-specific and everyday emotions. Each of these two aspects will be further elaborated upon in the subsequent sub-sections.

2.3.2 Prevalence of musical emotions

Researchers hold varying opinions and incongruent views on which emotions can be induced by music or how frequently they are elicited. Some researchers asserted that music can only evoke basic emotions (Konečni, 2008), or solely broad positive and negative affective states (Clark, 1983). In contrast, others proposed, for example, that “music listeners may experience anything from mere arousal, ‘chills’, and ‘basic’ emotions (e.g., happiness, sadness) to more ‘complex’ emotions (e.g., nostalgia, pride), and even ‘mixed’ emotions” (Juslin, 2013a, p. 238), through several shared psychological mechanisms between musical emotions and other emotions (Juslin & Västfjäll, 2008b).

Researchers have acknowledged the necessity of constructing theories about mechanisms related to musically related emotions based on empirical explorations (Juslin & Västfjäll, 2008a; Scherer & Zentner, 2008b). For example, in four interrelated studies, Zentner et al. (2008) developed a 9-factorial model of music-induced emotions, demonstrating that it better accounted for music-evoked emotions than traditional dimensional and basic emotion models. This, coupled with the preceding discussion on the differentiation between utilitarian and aesthetic emotions/appraisal-based and non-appraisal emotions (see *Section 2.3.1*), suggests the existence of music-specific emotions. On the contrary, through empirical studies on the prevalence of emotional responses to music, Juslin and Västfjäll (2008a) discovered that *happiness-elation* and *nostalgia-longing* were significantly more frequent in response to music stimuli, while *anger-irritation*, *boredom-indifference*, and *anxiety-fear* were more frequently caused by non-music stimuli. The findings instead suggest that musical emotions differ from non-musical emotions quantitatively (i.e., in frequency distribution and degree) but not qualitatively (i.e., in category). Thus, in this sense, the assumption of music-specific emotions has been unsubstantiated.

2.3.3 Everyday life emotions and music-specific emotions

Following on the above two sub-sections, this sub-section will further delve into the heated debate regarding whether music-related emotions are substantially different from other emotions in everyday life. From previous sub-sections, Scherer and Zentner explicitly indicated a substantial distinction between musically induced emotions and emotions induced by other stimuli in everyday life (e.g., Scherer, 2004a; Zentner et al., 2008), supported by evidence from the differentiation between aesthetic and utilitarian emotions (see *Section 2.3*), as well as the superior accountability of the Geneva Emotional Music Scale in the emotional responses to music compared to other emotion models (see *Section 2.3.1*). Zentner et al. (2008) also suggested that negative emotions, commonly experienced in daily life, may be seldom elicited by music. Correspondingly, Juslin and colleagues suggested that musically induced emotions are largely similar to emotions in other domains, supported by evidence from shared underlying mechanisms associated with emotion responses and the prevalence of musical emotions (see *Section 2.3.2*). Even Zentner et al. (2008) have noted that emotions felt in music could be just one example of a broader category of aesthetically appraised emotions that exist in human lives.

Juslin and Västfjäll (2008b) proposed a theoretical framework consisting of six underlying mechanisms through which music elicits emotions in listeners: *brain stem reflexes*, *evaluative conditioning*, *emotional contagion*, *visual imagery*, *episodic memory*, and *musical expectancy*. This framework, from their perspective, precisely reflects that music induces emotions through largely the same mechanisms as other stimuli, and the emotions triggered by music are accordingly largely similar. Researchers further augmented the framework (Juslin, 2013a; Juslin et al., 2010) and eventually presented an updated and expanded version called BRECVEMA. The revised framework includes two additional mechanisms: rhythmic entrainment and aesthetic judgment. The latter is particularly important in corresponding to aesthetic judgments and better accounting for appreciation emotions, such as admiration and awe. The augmentation of this theory has been proposed to reconcile the ongoing debate in conceptualising emotional responses to music as either “everyday emotions” or “aesthetic emotions” (Juslin, 2013a, p. 235).

2.3.4 Overview for emotion in music

Despite the disagreement between these two views on whether emotional responses to music and the involved mechanisms are unique to music, researchers do concur that there are both similarities and differences between music-related and music-irrelevant emotions. However, interpretations and emphasis on these similarities or differences may vary among researchers. In particular, this appears to reflect situations in which findings from other fields have often been used to explain the phenomenon in music. For instance, neurobiological evidence supporting the emotional contagion mechanism involved in emotional responses to music has been drawn from studies on face perception (van der Gaag et al., 2007).

While existing theory building and development regarding the categorisation or characterisation of emotions in music have largely centred on music-evoked emotions, attempts to elaborate on these issues from the perspective of emotion perception or recognition remain rare. This scarcity may be attributed to the fact that some theoretical concepts still need clarification and the field is in a developmental stage (Thompson & Coltheart, 2008). However, I deemed it necessary and of fundamental significance to review and clarify the issues as discussed thus far in the exploration of the issue of music emotion recognition, which forms the central focus of this thesis. This is specifically due to the following considerations. By definition, emotional contagion refers to the process in which the listener perceives the emotions expressed through the music and then internally “mimics” this emotional expression (Juslin & Västfjäll, 2008b). In other words, perceived emotions may be converted into felt emotions through emotional contagion related to mimicry, a process that relies on the decoding of certain psychophysical signal detectors (e.g., intensity and pitch contour) (Thompson & Coltheart, 2008). Juslin (2012) did point out that their theoretical framework, BRECVEMA (Juslin, 2013a; Juslin & Västfjäll, 2008b), has “implications for the connection between perceived and aroused emotion” (p. 284). This is exemplified by the alignment of aroused emotions with musically expressed emotions when emotional contagion is involved, whereas the emotions aroused may not necessarily align with the emotions expressed by the music when episodic memory is involved. These suggestions indicate that, to some extent, the theory of underlying mechanisms could also provide guidance in understanding emotion perception and expression in music. Similar logic can also be applied to other theories related to emotions in music.

Taken together, in this thesis, although the aim was not to explore whether musical emotions or the involved mechanisms are the same as emotions elicited by other stimuli in daily life, I did examine emotions perceived or recognised through music. Additionally, I touched upon some findings related to emotions from other domains to aid in a better interpretation of my findings.

2.4 Emotion Theories and Models for Music Research

Basic emotion model and dimensional emotion models are the two commonly used emotion models in psychology (Eerola & Vuoskoski, 2013). In the realm of music research, these two theories, as well as music-specific emotion models (e.g., Geneva Emotion Music Scale; Zentner et al., 2008), have also achieved widespread recognition. This section will introduce and discuss each of these three types of emotion models, provide a comparison between them, and elucidate why I have chosen to adhere to basic emotion model in this thesis.

2.4.1 Basic emotion model

Basic emotion model is based on the theory that all emotions can be derived from a limited number of universal and innate basic emotions (Eerola & Vuoskoski, 2013; Ekman, 1992b, 1992a; Gu et al., 2019; Song et al., 2016; Zentner & Eerola, 2010). While the perspective that certain emotions are more “basic” than others is broadly acknowledged among emotion theorists, there is minimal consensus on the specific emotions to be included in the list of basic emotions (Kowalska & Wróbel, 2017). Theories about basic emotions have origins in both Greece and China (Gu et al., 2019). According to Konstan (2022), the Chinese term “Qíng” emerges as an intriguing candidate for comparison with the contemporary term “emotions”. This is particularly notable as it functioned as the overarching category encompassing different classifications of specific basic emotions. In the case of Chinese philosopher Xúnzǐ, these encompassed the six feelings of liking (hào), disliking (wù), happiness (xǐ), anger (nù), sadness (āi), and joy (lè).

In modern times, the most commonly accepted basic emotions, identified through research on universal emotion recognition of facial expressions, include happiness/enjoyment, sadness, fear, anger, disgust, and surprise (Ekman, 1992a, 1992b;

Ekman et al., 1969)—often referred to as “The Big Six” (Kowalska & Wróbel, 2017). Plutchik (1980, 1982) further proposed acceptance and anticipation, in addition to the six basic emotions. Oatley and Johnson-laird (1987) displayed five basic emotions: happiness, sadness, anxiety, anger, and disgust. More recently, emotion theorists have continued to develop or update their lists of basic emotions. For example, building upon the original six basic emotions, Ekman and Cordaro (2011) introduced a seventh one, contempt, while Levenson (2011) expanded the list to include interest, love, and relief. More differently, Panksepp and Watt (2011) proposed seeking, fear, rage, lust, carer, panic/grief, and play as basic/primary-process emotions (for a review, see Tracy & Randles, 2011). With new empirical findings and insights, Izard has re-identified their list of basic emotions, which includes only joy, sadness, anger, fear, and interest (Izard, 2011), without surprise (Izard, 1977). Jack et al. (2014) advocated for four basic emotions instead of six, namely joy, sad, anger, and fear. According to Gu et al. (2019), from the perspective of evolution and adaptation, Izard (2007) pointed out that in Western culture, individuals typically require the concept of joy to express the sense of accomplishment associated with pride, sadness to clarify the emotional impact of transformative loss, anger to articulate the vexation stemming from obstructed goal pursuits, and fear to explain the instinct to seek safety through flight (also see Juslin & Laukka, 2003). Cespedes-Guevara and Eerola (2018, p. 2) pointed out that Juslin and colleagues have consistently championed the viewpoint that “perception of emotions in music is based on the resemblance between vocal and musical expression of a set of basic emotions”.

In the field of music, as discussed in *Section 2.3.3*, the debate over whether emotions in the musical context differ from those in everyday life has led to the emergence of two groups of theorists: basic-emotion theorists and music-specific emotion theorists. While both approaches to conceptualising emotion align with categorical theories—asserting that emotional expressions are represented as discrete and distinct categories (Izard, 1977; Juslin, 2013b), their differing answers to the aforementioned question are also noteworthy. Unlike Juslin and colleagues (e.g., Juslin & Västfjäll, 2008b), who advocate for basic emotion theory, Scherer and colleagues (Scherer, 2004; Scherer & Zentner, 2008a) conceptualise utilitarian and aesthetic emotions. They distinguish the latter by its absence of goal-oriented appraisal, focusing instead on pure appreciation that does not involve utilitarian considerations (Scherer & Coutinho, 2013). Based on this rationale, Scherer and colleagues developed the music-specific emotional scale (Zentner et al., 2008), which will be introduced

later in *Section 2.4.3*. Basic emotions, such as sadness, anger, and fear, are considered utilitarian emotions because they function to help individuals adapt to and adjust to events with significant consequences for their physical survival and well-being by preparing action tendencies (e.g., fight or flight) and facilitating recovery and reorientation (e.g., grief work) (Scherer & Coutinho, 2013).

As the most influential paradigm in affective science, the basic emotion theory has also faced criticism, as discussed in Colombetti (2014). For example, the basic emotion theory is criticised, first, from linguistic and anthropological perspectives, because not all emotion terms in one culture necessarily have corresponding equivalents in another (Russell, 1991). Second, the forced-choice methodology of emotion labels, used in early research on the recognition of facial expressions to validate the theory of basic emotions, has also been considered problematic (Russell, 1994). The third criticism is that the basic emotion theory overlooks the variety of emotional manifestations; for example, emotions may be expressed through facial expressions differently depending on the situation and context (Barrett & Kensinger, 2010; Ortony & Turner, 1990). Furthermore, the basic emotion theory is also criticised for the difficulty affective scientists face in identifying consistent brain and autonomic response patterns that distinctly emerge in situations purported to activate affect programs (Barrett, 2006). Despite discussing the above criticisms of the basic emotion theory, Colombetti (2014) also points out that the main problem with the theory is that it promotes the belief that empirical evidence supports the existence of a small number of basic emotions, while the process by which this view has been established is rather arbitrary. This is because the selection of basic emotion categories by some supporters of the theory is not supported by a clear justification (e.g., Ekman & Friesen, 1971; Tomkins, 1962). Colombetti (2014) also argued that the existing distinctions between the so-called basic and non-basic emotions are unsatisfactory. However, she acknowledged that, despite the aforementioned variability in the evidence for the basic emotion theory, it is undeniable that something recurring or manifesting relatively reliably and stably does exist. For example, the universality of some discrete and categorised emotions has been supported by extensive evidence from cross-cultural recognition research across various modalities, including facial (Elfenbein & Ambady, 2002), vocal (Bryant & Barrett, 2008), and musical expressions (Balkwill & Thompson, 1999; Fritz et al., 2009).

2.4.2 Dimensional emotion model

Another important theory concerning emotions is the dimensional theory of emotion (Schlosberg, 1954; Wundt, 1897), which posits that “emotions fall on a continuum within a multidimensional space” (Livingstone, 2021, p. 326). Most dimensional theories advocate that emotions can be elucidated through the consideration of merely two or three affective dimensions. For example, Schlosberg (1954) proposed a three-dimensional model, consisting of pleasantness-unpleasantness, attention-rejection, and sleep-tension, which was analysed with a series of facial expressions (Engen et al., 1958). The most predominant and commonly used dimensional model nowadays is the circumplex model proposed by Russell (1980), which categorises an emotion based on two dimensions: valence (pleasure-displeasure) and arousal (degree of arousal). Much research on music and emotion has been based on the valence-arousal model (e.g., Droit-Volet et al., 2013; Hofbauer & Rodriguez, 2023; Quinto & Thompson, 2013). Although some have proposed a three-dimensional model, suggesting the need to distinguish between energy arousal (awake-tired) and tension arousal (tense-relaxed) (Ilie & Thompson, 2006), it has been reported to be acceptable to reduce it to two dimensions with no sacrifice of fit (Eerola & Vuoskoski, 2011).

2.4.3 Domain-specific emotion model

As discussed in *Section 2.3.3*, some researchers suggest the need to develop a measurement tool specifically tailored to music, as emotions in music differ from those in other fields, particularly because music more often evokes aesthetic emotions than utilitarian ones (e.g., Scherer, 2004a; Zentner et al., 2008). For example, through exploratory factor analyses, Zentner et al. (2008) developed *The Geneva Emotional Music Scale (GEMS)*, which comprises nine musical emotion factors: *Wonder, Transcendence, Tenderness, Nostalgia, Peacefulness, Power, Joyful Activation, Tension, and Sadness*. They claimed this as a musical emotion model that differentiates from the dimensional model and the basic emotion model, offering more explanatory power for musically evoked emotions.

2.4.4 Comparisons of different emotion models

Among the three types of emotion models - basic emotion model, dimensional emotion model, and music-specific model - the last one has been indicated to be only used for induced emotions (Song et al., 2016). Although some have reported that musically induced emotions can be better discriminated using emotion terms derived from GEMS, this case did not generalise to perceived musical emotions; instead, the basic emotion model accounted better for perceived musical emotions (Zentner et al., 2008; Zentner & Eerola, 2010). This, specifically, has been related to the fact that the perceived characteristics of negative emotions do not necessarily convert to experienced negative emotions (Zentner et al., 2008), due to the lack of threats or dangers—the origins of emotions from the evolutionary perspective—in the context of music listening (Zentner & Eerola, 2010).

Basic emotion models contrast with dimensional models in that the former argue that a specific emotion arises from a specific neural network or physiological system, emphasising the distinction between different emotions, whereas the latter assume that any specific emotions can be characterised by two or three common or overlapped neurophysiological systems, enabling the representation of similarities or continuity between different emotions in terms of their proximity in the dimensional space (Chen, 2020; Livingstone, 2021; Marin & Bhattacharya, 2011). Some researchers are inclined to investigate emotions from dimensional perspectives, such as the valence-arousal theory, arguing that a type of emotion can be indicated by identifying valence and the level of arousal. While I agree that listeners can sometimes intuitively use valence and arousal to categorise an emotion, this may not always be the case. For instance, within the category of sadness, grief (which involves a high level of sadness) could be perceived as negative in valence but high in arousal (Garrido, 2021). This does not change its attribution as sadness (Ekman, 1992a; Juslin & Laukka, 2003). Such instances challenge the theoretical classification of sadness in the two-dimensional model, which categorises sadness as negative in valence and low in arousal. Additionally, the dimensional model has been criticised for its inability to distinguish emotions that are close neighbours in the valence and arousal space (Juslin & Laukka, 2004; Song et al., 2016), or to capture subtle qualitative nuances in musical emotions (Scherer, 2004a).

Regarding basic emotion theories, while some critics argue that many research studies in music have been restricted to a limited set of emotions, influenced by these theories

(Cespedes-Guevara & Eerola, 2018), this temporary bias—likely because this type of study has not yet fully developed to the complex or mixed emotions stage—should not be attributed to the theory itself. It is important to note that the usage of the term “basic” implies that those non-basic (Kowalska & Wróbel, 2017; Laukka et al., 2013), or complex emotions are combinations of the basic emotions (Ekman, 1992a), which may be conceptualised as mixed or blended emotions (Berrios et al., 2015; Mäkäräinen et al., 2018; Oh & Tong, 2022). This suggests that the use of basic emotion theory or model in music research has never meant that music can only induce the so-called “basic” emotions, or “discrete” and “primary” emotions, or music elicits mostly basic emotions, as clarified by Juslin and Västfjäll (2008a).

Based on the above, in this thesis, the three empirical studies are grounded in basic emotion theory, focusing on the five basic emotions that have typically been studied in research on music and emotion (e.g., Argstatter, 2016; Balkwill & Thompson, 1999; Castro & Lima, 2014; Juslin, 2013b; Juslin & Laukka, 2003; Kreutz, Ott, et al., 2008; Laukka et al., 2013; Siedlecka & Denson, 2019; Vieillard et al., 2008): happiness, sadness, peacefulness, anger, and fear. While the previously mentioned basic emotion theories rarely delve into the discussion about peacefulness, practical studies (e.g., Hanigan et al., 2023) often consider peacefulness as a basic emotion. In the cross-cultural study conducted by Laukka et al. (2013), researchers included certain emotions because they had previously been reported as recognisable in within-cultural music studies such as Gabrielsson and Juslin (1996) and Vieillard et al. (2008), among which peacefulness was incorporated. Furthermore, the milestone study by Balkwill and Thompson (1999) in the research area of cross-cultural music emotion recognition, also included peacefulness as a suitable opposite to anger and fear. Therefore, peacefulness has been included in the three studies of this thesis, to some extent, as a reasonable analogue to “tenderness/love”, one of the basic emotions believed to be expressed and perceived most easily in music (Juslin & Laukka, 2004).

It should be noted that the three empirical studies in this doctoral research are not responsible for verifying the notion of whether music can or cannot communicate basic emotions. Rather, to some extent, it would be fair to say I simply investigated cross-cultural emotion recognition of music by focusing on several commonly seen emotions. (Juslin, 1997a) stated that “what can be communicated reliably is the basic emotion categories, but not particular nuances within these categories” (p. 77). These emotional categories can be labelled as basic emotions that ordinary listeners—not just limited to researchers or specialists—can easily decode or recognise from musical expression (Gabrielsson & Juslin,

1996; Juslin & Laukka, 2004). However, previous studies (e.g., Argstatter, 2016) have found that happiness and sadness can be cross-culturally recognised more easily compared to anger, fear, disgust, and surprise among Western European and Asian samples, even though they are all classified as basic universal emotions. This reflects the nuances in the recognition sensitivity to specific basic emotions and indicates a scope for further investigation in the recognition of basic emotions in music and from cross-cultural context.

2.5 Music's Ability to Communicate Emotions

The two phenomena—music's ability to evoke and express emotions—garnered increasing attention from psychologists over the past two decades (Cespedes-Guevara & Eerola, 2018). The ability of music to express emotions has been reported to be one of the main reasons why people engage with musical activities (e.g., Kawase & Obata, 2016). It has been suggested that certain cues, shared between music and the other channels—such as vocal expression or speech prosody (Ilie & Thompson, 2006; Juslin & Laukka, 2003, 2004), and human behaviours or movements (Livingstone, 2021; Sievers et al., 2013)—have effectively explained the achievement of emotional communication in music (Juslin & Laukka, 2003).

2.5.1 Music and vocal expression

Both vocal expression, specifically the nonverbal aspects of speech, and music have been conceived as effective means of emotion communication, both relying on acoustic signals (Juslin & Laukka, 2003). In a review of 104 studies on vocal expression and 41 studies on music performance, Juslin and Laukka (2003) found that listeners can accurately decode discrete emotions expressed in both channels, and the emotion-specific patterns of acoustic cues used are largely the same between them, although some inconsistencies remain. The shared acoustic code for expressing emotions in both music and speech prosody has been organised into discrete categories, allowing the communication of “basic emotions” (Cespedes-Guevara & Eerola, 2018).

According to Garrido (2021), music often mimics vocal expressions of emotions through features in composition, instrumental sounds, or singing techniques. In this sense, what people interpret as sadness in music is linked to the acoustic cues they have learned to

associate with sadness over the course of their lives. The resemblance between vocal and musical expression of emotions has been supported by evidence from MRI study, suggesting that the neural areas involved in emotion perception in music overlap with those for emotion perception in speech (Nair et al., 2002). With the purpose of investigating emotional expression in music and speech, Scherer and Oshinsky (1977) asked 48 undergraduates to judge the emotions expressed by electronically synthesised tone sequences. These sequences were generated by systematically manipulating tempo, filtration, envelope, pitch level and contour, and amplitude and pitch variation. The results revealed the power of these acoustic cues in explaining listeners' ratings of happiness, sadness, anger, fear, disgust, surprise, and boredom.

Here, I present a brief summary of the psychoacoustic features (perceived correlates of acoustic cues, or musical features; terms used in e.g., Juslin & Laukka, 2003; Juslin & Lindström, 2010) for each of the five basic emotions (*happiness*, *sadness*, *peacefulness*, *anger*, and *fear*) investigated in the three empirical studies of this thesis, drawing from insights of previous studies (Juslin & Laukka, 2003, 2004; Juslin & Lindström, 2010; Scherer & Oshinsky, 1977):

Happiness: Fast tempo, small tempo variability, staccato articulation, large articulation variability, smooth and fluent rhythm, major mode, simple and consonant harmony, medium–high sound level, small sound level variability, medium high-frequency energy, high pitch level, much pitch variability, wide pitch range, rising pitch contour, fast tone attacks, and very little microstructural regularity, small timing variability, sharp contrasts between ‘long’ and ‘short’ notes, medium-fast vibrato rate, medium vibrato extent, bright timbre.

Sadness: Slow tempo, legato articulation, small articulation variability, minor mode, dissonance, low sound level, little-moderate sound level variability, little high-frequency energy, low pitch level, little pitch variability, narrow pitch range, falling pitch contour, ‘flat’ (or falling) intonation, slow tone attacks, and microstructural irregularity, *rubato*, soft contrasts between ‘long’ and ‘short’ notes, pauses, slow vibrato, small vibrato extent, *ritardando*, dull timbre.

Peacefulness: Slow tempo, legato articulation, small articulation variability, major mode, consonance, medium-low sound level, little sound level variability, little high-frequency energy, low pitch level, little pitch variability, fairly narrow pitch range,

falling pitch contours, slow tone attacks, and microstructural regularity, moderate timing variability, soft contrasts between long and short notes, accents on tonally stable notes, medium fast vibrato, small vibrato extent, soft timbre.

Anger: Fast tempo, small tempo variability, staccato articulation, moderate articulation variability, complex rhythm, sudden rhythmic changes (e.g. syncopations), minor mode, atonality, dissonance, high sound level, much sound level variability, much high-frequency energy, high pitch level, much pitch variability, rising pitch contour, fast tone attacks, and microstructural irregularity, small timing variability, accents on tonally unstable notes, sharp contrasts between ‘long’ and ‘short’ notes, *accelerando*, medium-fast vibrato rate, large vibrato extent, sharp timbre, spectral noise.

Fear: Fast tempo, large tempo variability, staccato articulation, large articulation variability, jerky rhythms, minor mode, dissonance, low sound level (except in panic fear), much sound level variability, rapid changes in sound level, little high-frequency energy, high pitch level, large pitch variability, wide pitch range, rising pitch contour, large pitch contrasts, a lot of microstructural irregularity, very large timing variability, pauses, soft attacks, fast vibrato rate, small vibrato extent, soft timbre.

Despite the associations found between psychoacoustic features and the perception of emotions in music based on within-culture design research (e.g., investigating Western listeners’ perceptions of emotions expressed through Western classical music), there is also evidence from cross-cultural designed studies. For example, Western listeners’ judgements of joy, sadness, anger, and peace expressed in Hindustani raga excerpts have been found to be significantly associated with their judgments of tempo, pitch range, melodic complexity, rhythmic complexity, and instrumental timbre in some cases (Balkwill & Thompson, 1999).

2.5.2 Music and behaviours and movements

It is also suggested that musical expression of emotions can be explained by the “structural resemblance” between music and human behaviours and movements (Livingstone, 2021). As an illustration, a descending pitch is akin to a human sigh and may convey emotions such as sorrow or despair. Similarly, a slow tempo mirrors the slow walking pace of a person in a sad

affective state, and thus may sound sad. Using a computer program that can generate both music and movement by manipulating five features, including “timing” features—tempo and jitter, and “pitch” features—consonance, step size, and direction, Sievers et al. (2013) conducted two experiments in the United States and an isolated tribal village in Cambodia. Music was generated as simple, monophonic piano melodies, while movement was generated as an animated bouncing ball. For each experiment/culture, participants were divided into two groups, with each group being informed about either the music or the movement operations. Participants manipulated the five slider bars representing the five features to express happiness, sadness, peacefulness, anger, and scare. During this process, the music and movement output were continuously updated in real-time as participants moved the bars. The results revealed three main findings: first, each emotion was expressed through a specific set of features; second, each combination of features conveyed the same emotion in both movement and music; and third, the shared dynamic structure between music and movement was invariant across cultures. Overall, the shared dynamic structure between music and movement found in their study also helps explain why musically expressed emotions can be universally intelligible, even cross-culturally.

2.6 Acoustics and Psychoacoustics

From the perspective of cognitive psychology, music is an acoustic event that consists of multiple acoustic symbols organised according to certain structural rules. Pitch, timbre and loudness, for example, are the basic psychoacoustic characteristics of acoustic symbols, whereas mode, rhythm and melody contour are the structural rules for organising these acoustic symbols. All of them are collectively known as music cues (Ma, Yang, et al., 2017). These cues, discussed in the above sections in terms of their ability to carry and transmit emotional meaning, have been often expressed as acoustic or psychoacoustic cues or features in music research, which are sometimes used interchangeably.

Here, the association and distinction between acoustics and psychoacoustics are made to avoid conceptual unclarity or confusion, and to inform part of the research methods employed in the three empirical studies of this thesis. According to Howard and Angus (2009, p. 74), “Psychoacoustics is the study of how humans perceive sound”. For example, loudness is the perceptual correlate (i.e., auditory percept) of sound intensity, which mirrors

the acoustic characteristics of physical strength (Coutinho & Dikken, 2013a; Lemaitre et al., 2018). By definition from the American National Standards Institute (1960) quoted in Howard and Angus (2009, p. 131), “pitch is that attribute of auditory sensation in terms of which sounds may be ordered on a scale extending from low to high”. Authors indicated that the measurement of pitch is deemed subjective as it is based on human listeners’ perceptual judgements. This, however, contrasts the measurement of the fundamental frequency of a note, which is objective.

It has been commonly reported that the five psychoacoustic features, including loudness, tempo, pitch, mode, and timbre, can influence emotion expression and perception in music (e.g., Eggermann et al., 2015; Hunter & Schellenberg, 2010; Juslin & Lindström, 2010). Therefore, these psychoacoustic features were extracted and analysed in this thesis. For more introduction of the psychoacoustic features examined in this thesis, see *Section 5.3.3*.

2.7 Models for Musical Expression of Emotions

As discussed in the previous sections, the universality of music in successful emotional communication may be attributed to specific psychoacoustic features shared between music and speech prosody (see *Section 2.5.1*), as well as to human behaviours and movements (see *Section 2.5.2*). For example, louder music might resemble human shouting to express anger. Similarly, the energetic nature of upbeat music might convey joy and excitement by mirroring human movements, such as jumping up and down or clapping hands. Researchers have developed various models for the musical expression and communication of emotions. This section summarises a few important models that have been widely used and examined in this regard, with the last three models specifically constructed for or extendable to the cross-cultural context.

Before delving into the discussion on these models, it is crucial to clarify what it really means when asserting that music can express emotions. According to Juslin (2013b), the notion that music can express emotions may be interpreted in two different ways. Firstly, a listener can perceive any emotion in a piece of music, and there is no right or wrong answer. That is to say, “Whatever a listener perceives in the music is what the music is expressing—for him or her at least!” (Juslin, 2013b, p. 2). Counter to this, for those who

adopt the more “restrictive” view on emotional expression, music can only be said to express emotions when there is a certain threshold of consensus among a certain group of listeners regarding the expression (e.g., Yang et al., 2021). Notably, the cross-cultural recognition of emotion in music investigated in this thesis has adhered to the latter conceptualisation. In this sense, expressed emotions have been studied in terms of the concept of “communication”, which requires a correspondence between an intention of expressing a specific emotion and its recognition.

2.7.1 Juslin’s lens models

Building upon Brunswik's (1956) behaviour lens model, Juslin proposed a modified lens model tailored to the context of music performance (Juslin, 1997b, 2000). This adapted model is based on viewing music performance as a communicative process, encompassing three components: the performer’s expressive intention, the musical performance, and the listener’s experience of the performance. This model illustrates the process in which music performers encode emotional information using a number of probabilistic (i.e., uncertain) but partly redundant expressive cues in their performance, while listeners use the same cues to decode (i.e., recognise) the emotions expressed by the performer in the music (Cespedes-Guevara & Eerola, 2018; Juslin, 2000). The intercorrelations (i.e., redundancy) among acoustic cues partly reflect the sound production of instruments (Juslin, 2000; Juslin & Laukka, 2003). For instance, harder hitting on a guitar can co-produce increased sound levels and sharper timbre. This intercorrelation, in turn, suggests that more than one way of using the cues can lead to similarly accurate decoding (Cespedes-Guevara & Eerola, 2018; Juslin & Laukka, 2003). However, in another sense, the acoustic cues are redundant and probabilistically related to encoding and decoding (Juslin & Laukka, 2003), in that “each cue is neither necessary nor sufficient, but the larger the number of cues used, the more reliable the communication” (Juslin, 2001a, p. 430). For example, fast tempo may be used to encode or decode both anger and happiness, and thus it solely is not a perfect predictor to either emotion.

The lens model, derived from the context of music performance, has in turn been indicated to resonate the close relationship between the nonverbal aspects of speech and music in terms of emotional expression (Juslin & Laukka, 2003). Juslin and colleagues (Juslin & Laukka, 2004; Juslin & Lindström, 2010) later proposed the *Expanded Lens Model*,

which updated the Lens Model by including composer cues (e.g., mode, pitch, melodic progression, rhythm) in addition to the performance-only features (e.g., tempo, sound level, articulation, timbre) in the original version. This has enabled the exploration of the relative contributions of composition and performance cues on listeners' emotion judgments, as well as the predictive power of their interactions.

2.7.2 Balkwill and Thompson's cue-redundancy model

Balkwill and Thompson (1999) proposed the cue-redundancy model, illustrating how a listener may utilise the universal and cultural-specific cues embedded in the music to achieve an understanding of emotions the music expresses. Psychophysical cues exist in all tonal systems, containing overlapped information, and thus enable the cross-cultural recognition of emotion expressed in music. For this, psychophysical cues are conceived as basic perceptual cues that correspond to psychophysical dimensions of music (e.g., pitch register, tempo, melodic complexity). Culture-specific cues, instead, are determined by cultural conventions, and thus are present in a distinct tonal system and have no overlap with culture-specific cues embedded in other tonal systems, such as harmonic progressions and specific instruments. The authors argued that composers and performers may use psychophysical cues along with cultural-specific cues to express emotion through their music. Accordingly, listeners recognise the musically expressed emotions also using both sources of emotional meaning.

The concept of redundancy here, on one hand, reflects the situation in which psychophysical cues and culture-specific cues function differently in reinforcing a specific emotion. On the other hand, it implies that the more cues present in the music, the more likely accurate communication is achieved (Cespedes-Guevara & Eerola, 2018). The cue-redundancy model indicates that even when there is an absence of familiar culture-specific cues, listeners can still obtain a general understanding of the musically expressed emotions by attending to the shared psychophysical cues. Nevertheless, this also suggests that there is an advantage of cue redundancy—in-group advantage (Argstatter, 2016; Thompson & Balkwill, 2010), in enhancing “the recognition process for members of the same culture” (Thompson & Balkwill, 2010, p. 765). In contrast, listeners from another culture must depend on psychophysical cues to recognise the emotions expressed in the music. The cue-redundancy model has also been suggested to be extendable to the domain of speech prosody (Thompson & Balkwill, 2010).

2.7.3 Fritz's dock-in model

Fritz (2013) drew upon the concept of a dock to describe the situation where a music culture continuously changes or evolves over historic time by “dock into” and “dock out of” the so-called universally perceivable music cues. During the process, additional, fewer, or distinct cues are utilised, which thus shift the capacity of that music culture in cross-cultural perception, interaction, and communication. In comparison to the cue-redundancy model discussed above, the dock-in model endeavours to conceptualise the cross-cultural perception and communication from a bigger picture, by accounting for music universals (i.e., “basic music features such as relative pitch, octave generalization, intervals with simple ratios, and tonality” (Fritz, 2013, p. 512) and even the more general perceptual universals (i.e., not limited to the perception of music; e.g., speech or gesture). However, the dock-in model also indicates an in-group advantage of decoding, though it specifically refers to the advantage for those whose music cultures overlap more strongly, rather than being within a specific music culture.

More specifically, the dock-in model of cross-cultural perception has several important implications. First, it suggests that some music universals (i.e., universal music features) may not be present in all music cultures. Second, two different music cultures may each have their own sets of universal features, while none of these features are shared between the two cultures. In addition, the author proposed a theoretical possibility of finding a music culture that docks out of all universally perceived music cues (e.g., John Cage's 4'33"). Furthermore, another theoretical possibility proposed is that certain music universals are not present in any existing music cultures. Here, Fritz (2013) considers the theoretical possibility that certain features or elements may qualify as “musical universals,” although no known music culture has yet adopted or developed them. These features are described as “universal” not because they are found in currently existing music cultures, but because they could potentially emerge in any culture over time.

2.7.4 Juslin's multiple-layer conceptualisation

Regarding musical expressivity, alongside the aforementioned lens models, Juslin (2013b) has also proposed a multiple-layer conceptualisation of musical expression of emotions. This

conceptualisation is grounded in the proposition that the emotional content conveyed by music is contingent upon the type of coding employed, with various types of content being transmitted through different coding mechanisms. The author categorised three types of coding: iconic coding, identified as the “core” layer associated with the expression of basic emotions; and two additional layers—intrinsic coding (involves “dynamically changing contours” such as variation in tension, arousal, or intensity, which facilitates “more time-dependent emotional expressions”, Juslin, 2013b, p. 10) and associative coding (spans from the “communal” subsection, which involves the common associations of a particular social group, to the “idiosyncratic” subsection, which refers to deeply personal associations, Juslin, 2013b, p. 10). The two additional layers enable the communication of more complex emotions, and these emotions are less consistent across cultures and more reliant on the social context and individual listener. This three-layer conceptualisation of musical expression of emotions aligns with Balkwill and Thompson's (1999) cue-redundancy model. This is reflected in that iconically-coded basic emotions correspond to the “psychophysical cues” that can be recognised cross-culturally, while the associative or intrinsically-coded emotions may partly correspond to the “culture-specific cues” (Juslin, 2013b).

2.8 Cross-cultural Studies on Music Emotion Recognition

Kowalska and Wróbel (2017) noted that Darwin (1872)’s proposition that emotions evolved to serve a communicative function, leading to consistent expression and recognition across cultures, has inspired numerous cross-cultural studies on the universality of emotional expression. Exploration in this regard originated from the study of facial expressions (e.g., Ekman, 1992a, 1992b; Ekman et al., 1969). Ekman et al. (1969) revealed that people can accurately recognise discrete emotions from photographs of the corresponding facial displays, though agreement may be higher in literate cultures compared to preliterate cultures. A recent study has also demonstrated that individuals can perceive emotions in the eyes of others, even when the observed individuals are wearing face masks (Franca et al., 2023). As attention shifted from research on facial expressions, the universality of emotional expression has also been established in the domain of music. Meanwhile, its culture-specificity has also been highlighted. In this section, a few representative studies on the recognition of musically-expressed emotions will be introduced.

Gregory and Varney (1996) explored whether there is a difference between listeners raised in the Western and Indian cultural traditions in interpreting the emotional and other connotations from 13 Western classical, 8 classical Indian, and 10 New Age music, and whether the communication of meaning through music is universal or culture-specific. British residents of Western and Indian heritage were tasked with selecting adjectives from a list modified from Hevner's (1936) adjective list to describe the emotional content conveyed through each musical excerpt. Additionally, participants were asked to indicate their perceived season for the nine pieces intended to express a particular season of the year, and identify the correct title of the New Age excerpts from a list of four different titles. The results showed that both Western and Indian listeners were sensitive to the intended emotions conveyed in Western music but not in Hindustani ragas. There was low accuracy in reporting the season and choosing the title. These findings suggest that emotional and other information in unfamiliar music may not always be interpreted by listeners.

Balkwill and Thompson (1999) conducted a study in which Western participants listened to Hindustani music, yielding contrasting findings. Thirty Western listeners were asked to rate the degree to which joy, sadness, peace, and anger were expressed in 12 Hindustani ragas. These ragas were obtained from field recordings in North India. Additionally, participants were asked to judge four psychophysical dimensions in these musical stimuli: tempo, rhythmic complexity, melodic complexity, and pitch range. The results indicated that excerpts intended to convey joy/*hasya*, sadness/*karuna*, and anger/*raudra*, received high ratings of joy, sadness, and anger, respectively. Furthermore, higher joy ratings were correlated with increased tempo and decreased melodic complexity ratings. Conversely, higher sadness ratings were associated to slower tempo and increased melodic complexity. Ratings of anger did not exhibit a significant association with tempo or complexity, but ragas played on stringed instruments received notably higher anger ratings compared to those performed on the flute. Overall, this study suggests that listeners are sensitive to musically expressed emotions in an unfamiliar tonal system, and this sensitivity is associated with psychophysical cues.

Balkwill et al. (2004) subsequently performed a study in Japan, extending previous findings and providing additional evidence for the cue-redundancy model. One hundred and forty-seven Japanese listeners (76 women, 71 men, mean age = 23.7) were asked to rate the expression of joy, sadness, and anger in Japanese, Western, and Hindustani music, as well as acoustic cues, including tempo, loudness, and complexity in the same musical stimuli.

Professional musicians from Japan, Canada, and India were invited to perform the music utilised as stimuli in the study. They were asked to choose music that they believed typically expresses joy, sadness, and anger. For each of Japanese, Western, and Hindustani music sets, half of the stimuli were performed on a stringed instrument, and the other half were played on a flute instrument. The music selected by Indian performers typically consisted of the *alap* section of mood-specific ragas, the music selected by Canadian performers was typically improvisations of familiar materials, and music selected by Japanese musicians was typically traditional repertoire pieces from *gagaku*, *shintou*, or *minyo* genres. All the collected music was edited to short excerpts, with a mean duration of 30 seconds. For each music set, the intended emotions (joy, sadness, and anger) each had 10 excerpts. The results showed that Japanese listeners were able to recognise all the intended emotions in Japanese, Western, and Hindustani music. Furthermore, acoustic predictors, on average, contributed to 75% of the variance in mean emotion ratings. Joy ratings increased with higher tempo and decreased complexity. Sadness ratings increased with higher complexity and decreased tempo. Anger ratings increased with higher complexity and loudness. Similar to the authors' previous research, these findings also confirm that listeners are sensitive to musically expressed emotion in both familiar and unfamiliar tonal systems, and listeners' recognition sensitivity is associated with their perceptions of psychophysical cues.

Thompson and Balkwill (2010) also reported a subsequent study by Balkwill (2006) that used the same music stimuli as in Balkwill et al. (2004) among Canadian and Japanese listeners. The results replicated previous findings, demonstrating that both cultural groups were able to recognise musically expressed joy, sadness, anger in all Western, Japanese, and Hindustani tonal systems. However, although emotion ratings were still observed to be significantly associated with at least one of the acoustic features—tempo, intensity, timbre, and complexity—an interesting difference in the cues utilised was also shown. For instance, in the ratings for anger, the perception of intensity, tempo, and complexity were all significant predictors for Japanese listeners, while for Canadian listeners, only the perception of intensity was significant. Based on findings from studies on visual stimuli, Thompson and Balkwill (2010) proposed an interpretation attributing this situation to cultural differences in attention focus or cognitive style between Japanese and Canadian groups. However, to the best of my knowledge, this assumption has not yet been examined or verified in any empirical study.

Fritz et al. (2009) conducted a cross-cultural study with the Mafa ethnic group and Western participants. The Mafa ethnic group is located in the Extreme North of the Mandara mountain range, culturally isolated and without access to electrical supply. As a result, they had never been exposed to Western music. Accordingly, Western listeners were also naïve to Mafa music. Twenty-one Mafas (13 males, mean age = 62.3) and 20 Westerners (10 males, mean age = 52.4) were asked to listen to 42 music stimuli, comprising 14 excerpts for each intended emotion, through headphones. The stimuli were computer-generated piano music excerpts lasting between 9 and 15 seconds. These excerpts were intentionally crafted to convey the emotions of happiness, sadness, and fear/scare, adhering to Western conventions by manipulating tempo, pitch range, mode, rhythmic regularity, and tone density. The results showed that both Mafa and Western participants were able to recognise all three intended emotions—happiness, sadness, and fearfulness—from Western music above chance level. It was also found that both cultural groups of listeners tended to categorise excerpts with higher tempo as happy and those with lower tempo as fearful, while no correlation with tempo was found for sad excerpts. Additionally, both Western and Mafa listeners classified most major-mode excerpts as happy, most indefinite-mode as sad, and most minor-mode as fearful. The results of the recognition of three basic emotions expressed by Western music largely align with the findings of Balkwill and Thompson's studies (Balkwill, 2006; Balkwill et al., 2004; Balkwill & Thompson, 1999), while the cultural difference in acoustic features associated with emotion recognition, as found in their studies, were less marked in this one.

Laukka et al. (2013) conducted a cross-cultural study on the recognition and performance of affective expression in music. Twelve professional bowed-string musicians from Swedish folk, Hindustani classical, Japanese traditional, and Western classical musical traditions were asked to perform short pieces of music to express 11 emotion and related states, including happiness, sadness, peacefulness, anger, fear, solemnity, spirituality, longing, humour, affection, and neutral. Each musician was required to choose one brief musical excerpt for each intended emotional expression from their respective musical genre. They then performed the excerpt with the purpose of expressing a specific emotion to a listener. In a balanced design, 30 Swedish (mean age = 27.2, 15 females), 30 Indian (mean age = 23.9, 15 females), and 27 Japanese (mean age = 22.4, 13 females) participants judged these musical stimuli. A variety of acoustic and musical cues were extracted from the stimuli using the MIR toolbox (Lartillot & Toivainen, 2007). The results showed that listeners could accurately recognise the performers' intentions above chance level, both within and across

music cultures. However, accuracy was higher for culturally familiar music and basic emotions, compared to unfamiliar music and nonbasic emotions. Furthermore, the association (i.e., matching) between the acoustic cues performers utilised to express intended emotions and listeners' recognition of affective content conveyed through music was analysed based on a lens-model approach. Many acoustic and musical cues exhibited similar correlations with both the expressive intentions of performers and the affective judgments of listeners across musical cultures. However, the alignment between performers' and listeners' utilisation of these cues was more pronounced in within-cultural conditions compared to cross-cultural contexts. Taken together, these results suggest an in-group advantage in cross-cultural recognition of musically expressed emotions. This advantage could be explained by closer performer-listener matching in the use of acoustic and musical cues in the within-cultural conditions.

With the purpose of examining in-group advantage for cross-cultural recognition performance in musically expressed emotions and exploring cultural, emotion, and item-specific similarities and differences, Argstatter (2016) conducted a study with two Western European groups (Germany and Norway) and two Asian groups (South Korea and Indonesia). Eligible participants were restricted to individuals who were born and raised in the target country, demonstrating native speaker-level proficiency. Musical stimuli, broadly representing classical or jazz music, consisted of recordings of improvised short musical pieces played by three professional musicians (a pianist, a percussionist, and a cellist), with the intention of conveying happiness, sadness, anger, fear, disgust, and surprise to listeners (Mohn et al., 2011). The stimuli comprised 18 musical excerpts, with three for each emotion category, and a maximum duration of 7 seconds. Participants were asked to classify each excerpt as one of the six emotions by marking the emotion category they thought was the best fit on a forced-choice answer sheet. The results revealed an in-group advantage, i.e., cultural proximity. Musically expressed emotions were recognised more accurately when the music and listeners originated from the same culture—Western European items were better recognised by Western European listeners. Furthermore, the two West European samples (Germany and Norway) and the two Asian samples (Korea and Indonesia) exhibited similar recognition patterns, with European participants outperforming their Asian counterparts. However, the universal ability to detect emotional quality in musical pieces was limited to the categories of “happy” and “sad”. An in-group advantage was more pronounced for emotions that are atypical for musical expression, such as “disgust”.

2.9 Summary of Implications for Research Gaps

Based on the aforementioned models for the musical expression of emotions and representative cross-cultural studies on the recognition of musically expressed emotions, the following summary can be made. First, basic emotions have been confirmed to be universally recognised across cultures; however, concerns have also been raised regarding emotional content may not be always interpretable. Second, the in-group advantage has been found in previous research; however, the cross-cultural study with Western music seems to have overwhelmingly focused on several music cultures such as Hindustani and Japanese music (Daimi et al., 2020). Many other cultures and musical genres are yet to be explored in this regard. Third, findings on whether the associations between psychoacoustic features and emotion recognition differ or remain invariant across cultures appeared inconsistent among various studies. Therefore, recognition of basic emotions, the in-group advantage, and the association between psychoacoustic features and emotion recognition, are worth further investigation, preferably with music cultures that have received limited attention in exploring these aspects. Thus, this thesis aimed to address the aforementioned gaps through empirical investigations.

2.10 Chinese Traditional Music versus Western Classical Music

Western music has been noted to emulate emotional prosody as a form of expressing emotions (Juslin, 2001b). The expression of emotions is considered a fundamental characteristic of Western music, and its ability to convey emotional expressions is often seen as a prerequisite for its appreciation in Western cultures (Fritz, 2013; Fritz et al., 2009). Tracing back to ancient Greece and ancient China, the investigation of basic emotions had already commenced, and people had closely associated music with human emotions (Gu et al., 2019; Juslin & Lindström, 2010; Luo & Huang, 2017). In ancient China, music held a significant role as a means to convey emotions, regulate psychological states, and impart education, thereby contributing to the establishment of a harmonious society (Luo & Huang,

2017). Hence, akin to Western cultures, Chinese culture also underscores the emotional expressivity in music. In light of this, I found it intriguing to examine the recognition of emotions in Chinese traditional and Western classical music.

Laukka and Elfenbein (2020) underscored the significance of ensuring sufficient variability between two cultures when examining the recognition sensitivity and in-group advantage in cross-cultural communication. As an important representative of the Oriental music cultures, Chinese traditional music is distinctly different from Western classical music in musical systems and instrumentations. This distinction has led us to consider that comparing the recognition of emotions in Chinese and Western music cultures would yield meaningful findings in this regard.

The *Oxford English Dictionary* offers the following definitions for the word “classical” related to music:

(https://www.oed.com/dictionary/classical_adj?tab=meaning_and_use)

“Of music: of acknowledged excellence; of, relating to, or characteristic of a formal musical tradition, as distinguished from popular or folk music; *spec.* of or relating to formal European music of the late 18th and early 19th centuries, characterized by harmony, balance, and adherence to established compositional forms”.

Western classical music adheres to systematised composition methods, utilising major-minor modes, and places emphasis on polyphony and harmonic progressions (Agmon, 2013; Harasim et al., 2021; Kohn, 1981; Loui & Wessel, 2007; Parncutt et al., 2019; Smit et al., 2020). In a review of studies on emotional expression in music performance (Juslin & Laukka, 2003), Western classical music has been noted as the most frequently studied musical style. The guitar, piano, synthesiser, violin, and flute, apart from the singing voice, were the most commonly investigated instruments. According to the book *Introduction to Chinese Traditional Music* (Wang & Du, 2004), Chinese traditional music comprises compositions crafted by the Chinese people, reflecting distinct styles and characteristics. This encompasses not only ancient pieces passed down through generations but also contemporary music produced in a manner that resonates with the unique attributes of Chinese musical tradition. Chinese traditional music manifests the monophonic quality of acoustic expressions, the pentatonic nature of melodic tones, and the incorporation of rhythmic beats,

encompassing the development of slow, medium, and fast rhythms. The typical Chinese instruments consist of four instrumental categories: wind instruments (e.g., Xiao), bowed string instruments (e.g., Erhu), plucked string instruments (e.g., Guzheng) and percussion instruments (e.g., Luo) (Ma, Tao, et al., 2017).

2.11 The Influences of Listener Features on Emotion Processing in Music

Scherer and Zentner (2001) suggested that emotions experienced in music listening are determined by the collective functioning of four influencing aspects, including structural features, performance features, listener features, contextual features. Structural features refer to the acoustic and musical structure, as well as the form of a piece of music. Performance features comprise the identity and ability of the performer, as well as their performance state. Listener features, in general, are constructed by the individual and sociocultural identity of the listener, such as their musical expertise, stable dispositions (e.g., personality or perceptual habits), and transient states (e.g., mood). Contextual features refer to the performance and listening situations, which are associated with the location and type of event.

Building on the initial aim of this research concerning listeners' recognition of emotions expressed in music from different cultures, this section further reviews the literature on the influences of additional listener features (i.e., individual factors in listeners) on emotion processing in music. These factors included *musical expertise* (2.11.1), *gender* (2.11.2), *current mood* (2.11.3), *familiarity with and preference for musical stimuli* (2.11.4), and *preferences for musical genres* (2.11.5) on listeners' emotion processing in music listening. The above sub-sections primarily inform the research focus in Study 2 (Chapter 6) and, partly (specifically, 2.11.1 and 2.11.2) in Study 1 (Chapter 5), which aimed to examine these factors as potential moderator variables in the relationship between cultural background and emotion recognition in music.

According to Juslin et al. (2016, p. 307), "Cultural differences need to be interpreted in the light of differences between individual listeners". Therefore, in addition to the factors mentioned above, stable dispositions, personality traits, and cognitive styles were also investigated in this research. The aim was to provide explanations for potentially observed

cultural differences in the recognition of emotions expressed in music, as well as the psychoacoustic features associated with this process at the individual level. Building on relevant literature and previous research, these cultural differences may be linked to variations in personality traits and cognitive styles. These associations are largely supported by evidence from previous studies comparing individualist and collectivist cultures. The differences between individualist and collectivist societies imply that individuals from individualist cultures prioritise the self, personal goals, and achievements, with relatively loose interpersonal ties among individualists. In contrast, within collectivist societies, there is a tendency to prioritise group interests over individual ones, fostering strong and cohesive bonds among individuals (Hofstede & McCrae, 2004; Juslin et al., 2016; Triandis, 2001; Triandis & Gelfand, 1998). The individualist-collectivist (IC) construct is a global and cultural framework that has been deemed significant in “explaining cross-national differences in emotion judgements” (Matsumoto et al., 2002, p. 9). The literature review on personality traits and cognitive styles and their connections with culture and music can be found in sub-sections 2.11.6, and 2.11.7. An empirical investigation of these aspects was conducted in Study 3 (Chapter 7), aiming to explore the potentially more direct influence of listeners’ stable dispositions on cultural differences in their recognition of musically expressed emotions. Thus, the mediating roles of personality traits and cognitive styles in the relationship between cultural background and emotion recognition in music were examined.

2.11.1 Musical expertise

It is often believed that musicians process music differently from non-musicians, a notion supported by empirical evidence. For instance, in Orr and Ohlsson's (2005) study, the inverted-U relationship in terms of complexity, which predicts moderately complex art objects (music in this case) should be preferred over simple or complex ones, was not observed in jazz nor bluegrass musicians for the improvisations of their respective styles. This finding unveils a distinction in aesthetic experience concerning the complexity-liking relationship between musically trained and untrained individuals, highlighting the influence of musical training on altering experiences of structural features in music. For the musically induced emotions, an interesting observation is that musicians seem to differ from non-musicians in their physiological responses to music, but the difference in their subjective experiences is less conclusively established (Marin & Bhattacharya, 2011). In a study

conducted by Bigand et al. (2005), musically trained and untrained listeners were asked to group musical excerpts that induced similar emotional experience in them. The results indicated that grouping performance was consistent within and between participants, and was minimally affected by listeners' musical background. However, there was a difference in neural activations between musically trained and untrained individuals. Park et al., (2014) investigated the responses to musically expressed happiness, sadness, and fear in both musicians and non-musicians using functional magnetic resonance imaging. The results revealed that musicians exhibited increased activations in their right hemisphere in response to sadness and fear, whereas no such increased activation was observed for non-musicians.

In terms of music perception, formal music training is often suggested to enhance music processing and perceptual skills (Lynch & Eilers, 1991; Thompson & Balkwill, 2010). When discussing the emotional connotation of music, the balance between consonance and dissonance has been suggested to play a crucial role (Thompson & Balkwill, 2010). Early studies indicated that infants might exhibit distinct responses to consonant and dissonant melodies, suggesting a biologically inherent sensitivity, common to all humans, to the difference between dissonance and consonance, and a preference for consonant music over dissonant music (Thompson & Balkwill, 2010; Zentner & Kagan, 1996). However, musicologists have suggested that the perception and interpretation of dissonance may vary across diverse musical traditions, cultures, styles, and historical periods (Thompson & Balkwill, 2010), suggesting this variation is attributed to the culturally or musically learned nature of this connection.

Empirical studies have demonstrated that individuals with musical training have an advantage in recognising emotions in music. For example, in Castro and Lima's (2014) study, participants, divided into musically trained and untrained groups spanning two age cohorts, encompassing both young and middle-aged adults, were exposed to music excerpts conveying happiness, sadness, peacefulness, and fear/threat. They were then tasked with rating the extent to which each excerpt expressed the four emotions using 10-point scales. The results indicated a positive correlation between the number of years of musical training and recognition accuracy. In a cross-cultural study conducted by Argstatter (2016), musicians exhibited a slight but statistically significant predominance, irrespective of cultural background, with higher correct hit rates for certain items (e.g., happy, sad, and angry excerpts). However, the authors' denotation that these differences do not represent a general pattern suggests a need for a more emotion-specific examination of this issue.

Taken together, the above shows that there has been ongoing discussion and study on the extent to which people's understanding and perception of musically expressed emotions is dependent on their music cultural experience (Ma, Yang, et al., 2017). Given the potential difference in the perception of emotions in music between musically trained and untrained listeners discussed above, I argue that considering musical background is important when investigating the impact of cultural traditions on listeners' emotion recognition. Hence, musical background has been considered as a variable in this thesis.

2.11.2 Gender

There seems to be a persistent belief surrounding the idea of emotional woman/female emotionality and rational man/male rationality. However, whether this notion is merely a stereotype or reflects a truth remains an interesting question to explore. A general conclusion may be drawn from many studies conducted in Western countries is that, despite some nuances, women are more likely to experience, express, and respond to emotions more intensely and overtly than their men counterparts (Brody & Hall, 2008; Marin & Bhattacharya, 2011). Nevertheless, gender differences may be more prominent in expressions than experiences, as females are found to be inclined to display their emotions more than males (Fischer & Manstead, 2000). Gender differences related to emotional functioning have been reported to be observed in various emotional paradigms (Marin & Bhattacharya, 2011), such as nonverbal sensitivity, expressiveness, the quality of defences (whether one tends to inhibit negative feelings or project them externally), cognitive correlates of recognition abilities, and self-reports of sadness, anger, and fear (Brody, 1985).

There is evidence from more recent emotion recognition studies in particular. For example, females were found to outperform their male counterparts, especially in the older group, in Abbruzzese et al.'s (2019) study on facial emotion recognition related to neuropsychological functions and face exploration strategies. Rafiee and Schacht (2023) replicated females' overall superior emotion recognition, particularly showing a noticeable difference in negative emotions such as anger and fear. This outperformance was observed across all visual, auditory, and audio-visual modalities, with the most significant differences in the last condition, while the sex of the actor did not exhibit any influences. Similarly, Lin et al. (2021) also discovered an overall advantage for women in emotion categorisation performance, although this superiority was contingent on specific emotions and channels. For

example, females outperformed males in nonverbal channels for two basic emotions (happiness and sadness) and in the anger category with verbal content. However, counter to these findings, some studies have reported opposite results. For example, Alotaibi et al. (2023) reported no significant group difference in emotion recognition accuracy, although male participants were faster at decoding emotional faces compared to their female counterparts.

In the field of music, Fuentes-Sánchez et al. (2020) demonstrated that females rated music excerpts as more fearful, angry, and arousing compared to males. This partially aligns with EEG-related evidence, indicating that females exhibited a higher disliking for negative musical stimuli (Altenmüller, 2002), and previous studies showing that females were more reactive to unpleasant pictures (Bradley et al., 2001). Empirical evidence from studies on culture and gender has also showed that gender differences in emotion are more pronounced in Western countries or individualist cultures than in non-Western countries or collectivist cultures (Fischer & Manstead, 2000). For example, Brody (1997) reported on a collaborative study that compared the emotional expressiveness of undergraduate students with European American ancestry and Asian-American ancestry, including Asian international students. The findings revealed that female students expressed more intense positive and negative emotions than their male counterparts. However, the significant gender difference in intense feelings was observed in European-American ethnicity but not in the two other ethnic groups. Taken together, all the aforementioned findings underscore the importance of considering the influence of gender in studies investigating the association between culture and music emotion recognition, as focused on in this thesis.

2.11.3 Current mood

Affective states have been found to influence the perception of emotions, as evidenced by facial expressions studies. For example, using brief autobiographical recall and audiovisual stimuli to evoke happy, sad, and neutral states, Trilla et al. (2021) found egocentric projections, showing that participants were more likely to judge others' faces as happy when they themselves were in a happy state compared to when they were sad. Similarly, one's current mood can also influence how a piece of music is perceived. Emotion theorists have indicated that listeners' personal perception of circumstances as positive or negative influences how they distinguish emotions, particularly those that are similar in arousal or

energy but different in valence (Garrido, 2021). For example, music that is calm or peaceful (positive low-energy) may be perceived as sad if the listener is in a sad state of mind. Conversely, when the listener is feeling relaxed or peaceful, they may perceive the same music as simply expressing serenity or beauty. Vuoskoski and Eerola (2011b) conducted a study in which 67 participants were asked to judge 50 music excerpts in terms of perceived happiness, sadness, tenderness, anger, and fear, as well as preference. The results showed that the current mood was associated with mood-congruent biases in the judgement of musically expressed emotions. For example, a vigorous mood was positively correlated with happiness ratings, an angry mood was negatively correlated with happiness ratings, and a depressed mood was positively correlated with sadness ratings. Overall, this sub-section highlights the influence of mood on the perception of musically expressed emotions, an aspect that will be further discussed in Study 2.

2.11.4 Familiarity and preference

Musical expertise, as discussed in *Section 2.11.1*, is closely linked to familiarity and its role in emotion induction, as well as related issues of individual differences (Marin & Bhattacharya, 2011). Additionally, a positive relationship between familiarity and preference (liking) has been frequently reported (Schubert, 2007), often measured through responses in the brain (Freitas et al., 2018). Ali and Peynircioğlu's (2010) study demonstrated that listeners' preference or liking ratings increased with their familiarity with the music stimuli through mass repetitions. Similarly, van den Bosch et al. (2013) found that increased familiarity through repeated exposure to novel music significantly heightened experienced pleasure, as measured by electrodermal activity. However, some studies have indicated an inverted-U-shape relationship between familiarity and hedonic value, i.e., pleasure or enjoyment, suggesting that repeated exposure to music to an extremely high extent may lead to displeasure (Freitas et al., 2018; Schellenberg, 2008). Whatever the case, however, all the above findings have supported the notion that familiarity with musical stimuli closely associates with the hedonic experience for these stimuli.

Apart from their intercorrelation, the individual effects of familiarity and preference, as well as their interacting effects on emotional responses to music, have also been widely studied. Pereira et al. (2011) found that familiar music can induce significantly more activations in the emotion-related limbic and paralimbic regions, as well as in the reward

circuitry, compared to unfamiliar music. On the contrary, no difference in brain activations related to affective or cognitive processing was observed between liked music and disliked music. In contrast to this finding, Fuentes-Sánchez et al. (2022) discovered that preferred music was evaluated as more pleasant, and evoked increased heart rate acceleration and facial electromyographic activity. However, familiarity did not have a significant effect on emotional correlates.

Compared to studies on induced emotions, there are fewer investigations into the influence of familiarity or preference on emotion perception or recognition in music. However, findings focusing on the former do have implications for the latter, as reflected in studies regarding machine learning through musically induced emotions for music emotion recognition. For example, in a recent study conducted by Daimi et al. (2020), researchers asked six healthy subjects to watch Hindi music videos and rate their felt emotions in terms of valence and familiarity, during which a 32-channel EEG was recorded from participants. Researchers grouped the valence trials into three groups based on familiarity ratings: familiar (ratings 3-5), unfamiliar (ratings 1-2), and regardless of familiarity (all songs). Within each group, the valence ratings were separated into two classes: pleasant and unpleasant. The results of emotion recognition using standard machine learning showed that the classification performance of pleasant and unpleasant emotions was better in the familiar music videos condition, compared to the unfamiliar and regardless of familiarity cases. It was also found that familiar music induces discriminative brain responses to pleasant and unpleasant stimuli. This study reveals the role of familiarity in the recognition of pleasant and unpleasant emotions.

It should be noted that the focus on familiarity and preference in this thesis pertains to their roles in music emotion recognition within a cross-cultural context. More precisely, it explores their moderating effects on the association between cultural origin and emotion recognition in music. Marin and Bhattacharya (2011) proposed that the role of familiarity in emotion processing can be explored at various level, both within and across cultures. This includes considerations related to repeated exposure to the same musical piece, familiarity with a musical style overall, and even a musical system or tradition. When considering the cultural level or taking a cross-cultural perspective, two situations need to be considered: first, familiarity with musical works within one's familiar culture; second, familiarity with music from different cultures (Marin & Bhattacharya, 2011). Based on all the above, in this thesis, I have addressed the consideration of the factor related to repetition by examining the

role of familiarity (and preference) with specific musical stimuli, and explored familiarity with specific musical traditions by examining the influence of cultural origins.

2.11.5 Preferences for musical genres

Music is conceived as a ubiquitous social phenomenon, and music preferences reflect individual differences (Eerola & Vuoskoski, 2021; Rentfrow et al., 2011; Rentfrow & Gosling, 2003). Thompson and Olsen (2021) pointed out the possibility that individuals who have been listening to a particular musical genre throughout their lifetime may influence the way they perceive or evaluate music of other genres. When investigating listeners' perceptions, they emphasised the necessity to "learn about the experiences, values, and behaviours of the people who listen to that music" (Thompson & Olsen, 2021, p. 64). Hence, in this thesis, preferences for musical genres were examined, providing information about listeners' overall listening background in terms of broad music preferences. To some extent, these preferences may also be seen as an indicator of how frequently listeners engage with or listen to various musical genres, suggesting a general familiarity with broad music-preference dimensions. In a previous cross-cultural study among three cultures (Sweden, India, and Japan) conducted by Laukka et al. (2013), data on participants' general familiarity with Western classical, Hindustani classical, Japanese traditional, and Swedish folk music were collected to investigate the relationship between familiarity with the studied musical genres and emotion recognition accuracy. Similarly, considering that preferences for different musical genres or styles may affect listeners' recognition sensitivity of musically expressed emotions, participants, as described in the second empirical study of this thesis, were asked about their general preferences for a list of musical genres.

2.11.6 Personality traits, culture, and emotion processing in music

As mentioned earlier in this section (*Section 2.11*), this sub-section reviews literature on personality traits and their relationships with culture and music. Both the Big Five personality traits (*Section 2.11.6.1*) and alexithymia (*Section 2.11.6.2*) are considered and discussed with the aim of explaining potential cultural differences in music emotion recognition. This is based on the association of personality traits with culture and emotion processing in music,

respectively, which are detailed below (from *Section 2.11.6.1.1* to *2.11.6.1.4*; and from *Section 2.11.6.2.1* to *2.11.6.2.2*).

2.11.6.1 The Big Five personality traits

According to Eerola and Vuoskoski (2021, p. 206), “Individuals differ from each other in terms of their patterns of thought, emotions, and behavior, and personality traits are one way of describing and measuring these individual differences”. As one of the most widely acknowledged methods for assessing personality traits, the Big Five personality theory, or the Five-Factor Model (McCrae & John, 1992; Soto & Jackson, 2020), categorises individuals into five trait dimensions: extroversion, neuroticism, agreeableness, openness to experience, and conscientiousness. It is important to note that these trait dimensions are represented as continua, each measured through a set of bipolar adjective scales. *Extroversion*, may be conceptualised as a continuum that spans from introversion (characterised by reserved, reflective, and self-absorbed tendencies) at the lower end to extroversion (characterised by outgoing, energetic, sociable, enthusiastic, and talkative attributes) at the higher end. *Neuroticism*, is construed as the inclination to undergo negative emotions, such as anxiety, nervousness, tension, worry. Individuals characterised by low neuroticism exhibit emotional stability, experiencing infrequent anxiety or worry, whereas those with high neuroticism often encounter a heightened frequency of negative emotional experiences. *Agreeableness* is defined by attributes such as kindness, tender-mindedness, trust, and modesty. Individuals scoring high in agreeableness typically exhibit enhanced control over expressions of anger within social settings. *Openness to Experience* can be characterised as the inclination to display imagination, curiosity, creativity, and open-mindedness, possess diverse interests, and value the arts and music. Individuals high in openness to experience, for instance, are inclined to encounter more “chills” or “shivers down the spine” when listening to music. *Conscientiousness* is associated with the constraint and control of impulses, facilitating high levels of self-discipline and goal-oriented behaviours, along with adherence to norms and rules, as well as proficient planning and organising of tasks. (Church, 2016; Eerola & Vuoskoski, 2021; John et al., 2008).

2.11.6.1.1 The Big Five personality traits and culture

While the Big Five is often considered a human universal (Smaldino et al., 2019), it has been observed that these dimensions or factors may not hold equal importance across cultures (McCrae, 2002; McCrae & Allik, 2002). Studies have identified both the universality and cultural uniqueness of personality traits, as well as cultural differences at the broad trait dimension or specific facet level (e.g., Allik & McCrae, 2004; McCrae et al., 2005). For example, European and American cultures have been shown to be higher in Extraversion and Openness to Experience, and lower in Agreeableness compared to Asian and African cultures (Allik, 2012; Allik & McCrae, 2004; Church, 2016; Schmitt et al., 2007). It has been suggested that the cultural differences observed in people's emotional experiences may find explanations in the values and norms inherently held within different social formations or cultural contexts (Juslin et al., 2016). In light of this, I can accordingly seek plausible explanations for cultural differences in the emotions perceived in music from a sociological perspective, considering cultural-specific characteristics. Examining the average personality traits in different cultures can provide a practical lens to approach this.

2.11.6.1.2 The Big Five personality traits and preferences for music genres

Previous research has observed an overall correspondence between specific personality traits and preferences for particular musical genres (Eerola & Vuoskoski, 2021; Rentfrow & McDonald, 2010). Early in the last century, Cattell and colleagues (Cattell & Anderson, 1953; Cattell & Saunders, 1954) developed the I.P.A.T. Music Preference Test as a tool to measure personality and behaviour disorders. Each of the 12 identified music preference factors is interpreted as an unconscious reflection of one's personality traits. Building on previous studies, such as this one, Rentfrow and Gosling (2003) created the Short Test of Music Preferences (STOMP), employing a comprehensive and systematic selection of music genres and personality dimensions. This test consists of 14 music genres, further classified into four music preference dimensions: Reflective and Complex (classical, blues, folk, jazz), Intense and Rebellious (alternative, rock, heavy metal), Upbeat and Conventional (country, religious, pop, soundtracks/theme songs), Energetic and Rhythmic (dance/electronica, rap/hip-hop, soul/funk). This test, which suggests a connection between preferences for the classified music genres or the broader dimensions and specific personality characteristics, has

been examined in numerous studies using personality tests such as the Big Five Inventory or the NEO-PI (e.g., Rentfrow & Gosling, 2003; Zweigenhaft, 2008). For example, individuals with a preference for the Reflective and Complex dimension of musical genres (e.g., classical and folk), often exhibit high scores in Openness to Experience. Conversely, those with a preference for the Upbeat and Conventional dimension of musical genres are more likely to score higher in Extroversion, Agreeableness, and Conscientiousness (Rentfrow & Gosling, 2003). As previously discussed in *Section 2.11.5*, a preference for a musical genre or style may result in more frequent listening or engagement with that type of music, subsequently enhancing one's overall familiarity with that musical genre or style.

2.11.6.1.3 The Big Five personality traits, emotion perception in music, and preferences for emotional music

Individual differences have been found to moderate the effect of emotional expressions in music on experienced emotions. For instance, individuals who were not fans of anger-sounding musical genres reported more pronounced increases in anger compared to lovers of the anger-inducing musical genres (Gowensmith & Bloom, 1997). This underscores the importance of considering individual differences when examining the expression and reception of emotions in music. Vuoskoski and Eerola (2011b) conducted a study investigating the role of personality and mood in the perception of emotions expressed in music. The results regarding the association between personality traits and emotions represented through music partly demonstrated a trait-congruency: Neuroticism was positively correlated with sadness ratings, while Extraversion was negatively correlated with sadness ratings. It was also found that Extraversion had a moderating effect on the relationship between current mood states and emotion ratings. For example, the positive correlation between vigour and happiness ratings became stronger as Extraversion increased. More importantly, this study found significant associations between personality traits and music expressing different emotions. There was a strong and positive correlation between liking for happy-sounding music and Agreeableness and Extroversion, and a positive correlation between Openness to Experience and liking for sad-sounding and fearful-sounding music. Agreeableness exhibited a positive correlation with liking for happy- and tender-sounding music, as well as a negative correlation with liking for angry- and fearful-sounding music. Most of these correlations have shown a trait-congruent trend, except for the

correlation between Openness to Experience and liking for sad- and fearful-sounding music, which has been attributed to openness to various types of music (Vuoskoski & Eerola, 2011b).

2.11.6.1.4 The Big Five personality traits modulate brain responses to musically expressed emotions

It has also been found that personality traits modulate brain responses to musically expressed emotions (Koelsch et al., 2007; Montag et al., 2011; Oudyk et al., 2019; Park et al., 2013). In Park et al.'s (2013) study, researchers utilised functional magnetic resonance imaging (fMRI) to investigate the correlation between personality traits Extraversion and Neuroticism and changes in brain responses to music stimuli conveying happiness, sadness, and fear. They found that Neuroticism was positively correlated with activations in bilateral basal ganglia, insula and orbitofrontal cortex, when exposed to music conveying happiness. Additionally, Extraversion exhibited a marginal negative correlation with activations in the right amygdala in response to music conveying fear. Similarly, Oudyk et al. (2019) investigated the association between brain activations and the personality traits—Extraversion, Neuroticism, and Openness to Experience, when perceiving emotions (happiness, sadness, and fear) represented by instrumental music. However, they found that there was no observed relationship between Extraversion and brain activations during happy music listening, nor was there any association between Neuroticism and brain activations during fearful music listening. The authors suggested that this result may not be occasional, although these findings were rarely reported. However, this could be attributed to the publication bias towards null results in such associations. They suggested that inconsistent results regarding the association between personality traits and neural responses to emotions could potentially be caused by the use of different modalities. For instance, a happy facial expression may consistently lead to greater brain activations in individuals with higher levels of Extraversion, compared to when happy music is used as the emotional stimulus. Overall, these distinct findings call for more empirical studies on the relationship between personality traits and neural correlates of musically expressed emotions, and the consideration of personality traits is particularly important “in the context of experimental group homogeneity” (Park et al., 2013, p. 68).

2.11.6.2 Alexithymia

In addition to exploring the Big Five personality traits structure, it is also worthwhile to investigate the role of alexithymia in the cross-cultural recognition of musically expressed emotions. Alexithymia, not only considered a clinical phenomenon but also conceived as a personality dimension, is associated with one's ability to recognise emotions (Mamatova & Wille, 2012). Additionally, cultural differences in alexithymia are potentially influenced by culturally determined values related to emotion processing. Similar to the above discussion on the Big Five personality traits (*Section 2.11.6.1*), the relationships of alexithymia and both culture and emotion processing in music will also be explored. Both findings necessitate the consideration of alexithymia as one of the contributing factors to the observed cultural differences in the recognition of musically expressed emotions. Detailed reflections on these two aspects can be found below.

2.11.6.2.1 Alexithymia and culture

Empirical evidence indicates differences in alexithymia across cultures. For example, in a cross-cultural study on emotional expression, Mamatova and Wille (2012) reported higher levels of alexithymia among Kyrgyz participants compared to participants from the USA. This aligns with earlier findings showing that Eastern cultural groups tend to have higher levels of alexithymia compared to Western cultural groups (Dion, 1996; Le et al., 2002; Zhu et al., 2007). Researchers have identified the cultural roots of alexithymia, suggesting that certain historical, social, and cultural framework, such as rigorous social control over emotional expression in some cultures or traditions, may contribute to higher scores in alexithymia (Mamatova & Wille, 2012). From this perspective, researchers have emphasised not to see alexithymia as an inability, “but rather a culturally-bounded phenomenon reflecting the population norm” (Mamatova & Wille, 2012, p. 199), and meanwhile suggested the importance of considering emotion-related values within specific cultures to prevent the overestimation of alexithymia (Dere et al., 2012, 2013).

2.11.6.2.2 Alexithymia and music emotion recognition

Previous research has indicated the influence of alexithymia on the perception of emotions expressed by music. For instance, Taruffi et al. (2017) investigated the association between individual differences and listeners' recognition of five basic emotions (happiness, sadness, tenderness, anger, and fear) represented by selected film music. The results demonstrated that listeners could recognise musically expressed emotions above the chance level, and their recognition accuracy was negatively correlated with a subscale of the Toronto Alexithymia Scale (TAS-20)—*externally oriented thinking*, with this correlation being particularly pronounced in musical stimuli representing sadness. Externally oriented thinking refers to a cognitive style characterised by a focus on concrete, practical aspects and external details of daily life, rather than on one's personal thoughts, feelings, or inner experiences (Taruffi et al., 2017). The significant finding that externally oriented thinking results in a perceptual bias against musical stimuli associated with sadness can be explained by the notion that this cognitive style helps shield individuals from negative emotions by steering them away from unpleasant stimuli. For this, I considered it worthwhile to explore the role of alexithymia in the cross-cultural recognition of musically conveyed emotions in this thesis.

2.11.7 Cognitive Styles, culture, and perceptual habits

As mentioned earlier in this section (*Section 2.11*), in the current sub-section, the relationships of two pairs of cognitive styles—*Holistic-Analytic* (*Section 2.11.7.1*) and *Empathising-Systemising* (*Section 2.11.7.2*) cognitive styles—with both culture and information processing or perceptual habits (Scherer & Zentner, 2001), will be explored below, respectively. These relationships underscore the significance of investigating cognitive styles as contributing factors to cultural differences in the recognition of musically expressed emotions.

Before delving into elaborations of each cognitive style and their respective research focus in this thesis, a brief clarification about the definition of cognitive style is provided. The term “style” is often employed to denote a set of habitual patterns (Broeck et al., 2003). Cognitive style is defined as individual's distinctive and consistent approach to perceiving, thinking, learning, problem-solving, and interpersonal interactions (Witkin et al., 1977), as well as processing and organising information and experience (Messick, 1984). More briefly,

Broeck et al. (2003, p. 5) defined cognitive style as “the way an individual perceives environmental stimuli, and organizes and uses information”.

2.11.7.1 Holistic-Analytic Cognitive Style

It has often been suggested that East Asians tend to exhibit a holistic cognitive style of thinking, focusing on the entire field, attributing causality, minimally utilising categories and formal logic, and relying on “dialectical” reasoning (Choi et al., 2007; Lux et al., 2021; Nisbett et al., 2001). In contrast, Westerners tend to adopt an analytic cognitive style, focusing primarily on the object and its associated categories, and employing rules, including formal logic, to comprehend its behaviour. Differences in individual behaviour related to holistic and analytic cognitive styles have been shown to be reflected in brain activity and the level of neuro-visceral coordination (Bakhchina et al., 2021). This distinction has been associated with the markedly different social systems, and the long tradition of theories embedded in cultures. For example, the chief moral system of China, Confucianism, which substantially elaborates and guides relations and obligations among various family and social roles (Lin, 1936), is thought to underpin collectivism, valuing group interests over individual ones (Nisbett et al., 2001).

One facet of the holistic-analytic cognitive style, attention and perception focus (Pae, 2020), is particularly relevant to the issues addressed in this thesis. The preliminary findings described in Study 1 (Chapter 5) showed that the psychoacoustic features associated with the recognition of emotions in music differed between Chinese and Western participants. This finding aligns with previous study conducted by Balkwill (2006), in which the number of psychoacoustic features associated with listeners’ emotion judgements was lower in Canadian participants compared to Japanese participants. Thompson and Balkwill (2010) interpreted that this phenomenon might stem from cultural differences in attention focus related to the holistic-analytic cognitive style.

There has been substantial evidence supporting this phenomenon in other fields, such as the processing of visual information (e.g., Boduroglu et al., 2009; Masuda & Nisbett, 2006; Miyamoto et al., 2006). It has often been shown that Westerners’ perceptions typically involve context-independent and analytic perceptual processes, concentrating on focal and salient objects. In contrast, Asians tend to employ context-dependent and holistic perceptual

processes, paying attention to the relationship between the object and the surrounding context (Nisbett & Miyamoto, 2005). For instance, Chua et al.'s (2005) study on culturally different viewing patterns revealed that American participants focused more on specific objects, in contrast to Chinese participants who made more saccades (i.e., eye movements) to the background. This observed difference has been attributed to socialisation or cultural effects (Martin et al., 2013), and, as mentioned earlier, is often conceptualised as a distinction between individualist and collectivist cultures (Brewer & Venaik, 2011; Juslin et al., 2016; Matsumoto et al., 2008; Triandis, 2001; Triandis et al., 1988; Zhang & Han, 2023). This difference is also reflected in artists' creative styles in visual arts. For instance, in contrast to East Asian portraiture, Western portraiture typically emphasises the individual by omitting contextual information. Summarising this contrast, Martin et al. (2013) noted that traditional East Asian art tends to be context-inclusive, whereas Western art is object-focused.

By reviewing cross-cultural studies on the perception of facial expression of emotions, Engelmann and Pogosyan (2013) identified a cascade of cultural influences on cognitive mechanisms related to emotion perception. The researchers illustrated that “Culture shapes display rules and behavioral practices, which, through learning, influence specific cognitive mechanisms, such as attentional biases and mental representations” (Engelmann & Pogosyan, 2013, p. 7). Display rules are cultural norms prescribing the situations in which specific emotions, and the intensity levels at which these emotions, are expected or not expected to be expressed (Engelmann & Pogosyan, 2013; Matsumoto et al., 2008). The attention biases in the perception of facial expressions, shaped by display rules (Engelmann & Pogosyan, 2013), are reflected in the distinct focuses on different facial regions among observers from different cultures. Research indicated that East Asian participants concentrated on a central region around the nose, whereas Westerners tended to have a broader focus, encompassing the eyes and mouth (Blais et al., 2008). It was also found that unlike Western observers who distributed their fixations evenly across the face, Eastern observers consistently fixated on the eye region, which has been related to the confusion in their categorisation of facial expressions of fear and disgust (Jack et al., 2009). As Engelmann and Pogosyan (2013, p. 8) stated, “culture-specific cognitive styles can account for some of the cultural differences in emotion perception”. However, while Thompson and Balkwill (2010) proposed a similar assumption in the music domain—that differences in psychoacoustic features utilised by listeners from different cultures may be attributed to variations in holistic-analytic cognitive styles—this, to the best of my knowledge, has not yet

been empirically examined. Therefore, one of the objectives of this thesis is to test this assumption.

2.11.7.2 Empathising-systemising cognitive style

The Empathising-Systemising (E-S) theory argues two factors: one, “empathising”, is characterised by the capacity to respond to the feelings of others, with a tendency to focus on emotions. The other, “systemising”, is characterised by the capacity to respond to the regularities of objects and events, with a tendency to focus on analytic structures (Baron-Cohen, 2009; Greenberg, Rentfrow, et al., 2015; Kreutz, Schubert, et al., 2008; Villarreal et al., 2012). A sex difference has been shown in the empathising-systemising cognitive styles. Females were found to be more empathising than males, whereas males were found to be more systemising than females (Wakabayashi et al., 2007). Given the aforementioned, the sex difference in empathising-systemising cognitive styles might account for the superior performance of females in certain emotion recognition tasks compared to males. For a more detailed discussion about the gender difference in emotion recognition, please refer to *Section 2.11.2* (Kreutz, Schubert, et al., 2008).

The Empathising-Systemising theory has been demonstrated to be applicable to the music domain. It has been suggested that individuals with an empathising inclination are more likely to appreciate music based on its emotional content. Conversely, those with a systemising inclination tend to focus on the structural characteristics of the music and its performance level (Greenberg, Rentfrow, et al., 2015; Kreutz, Schubert, et al., 2008; Villarreal et al., 2012). Kreutz, Schubert, et al. (2008) addressed cognitive styles in music from the perspective of Baron-Cohen’s empathiser-systemiser (E-S) theory (Baron-Cohen, 2009; Baron-Cohen et al., 2005), and developed the *Music Empathising (ME)* and *Music Systemising (MS) scales*, which measures the empathising-systemising cognitive styles in the context of music listening. A sex difference was also observed in Music Empathising and Music Systemising. Specifically, females tend to be positive in music empathising and negative in music systemising, whereas males exhibit the opposite pattern. Additionally, a high level of proficiency in music performance is likely to be linked with a cognitive style that prioritises the perception of musical structure and other performing technical aspects,

rather than focusing on its potential emotional impact on listeners (Kreutz, Schubert, et al., 2008).

Greenberg, Baron-Cohen, et al. (2015) investigated how individual differences in musical preferences are explained by the empathising-systemising (E-S) cognitive styles. The researchers employed the five-factor model of musical preferences called MUSIC, which has been suggested to be able to uncover the mechanisms behind the musical preferences in terms of preferences for particular acoustic and musical properties as well as psychological attributes (Rentfrow et al., 2011, 2012). The results indicated that individuals with empathising cognitive style (type E) showed a preference for music falling within the Mellow dimension (R&B/soul, adult contemporary, soft rock genres). On the other hand, individuals with systemising cognitive style (type S) displayed a preference for music in the Intense dimension (punk, heavy metal, and hard rock). Analyses of psychological attributes demonstrated that type E individuals exhibited a preference for music characterised by low arousal, negative valence, and emotional depth. In contrast, type S favoured music with high arousal, and aspects of positive valence and cerebral depth (Greenberg, Baron-Cohen, et al., 2015).

Although the difference between collectivist Eastern and individualist Western cultures, in terms of community- or individual-oriented values (Wang et al., 2023), has been suggested to influence the results on empathising and systemising scores (Qin & Zhang, 2024), as well as the proportion of different cognitive styles, termed brain types—for example, the Empathising brain type, which refers to individuals whose empathising is at a higher level than their systemising, and the Systemising brain type, which describes individuals whose systemising is at a higher level than their empathising (Wakabayashi et al., 2007)—there are few studies that have empirically investigated this. Wakabayashi et al. (2007) found a notable similarity in the differences between the autistic group and the control groups regarding the EQ and SQ and the distribution of different brain types in both Japan and the UK. Nevertheless, they also observed clear cultural differences and variations in the scores themselves on the EQ and SQ between individuals from the two countries. Drawing on existing cross-cultural research, Qin and Zhang (2024) recently concluded that findings regarding EQ scores among individuals from East Asian and Western countries are inconsistent. In particular, the average EQ scores for both males and females in Asian countries (across student and community samples) tend to be approximately one standard deviation lower than those in Western countries. Additionally, gender differences in these

Asian countries generally show a small effect size and are not consistently significant for the overall EQ scale (Groen et al., 2015). In contrast, Asian samples (including both student and community groups) tend to have scores on the SQ that are comparable to those of Western samples. Additionally, the sex differences in these scores are of a similar magnitude, typically ranging from medium to large across various international studies (Groen et al., 2015). For this, it is reasonable to expect that the potential differences in the empathising-systemising cognitive styles may account for some cultural differences shown in the recognition of musically expressed emotions. Therefore, based on all the above, Study 3 (Chapter 7) explores the influence of empathising-systemising cognitive styles on cross-cultural music emotion recognition.

2.12 Research Questions

Based on all the above literature review, this thesis mainly explores an overarching research question (RQ): how do cultural familiarity and individual differences among Chinese and Western listeners influence the recognition of emotions in Chinese traditional and Western classical music? Specifically, the aims were to explore whether in Chinese traditional and Western classical music among Chinese and Western listeners, the previously found in-group advantage in recognition of emotions conveyed in music of familiar music traditions can be replicated or not, and how differently psychoacoustic features are associated with emotion recognition in music between different cultural groups. In addition to these, the thesis further aimed to explore whether and how individual differences in listeners influence cultural differences in their recognition of emotions expressed in music and associated psychoacoustic features. All the specific RQs tested in this thesis are listed below:

RQ1 (Study 1, Chapter 5): Is there an in-group advantage when listeners recognise emotions from the music of their own cultures?

RQ2 (Study 1, Chapter 5): How do psychoacoustic cues correlate with the emotion recognition of listeners from different cultures in music?

RQ3 (Study 2, Chapter 6): Is there an in-group advantage in emotion recognition through music across cultures? [re-test in a different sample using a different method]

RQ4 (Study 2, Chapter 6): Do gender and musicianship influence listeners' music emotion recognition?

RQ5 (Study 2, Chapter 6): How do current mood, familiarity and preference for musical stimuli, preferences for musical genres influence the relationship between cultural background and music emotion recognition?

RQ6 (Study 3, Chapter 7): Do personality traits and cognitive styles mediate the relationship between cultural background and emotion recognition in music?

RQ7 (Study 3, Chapter 7): Is there a cultural difference in the association between music emotion recognition and psychoacoustic features?

RQ8 (Study 3, Chapter 7): If yes, do cognitive styles influence the cultural difference in the association between music emotion recognition and psychoacoustic features?

Chapter 3. Methodology

This thesis employed a quantitative research approach. However, rather than simply categorising the research in this thesis as either experimental research or survey research (Al-Ababneh, 2020), it is more appropriate to define these studies as quasi-experiments. In quasi-experiments, a cause-and-effect relationship between an independent and dependent variable is established similarly to a true experiment. However, subjects are pre-existing groups or assigned to groups based on non-random criteria (Price et al., 2015). The quasi-experiments in this thesis incorporate naturally occurring independent variables, such as cultural background, gender, and musical expertise, which are inherent differences among individual listeners. The variables, including all types of listener features, have been discussed in *Section 2.11*. Methodology is “concerned with why, what, from where, when and how data is collected and analyzed” (Scotland, 2012, p. 9). The methods, measurements, and ethical considerations employed in this research are described below, providing an explanation about how and why each was taken. Specific methods of data collection will be discussed in each study later (see *Section 4.2.1*, *4.3.1*, *5.2*, *6.2*, and *7.2*).

3.1 Self-reports

Self-reports were the primary method used for collecting participants’ data in the empirical studies of this thesis. All music stimuli were presented, and responses were gathered through online questionnaires on the Qualtrics platform. Self-reports, one of the mainstays of the methodology in this field, have been indicated to be the most straightforward method for assessing individuals’ judgments of an emotion (Barrett et al., 2007; Scherer, 2004). The experimental design commonly used for this method—administering ratings of emotional words through Likert scales—was implemented in this thesis. Participants were directed to assess their perception of each of the five target emotions, as well as their familiarity and preference for each presented music excerpt, using a five-point scale. In Study 2 and 3 (Chapter 6, and 7), participants were also required to complete various existing inventories or scales related to current affective states, preferences for musical genres, or personality traits and cognitive styles, with Likert scales serving as the primary mode of response for these assessments.

3.2 Adjusted Forced-choice Method

Despite concerns about the application of the forced-choice method being raised (e.g., it tends to minimise the differences in participants' responses due to the limited number of emotion categories provided, leading to an overestimation of recognition success and making it difficult to reveal the potential impact of cultural experience on the depth of emotion understanding, Eerola & Vuoskoski, 2013; Ma, Yang, et al., 2017), it was still employed in this study to maintain consistency with prior research on the in-group advantage in cross-cultural emotion recognition in music (Laukka et al., 2013). According to Russell (1994), there will be no significant issue if the emotions the participant has already spontaneously thought of can be found in the pre-specified list of emotion labels. Therefore, the forced-choice setting in this thesis was modified and implemented in a more stringent manner. In all three empirical studies of this thesis, participants were instructed to identify the emotions they perceived in each musical excerpt from a predetermined list (happiness, sadness, peacefulness, anger, and fear). The labels assigned to the emotions expressed in the music across the studies were based on suggestions from music professionals and were pre-tested through two pilot studies involving separate groups of musicians, as detailed in the Pilot Studies (Chapter 4). Furthermore, unlike previous studies (e.g., Fritz et al., 2009), where participants were tasked with selecting the "best fit" option, in this thesis, participants were instructed to assign ratings to each provided emotion label on a five-point scale, with 1 representing "Not at all" to specify no perceived expressions. This approach was implemented to minimise the likelihood of guessing responses (Juslin & Laukka, 2003), and further prevent inaccurate results.

3.3 Balanced Design

Laukka et al. (2013, p. 2) emphasised the importance of using "a balanced design—where stimuli from each culture are judged by individuals from each culture—when testing a possible in-group advantage, otherwise cultural effects cannot be separated from other group effects". Consistent with this approach, in all three studies of this thesis, both Chinese and Western music stimuli were presented to and evaluated by participants from both Chinese

and Western backgrounds. This design facilitated concurrent testing and comparison of the in-group advantage within each respective culture.

3.4 Ecological Validity

The musical stimuli utilised in this thesis consisted exclusively of studio or live-recorded performances by human musicians, as opposed to computer-generated or manipulated music. This choice was made in consideration of ecological validity (Greenberg, Baron-Cohen, et al., 2015), ensuring the preservation of the classical and traditional nature of the targeted musical genres—Western classical music and Chinese traditional music, both having long been recognised for their capacity to express emotions. The instruction for music recommenders to abstain from including film music in the pre-pilot stage was also guided by the consideration of the ecological validity of the music. This is because music specifically composed for a film may incorporate sound effects that could be considered too unconventional to be classified as authentic music. See Chapter 4. Pilot Studies for more details regarding the selection of music stimuli.

3.5 Measurement of Psychoacoustic Features

Psychoacoustic features involved with the recognition of musically expressed emotions constitute one of the primary focuses of this thesis. The exploration and analysis of these features have been undertaken in both Study 1 and 3, as discussed in Chapter 5, and 7. Two widely employed methods for measuring psychoacoustic features exist. According to Juslin and Laukka (2003), who reviewed 41 studies on emotional expression in music performance, 85% of the studies reported data on psychoacoustic features. Five studies, however, used listeners' subjective ratings of the perceptions of cues rather than acoustic measurements. Early studies in this area (e.g., Balkwill & Thompson, 1999) asked participants about their subjective perceptions of cues in the music. However, as audio and musical processing software has advanced, the measurement of acoustic and musical properties has increasingly relied on dedicated software designed to extract music-related features from musical materials, such as the MIR toolbox (Lartillot et al., 2008; Lartillot & Toivainen, 2007). This

trend is evident in studies like those by Egermann et al. (2015) and Laukka et al. (2013). Specifically, I used the acoustic measurements for psychoacoustic features of the music for two reasons. One reason is that this method is more efficient compared to subjective ratings, preventing boredom from lengthy semantic explanations, saving participants' time, and allowing for better control over the experiment duration—especially crucial given the format of an online questionnaire. The second reason is that this method is not dependent on participants' musical expertise to comprehend psychoacoustic terms, thereby minimising the potential for misunderstandings.

3.6 Ethics

All the empirical studies detailed in this thesis were conducted under ethical considerations, with ethics approval obtained from the *University of York Arts and Humanities Ethics Committee* (pilot studies and Study 1) and the *University of York School of Arts and Creative Technologies Ethics Committee* (Study 2 and 3). Participants' personal information and privacy were taken seriously. Thus, anonymity was consistently maintained throughout the data collection process of all three empirical studies. No sensitive questions or questions that may identify participants were asked. Participants' contact information was only collected voluntarily for the purpose of sharing the research results and/or entering a prize draw as a token of appreciation for their participation. This personal information was collected using a separate questionnaire to prevent it from being associated with the previous demographic information, thereby ensuring anonymity. In all three studies, a listening test was conducted, and the possibility of participants experiencing discomfort or harm from the music stimuli was considered. To mitigate this risk, all musical stimuli were pre-edited with fade-in and fade-out effects. Additionally, participants were given a pre-experiment sound test, which allowed them to adjust the sound level to a comfortable volume. Before each study, every participant received the participant information sheet and completed the consent form.

Chapter 4. Pilot Studies

4.1 Introduction

The purpose of the pilot study is to select initial candidate music excerpts and verify that these excerpts effectively convey the five target emotions—happiness, sadness, peacefulness, anger, and fear—for use in the subsequent main studies. For a discussion of the selection of these basic emotions, refer to *Section 2.4.4*. When it comes to expressing and communicating emotions in music, there have been different opinions regarding when music can be considered to convey or express emotions. The more “restrictive” perspective, as discussed in *Section 2.7*, has been employed in selecting music stimuli for previous studies on the recognition of musically expressed emotions (e.g., Balkwill et al., 2004; Laukka et al., 2013). In these studies, the intended emotion of a musical piece is determined by a group of music experts, with a consensus reached among their judgments regarding the expressed emotions. A group of professional music recommenders or selectors not only aligns with the “restrictive” principle but also benefits from the expertise of the experts. While some may argue for the inclusion of non-musicians in the selection of music stimuli, there are more advantages to exclusively relying on musicians’ perspectives. Firstly, musicians are influenced not only by cultural conventions but also by their specialisation in particular musical genres. More importantly, musicians’ expertise in expressing emotions through musical performance, as demonstrated in previous studies (e.g., Gabrielsson & Juslin, 1996; Laukka et al., 2013), can lead to a higher degree of consensus among them, reflecting a professionally typical perspective in contrast to non-musicians. Therefore, the musical stimuli used in the three studies of this thesis were initially recommended by experts of Chinese traditional or Western classical music, and were subsequently judged by a group of musicians from each of these two musical genres, respectively.

It is worth noting that, in addition to considering the target five emotions expressible through music, several criteria were set in place for the recommendations by the experts. The recommended music stimuli should be, to the best of these musicians’ knowledge, as unfamiliar as possible to the general population. Additionally, they should consist of ensemble music rather than solo pieces and should not be compositions specifically created

for films. The reasons are displayed in the following. First, as discussed in *Section 2.11.5*, familiarity has an effect on the recognition of affective content. Thus, it has been suggested that familiarity should be taken into account when selecting music stimuli for emotion recognition (Daimi et al., 2020), and unfamiliar music is most appropriate for constructing a system for emotion recognition (Thammasan et al., 2017). Second, while it has been shown that different instruments have different emotional qualities and capacities to convey emotions (Huron et al., 2014), studies on emotional expression in music are largely focused on individual instruments (Grimaud & Eerola, 2022; Saitis & Siedenburger, 2020; Schutz et al., 2008; Siedenburger et al., 2016), or monophonic melodies (Juslin & Laukka, 2003; Sulem et al., 2022), rather than ensembles. In this thesis, ensemble music was used as musical stimuli to avoid bias towards any particular individual instruments. This approach allowed us to eliminate the restrictions imposed by the register ranges of specific instruments (Grimaud & Eerola, 2022). Third, while the advantages of using film music have been stated in previous studies (e.g., Eerola & Vuoskoski, 2011; Vuoskoski & Eerola, 2011b), it is also evident that there are reasons not to use film music in research on emotion recognition. It might lead to arguments about the authenticity of the composed music being “classical” and could influence the principle of low familiarity if listeners have watched the films for which the music was composed.

4.2 Pilot Study 1

4.2.1 Method

4.2.1.1 Participants

All participants were approached via social media or email. Only Western classical musicians from Western culture and Chinese traditional musicians from Chinese culture participated in this pilot study. Musicians were identified as university-level music major students specialising in either Western classical or Chinese traditional Instrumental Performance or Music Education, or as degree holders in these two musical genres. Twelve Western participants (five males, $M = 45.58$ years old, $SD = 13.82$) and nine Chinese participants (three males, $M = 23.78$ years old, $SD = 2.95$) voluntarily took part in the first pilot study. The Western participants represented nine different nationalities: British, Italian, Australian,

German, Swedish, Argentine, Dutch, American, and Portuguese. All Western participants could read English. Both cultural groups of participants were primarily raised in their respective countries of nationality. Western participants reported no or no more than two years of overseas study or working experience, and these experiences were within Western countries. Chinese participants reported no overseas study or working experiences.

4.2.1.2 Musical stimuli

Six Western classical music experts and five Chinese traditional music experts were respectively asked to recommend as many as possible of pieces of Western classical orchestral music or Chinese traditional ensemble music that they believed could best convey happiness, sadness, peacefulness, anger, and fear, drawing on their musical expertise and understanding. There were no restrictions on the musical instruments involved and the orchestral or ensemble size of the music recommended. However, the recommended music should be non-film music and unfamiliar to the public, as discussed in the introduction. Although specifying a 10 to 20 seconds musical excerpt for each type of emotion was encouraged, no specific excerpts were recommended. As a music degree holder with experience in Western classical music and Chinese traditional music modules, and with reference to the theorised characteristics of target emotions in music (e.g., Juslin & Laukka, 2003, 2004), I selected specific excerpts from the recommended music tracks. These selected excerpts were then sampled by a music psychologist. All selected music excerpts had a duration of no more than 20 seconds and were edited by adding fade-in and fade-out using a web-based audio editor (<https://mp3cut.net/>) at the beginning and the end to avoid inducing a sense of surprise or suddenness for participants.

It should be noted that none of the five Chinese recommenders recommended any music for fear, and one of the Western recommenders also failed to do so. The Chinese recommenders unanimously expressed that recommending music for fear was very tricky for them, as they had never thought or accessed the kind of Chinese traditional music that expresses fear. In light of this, 20 excerpts of Western classical music and 16 excerpts of Chinese traditional music were eventually prepared for the Western experiment and the Chinese experiment, respectively, with four musical excerpts for each available emotion in each culture. Considering the possibility that people may perceive a certain emotion

regardless of whether it is intended to be expressed in the music or not, and aiming to make the outcomes of the two experiments as comparable as possible, fear was still included as an emotion label to be rated in the Chinese questionnaire.

4.2.1.3 Procedure

This pilot study was conducted through an online questionnaire using the Qualtrics system. The English version questionnaire and Western musical excerpts were presented to Western participants, while the Chinese version questionnaire and Chinese musical excerpts were presented to Chinese participants. The translated terms used in the Chinese version of the questionnaire were derived from *The Modern English-Chinese-English Psychological Vocabulary* (Zhang et al., 2006), and relevant Chinese peer-reviewed publications in which these terms were used. Participants were instructed to find a quiet place away from interfering noise or distractions and were reminded to start the volume low, adjusting it to a comfortable level. For the music listening test, participants were instructed to click the Play button and listen to the music excerpt only once before answering the subsequent questions. All the musical stimuli were played in a random order for every participant. After listening to each excerpt, participants were required to rate their familiarity with the music and their perception of each of the five intended emotions (happiness, sadness, peacefulness, anger, and fear) on scales numbered from one to five (low to high). In the instructions, participants were reminded to rate the extent to which they thought the music expressed the given emotions rather than how the music made them feel.

4.2.2 Analysis

According to the rating results, scores 1 and 2 were coded as *Low Level*, 3 as *Medium Level*, and 4 and 5 as *High Level*. Frequencies of these three levels of emotion ratings were calculated for each musical excerpt (see Chapter 4. Pilot studies). The valid excerpts were identified according to the following criteria: 1) The highest rating for *High Level* should lie on the intended emotion; 2) For the ratings of the intended emotion, the sum of *High Level* and *Medium Level* ratings should be higher than the *Low Level* rating; 3) The sum of *High Level* and *Medium Level* ratings for the intended emotion should be higher than the sum of

the ratings for *High Level* and *Medium Level* for the other emotions¹. The durations of the musical excerpts were also considered during the selection process to prevent significant differences in durations between Western and Chinese music for the same emotion.

4.2.3 Results

Based on the frequencies results, for the Chinese traditional music stimuli used in the Chinese experiment, musical excerpt CH1 and CH2 were selected for happiness, CS1 and CS2 for sadness, CP2 and CP3 for peacefulness. However, no musical excerpts were selected for anger (or fear). For the Western classical music used in the Western experiment, musical excerpts WH2 and WH4 were selected for happiness, WP2 and WP3 for peacefulness, WA1 and WA3 for anger, and WF2 and WF4 for fear. However, no musical excerpts were selected for sadness. Due to the absence of Chinese angry (and fearful) music excerpts, and Western sad music excerpts, an adjusted pilot study was subsequently followed.

Chinese Experiment						
Excerpt	Level	Happiness	Sadness	Peacefulness	Anger	Fear
CH1	Low	0	9	9	9	9
	Medium	0	0	0	0	0
	High	9	0	0	0	0
CH2	Low	0	9	9	9	9
	Medium	0	0	0	0	0
	High	9	0	0	0	0
CH3	Low	3	9	9	7	9
	Medium	2	0	0	2	0
	High	4	0	0	0	0
CH4	Low	1	9	8	9	9
	Medium	1	0	1	0	0
	High	7	0	0	0	0
CS1	Low	9	1	4	6	9
	Medium	0	0	3	1	0
	High	0	8	2	2	0
	Low	9	1	7	6	8

¹ The criteria were slightly adjusted for anger and fear because they are theoretically (Juslin & Laukka, 2003; Russell, 1980) and practically (e.g., Argstatter, 2016) similar. Emotion labels given by experts were still followed when anger and fear ratings for either of these two types of music were similarly high. For example, the given anger label for the Western music was abided by for the case where anger *High* (8) + anger *Medium* (3) = fear *High* (7) + fear *Medium* (4).

CS2	Medium	0	0	1	2	1
	High	0	8	1	1	0
CS3	Low	8	1	3	8	9
	Medium	1	2	4	1	0
	High	0	6	2	0	0
CS4	Low	9	0	7	7	9
	Medium	0	3	1	2	0
	High	0	6	1	0	0
CP1	Low	2	7	5	9	9
	Medium	3	2	2	0	0
	High	4	0	2	0	0
CP2	Low	3	7	1	9	9
	Medium	4	1	4	0	0
	High	2	1	4	0	0
CP3	Low	5	8	2	9	9
	Medium	3	1	2	0	0
	High	1	0	5	0	0
CP4	Low	6	6	4	9	9
	Medium	2	3	2	0	0
	High	1	0	3	0	0
CA1	Low	6	7	9	5	5
	Medium	2	2	0	3	2
	High	1	0	0	1	2
CA2	Low	3	8	8	8	9
	Medium	3	0	0	1	0
	High	3	1	1	0	0
CA3	Low	1	8	8	8	9
	Medium	3	1	0	0	0
	High	5	0	1	1	0
CA4	Low	4	9	9	6	9
	Medium	3	0	0	2	0
	High	2	0	0	1	0

Western Experiment

Excerpt	Level	Happiness	Sadness	Peacefulness	Anger	Fear
WH1	Low	0	12	4	11	12
	Medium	0	0	6	1	0
	High	12	0	2	0	0
WH2	Low	0	12	8	10	12
	Medium	0	0	3	1	0
	High	12	0	1	1	0
WH3	Low	1	12	7	12	12
	Medium	1	0	4	0	0

	High	10	0	1	0	0
WH4	Low	0	12	8	10	12
	Medium	0	0	3	1	0
	High	12	0	1	1	0
WS1	Low	7	6	2	12	12
	Medium	1	2	0	0	0
	High	4	4	10	0	0
WS2	Low	8	1	3	12	12
	Medium	3	1	5	0	0
	High	1	10	4	0	0
WS3	Low	8	4	3	11	12
	Medium	1	3	3	1	0
	High	3	5	6	0	0
WS4	Low	10	2	1	12	12
	Medium	1	3	6	0	0
	High	1	7	5	0	0
WP1	Low	1	8	0	12	12
	Medium	5	4	0	0	0
	High	6	0	12	0	0
WP2	Low	5	7	0	12	12
	Medium	2	2	2	0	0
	High	5	3	10	0	0
WP3	Low	4	3	0	12	11
	Medium	5	6	2	0	1
	High	3	3	10	0	0
WP4	Low	1	10	1	12	12
	Medium	5	2	1	0	0
	High	6	0	10	0	0
WA1	Low	10	10	12	1	1
	Medium	2	1	0	3	4
	High	0	1	0	8	7
WA2	Low	10	10	12	3	3
	Medium	2	2	0	3	3
	High	0	0	0	6	6
WA3	Low	10	11	12	2	2
	Medium	2	1	0	1	2
	High	0	0	0	9	8
WA4	Low	7	7	12	2	3
	Medium	3	4	0	6	5
	High	2	1	0	4	4
WF1	Low	7	10	12	2	5
	Medium	2	2	0	7	3
	High	3	0	0	3	4

WF2	Low	9	11	11	3	1
	Medium	1	1	0	4	4
	High	2	0	1	5	7
WF3	Low	11	10	12	3	2
	Medium	1	1	0	3	5
	High	0	1	0	6	5
WF4	Low	12	6	12	1	0
	Medium	0	2	0	3	2
	High	0	4	0	8	10

4.3 Pilot Study 2

4.3.1 Method

4.3.1.1 Participants

Similar to the first pilot study, all participants were approached via social media or email contact, and the eligibility requirements for participants remained the same. For more details, refer to *Section 4.2.1.1*.

Twelve Western participants (four males; $M = 31.25$ years, $SD = 9.52$) and 15 Chinese participants (three males, one preferring not to say; $M = 22.60$ years old, $SD = 1.72$) volunteered to participate in the study. Western participants comprised five nationalities: British, Italian, Czech, Hungarian, United States. All Western participants could read English. Both cultural groups of participants were born and raised in the country of their nationality. Six Western participants reported having overseas study or work experiences, all of which occurred within Western countries, except for one participant who had a three-week experience in Japan. No Chinese participants reported any overseas study or working experiences.

4.3.1.2 Musical stimuli

Two Western classical music experts were asked to recommend at least one Western classical orchestral musical excerpt, approximately 10 to 20 seconds in length, that they believed best conveys sadness. Similarly, three Chinese traditional music experts were asked to

recommend at least one Chinese traditional ensemble musical excerpt of a comparable duration that they thought best conveys anger, based on their musical expertise and understanding. The requirements for recommending the Chinese excerpts conveying anger and the Western excerpts conveying sadness in this study were the same as those in the first pilot study. However, experts still recommended the entire musical pieces without specifying specific excerpts. In addition, Chinese experts held similar opinions about fearful music, and thus, there was still no fearful music recommended for the Chinese experiment. In light of this, I initially selected several specific excerpts from the recommended music tracks and then asked the experts to verbally identify those they thought best fit the angry emotion for the Chinese experiment and the sad emotion for the Western experiment. In this way, the purpose of having experts recommend music excerpts for the target emotions was achieved. The musical excerpts chosen for the second pilot study had a duration of no more than 21 seconds and were edited by adding fade-in and fade-out at the beginning and the end of the excerpts. Eventually, five excerpts of Western classical music for sadness and five excerpts of Chinese traditional music for anger were prepared for the Western experiment and the Chinese experiment, respectively.

4.3.1.3 Procedure

The questionnaires and all experimental procedures remained unchanged compared to the first pilot study. See *Section 4.2.1.3* for details.

4.3.2 Analysis

The selection criteria were the same as those in Pilot Study 1, as indicated in *Section 4.2.2*, except that ratings for fear were excluded from the selection criteria for Chinese angry music in this study. This adjustment was made because the Chinese experts were still unable to recommend music conveying fear, and the current Chinese experiment aimed solely to select music conveying anger.

4.3.3 Results

Following the same frequencies analysis, selection criteria, and requirements as those used in the first pilot study, musical excerpts CA7 and CA8 were selected for anger in the Chinese experiment, while musical excerpts WS5 and WS6 were selected for sadness in the Western experiment. For a full list of all 18 music stimuli selected for the subsequent main studies, see Appendix 1.

Chinese Experiment						
Excerpt	Level	Happiness	Sadness	Peacefulness	Anger	Fear
CA5	Low	9	6	11	11	13
	Medium	3	5	4	1	2
	High	3	4	0	3	0
CA6	Low	14	3	13	8	14
	Medium	0	3	2	4	0
	High	1	9	0	3	1
CA7	Low	13	9	12	6	6
	Medium	1	6	1	3	2
	High	1	0	2	6	7
CA8	Low	11	10	14	5	11
	Medium	1	2	0	5	2
	High	3	3	1	5	2
CA9	Low	11	6	14	4	13
	Medium	1	4	0	4	2
	High	3	5	1	7	0
Western Experiment						
Excerpt	Level	Happiness	Sadness	Peacefulness	Anger	Fear
WS5	Low	12	0	7	10	6
	Medium	0	1	3	0	3
	High	0	11	2	2	3
WS6	Low	12	1	9	9	6
	Medium	0	0	3	2	2
	High	0	11	0	1	4
WS7	Low	7	5	8	9	9
	Medium	5	1	3	2	3
	High	0	6	1	1	0
WS8	Low	10	1	2	11	11
	Medium	2	2	5	1	1
	High	0	9	5	0	0

WS9	Low	7	4	7	10	10
	Medium	4	2	3	1	0
	High	1	6	2	1	2

Chapter 5. Study 1 - Exploratory Study on Music Emotion Recognition and Associated Psychoacoustic Features between Chinese and Western Contexts

5.1 Introduction

Based on the comparisons of the three most widely used emotion models related to music, as discussed in *Section 2.4.4*, I chose to focus on five commonly studied basic emotions in the field of music and emotion in this study: happiness, sadness, peacefulness, anger and fear (Argstatter, 2016; Cespedes-Guevara & Eerola, 2018; Juslin, 2013b; Juslin & Laukka, 2003, 2004; Vieillard et al., 2008). The investigation of the recognition of musically expressed emotions is built upon music's ability to convey emotions (Midya et al., 2019), as described in Juslin's lens models (see *Section 2.7.1*), and its link to the shared psychoacoustic cues in both speech and movement (see *Section 2.5.1, 2.5.2*). In the cross-cultural context, the emotional communication of music has been examined, leading to the proposal of culture- and music-related emotion models. Detailed reviews on this content can be found in *Section 2.7.2, 2.7.3, 2.7.4, and 2.8*. This study was conducted to address the research gaps summarised in *Section 2.9*, which focused on two main aspects: the in-group advantage in recognising emotions expressed in familiar music traditions, and associated psychoacoustic features. Based on the previously discussed literature, therefore, there are two research questions for this study:

RQ1: Is there an in-group advantage when listeners recognise emotions from the music of their own cultures?

RQ2: How do psychoacoustic cues correlate with the emotion recognition of listeners from different cultures in music?

5.2 Method

5.2.1 Participants

All participants were approached via social media or email contact. Participants were informed of the opportunity to be notified about the results of the study and the chance to win a £10 Amazon Voucher or equivalent cash prize. People who were born and raised in a Western cultural background² or the Chinese cultural background were eligible to take part in the study. Musicians were identified as those who ever undertook a music-related major or job or those who had received ten years or more of professional musical training. Two hundred and seventy-eight Chinese (69 males, 98 musicians, $M = 25.01$ years old, $SD = 6.44$) and 136 Westerners (54 males, 68 musicians; $M = 34.91$ years old, $SD = 14.95$) participated in the study.

5.2.2 Musical stimuli

The musical stimuli were selected from the two pilot studies. The 18 music excerpts consist of 10 excerpts of Western classical orchestral music and 8 excerpts of Chinese traditional ensemble music, with two musical excerpts for each emotion of each culture. Note that Western musical stimuli include all the five types of emotions, while Chinese music stimuli only include four emotions, happiness, sadness, peacefulness, and anger but without fear, as Chinese experts were not able to recommend fearful music in both pilot studies. A full list of musical stimuli selected for this study can be found in Appendix 1. For further details regarding the music selection process, refer to Chapter 4. Pilot Studies.

5.2.3 Procedure

This study was conducted through an online questionnaire based on the Qualtrics system. The translated terms used in the Chinese version of the questionnaire were based on the reference

² To avoid ambiguity, a definition of Western culture from Wikipedia (Western culture is commonly said to include: Australia and New Zealand, Canada, all European member countries of the EFTA and EU, the European microstates, the NATO military alliance, the United Kingdom, and the United States) was applied and indicated in the *Participant Information* section of the questionnaire (also see in *Section 4.2.1.1*).

to the dictionary book *The Modern English-Chinese-English Psychological Vocabulary* (Zhang et al., 2006), and those relevant Chinese peer-reviewed publications in which these terms were used. English and Chinese versions of questionnaires were provided for participants to choose from according to personal needs. Participants were required to find a quiet place away from interfering noise or distractions. After completing the demographic questions, a sound test was first provided for participants to set the volume to a comfortable level, which was asked not to be changed afterwards. Participants were then instructed to click on the play button and listen to the music excerpt only once before answering the subsequent questions. All 18 musical excerpts were set to be played in random order for every participant. Participants were required to rate on scales numbered one to five (low to high), for their familiarity with the music, and their perception of each of the five intended emotions (happiness, sadness, peacefulness, anger, and fear) conveyed by the music. A reminder in the instructions was given to participants that they needed to rate the extent to which they thought the music expressed the given emotions rather than how the music made them feel.

5.3 Results

5.3.1 Familiarity

Figure 1 shows that the 18 musical excerpts were generally unfamiliar to both cultural groups. For the familiarity ratings, only *Excerpts 1* and *5* (see Appendix 1 for details on the music excerpts) were above the medium level (rating score ‘3’) for the Chinese group. For the Western group, all the music excerpts were below the medium level. Both cultural groups were more familiar with all music excerpts of their own culture than one another, except for *Excerpts 4, 7, and 13* (see Appendix 1 for details on the music excerpts). Given the above, on a general level, it can be believed the cultural advantages in recognising specific emotions shown in the later analysis are not influenced by familiarity.

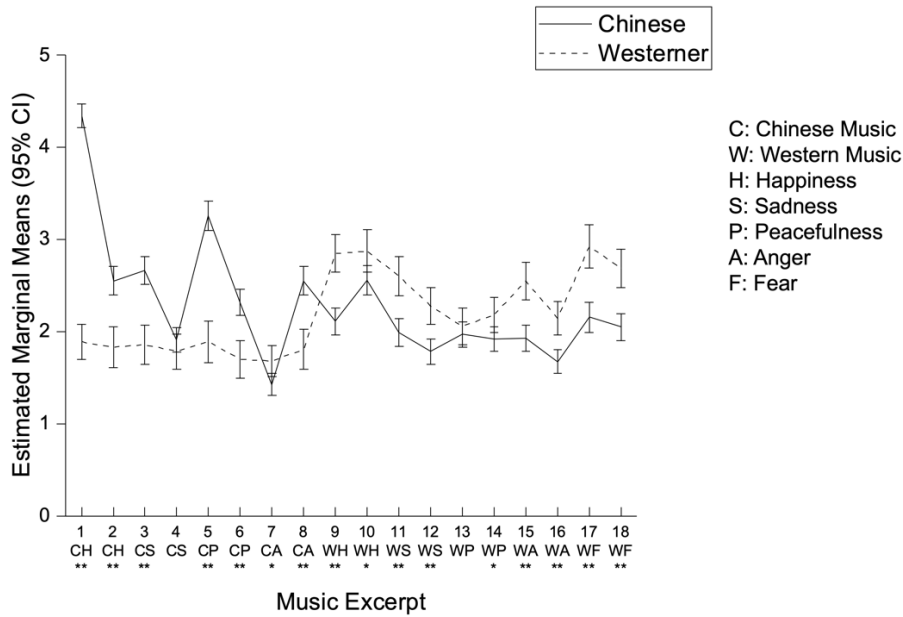


Figure 1. Estimated marginal means of ratings of stimulus familiarity for Chinese and Western participants ($*p < .05$, $**p < .01$; two-sided independent samples t -tests).

5.3.2 Recognised emotions

After calculating the mean ratings per participant for each emotional category of the music, I conducted a repeated measures ANOVA for each type of rating, with the within-subjects factor emotion of music (happy, sad, peaceful, and angry music for Chinese music, and happy, sad, peaceful, angry, and fearful music for Western music), and the between-subjects factor cultural background (Chinese vs. Westerners). Figure 2 and Figure 3 present the estimated marginal means of ratings for happiness, sadness, peacefulness, anger and fear for different cultural groups, in Chinese music and Western music, significant group differences are indicated through asterisks (see Appendix 2 for statistical details). Through pairwise comparisons, a cultural difference in the recognition of an emotion was determined by the group difference in the targeted emotional music. The highest rating scores for both cultural groups all lay on the targeted emotional music in all types of ratings, except for the ratings for fear in Western music.

I also included musical background and gender as between-subjects factors, along with cultural background, to examine whether musicianship and gender influenced the cultural differences in the emotion recognition of music. Results for the follow-up analyses

are only reported if the cultural differences in the targeted emotional music in different musical backgrounds or genders are distinct, and if the results of the cultural difference in the targeted emotional music differ from that in the first analysis (e.g., the significant group difference in the targeted emotional music becomes non-significant). For the full results of the effects of all variables and interactions, as well as all the relevant pairwise comparisons, for the follow-up analyses, see Appendix 3.

5.3.2.1 Chinese music

In general, Chinese participants only showed an in-group advantage in recognising happiness and sadness. No group difference was found in peacefulness and anger, and Chinese participants were even less sensitive to fear compared to Western participants.

Specifically, for the happiness ratings, the first analysis (with the cultural background as the only between-subjects factor) results revealed the main effects of emotion of music ($F(3, 410) = 960.842, p < .001, \eta_p^2 = .875$), and cultural background ($F(1, 412) = 7.598, p = .006, \eta_p^2 = .018$), as well as the interaction between them ($F(3, 410) = 56.650, p < .001, \eta_p^2 = .293$). The pairwise comparisons indicated that the Chinese group rated the targeted happy music significantly higher ($p < .001$), and rated sad and peaceful music significantly lower (both $p < .001$) than the Western group. For the sadness ratings, there was a main effect of emotion of music ($F(3, 410) = 521.967, p < .001, \eta_p^2 = .792$), and the interaction between emotion of music and cultural background ($F(3, 410) = 18.528, p < .001, \eta_p^2 = .119$), though the effect of the cultural background was not significant ($F(1, 412) = .001, p = .982, \eta_p^2 < .001$). The Chinese group rated the targeted sad music significantly higher ($p < .001$) and rated happy music significantly lower ($p < .001$) than the Western group. For the peacefulness ratings, there was an emotion of music main effect ($F(3, 410) = 378.056, p < .001, \eta_p^2 = .734$), a cultural background main effect ($F(1, 412) = 42.541, p < .001, \eta_p^2 = .094$), and the interaction between them ($F(3, 410) = 17.367, p < .001, \eta_p^2 = .113$). The Chinese group rated happy, sad, and angry music significantly lower ($p < .001, p < .001, p = .001$) than the Western group, while the group difference in the targeted peaceful music was not significant ($p = .593$). For the anger ratings, there was an emotion of music main effect ($F(3, 410) = 385.120, p < .001, \eta_p^2 = .738$), a cultural background main effect ($F(1, 412) = 14.914, p$

$< .001$, $\eta_p^2 = .035$), and the interaction between emotion of music and cultural background ($F(3, 410) = 15.569$, $p < .001$, $\eta_p^2 = .102$). The Chinese group rated happy and peaceful music significantly lower (both $p < .001$) than the Western group, while no significant group difference was shown in the targeted angry music ($p = .120$). For the fear ratings, there was an emotion of music main effect ($F(3, 410) = 395.941$, $p < .001$, $\eta_p^2 = .743$), a cultural background main effect ($F(1, 412) = 35.410$, $p < .001$, $\eta_p^2 = .079$), and the interaction between emotion of music and cultural background ($F(3, 410) = 4.063$, $p = .007$, $\eta_p^2 = .029$). The Chinese group rated significantly lower fear than the Western group across happy ($p < .001$), sad ($p = .03$), peaceful ($p < .001$) and targeted angry music ($p = .001$). Both ratings for anger and fear in angry music by both cultural groups were at a relatively high level. This suggests that the angry music conveyed both anger and fear. Thus, in this case, ratings for fear by both cultural groups were compared in angry music. The follow-up analyses for the fear ratings showed that the Chinese group rated angry music significantly lower than the Western group only in non-musicians ($p < .001$) but not in musicians ($p = .419$). This suggests that when listening to Chinese music, for those without a musical background, Chinese participants rated significantly lower fear than Western participants in the targeted angry music, while musicianship seemed to moderate these cultural differences.

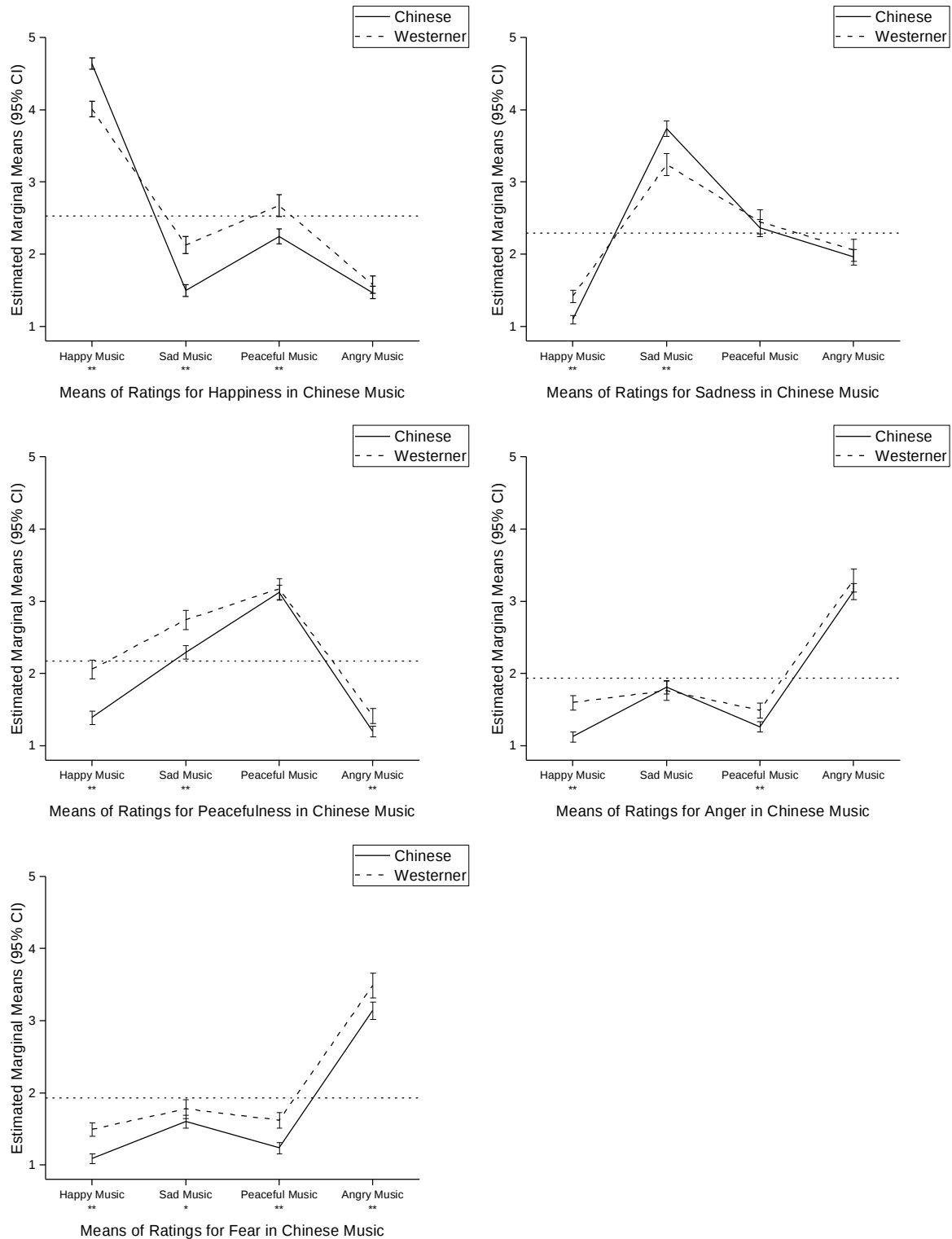


Figure 2. Estimated marginal means of ratings for happy, sad, peaceful, and angry music in Chinese music, separated by rating types. Asterisks indicate significant differences between Chinese and Westerner groups: * $p < .05$, ** $p < .01$ (two-sided independent samples t -tests).

5.3.2.2 Western music

In general, Western participants only showed an in-group advantage in recognising fear. No group difference was found in peacefulness and anger, and Western participants were even less sensitive to happiness and sadness compared to Chinese participants.

Specifically, for the happiness ratings, the first analysis revealed an emotion of music main effect ($F(4, 409) = 501.593, p < .001, \eta_p^2 = .831$), a cultural background main effect ($F(1, 412) = 9.769, p = .002, \eta_p^2 = .023$), and the interaction between them ($F(4, 409) = 7.868, p < .001, \eta_p^2 = .071$). The pairwise comparisons indicated that the Chinese group rated the targeted happy music significantly higher ($p = .02$), and rated sad, peaceful and fearful music significantly lower ($p < .001, p = .005, p = .018$) than the Western group. The follow-up analyses for the happiness ratings showed that the Chinese participants rated happy music significantly higher than the Western participants only in males ($p = .047$) but not in females ($p = .074$). This suggested that in the recognition of happiness, the cultural difference was more pronounced in males. For the sadness ratings, there was an emotion of music main effect ($F(4, 409) = 496.366, p < .001, \eta_p^2 = .829$), a cultural background main effect ($F(1, 412) = 8.893, p = .003, \eta_p^2 = .021$), and the interaction between them ($F(4, 409) = 12.219, p < .001, \eta_p^2 = .107$). The Chinese group rated happy and peaceful music significantly lower (both $p < .001$) than the Western group. Although the Chinese group seemed to rate the targeted sad music higher than the Western group, the difference was in a non-significant trend ($p = .050$). The follow-up analyses for the sadness ratings showed that the difference between the Chinese group and the Western group in the targeted sad music changed to be significant ($p = .028$). For the peacefulness ratings, there was an emotion of music main effect ($F(4, 409) = 433.056, p < .001, \eta_p^2 = .809$), a cultural background main effect ($F(1, 412) = 12.188, p < .001, \eta_p^2 = .029$), and the interaction between them ($F(4, 409) = 5.166, p < .001, \eta_p^2 = .048$). The Chinese group rated happy, angry and fearful music significantly lower (all $p < .001$) than the Western group, while the group difference in the targeted peaceful music ($p = .273$) was not significant. For the anger ratings, there was an emotion of music main effect ($F(4, 409) = 383.306, p < .001, \eta_p^2 = .789$), a cultural background main effect ($F(1, 412) = 4.835, p = .028, \eta_p^2 = .012$), and the interaction between emotion of music and cultural background ($F(4, 409) = 5.210, p < .001, \eta_p^2 = .048$). The Chinese group rated happy and peaceful music significantly lower (both $p < .001$) than the Western group, while

the group differences in the targeted angry music and fearful music were not significant ($p = .626, p = .669$). For the fear ratings, there was an emotion of music main effect ($F(4, 409) = 366.336, p < .001, \eta_p^2 = .782$) and a cultural background main effect ($F(1, 412) = 31.760, p < .001, \eta_p^2 = .072$). The interaction between emotion of music and cultural background was not significant ($F(4, 409) = 0.657, p = .622, \eta_p^2 = .006$). The Western group rated generally higher fear than the Chinese group across all the emotional music sets (all $p < .05$, four out of five $p < .01$), including angry music ($p = .014$) and the targeted fearful music ($p < .001$). Both cultural groups rated relatively high fear in angry and fearful music compared to other emotional music sets. The follow-up analyses for the fear ratings showed that the Western group rated fearful music significantly higher than the Chinese group only in non-musicians ($p = .002$), but not in musicians ($p = .069$). This suggests that in Western music, musicianship may reduce the disparity between different cultural groups in the recognition of fear.

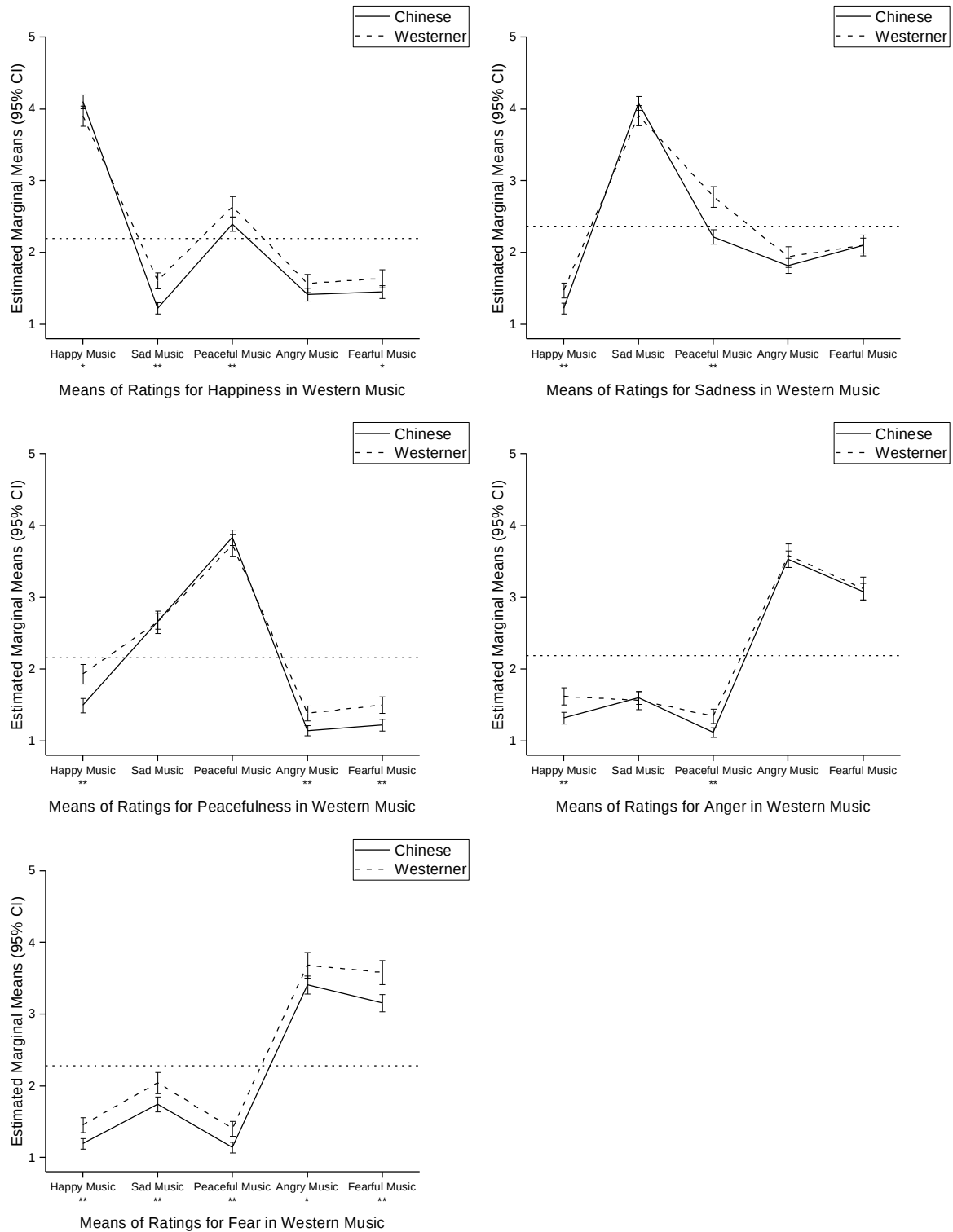


Figure 3. Estimated marginal means of ratings for happy, sad, peaceful, angry and fearful music in Western music, separated by rating types. Asterisks indicate significant differences between the Chinese and Western groups: $*p < .05$, $**p < .01$ (two-sided independent samples t -tests).

5.3.3 Correlates of psychoacoustic features

I subsequently investigated whether psychoacoustic features of musical stimuli were associated with listeners' emotion recognition in both Chinese and Western music (Egermann et al., 2015). First, I extracted seven psychoacoustic features which were represented by the mean for each music excerpt, through the MIR Toolbox 1.8.1 (Lartillot et al., 2008): This included pitch through computing an autocorrelation function of the audio waveform, event density through estimating the number of events detected per second, roughness based on the summation of roughness between all pairs of sines (obtained through spectral peak-picking) (Sethares, 1998), the centroid of the frequency spectrum, RMS energy by taking the root average of the square of the amplitude, brightness through measuring the amount of energy above the cut-off frequency (Juslin, 2000), and mode by computing the key strength difference between the best major key and the best minor key. Tempo was measured in beats per minute (BPM) through a web-based BPM-Tracker by tapping with the dominant beat of the music excerpt manually. For parameters of all the psychoacoustic features for all the 18 music excerpts, see Appendix 1. Second, I conducted a Principal Component Analysis on those mean audio features (Table 1) to reduce the number of predictor variables and their collinearity.

Table 1. Component Loadings from Principal Component Analyses of Psychoacoustic Features of Music Excerpts ($n = 18$).

	Component					
	1	2	3	4	5	6
Centroid	.962	.009	-.010	.025	-.095	.203
Brightness	.954	-.021	.000	.008	-.247	.068
Roughness	.011	.962	.155	-.011	-.106	.103
RMS Energy	-.026	.957	.029	-.045	.051	.220
Event Density	-.007	.137	.989	-.031	-.015	-.047
Mode	.025	-.039	-.031	.995	.074	-.022
Pitch	-.284	-.047	-.017	.086	.949	.085
Beats Per Minute	.265	.328	-.062	-.030	.098	.898

Note. Rotation Method: Varimax with Kaiser Normalisation.

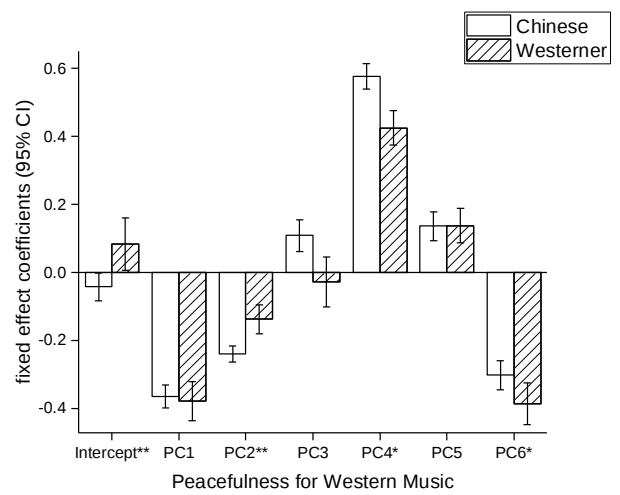
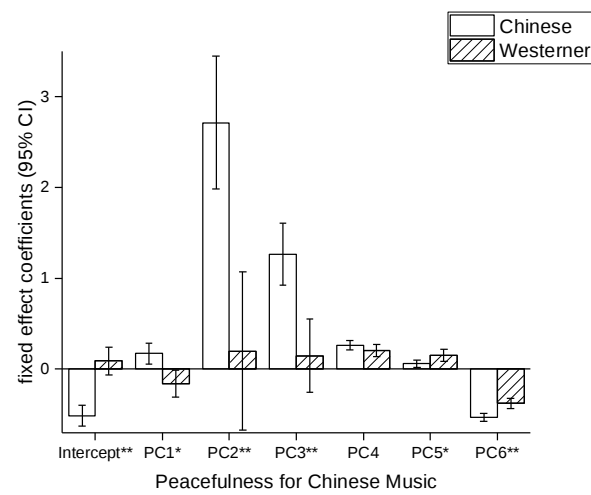
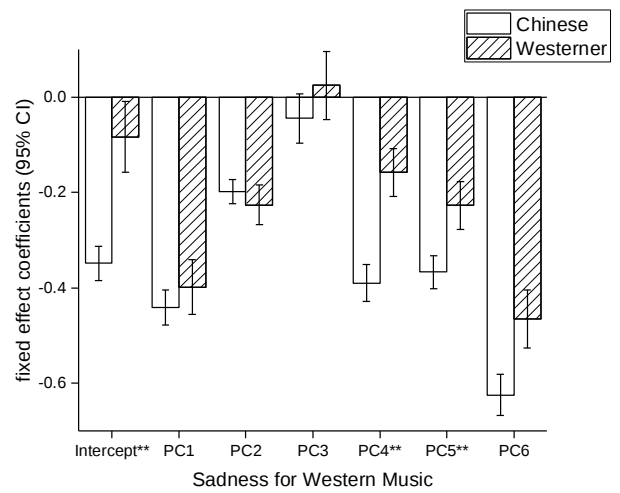
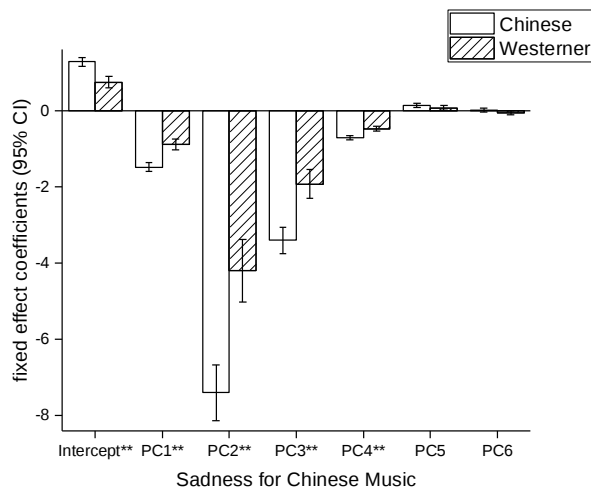
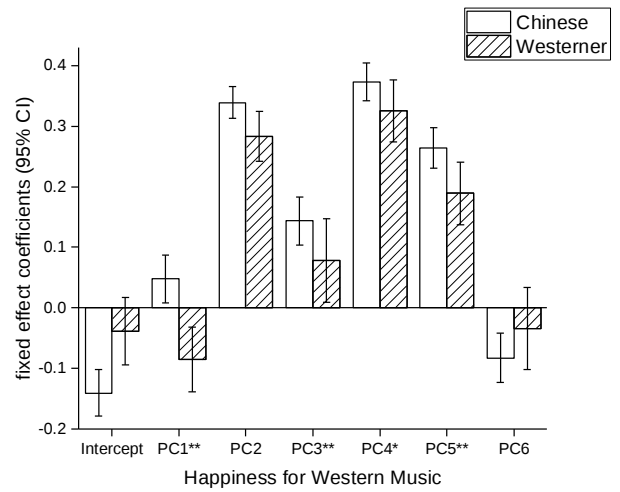
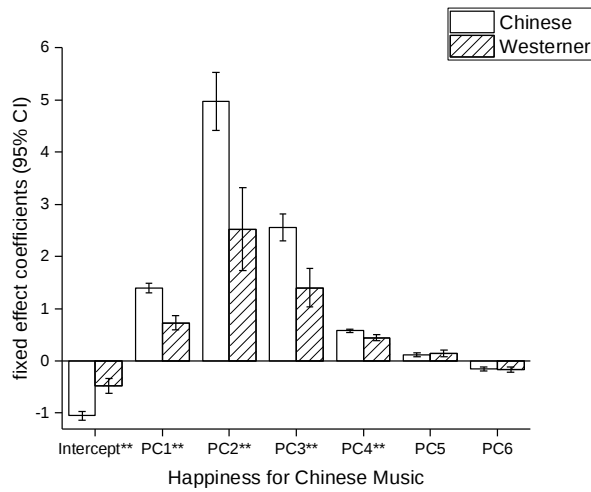
Factor loadings greater than .8 are shown in bold.

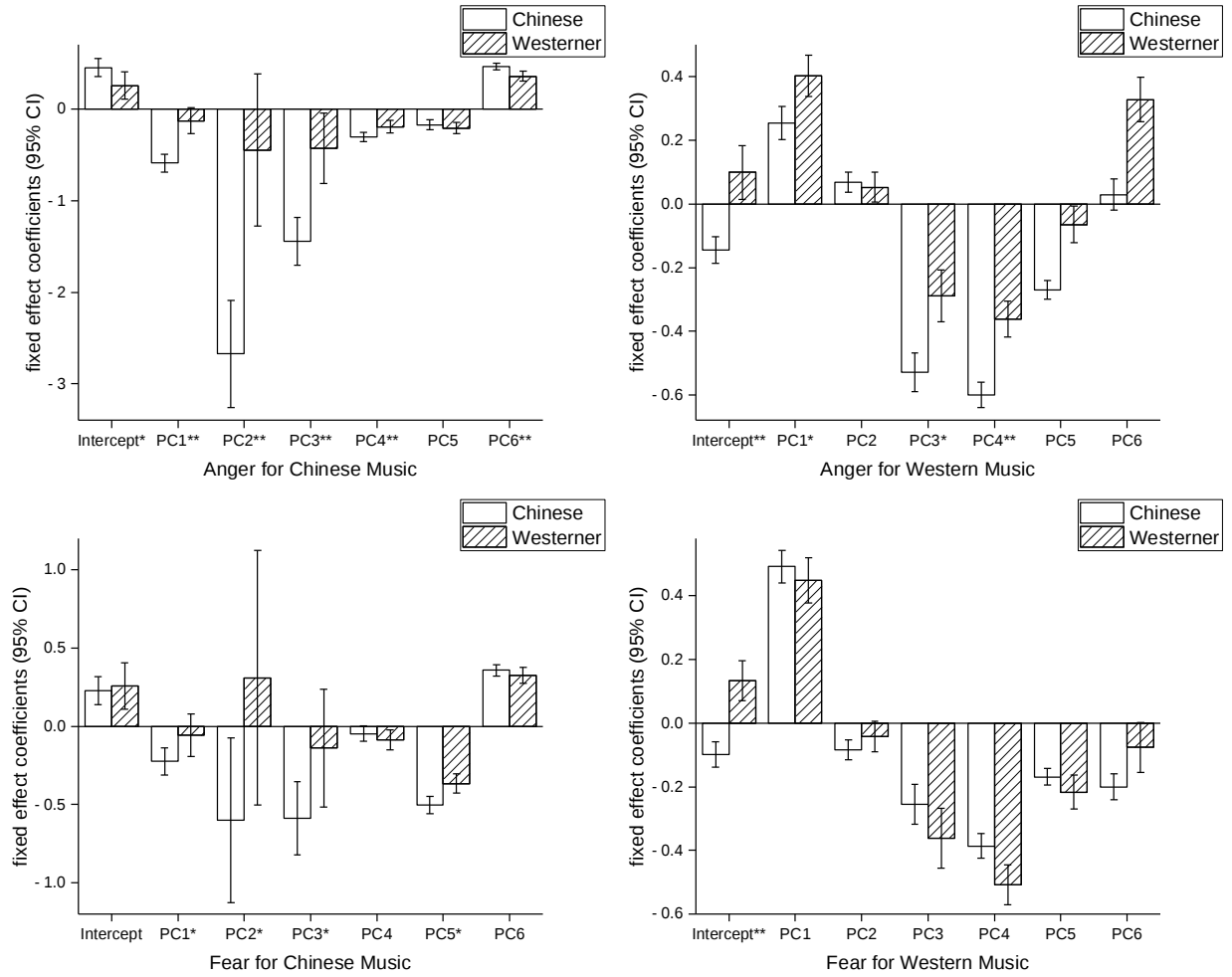
Third, the scores resulting from those six principal components [PC1-6] were used as predictor variables. Together with all the outcome variables (rating scores) they were then z-standardised and subsequently tested in a hierarchical linear regression for each type of rating for Chinese music and Western music separately. Then I ran a third regression model which added a dummy variable that coded the Western participant group as the reference group. The group differences were estimated by the interaction effects between the cultural background and all the z-standardised predictors. Figure 4 displays the estimated fixed-effects coefficients, separated by cultural groups, rating types, and cultures of the music. A significant effect (greater or smaller than zero) of the predictors is determined by that the 95% confidence interval (error bar) does not cross through the zero line, and the significant group differences are indicated by asterisks (see Appendix 4 for statistical details).

It can be seen that there was a general difference across different PCs, between the Chinese and Western groups, and between Chinese and Western music, though some similarities were also shown. These analyses focused on the group difference in the PC(s) with particularly strong responses, the response/effect size, and the number of PCs associated with emotion recognition. Overall, in Chinese music, the Chinese group generally responded stronger to PC2, while both cultural groups generally responded stronger to PC4 in Western music. In addition, the Chinese group seemed to respond to PCs generally stronger than the Western group. Furthermore, the Chinese group seemed to generally respond to more psychoacoustic PCs than the Western group.

Specifically, when rating for happiness, both cultural groups responded to all PCs in both Chinese and Western music, except for PC6 for the Western group. Both cultural groups responded stronger to PC2 in Chinese music, and PC4 in Western music. The asterisks indicated that the correlation was generally stronger for the Chinese group, as shown in PC1 to PC4 in Chinese music, and PC3 to PC5 in Western music. When rating for sadness, both cultural groups responded to all PCs in both Chinese and Western music, except for the Chinese group to PC6 in Chinese music, and both cultural groups to PC3 in Western music. Both cultural groups responded stronger to PC2 in Chinese music, and particularly strong to PC6, with equally moderately strong to the other PCs, except for PC3. The asterisks indicated that the correlation was generally stronger for the Chinese group, as shown in PC1 to PC4 in Chinese music, and PC4 to PC5 in Western music, and there were more group differences in Chinese music (four asterisks) than in Western music (two asterisks). When rating for peacefulness, both cultural groups responded to all PCs in both Chinese and Western music,

except for PC2 and PC3 in Chinese music, and PC3 in Western music. In Chinese music, the Chinese group responded stronger to PC2, while in Western music, both cultural groups responded stronger to PC4. The asterisks indicated that the correlation was generally stronger for the Chinese group, as shown in PC1 to PC3, and PC6 in Chinese music, and PC2 and PC4 in Western music, and there were more group differences in Chinese music (five asterisks) than that in Western music (three asterisks). When rating for anger, both cultural groups responded to all PCs in both Chinese and Western music, except for the Western group to PC1 and PC2 in Chinese music, and the Chinese group to PC6 in Western music. In Chinese music, the Chinese group responded stronger to PC2, while in Western music, both cultural groups responded relatively stronger to PC4. The asterisks indicated that the correlation was generally stronger for the Chinese group, as shown in PC1 to PC4, and PC6 in Chinese music, and PC3 and PC4 in Western music, and there were more group differences in Chinese music (five asterisks) than that in Western music (three asterisks). When rating for fear, the Chinese group responded to all PCs in both Chinese and Western music, except for PC4 in Chinese music. By contrast, the Western group only responded to PC4 to PC6 in Chinese music, while in Western music, the Western group responded to all PCs, except for PC2. The Chinese group responded slightly stronger to PC2 and PC3 in Chinese music, while in Western music, both cultural groups responded relatively stronger to PC1 and PC4. The asterisks indicated that the correlation was generally stronger for the Chinese group, as shown in PC1 to PC3, PC5 and PC6 in Chinese music, and there were more group differences in Chinese music (five asterisks) than in Western music (zero).





[PC1] Centroid/Brightness
[PC2] Roughness/RMS Energy
[PC3] Event Density
[PC4] Mode
[PC5] Pitch
[PC6] Beats Per Minutes

Figure 4. Error bar graphs of fixed effect coefficients estimated for the Acoustical PCs, separated by cultural group, rating types, and culture of the music. Asterisks indicate the significance of fixed effect differences between the Chinese and Western groups: * $p < .05$, ** $p < .01$ (two-sided independent samples t -tests).

5.4 Discussion

The first question to be addressed in this study is whether the in-group advantage of cross-cultural music emotion recognition can be confirmed between Chinese and Western cultures.

Through a series of repeated measures ANOVA and pairwise comparisons, I found both similarities and differences in emotion recognition between the Chinese and Western participants. The results showed that the highest ratings by both groups all lay on the targeted emotional music, though there might be some confusion between anger and fear. This may be because anger and fear both are considered to have negative valence and high arousal (Russell, 1980), both are expressed with very similar psychoacoustic features, such as roughness, which is related to “the perceptual quality of buzz, raspiness, or harshness” and “dissonance” (Coutinho & Dibben, 2013b, p. 18), and both are often represented by minor harmonic progressions and varied rhythms (Hailstone et al., 2009). In general, both cultural groups were able to identify musical emotions within and across cultures, which was in line with previous studies (e.g., Balkwill et al., 2004; Balkwill & Thompson, 1999; Fritz et al., 2009). There were no significant group differences in the recognition of peacefulness and anger in both Chinese and Western music. In both Chinese and Western music, the Chinese participants seemed to be relatively more sensitive to the recognition of happiness and sadness, while the Western participants were more sensitive to the recognition of fear, compared to each other. Apart from the higher fear ratings for the Western group in the target music in both Chinese and Western music, this finding was also indicated by that the Chinese group rated generally lower fear than the Western group across all of the emotional music sets. This suggests that the Chinese may be more conservative in their judgements of fear compared to Westerners. This cultural difference reflected the statements made by the Chinese traditional music experts in the pilot studies. Here, they stated “there appears to be no fearful music in Chinese traditional music” or “it is difficult to categorise so-called fearful music”, which thus led to having no fearful music provided from Chinese culture in this study. Overall, the above findings indicated that the in-group advantage found in previous studies (Argstatter, 2016; Zacharopoulou & Kyriakidou, 2009), was not well established between Chinese and Western contexts in this study. Instead, the above suggested a cultural advantage in particular emotions in music. However, this needs further studies on a wider range of cultures and emotions.

Musical background seems to somehow influence the relationship between cultural background and emotion recognition, but the influence is only limited to certain emotions. For instance, in both Chinese and Western music, the Chinese participants were less sensitive to the recognition of fear than the Western participants only in non-musicians, but not in musicians. These results suggest that Western culture may have an advantage in the

recognition of fear, but musicianship could counteract it. The overall findings suggest that musicianship may confer an advantage in recognising emotions that are often confused with others, or are not easily identifiable. There was little gender difference shown in this study, though cultural background seemed to influence the recognition of happiness differently between males and females. The findings of previous studies on the effects of musical training or gender on music emotion recognition remained mixed. Some indicated better performance for those with more years of musical training (Lima & Castro, 2011) and for female listeners (Gabrielsson & Juslin, 1996), while some reported no effects of musical training (Nineuil et al., 2021) or gender (Gregory & Varney, 1996; Shen et al., 2018) on emotional judgements in music. In contrast, this study's findings align more closely with Argstatter's (2016) study, which also observed that musicians exhibited a slight but significant advantage in judging musical emotions compared to non-musicians. However, this advantage was limited to specific music excerpts and may not be generalised to all cases.

For the overall cultural differences observed in recognised emotions, it is worth considering individual differences (such as personality traits) as one of the causes (Juslin et al., 2016). Researchers in the field of culture and personality have noted differences in fundamental values between individualist cultures, which emphasise self, personal goals, and achievements, and collectivist cultures, which prioritise social harmony and group interests over the individual (Hofstede & McCrae, 2004; Triandis, 2001; Triandis & Gelfand, 1998), which influence personality traits. For example, Openness to Experience, a trait reflecting a preference for novelty, curiosity, and a variety of experiences, is typically higher in individualist cultures. This is because such cultures emphasise personal growth and self-expression, which align with the characteristics of Openness to Experience. In contrast, individuals from collectivist cultures may score lower on this trait, as these cultures often prioritise tradition and conformity over novelty and experimentation. Previous research on personality profiles across cultures showed that Europeans and Americans scored higher in Extraversion and Openness to Experience, and lower in Agreeableness compared to Asians and Africans (Allik & McCrae, 2004). It has been argued that individuals with a higher score in Openness to Experience were more sensitive and tended to experience strong feelings towards art and beauty (McCrae, 2007), which can be extended to the field of music, where listeners with higher scores in Openness to Experience were also found to experience emotions more intensely than those with lower scores (Liljeström et al., 2012). This seems to partly explain the higher sensitivity to the recognition of fear in Western participants (i.e., the

lower sensitivity in Chinese participants) observed in this study. In research on the perception of musical emotions, Vuoskoski and Eerola (2011b) indicated that personality traits were strongly linked to preferences for music expressing different emotions. For instance, in line with the definition of a prosocial trait that reflects cooperation and social harmony (Graziano & Eisenberg, 1997), Agreeableness—often observed higher in collectivist cultures—has been found to be closely related to liking for happy and tender music, and disliking for angry and fearful music. These trait-congruent associations seem to align with the findings in the present study: Chinese listeners were more sensitive to the recognition of happiness and sadness (aesthetic enjoyment in music) but less sensitive to fear compared to Western listeners. However, the possible correlations between personality traits and emotion recognition, even from a cross-cultural perspective, need further investigation in future research.

The second question in this study is how psychoacoustic cues correlate with music emotion recognition among listeners from different cultures. Results of the hierarchical linear regression indicated that psychoacoustic features were somehow associated with musical emotion recognition, though the association varied across cultures and types of emotion ratings. In general, when listening to Chinese music, the Chinese group seemed to respond stronger to timbre/loudness [PC2]. By contrast, when listening to Western music, both cultural groups showed relatively high response to mode [PC4]. This reflects differences in structural and psychoacoustic characteristics between Chinese and Western music. The former emphasises the psychoacoustic attribute of timbral roughness and sound intensity, while the latter emphasises mode system. This, in return, implies the different significance of psychoacoustic features in predicting emotion recognition between Chinese and Western music. In a recent cross-cultural study (Wang et al., 2022), five musical elements (timbre, pitch, rhythm, loudness, and MFCC) were examined for emotion recognition in Western and Chinese classical music, employing the Valence-Arousal model. The study identified pitch as the predominant factor in emotional recognition for Western classical music. Conversely, in Chinese music, all musical elements exhibited relatively equal importance, with loudness and rhythm playing more significant roles compared to those in Western classical music. The researchers suggested that this discrepancy might be due to the structured and precise rhythm theory of Western classical music, where most compositions follow a regular rhythm and tempo, whereas Chinese classical music tends to place greater emphasis on personalisation and individual expression. This flexibility, described as “dynamic fluctuation” (Wang et al.,

2022, p. 14), contributes to the heightened influence of rhythm and loudness on the emotional perception of Chinese classical music.

Cultural differences were also shown in the degree and number of psychoacoustic features correlated with emotion recognition. Chinese participants generally responded stronger, and responded to more psychoacoustic features than Western participants in both Chinese and Western music, as indicated by the more significant and larger absolute values of the fixed effect coefficients for the Chinese group. For example, in the ratings for anger in Chinese music, all six psychoacoustic components were significant predictors for Chinese listeners, while for Western listeners, only four psychoacoustic components were significant, and their effects were relatively low. This is similar to findings in previous research – when rating for anger, perceived complexity, tempo, and intensity significantly influenced the judgments of Japanese listeners, while for Canadian listeners, only perceived intensity had a significant association with their judgements (Balkwill, 2006; Thompson & Balkwill, 2010). This phenomenon was hypothesised to be related to the attention focus or cognitive styles of listeners from different cultural backgrounds (Thompson & Balkwill, 2010), although further research is needed.

Results related to psychoacoustic features also highlighted greater cultural differences in Chinese music than in Western music, as indicated by a higher number of asterisks representing significant group differences across features. Western music, guided by a precise system, allows for clear intentions and direct expressions, whereas Chinese music, characterised by sensual expressions, prioritises symbolic abstractions (Lin, 2010). From musicologists' perspective, this difference may be attributed to distinct national characters and compositional traditions. However, the heightened group differences in Chinese traditional music may primarily arise from its less widespread exposure across cultures compared to Western classical music, posing challenges for non-Chinese listeners in grasping emotional content in an unfamiliar genre.

5.5 Limitations

Since the music stimuli used in this study were all ensemble music, multiple psychoacoustic cues worked simultaneously, which limited the ability to differentiate the effects of individual psychoacoustic elements separately. This study is also limited to five basic emotions and six

categories of psychoacoustic features. Further exploration is warranted for more complex emotions (e.g., nostalgia) and psychoacoustic cues (e.g., melodic and rhythmic complexity). Furthermore, there are only 18 musical excerpts tested, selected by a small number of professionals, which might not be representative of all Chinese traditional music and Western classical music.

5.6 Conclusions

The in-group advantage of cross-cultural emotion recognition in music could not be confirmed in this study. Instead, in both Chinese and Western music, a cultural advantage in the recognition of happiness and sadness for the Chinese group, and the recognition of fear for the Western group were found, although more studies are needed. Musicianship may affect the relationship between cultural background and recognising certain emotions, such as fear. Gender showed little effect on music emotion recognition in this study. Psychoacoustic features correlated with listeners' emotion recognition in music differently across cultures. The in-group advantage in cross-cultural music emotion recognition and the varied associations of psychoacoustic cues across different emotions and cultural contexts needs further investigation. Future research should also consider individual differences in personality traits and cognitive styles, as well as historical, sociocultural, and ethnographic factors, which I believe can lead to more comprehensive insights into the intricate issue of cross-cultural emotion recognition in music.

To highlight the key findings, the first study contributes to our understanding of cross-cultural emotion recognition by challenging the notion of an in-group advantage. It suggests that recognition performance may be influenced more by specific emotions than by a general cultural bias. This study preliminarily addresses one aspect of the overall research objectives concerning the influence of cultural familiarity on the recognition of musically expressed emotions across Chinese and Western contexts. Another aspect regarding individual differences will be further investigated in the next two studies, specifically aiming to explore whether and how individual factors influence emotion recognition in a cross-cultural context.

Chapter 6. Study 2 - Moderators of the Relationship between Cultural Background and Music Emotion Recognition

6.1 Introduction

This study builds on the previously observed in-group advantage in emotion recognition in music (Argstatter, 2016; Laukka et al., 2013; Thompson & Balkwill, 2010), suggesting that listeners tend to outperform in recognising emotions when the music is from their own culture compared to that from other cultures. This phenomenon has been reflected in some models for cross-cultural emotion communication in music, such as the Cue-Redundancy Model (CRM) proposed by Balkwill and Thompson (1999) and the Dock-In Model proposed by Fritz (2013) (see *Section 2.7.2, 2.7.3*). However, in music and related fields (e.g., vocal expression), some researchers have pointed out that some emotions (e.g., anger) may be poorly decoded cross-culturally (Fuentes-Sánchez et al., 2020; Susino & Schubert, 2016), and the in-group advantage may also vary for different emotions. For instance, Laukka and Elfenbein (2020), in their meta-analysis of 37 cross-cultural studies on emotion recognition from speech prosody and nonlinguistic vocalisations, found that the in-group advantage was not consistently observed for emotions such as relief and sadness. A recent example of inconsistency in the in-group advantage across different emotions was demonstrated in Study 1 (Chapter 5, also available in Lyu & Egermann, in press). The findings indicated that Chinese listeners were more sensitive to the recognition of happiness and sadness but less sensitive to the recognition of fear, compared to Western listeners. This suggests a cultural advantage in specific emotion recognition in music rather than an in-group advantage. Therefore, the first aim of this study was to examine whether the cultural advantage in recognising specific emotions, as observed in Study 1 (Chapter 5), can be replicated, or if there is an in-group advantage instead.

In addition to investigating music emotion recognition from cross-cultural perspectives, previous research has also explored the role of gender and musical expertise in

it. Building upon previous incongruent findings, as described in *Section 2.11.1* and *2.11.2*, the present study also aimed to investigate the role of gender and musical expertise in emotion recognition in music among this sample of two cultures. Given the complexity that arises from the nature of cross-cultural studies, which involve potentially other-than-cultural factors, and the observed unbalanced samples of different cultures in terms of individual differences, the roles of current mood, familiarity with and preference for musical stimuli presented, and preferences for musical genres, were also investigated in this study, based on the previous reviews of their roles in music listening research (see from *Section 2.11.3* to *2.11.5*). Additionally, this was done because, despite the examination of all the factors mentioned above in the field of music and emotion, there is still rare research on the influence of these factors on emotion recognition in music from a cross-cultural perspective. Particularly, there is a need to investigate whether and how the cultural differences observed in emotion recognition in music are at least partially moderated by these factors (see *Section 2.11*). Based on the above literature review, three main research questions were to be addressed in this study:

RQ3: Is there an in-group advantage in emotion recognition through music across cultures?

RQ4: Do gender and musicianship influence listeners' music emotion recognition?

RQ5: How do current mood, familiarity with and preference for musical stimuli, and preferences for musical genres influence the relationship between cultural background and music emotion recognition?

6.2 Method

6.2.1 Instruments

The Short Test Of Music Preferences (STOMP, Rentfrow & Gosling, 2003), which includes four music preference dimensions, consisting of 14 original music genres: Reflective and Complex (classical, blues, folk, jazz), Intense and Rebellious (alternative, rock, heavy metal), Upbeat and Conventional (country, religious, pop, soundtracks/theme songs), Energetic and

Rhythmic (dance/electronica, rap/hip-hop, soul/funk). These preference dimensions were classified based on the similarities among specific musical genres within each dimension. A correlation analysis was conducted between the preferences for Chinese traditional music and all 14 musical genres from the STOMP. Compared to other dimensions of the STOMP, the preferences for Chinese traditional music correlated most strongly with the Reflective and Complex dimension, significantly correlating with Western classical, Blues, and Folk (all $p < .01$), three out of the four specific musical genres within that dimension. Due to the observed correlation between Chinese traditional music and Western classical music, Chinese traditional music was classified into the Reflective and Complex dimension in this study. The inclusion of Chinese traditional music is due to its status as one of the two central musical genres focused on in this study. This decision is consistent with previous cross-cultural studies on musically related emotions (e.g., Juslin et al., 2016), wherein the musical genres from each investigated country were included when assessing music preferences. Overall, the analysis of preferences for musical genres focused on how listeners' general preferences for musical genres may moderate the influence of their cultural background on emotion recognition in music. Preference ratings were given on a 7-point Likert scale with endpoints at 1 (Dislike strongly) and 7 (Like strongly). The Chinese version of STOMP was obtained from Sun (2011).

The International Positive and Negative Affect Schedule Short Form (I-PANAS-SF) (Thompson, 2007), comprises 10 mood descriptors: upset, hostile, alert, ashamed, inspired, nervous, determined, attentive, afraid, and active. Rating scores ranged from 1 (Very slightly or not at all) to 5 (Extremely) on a 5-point Likert-type scale. The Chinese version of I-PANAS-SF was obtained from Liu et al. (2020).

6.2.2 Procedure

The questionnaire used in this study was adapted from the previous version used in Study 1 (Chapter 5, specifically see *Section 5.2.3*), with the majority of instructions for the listening test remaining unchanged. The updated version of the questionnaire consisted of two parts: Part 1, which took approximately 20 minutes to complete, included the information sheet and consent form, demographic survey, and listening experiment; and Part 2, which took about 10 minutes to complete, encompassed personality traits and cognitive styles scales. To prevent fatigue, at the end of Part 1, participants were given the option to take a short break and

complete the entire questionnaire in one sitting or to finish the remaining Part 2 at another time, at their earliest personal convenience. If participants chose to complete Part 2 at a later time, they were prompted to create a personal Memorable Word, which the participant needed to enter in the Part 2 questionnaire, allowing data collected from both parts to be merged for later analysis. Then, after submitting the Part 1 questionnaire, a reminder email, including the link to the Part 2 questionnaire and the Memorable Word created by the participant, was sent to the email address they provided.

6.2.3 Participants

The chapter focused on the first half of the data, specifically Part 1 of this study, aiming to address the research questions indicated above. The second half of the data is analysed and reported in a separate study (Chapter 7), investigating the potential correlation between personality traits and cognitive styles, and music emotion recognition. Data from participants with incomplete responses for the Part 1 questionnaire and unknown gender were excluded from the analysis. A total of 471 eligible participants completed at least Part 1, with 418 participants completing both Part 1 and Part 2. Table 2 presents the eligible number of participants who completed at least Part 1, categorised by cultural background, gender, and musical background. Table 3 provides the number and percentage of musical genres for participants who completed at least Part 1. As shown in Table 3, there was a significantly higher percentage of Western classical musicians compared to Chinese traditional musicians. Given that music learning or training in any genre develops fundamental and universal music-related skills, such as music perception, and considering the significant imbalance in the number of Chinese classical musicians versus Western classical musicians among participants (as detailed in Table 3), musicians in this study were classified based on their self-reported expertise and years of training, without limiting the classification to those specialised in Chinese traditional or Western classical music.

Table 2. Basic Demographic Information for Participants Completing At Least Part 1

Culture	Demographics	N	Mean (Years)	Gender	Demographics	N	Mean (Years)	Musicianship	Demographics	N	Mean (Years)
Chinese	Age	246	25	Male	Age	47	28	Non-musician	Age	146	25
					Music Training	24	10		Music Training	0	
	Music Training	100	11	Female	Age	199	25	Amateur musician	Age	55	25
					Music Training	76	11		Music Training	55	7
								Professional musician	Age	45	27
									Music Training	45	16
Westerner	Age	225	38	Male	Age	93	43	Non-musician	Age	74	37
					Music Training	71	12		Music Training	0	
	Music Training	151	14	Female	Age	132	36	Amateur musician	Age	104	37
					Music Training	80	15		Music Training	104	9
								Professional musician	Age	47	43
									Music Training	47	24

Table 3. Musical Genres Specialisation Reported by Professional and Amateur Musicians Who Completed At Least Part 1

Genre	N	%
Western Classical	133	52.99%
Chinese Traditional	35	13.94%
Other	78	31.08%
Both	5	1.99%

6.3 Analysis

Data from participants who completed Part 1 of the questionnaire, regardless of whether Part 2 was completed or not, were all entered into the analysis for recognition sensitivity. After calculating the mean ratings for each emotion per participant, I determined a sensitivity index by subtracting the mean of all the non-target emotions from the target one. The calculation of the sensitivity index for anger and fear in Chinese music excluded the ratings of each other, as the labelled Chinese angry music excerpts were rated relatively high in both anger and fear, as observed in Study 1 (Chapter 5).

6.3.1 Cultural background, gender, and musicianship

A repeated measures ANOVA for the recognition sensitivity of each emotion was then conducted, with the within-subjects factor emotion (happiness, sadness, peacefulness, anger, and fear), the between-subjects factors cultural background (Chinese vs. Westerners), gender (male vs. female), and musical background (non-musician, amateur musician, and professional musician), and the covariate age, for both Chinese and Western music, respectively.

Table 4 displays all the main effects and interactions that are significant in Chinese music. Overall, a difference was found in the sensitivity index across different emotions, and this difference varied among different cultural and gender groups. The average sensitivity index for all Chinese music differed between different cultural groups.

Table 4. Main Effects and Interactions in Chinese Music

	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Tests of Within- Subjects Effects	emotion	18.1	4	1711	<.001	.04
	emotion x cultural background	30.0	4	1711	<.001	.06
	emotion x gender	2.9	4	1711	.03	.01
Tests of Between- Subjects Effects	cultural background x musical background	9.7	1	458	<.001	.04

Table 5 displays all the main effects and interactions that are significant in Western music. A difference was found in the sensitivity index across different emotions, and this difference varied among different cultural groups. The average sensitivity index for all Western music differed between different cultural groups and musical backgrounds.

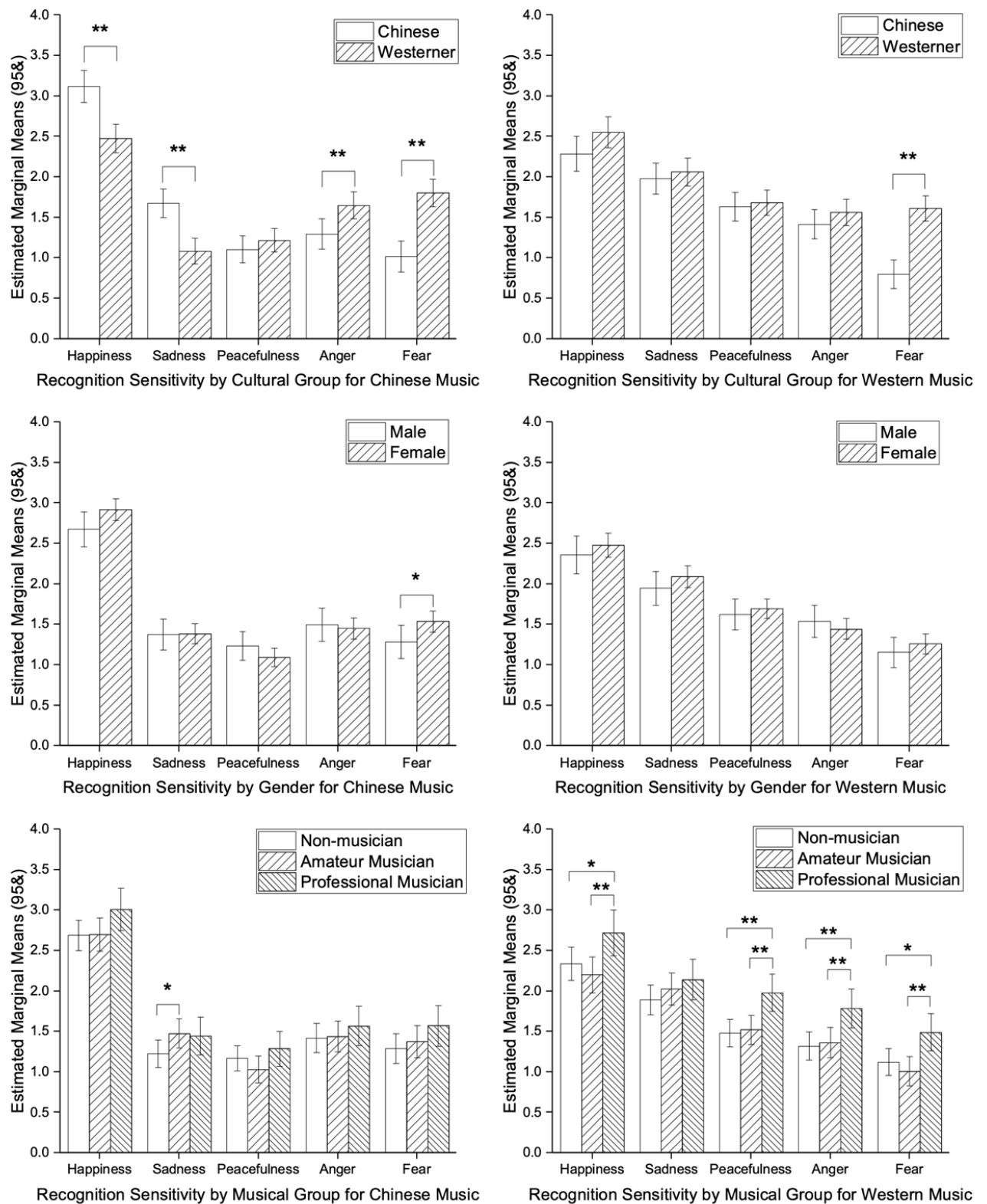
Table 5. Main Effects and Interactions in Western Music

	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Tests of Within- Subjects Effects	emotion	15.1	4	1786	<.001	.03
	emotion x cultural background	8.4	4	1786	<.001	.02
Tests of Between- Subjects Effects	cultural background	8.4	1	458	.004	.02
	musical background	8.0	2	458	<.001	.03
	cultural background x musical background	8.5	2	458	<.001	.04

Based on the results of the main effects and interactions involving emotion, relevant pairwise comparisons were examined. Figure 5 presents the estimated marginal means of the sensitivity index for happiness, sadness, peacefulness, anger, and fear for groups by cultural background, gender, and musical background, in Chinese and Western music. Significant group differences are indicated through asterisks. It can be seen from Figure 5 that all five emotions in both cultures can be recognised from the target emotional music (all sensitivity indices above 0). According to the first line in Figure 5, in Chinese music, cultural differences were shown in the sensitivity indices of all emotions, except for peacefulness, with the Chinese group higher in happiness and sadness, and lower in anger and fear, compared to the Western group. In Western music, the only cultural difference was in fear, with the Western group higher than the Chinese group. From the second line of Figure 5, the gender difference was only shown in the fear sensitivity in Chinese music, with females higher than males, compared to none shown in Western music. From the last line of Figure 5, in Chinese music, the only difference by musical background was shown in sadness, with amateur musicians higher than non-musicians. By contrast, in Western music, the difference by musical background was shown in all emotions, except for sadness, with professional musicians higher than non-musicians and amateur musicians in happiness, peacefulness, anger, and fear respectively.

Figure 5. Estimated marginal means of the sensitivity index for happiness, sadness, peacefulness, anger, and fear for groups by cultural background, gender, and musical background, in Chinese and Western music. Asterisks indicate significant group differences:

* $p < .05$, ** $p < .01$ (two-sided independent samples t -tests).



6.3.2 Current mood

To investigate how current mood may influence emotion recognition sensitivity in the cross-cultural context among Chinese traditional and Western classical music in this study, a correlation analysis was first conducted between positive affect score and negative affect score, and the average emotion recognition sensitivity in Chinese (c_sen) and Western music (w_sen) respectively.

Table 6. Correlation between positive affect score and negative affect score, and the average emotion recognition sensitivity for Chinese and Western music respectively.

Current Mood		c_sen	w_sen
Positive Affect score	Pearson Correlation	.031	.012
	Sig.	.497	.796
Negative Affect score	Pearson Correlation	-.231**	-.216**
	Sig.	<.001	<.001

** . Correlation is significant at the .01 level (2-tailed).

Table 6 shows that the negative affect score had a significant negative correlation with the average emotion recognition sensitivity for both Chinese ($r = -.231, p < .001$) and Western music ($r = -.216, p < .001$). However, the positive affect score showed no correlation with the average emotion recognition sensitivity for Chinese or Western music.

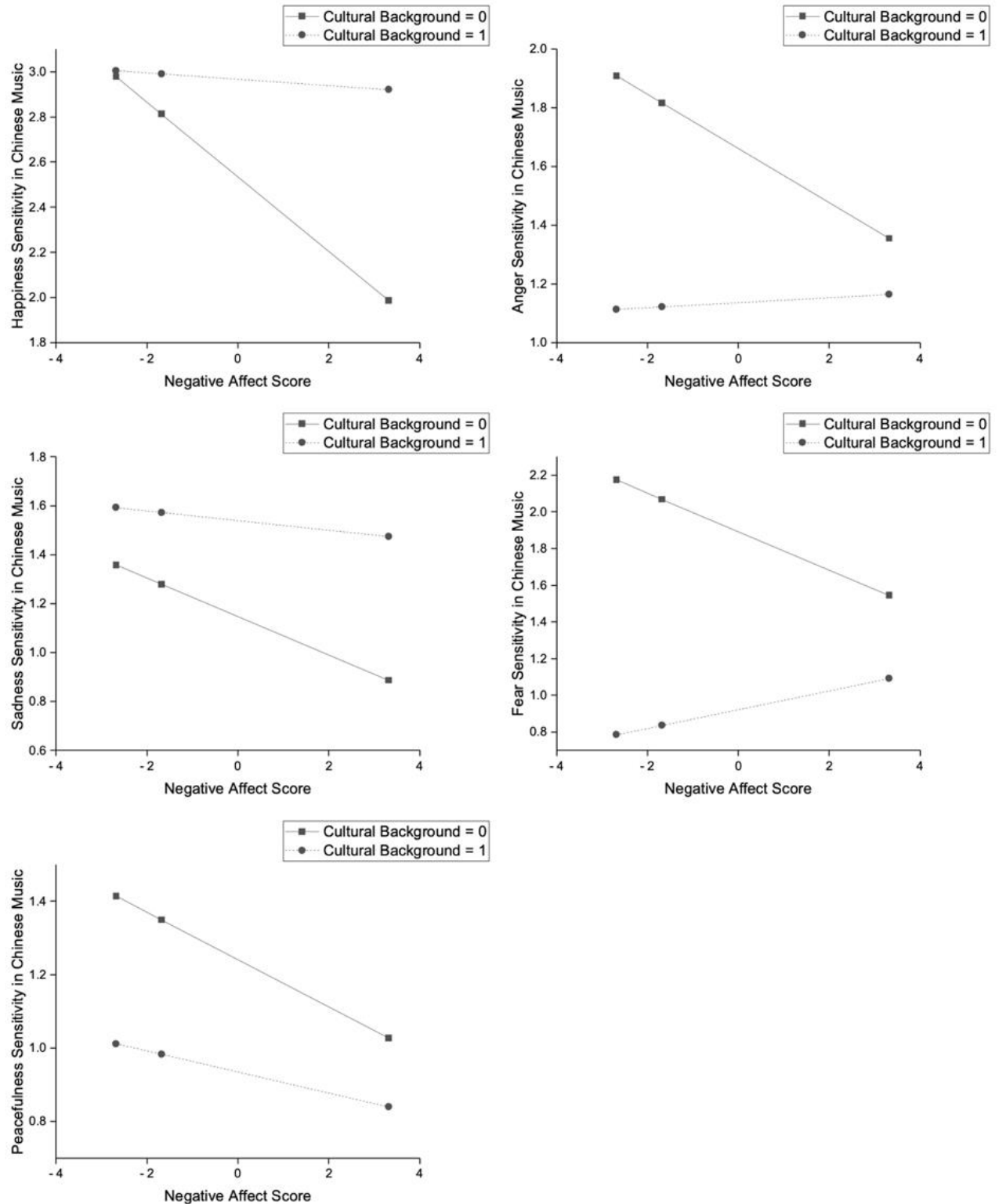
To further understand how negative affect moderates the relationship between cultural background and music emotion recognition sensitivity, a moderation model was conducted through SPSS PROCESS 4.2 by Andrew F. Hayes using model 1, for the recognition sensitivity of each emotion in each culture of the music, with cultural background (Western participants = 0, Chinese participants = 1) as the focal predictor, negative affect score as the moderator, and positive affect score and age as covariates. All continuous variables used to form an interaction product were mean-centred in the model.

6.3.2.1 Chinese music

Table 7 (A, B, C, D, E). Coefficients of cultural background, negative affect, their interaction product, positive affect, age, and the difference in the squared multiple correlations, for recognition sensitivity of happiness, sadness, peacefulness, anger, and fear in Chinese music

A. Happiness					D. Anger				
	Coeff	<i>p</i>	ΔR^2	<i>p</i>		Coeff	<i>p</i>	ΔR^2	<i>p</i>
constant	2.326	<.001	—	—	constant	1.623	<.001	—	—
culture	0.432	<.001	—	—	culture	-0.524	<.001	—	—
NA	-0.165	<.001	—	—	NA	-0.092	<.001	—	—
culture x NA	0.151	<.001	.046	<.001	culture x NA	0.101	.001	.024	.001
PA	0.026	.044	—	—	PA	0.011	.390	—	—
age	-0.004	.362	—	—	age	-0.003	.451	—	—
B. Sadness					E. Fear				
	Coeff	<i>p</i>	ΔR^2	<i>p</i>		Coeff	<i>p</i>	ΔR^2	<i>p</i>
constant	1.293	<.001	—	—	constant	1.964	<.001	—	—
culture	0.393	<.001	—	—	culture	-0.970	<.001	—	—
NA	-0.078	<.001	—	—	NA	-0.105	<.001	—	—
culture x NA	0.059	.035	.009	.035	culture x NA	0.156	<.001	.048	<.001
PA	0.013	.292	—	—	PA	0.003	.836	—	—
age	-0.010	.015	—	—	age	-0.003	.433	—	—
C. Peacefulness									
	Coeff	<i>p</i>	ΔR^2	<i>p</i>					
constant	1.305	<.001	—	—					
culture	-0.306	.003	—	—					
NA	-0.064	<.001	—	—					
culture x NA	0.036	.173	.004	.173					
PA	0.015	.186	—	—					
age	-0.008	.033	—	—					

Figure 6. A visual representation of how the relationship between cultural background and emotion recognition sensitivity for Chinese music varies by negative affect score. Values of negative affect score were the 16th, 50th, and 84th percentiles.



From Table 7, it can be seen that in Chinese music, negative affect moderated the relationship between cultural background and the recognition sensitivity for all emotions, except for peacefulness. Figure 6 shows that the correlation (slope) between negative affect and the recognition sensitivity varied between the Chinese and Western group across different emotions.

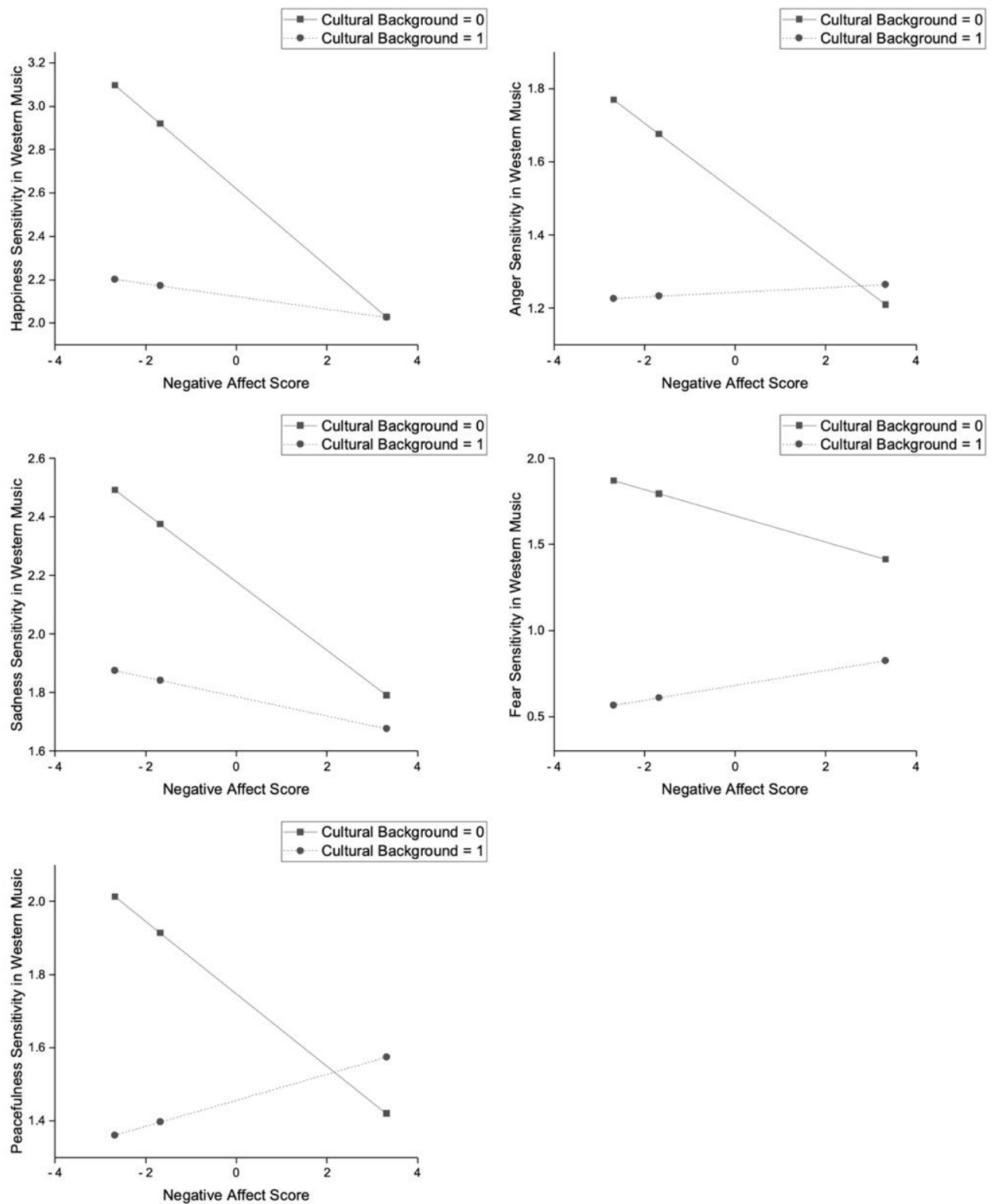
Negative affect strengthened the advantage of the Chinese group ($b = 0.432, p < .001$) on the recognition sensitivity of happiness ($b = 0.151, p < .001$). Negative affect negatively correlated with the happiness sensitivity for both cultural groups, with a stronger correlation in the Western group (displayed by the steeper slope for cultural background = 0) than the Chinese group. For the recognition sensitivity of sadness, negative affect also strengthened ($b = 0.059, p = .035$) the advantage of the Chinese group ($b = 0.393, p < .001$). Negative affect negatively correlated with the sadness sensitivity for both cultural groups, with a stronger correlation in the Western group (steeper slope for cultural background = 0) than the Chinese group. For the recognition sensitivity of peacefulness, negative effect did not show a moderating effect ($b = 0.036, p = .173$). For the recognition sensitivity of anger, negative affect conversely strengthened ($b = 0.101, p = .001$) the advantage of the Western group ($b = -0.524, p < .001$). Negative affect showed a negative correlation with anger sensitivity for the Western group; however, for the Chinese group, although a positive correlation was observed, it appeared not to be significant, as indicated by the nearly flat slope. For the recognition sensitivity of fear, negative effect also conversely strengthened ($b = 0.156, p < .001$) the advantage of the Western group ($b = -0.970, p < .001$). Negative affect showed a negative correlation with the fear sensitivity for the Western group, while showed a positive correlation with the fear sensitivity for the Chinese group.

6.3.2.2 Western music

Table 8 (A, B, C, D, E). Coefficients of cultural background, negative affect, their interaction product, positive affect, age, and the difference in the squared multiple correlations, for recognition sensitivity of happiness, sadness, peacefulness, anger, and fear in Western music.

A. Happiness					D. Anger				
	Coeff	p	ΔR^2	p		Coeff	p	ΔR^2	p
constant	2.922	<.001	—	—	constant	1.379	<.001	—	—
culture	-0.496	<.001	—	—	culture	-0.275	.016	—	—
NA	-0.178	<.001	—	—	NA	-0.093	<.001	—	—
culture x NA	0.149	<.001	.039	<.001	culture x NA	0.100	.001	.024	.001
PA	0.011	.436	—	—	PA	0.020	.107	—	—
age	-0.014	.003	—	—	age	-0.004	.376	—	—
B. Sadness					E. Fear				
	Coeff	p	ΔR^2	p		Coeff	p	ΔR^2	p
constant	2.232	<.001	—	—	constant	2.094	<.001	—	—
culture	-0.392	.001	—	—	culture	-0.983	<.001	—	—
NA	-0.117	<.001	—	—	NA	-0.076	<.001	—	—
culture x NA	0.084	.005	.016	.005	culture x NA	0.120	<.001	.033	<.001
PA	0.014	.259	—	—	PA	-0.018	.133	—	—
age	-0.008	.077	—	—	age	-0.006	.111	—	—
C. Peacefulness									
	Coeff	p	ΔR^2	p					
constant	2.159	<.001	—	—					
culture	-0.291	.008	—	—					
NA	-0.099	<.001	—	—					
culture x NA	0.134	<.001	.048	<.001					
PA	-0.015	.202	—	—					
age	-0.007	.080	—	—					

Figure 7. A visual representation of how the relationship between cultural background and emotion recognition sensitivity for Western music varies by negative affect score. Values of negative affect score were the 16th, 50th, and 84th percentiles.



From Table 8, it can be seen that in Western music, negative affect moderated the relationship between cultural background and the recognition sensitivity for all emotions. Figure 7 shows that the correlation (slope) between negative affect and the recognition sensitivity varied between the Chinese and Western groups across different emotions.

Specifically, negative affect strengthened the advantage of the Western group ($b = -0.496, p < .001$) on the recognition sensitivity of happiness ($b = 0.149, p < .001$). Negative affect negatively correlated with the happiness sensitivity for both cultural groups, with a stronger correlation in the Western group (due to the steeper slope for cultural background = 0) than the Chinese group. For the recognition sensitivity of sadness, negative affect strengthened ($b = 0.084, p = .005$) the advantage of the Western group ($b = -0.392, p = .001$). Negative affect negatively correlated with the sadness sensitivity for both cultural groups, with a stronger correlation in the Western group (indicated by the steeper slope for cultural background = 0) than the Chinese group. Similarly, for the recognition sensitivity of peacefulness, negative affect strengthened ($b = 0.134, p < .001$) the advantage of the Western group ($b = -0.291, p = .008$). Negative affect showed a negative correlation with peacefulness sensitivity for the Western group, while showing a positive correlation with peacefulness sensitivity for the Chinese group. In addition, for the recognition sensitivity of anger, negative affect strengthened ($b = 0.100, p = .001$) the advantage of the Western group ($b = -0.275, p = .016$). Negative affect showed a negative correlation with anger sensitivity for the Western group, while showing a slight positive correlation with anger sensitivity for the Chinese group. Finally, for the recognition sensitivity of fear, negative affect strengthened ($b = 0.120, p < .001$) the advantage of the Western group ($b = -0.983, p < .001$). Negative affect exhibited a negative correlation with fear sensitivity for the Western group, while showing a positive correlation with fear sensitivity for the Chinese group.

6.3.3 Familiarity and preference

Figure 8 shows that both the Chinese and Western groups were more familiar with their own culture's music. The Western group showed higher preferences than the Chinese group across all emotional music, although the difference in Chinese happy music was not significant ($p > .05$). These findings suggest that both cultural groups consistently score either higher or lower on both familiarity and preference within each music culture compared to each other. In other words, there were no cases where one cultural group showed higher scores in some emotions within a music culture while showing lower scores in others within the same music culture, or vice versa. Therefore, I decided to investigate how the average familiarity with and preference for all types of music within each music culture, rather than for specific music types, were correlated with listeners' recognition sensitivity within each music culture.

Figure 8. Estimated marginal means (95% confidence interval) of the average familiarity and preference for each emotion in each culture of the music, separated by the Chinese and Western group. (* $p < .05$, ** $p < .01$; two-sided independent samples t -tests).

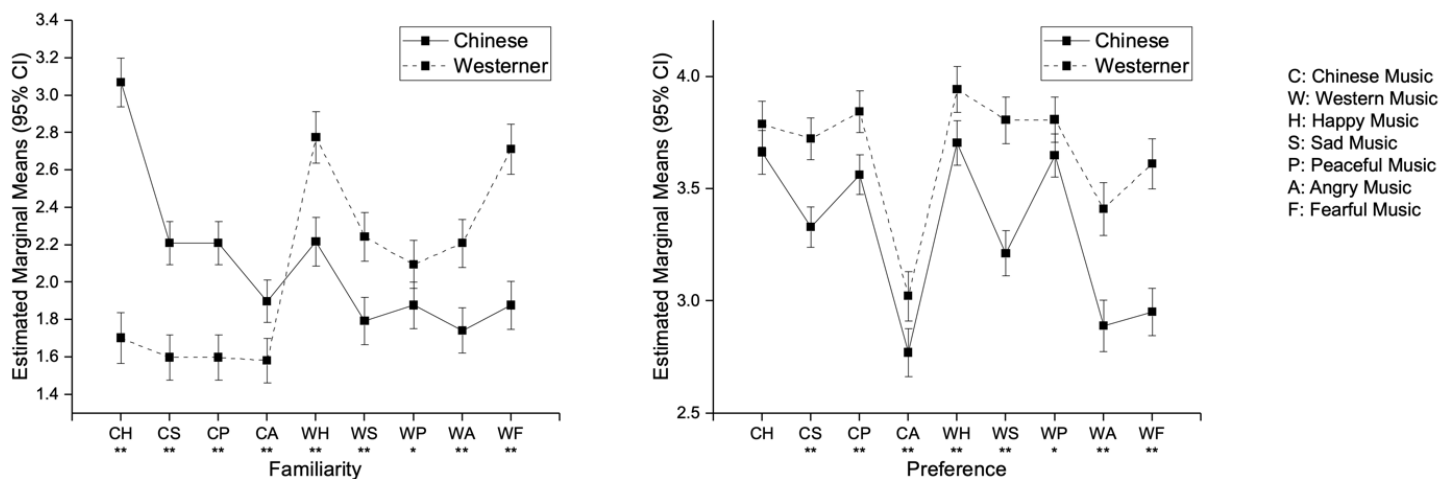


Table 9. Correlation between the average familiarity (fami)/preference (like) for Chinese (c) and Western music (w) respectively, and the average emotion recognition sensitivity index (sen) for Chinese (c) and Western music (w) respectively, separated by the Chinese and Western group.

Cultural Background		c_fami	c_like	w_fami	w_like	c_sen	w_sen
Chinese	c_fami	—					
	c_like	.407**	—				
	w_fami	.686**	.274**	—			
	w_like	.277**	.619**	.413**	—		
	c_sen	.250**	.206**	.103	.317**	—	
	w_sen	.196**	.153*	.056	.306**	.795**	—
Westerner	c_fami	—					
	c_like	.053	—				
	w_fami	.591**	.140*	—			
	w_like	-.049	.620**	.305**	—		
	c_sen	-.416**	.180**	-.137*	.204**	—	
	w_sen	-.446**	.191**	-.137*	.240**	.774**	—

** . Correlation is significant at the .01 level (2-tailed).

* . Correlation is significant at the .05 level (2-tailed).

From Table 9, it can be seen that, for the Chinese group, the average familiarity with ($r = .250, p < .001$) and preference for Chinese music ($r = .206, p = .001$) were both positively correlated with average emotion recognition sensitivity for Chinese music. In contrast, for Western music, there was a positive correlation between average preference and average emotion recognition sensitivity ($r = .306, p < .001$), but the correlation between average familiarity and average emotion recognition sensitivity was not significant ($r = .056, p = .381$). This suggested that Chinese participants with higher familiarity and preference for Chinese music, and higher preference for Western music, may be more sensitive in recognising emotions from the music of the respective culture, compared to those with lower familiarity and preference. For the Western group, the average preference for Chinese ($r = .180, p = .007$) and Western music ($r = .240, p < .001$) was positively correlated with the

average emotion recognition sensitivity of the respective culture of the music. By contrast, the average familiarity for Chinese ($r = -.416, p < .001$) and Western music ($r = -.137, p = .040$) was negatively correlated with the average emotion recognition sensitivity of the respective culture of the music. This suggested that Western participants with higher preference for Chinese and Western music may be more sensitive in recognising emotions from the music of the respective culture, compared to those with lower preference. However, in this study, surprisingly, Western participants with higher familiarity showed lower sensitivity in recognising emotions from the music, compared to those with lower familiarity, regardless of the culture of the music.

6.3.4 Preferences for musical genres

Given the correlation observed between preferences for Chinese traditional and Western classical music ($r = .24, p < .001$), and to prevent potential overlap with the analysis of musical background (e.g., Western classical musicians are likely to have a preference for Western classical music), the analysis of the influence of musical genre preferences here focuses on the broader categorisation of musical genres, as classified in the STOMP, rather than specific genres. Therefore, to investigate the potential influence of preferences for musical genres on emotion recognition sensitivity in the cross-cultural context among Chinese traditional and Western classical music in this study, a correlation analysis was first conducted between each genre dimension of the STOMP, including Reflective and Complex (including the Chinese traditional genre; *stomp_rcc*), Intense and Rebellious (*stomp_ir*), Upbeat and Conventional (*stomp_uc*), and Energetic and Rhythmic (*stomp_er*), and the average emotion recognition sensitivity in Chinese (*c_sen*) and Western music (*w_sen*) respectively.

Table 10. Correlation between each STOMP dimension and the average emotion recognition sensitivity for Chinese and Western music respectively.

STOMP Dimension		c_sen	w_sen
stomp_rcc	Pearson Correlation	.132**	.123**
	Sig.	.004	.008
stomp_ir	Pearson Correlation	.016	.052
	Sig.	.729	.263
stomp_uc	Pearson Correlation	.029	-.021
	Sig.	.530	.654
stomp_er	Pearson Correlation	-.073	-.028
	Sig.	.115	.538

** . Correlation is significant at the .01 level (2-tailed).

* . Correlation is significant at the .05 level (2-tailed).

Table 10 shows that only the Reflective and Complex dimension had a positive correlation with the average emotion recognition sensitivity for both Chinese ($r = .132$, $p = .004$) and Western music ($r = .123$, $p = .008$).

To further understand the moderating role of preferences for the Reflective and Complex dimension in the relationship between cultural background and music emotion recognition sensitivity, a simple moderation model was also conducted through SPSS PROCESS 4.2 by Andrew F. Hayes using model 1, for the average emotion recognition sensitivity for each music culture separately, with cultural background (Westerner = 0, Chinese = 1) as focal predictor, the stomp_rcc as moderator, and stomp_ir, stomp_uc, stomp_er, as well as age as covariates. All continuous variables used to form an interaction product were mean-centred in the model.

Table 11. Coefficients of cultural background, stomp_rcc, and their interaction product, and the difference in the squared multiple correlation, for the average emotion recognition sensitivity for Chinese and Western music respectively.

Chinese Music					Western Music				
	Coeff	<i>p</i>	ΔR^2	<i>p</i>		Coeff	<i>p</i>	ΔR^2	<i>p</i>
constant	2.069	<.001	——	——	constant	2.481	<.001	——	——
culture	-0.180	.017	——	——	culture	-0.432	<.001	——	——
stomp_rcc	0.028	.622	——	——	stomp_rcc	0.075	.234	——	——
culture x stomp_rcc	0.278	<.001	.025	<.001	culture x stomp_rcc	0.257	.004	.016	.004
stomp_ir	0.010	.743	——	——	stomp_ir	0.002	.964	——	——
stomp_uc	0.010	.828	——	——	stomp_uc	-0.028	.577	——	——
stomp_er	-0.105	.002	——	——	stomp_er	-0.084	.031	——	——
age	-0.001	.735	——	——	age	-0.003	.341	——	——

Figure 9. A visual representation of how the relationship between cultural background and emotion recognition sensitivity for Chinese and Western music respectively varied by preference for stomp_rcc. Values of stomp_rcc were the 16th, 50th, and 84th percentiles.

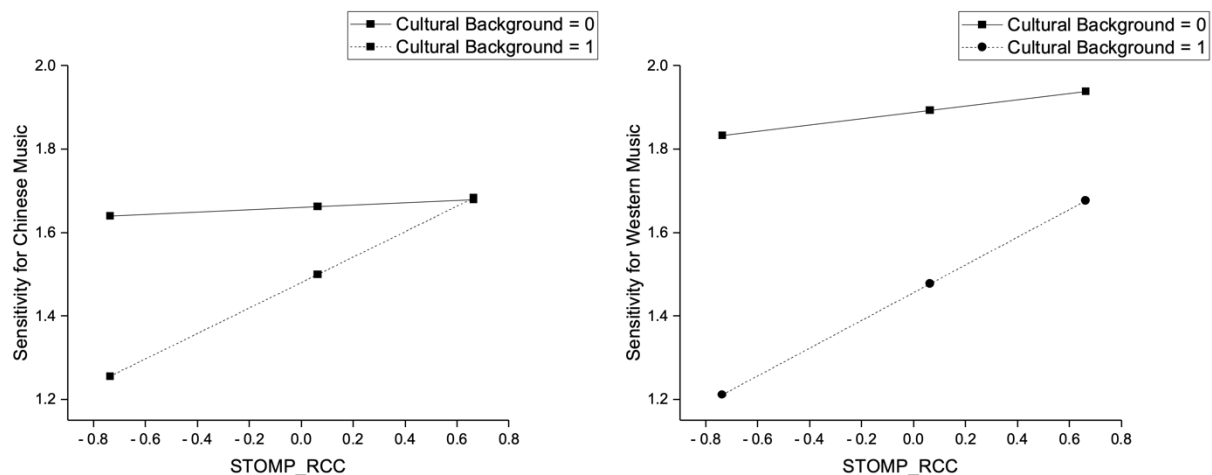


Table 11 shows that preference for stomp_rcc moderated the relationship between cultural background and the average emotion recognition sensitivity for both Chinese ($b = 0.278, p < .001$) and Western music ($b = 0.257, p = .004$). Figure 9 is a visual representation of how preference for stomp_rcc moderated the relationship between cultural background and

emotion recognition sensitivity for Chinese and Western music respectively. In both Chinese and Western music, the moderating effect of *stomp_rcc* was larger for the Chinese group than the Western group (due to the steeper slope for cultural background = 1).

6.4 Discussion

The first two research questions examined whether there was a cultural advantage in recognising specific musically-conveyed emotions or a general in-group advantage, and examined the roles of musical background and gender. The results revealed a cultural advantage for the Western group in the recognition of fear in both Chinese and Western music. Meanwhile, similar to the findings in Lyu and Egermann (in press) (Study 1, Chapter 5), an in-group advantage in the emotion recognition from both Chinese and Western music was not established. In Chinese music, compared to the Western group, the Chinese group was more sensitive only in the recognition of happiness and sadness, but less sensitive to the recognition of anger and fear. In Western music, although the Western group appeared to be more sensitive than the Chinese group in the recognition of all the emotions, the group difference was only significant in fear. Overall, there were more cultural differences in the Chinese music than in the Western music. This observation partially reflected the finding regarding the associations between emotion recognition and psychoacoustic features in Lyu and Egermann (in press) (Study 1, Chapter 5), where more cultural differences were also identified in these associations in Chinese music compared to in Western music. This appears to align with musicologists' opinions regarding the difference between music tradition from Chinese culture, and music from Western culture: the rational thinking of Western culture is reflected in the creation of Western classical music, manifested its rigorous structure and composition techniques, while Chinese music is more flexible in structure, emphasising abstract artistic conception and sensibility (Cai, 2014; Lin, 2010; Yin, 2010). Additionally, this phenomenon may be attributed to the higher proportion of Western classical musicians compared to Chinese traditional musicians participating in this study, resulting in increased variability in emotion recognition sensitivity in Chinese music.

The results of repeated measures ANOVA also indicated that, overall, there was little gender difference in the emotion recognition, regardless of the culture of the music. However, females appeared to be more sensitive in the recognition of fear than male in Chinese music.

This result partly reflects previous findings that across all the visual, auditory, and audio-visual modalities, females were found to represent particularly better emotion recognition in negative expressions, such as fear and anger, compared to males (Rafiee & Schacht, 2023). Furthermore, in general, musicianship had an influence on emotion recognition in music. This finding adds more evidence to the body of previous studies suggesting the influence of musicality on music perception performance (Lynch & Eilers, 1991; Thompson & Balkwill, 2010), and the recognition of emotions conveyed in music (Argstatter, 2016; Castro & Lima, 2014). However, the influence of musical background appeared to be stronger in Western music than in Chinese music. Specifically, in Chinese music, the influence of musical background was only shown in the recognition of sadness, where amateur musicians exhibited greater sensitivity than non-musicians. In contrast, in Western music, professional musicians were more sensitive to the recognition of happiness, peacefulness, anger, and fear, compared to both amateur musicians and non-musicians. This phenomenon may, again, be attributed to the generally higher proportion of Western classical (amateur) musician participants compared to Chinese traditional (amateur) musician participants in this study, making the advantage for professional musicians more pronounced in Western music.

Results for the correlation and moderation analysis of current mood indicated that negative affect had a negative correlation with the recognition sensitivity of all emotions in both Chinese and Western music, irrespective of the effects of positive affect and age. However, the visual representation of the moderation analysis showed that negative affect moderated the association between cultural background and recognition sensitivity differently for different emotions. In Chinese music, both cultural groups exhibited a negative correlation between negative affect and recognition sensitivity for happiness, sadness, and peacefulness, while negative correlations with negative affect for anger and fear were exclusive to the Chinese group. In Western music, a negative correlation for both cultural groups were shown only in happiness and sadness, while negative correlations with peacefulness, anger, and fear were only observed in the Chinese group. This finding was not in line with the mood-congruency indicated in Vuoskoski and Eerola (2011b) and Garrido (2021), as well as studies in relevant fields, such as facial expressions and judgements (Trilla et al., 2021). For example, vigour was positively correlated with happiness ratings, anger was negatively correlated with happiness ratings, and depression was positively correlated with sadness ratings (Vuoskoski & Eerola, 2011b). In contrast, in this study, positive current mood was not found to be positively correlated with recognition sensitivity to all positive emotions

and negatively with all negative emotions. The Western group demonstrated an overall negative correlation between negative affect and recognition sensitivity across all emotions in both Chinese and Western music, suggesting a tendency for higher recognition sensitivity without the influence of negative mood states. Compared to the Western group, the Chinese group was more susceptible to the variance of emotions. Its correlation between negative affect and recognition sensitivity changed to be mood-congruent for anger and fear, regardless of the culture of the music, but not for peacefulness in Western music. Overall, this highlights the importance of considering the current affective states of listeners in studies on music emotion recognition. This is because current mood influences researchers' interpretations regarding whether the observed results reflect the actual recognition sensitivity of the listener or are merely biased by the transient mood of them. Particularly in the complex context of a cross-cultural study, the correlation between negative affect and recognition sensitivity may vary across different cultural groups and emotions, as discussed above. It is recommended to either collect data from participants who are in a neutral mood state before the experiment, if using a lab-based design, or to ask participants about their current mood state and include this information in the analysis. This approach may help in better identifying and interpreting the influence of cultural background on the results.

The correlation analysis for familiarity and preference revealed that preference had a positive correlation with emotion recognition sensitivity for both Chinese and Western groups, irrespective of the culture of the music, while the positive correlation with familiarity was observed only for the Chinese group in Chinese music. Most surprisingly, Western participants with higher familiarity showed lower sensitivity in recognising emotions from the music, compared to those with lower familiarity, in both Chinese and Western music. This may be because these Western participants had previously listened to the musical stimuli used, but had not necessarily learnt about the knowledge of the music in terms of its emotional connotations. It is also possible that music is seldom considered in terms of expressing basic emotions, and greater familiarity with the music may be associated with an increased cognitive appreciation of its features rather than a heightened reflection on the emotions it might express. In this sense, higher familiarity may not lead to higher sensitivity. Another explanation for this finding could be the chance resulting from relatively limited size and representativeness of the sample.

The correlation and moderation analysis examining the role of preferences for musical genres demonstrated that the relationship between cultural background and listeners' emotion

recognition sensitivity was moderated by their general preferences for the stomp_rcc dimension in both Chinese and Western music, regardless of the effects of other musical genre dimensions and age. The visual representation of the moderation analysis further illustrated a consistently positive correlation between preferences for the stomp_rcc musical genre and emotion recognition sensitivity in both Chinese and Western music. Although preferences for the stomp_rcc did not have a simple effect on emotion recognition sensitivity through music, it did moderate the relationship between cultural background and emotion recognition sensitivity in music. This suggests the significance of considering listeners' previous experiences or behaviours (Thompson & Olsen, 2021), such as their general preferences for musical genres, in investigating cross-cultural emotion recognition in music.

6.5 Limitations

Given the nature of a cross-cultural study, the most significant limitation of this study was the limited sample size. Additionally, the current study only involved Chinese traditional and Western classical music among Chinese and Western participants. Comparing a broader range of cultures might yield richer results in the future. Furthermore, this study was also limited to six factors in terms of their potential moderating roles in the relationship between cultural background and the recognition of musically expressed emotions. Future research could aim to encompass or explore more factors, including individual factors, to better clarify and understand the influence of cultural differences on the recognition of emotions expressed in music.

6.6 Conclusion

In summary, the findings of this study contribute additional evidence to the presence of cultural differences in cross-cultural emotion recognition through music, and demonstrate the influence of musical expertise in Western music, with minimal effects of gender. The study emphasises the importance of considering factors associated with emotion recognition in music, such as negative affect, familiarity with, and preference for musical stimuli, as well as general preferences for the Reflective and Complex musical genre. These considerations can

enhance the understanding and interpretation of the observed cultural differences in emotion recognition in cross-cultural design studies.

Chapter 7. Study 3 - The Influences of Personality Traits and Cognitive Styles on Cross-cultural Music Emotion Recognition

7.1 Introduction

Personality psychology research has reported a relationship between personality traits and individuals' tendency to experience emotions. Individuals higher in trait extraversion experience greater positive affect, while individuals higher in neuroticism are more likely to experience negative affect (Fleeson et al., 2002; Lucas et al., 2008; Matthews et al., 1990; McNiel & Fleeson, 2006; Miller et al., 2009; Smillie et al., 2015; Widiger & Oltmanns, 2017; Wilt et al., 2012). In the field of music, personality traits were also found to be related to both the perception and experience of emotions conveyed by music (see *Section 2.11.6.1.3*), and to preferences for musical genres (see *Section 2.11.6.1.2*). The findings in Study 1 (Chapter 5) indicating Chinese listeners' higher sensitivity to happiness and sadness and lower sensitivity to fear compared to Western listeners have been interpreted in relation to the trait-congruent patterns found in the relationship between personality traits and preferences for music expressing different emotions (Vuoskoski & Eerola, 2011b) (see *Section 5.4*). Nevertheless, the role of personality traits in the perception and recognition of musical emotions has still received limited attention in previous research (e.g., Taruffi et al., 2017; Vuoskoski & Eerola, 2011b). Moreover, there are even fewer studies on this aspect in a cross-cultural music listening context, despite reported differences between individual and collective cultures (McCrae, 2002; McCrae et al., 2005) (see *Section 2.11*). Thus, the first aim of this study was to examine whether and how personality traits relate to cross-cultural emotion recognition in Chinese traditional and Western classical music. A detailed literature review on personality traits, culture, and emotion processing in music has been provided in *Section 2.11.6*.

Previous research has also suggested a potential association between cognitive styles and the process of emotion recognition in music. In addition to the finding that musically-expressed emotions can be recognised cross-culturally (Argstatter, 2016; Balkwill et al.,

2004; Balkwill & Thompson, 1999; Fritz et al., 2009; Fritz et al., 2013; Thompson & Balkwill, 2010), it has indicated a cultural difference in the use of psychoacoustic features of the music for listeners to judge emotions (Balkwill, 2006). Further details about relevant studies can be found in *Section 2.8*. Similar findings regarding the cultural difference in the association between emotion recognition and psychoacoustic features between the Chinese and Western listeners were also observed in Study 1 (Chapter 5; also available in Lyu & Egermann, in press). Balkwill (2006) hypothesised that this phenomenon was associated with the cultural difference in the holistic-analytic dimension of cognitive style (Nisbett et al., 2001; Nisbett & Miyamoto, 2005). Refer to *Section 2.11.7.1* for the definition of the holistic-analytic dimension of cognitive style, and the initial research on visual perception. Literature review in this regard indicates limited research on the holistic-analytic cognitive style in the field of aural processing, and there is still no empirical evidence for the hypothesised influence on the association between emotion recognition in music and psychoacoustic features. Thus, this study also aimed to investigate whether the association between emotion recognition and psychoacoustic features differed between Chinese and Western participants, and whether this difference was mediated by the holistic-analytic cognitive styles.

Another dimension of cognitive style that is worth taking into account in musical emotion processing is the empathising-systemising (E-S) cognitive styles. These cognitive styles distinguish empathisers and systemisers in the processing of external stimuli (Baron-Cohen et al., 2003; Baron-Cohen & Wheelwright, 2004), which in the field of music listening is represented as a tendency to focus either on the structural features or the emotional content of the musical work (Kreutz, Schubert, et al., 2008). Gender differences, the role of musical expertise in empathising-systemising (E-S) cognitive styles, and the link between these cognitive styles and different musical preferences have also been discussed in *Section 2.11.7.2*. However, there is still rare research on the role of empathetic-systematic cognitive styles in musical emotion recognition from a cross-cultural perspective, though subtle cultural differences between samples from individualist and collectivist cultures in the empathising and systemising cognitive styles were observed in previous research (Groen et al., 2015; Wakabayashi et al., 2007). Therefore, this study also aimed to explore the effect of the empathising-systemising cognitive styles on the potential cultural difference in emotion recognition in music.

In this study, it is noteworthy that both personality traits and cognitive styles will be examined as potential mediators in the relationship between cultural background and music

emotion recognition. As discussed earlier in *Section 2.11*, besides the observed impact of cultural background on listeners' emotion recognition in music, there is evidence suggesting potential cultural differences in both personality traits and cognitive styles (Allik & McCrae, 2004; Choi et al., 2007; Lux et al., 2021; Mamatova & Wille, 2012; McCrae et al., 2005; Nisbett et al., 2001; Wakabayashi et al., 2007). Moreover, there is indication of the potential influence of these factors on the processing of musically expressed emotions (Kreutz, Schubert, et al., 2008; Taruffi et al., 2017; Thompson & Balkwill, 2010; Vuoskoski & Eerola, 2011b). All these hypothesised intercorrelations between cultural background, personality traits/cognitive styles, and music emotion recognition, have allowed us to examine the mediating roles of personality traits and cognitive styles in the relationship between cultural background and music emotion recognition in this study. Overall, based on the literature discussed above this study sought to address the following three research questions:

RQ6: Do personality traits and cognitive styles mediate the relationship between cultural background and emotion recognition in music?

RQ7: Is there a cultural difference in the association between music emotion recognition and psychoacoustic features?

RQ8: If yes, do cognitive styles influence the cultural difference in the association between music emotion recognition and psychoacoustic features?

7.2 Methods

7.2.1 Instruments

The Big Five Inventory (BFI) (John et al., 2008), which includes five dimensions, consisting of 44 short phrases describing individuals' personality characteristics: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. Rating scores were given on a 5-point Likert-type scale with endpoints at 1 (Disagree strongly) and 5 (Agree strongly). The Chinese version of BFI was from Li and Chung (2020).

The Analysis-Holism Scale (AHS) (Choi et al., 2007) consists of 24 items covering four factors: Causality, Attitude Toward Contradictions, Perception of Change, and Locus of

Attention. Only the subscale of AHS Locus of Attention which focuses on the extent to which information is processed segmentally, or as a whole was analysed in this study. Rating scores were given on a 7-point Likert-type scale with endpoints at 1 (Strongly disagree) and 7 (Strongly agree). Using the back-translation method, the Chinese version of AHS was created with the assistance of a Music Psychology PhD student, who was a Chinese native-speaker using English as the working language in the United Kingdom. The final Chinese version of AHS was a consensus between both the researcher and the PhD student.

The 10-item short form of the Empathy Quotient (EQ-10) (Greenberg et al., 2018), which consists of 10 statements reflecting individuals' empathising cognitive style. Rating scores were given on a 4-point Likert-type scale with endpoints at 1 (Strongly disagree) and 4 (Strongly agree). The Chinese version of EQ-10 was based on the corresponding items in the simplified Chinese 60-item long forms of the Empathy Quotient (EQ-60) (Qing, 2023).

The 10-item short form of the Systemising Quotient-Revised (SQ-R-10) (Greenberg et al., 2018), which consists of 10 statements reflecting individuals' systemising cognitive style. Rating scores were given on a 4-point Likert-type scale with endpoints at 1 (Strongly disagree) and 4 (Strongly agree). The Chinese version of SQ-R-10 was created with the assistance of the same Music Psychology PhD student, following the same back-translation procedure as in the translation of AHS mentioned above.

The 20-Item Toronto Alexithymia Scale (TAS-20) (Bagby et al., 1994), which includes three factors: Difficulty Identifying Feelings, Difficulty Describing Feelings, and Externally-Oriented Thinking. Rating scores were given on a 5-point Likert-type scale with endpoints at 1 (Strongly disagree) and 5 (Strongly agree). The copyright of the TAS-20 and the simplified Chinese version were granted and shared by the creator of TAS-20. Note that due to the copyright of TAS-20, a separate version of the questionnaire, with the TAS-20 included, was distributed within an internal academic team at the University of York and to those who expressed an interest in completing the copyrighted version through a private link via individual emails. Participants were asked to consent not to in any way copy, screenshot, download, save, or share any of the content with a third party before starting the copyrighted version.

7.2.2 Procedure

The data used in this study were collected alongside that collected in Study 2. Refer to *Section 6.2.2* for more details. This study focused on the potential correlation between personality traits and cognitive styles, and emotion recognition in music, and thus only data from participants who completed both Part 1 and Part 2 are analysed and reported in this study. Data collected from participants who completed at least Part 1, with the aim of examining the influencing factors on emotion recognition in music, were analysed and reported in Study 2 (Chapter 6).

7.2.3 Participants

471 eligible participants completed at least Part 1, and 418 participants completed both Part 1 and Part 2. Table 12 displays the specific number of participants who completed both Part 1 and Part 2, separated by cultural background, gender, and musical background. Table 13 shows the distribution of musical background for participants completing both Part 1 and Part 2. It should be noted that among the 471 participants, only 18 participants completed the 20-item Toronto Alexithymia Scale, comprising 6 Chinese participants and 12 Western participants. The sample was too small to yield reliable results, and thus, I have chosen not to conduct further analysis or report results related to alexithymia at this time.

Table 12. Basic Demographic Information for Participants Completing Part 1&2

Culture	Demographics	N	Mean (Years)	Gender	Demographics	N	Mean (Years)	Musicianship	Demographics	N	Mean (Years)
Chinese	Age	204	26	Male	Age	36	29	Non-musician	Age	114	26
					Music Training	20	8		Music Training	0	
	Music Training	90	11	Female	Age	168	25	Amateur musician	Age	52	25
					Music Training	70	11		Music Training	52	7
								Professional musician	Age	38	27
									Music Training	38	16
Westerner	Age	214	39	Male	Age	89	42	Non-musician	Age	71	37
					Music Training	68	11		Music Training	0	
	Music Training	143	13	Female	Age	125	36	Amateur musician	Age	100	38
					Music Training	75	15		Music Training	100	8
								Professional musician	Age	43	44
									Music Training	43	24

Table 13. Musical Genres Specialisation Reported by Professional and Amateur Musicians Who Completed At Least Part 1

Genre	N	%
Western Classical	123	52.79%
Chinese Traditional	32	13.73%
Other	73	31.33%
Both	5	2.15%

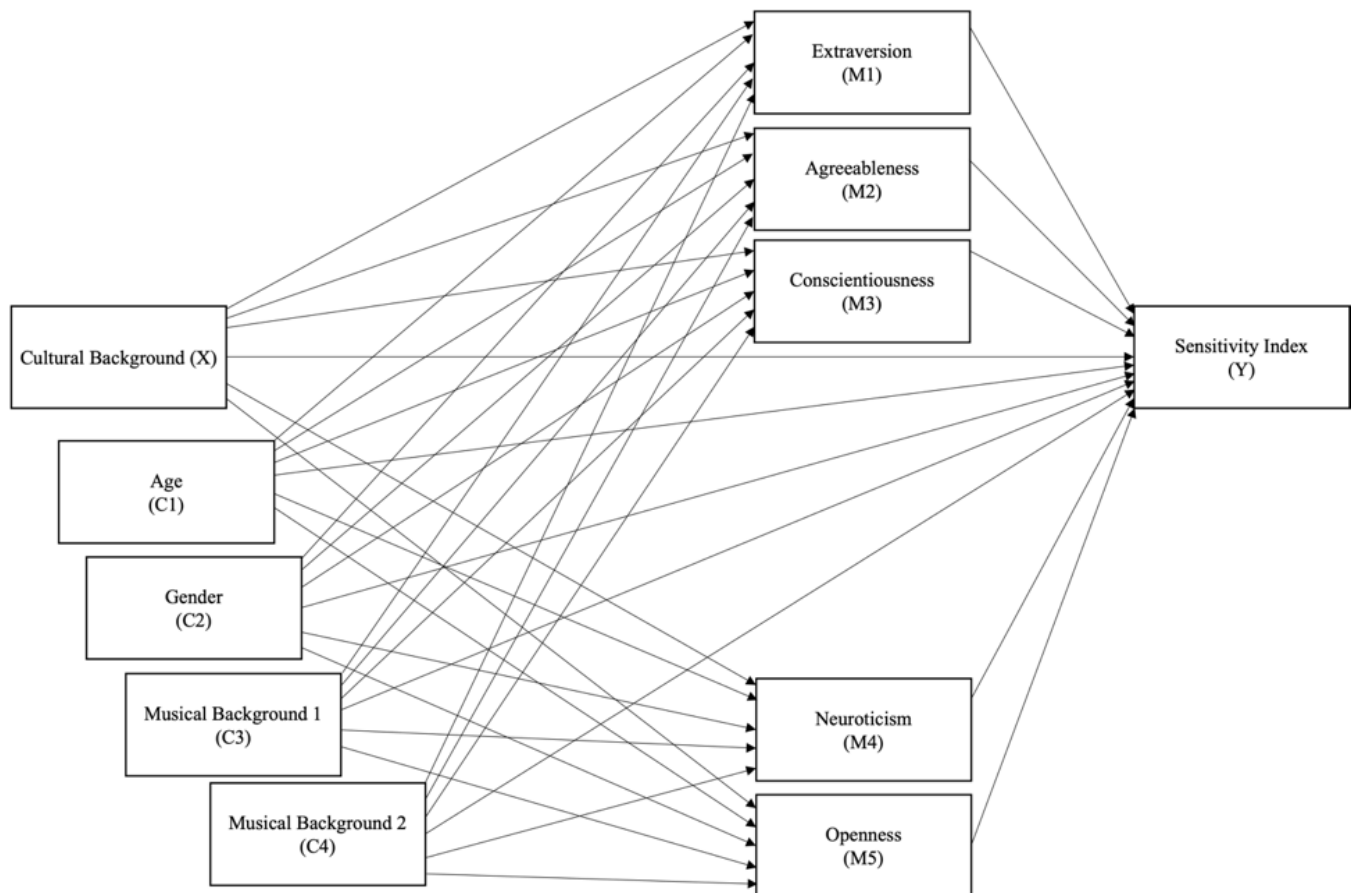
7.3 Analysis

First of all, after calculating the mean ratings for each emotion per participant, I determined a sensitivity index by subtracting the mean of all the non-target emotions from the target one. The calculation of the sensitivity index for anger and fear in Chinese music excluded the ratings of each other, as the labelled Chinese angry music excerpts were rated relatively high in both anger and fear, as observed in Study 1 (Chapter 5).

7.3.1 The Big Five personality traits relate to the cross-cultural emotion recognition sensitivity

To investigate the influence of personality traits, I first conducted a parallel multiple mediator model for each sensitivity index of each emotion for Chinese and Western music respectively, with the Big Five dimensions as mediators, following the statistical diagram illustrated in Figure 10.

Figure 10. Statistical diagram of the parallel multiple mediator model, with cultural background as antecedent variable X (Westerner = 0, Chinese = 1), sensitivity index as consequent variable Y , the five BFI factors as mediators M s, and age, gender, dummy coded musical background setting professional musician as the reference group, as covariates C s.



The analysis of the indirect effects of the Big Five was based on 5000 bootstrap samples for percentile bootstrap confidence intervals at a level of 95% (Hayes, 2013), with the existence of indirect effects determined through 0 not being covered by the 95% bootstrap confidence interval.

7.3.1.1 Chinese music

Table 14 (A, B, C, D, E). Total, direct, and indirect effects of cultural background on recognition sensitivity for each emotion in Chinese Music.

A. Happiness				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	0.628	0.122	0.388	0.869
Direct	0.683	0.124	0.438	0.927
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.054	0.047	-0.152	0.039
Extraversion	-0.005	0.010	-0.032	0.010
Agreeableness	-0.030	0.020	-0.079	0.001
Conscientiousness	-0.012	0.015	-0.047	0.013
Neuroticism	-0.028	0.028	-0.087	0.025
Openness	0.021	0.030	-0.033	0.091
B. Sadness				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	0.594	0.116	0.366	0.822
Direct	0.576	0.122	0.337	0.815
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	0.018	0.040	-0.061	0.095
Extraversion	-0.007	0.012	-0.036	0.013
Agreeableness	0.003	0.013	-0.022	0.030
Conscientiousness	0.003	0.013	-0.025	0.033
Neuroticism	0.006	0.027	-0.049	0.060
Openness	0.013	0.020	-0.021	0.058
C. Peacefulness				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	-0.247	0.109	-0.460	-0.033
Direct	-0.180	0.113	-0.401	0.042
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.067	0.044	-0.157	0.016

Extraversion	-0.013	0.018	-0.055	0.018
Agreeableness	-0.021	0.017	-0.060	0.004
Conscientiousness	-0.004	0.014	-0.033	0.025
Neuroticism	-0.039	0.029	-0.103	0.015
Openness	0.009	0.015	-0.015	0.046
D. Anger				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	-0.400	0.124	-0.644	-0.156
Direct	-0.361	0.130	-0.618	-0.105
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.039	0.042	-0.121	0.043
Extraversion	-0.007	0.013	-0.037	0.014
Agreeableness	0.000	0.014	-0.027	0.032
Conscientiousness	-0.013	0.015	-0.049	0.012
Neuroticism	-0.027	0.030	-0.088	0.031
Openness	0.008	0.013	-0.016	0.037
E. Fear				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	-0.878	0.124	-1.122	-0.635
Direct	-0.788	0.128	-1.039	-0.537
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.091	0.049	-0.190	0.003
Extraversion	-0.006	0.011	-0.034	0.011
Agreeableness	-0.011	0.015	-0.045	0.016
Conscientiousness	0.004	0.014	-0.025	0.035
Neuroticism	-0.092	0.036	-0.168	-0.030
Openness	0.015	0.021	-0.025	0.061

In Chinese music, no total indirect effects of cultural background through the Big Five on the recognition sensitivity of any of the emotions were found, though a direct effect of cultural background on the recognition sensitivity of happiness, sadness, anger, and fear, and a specific indirect effect on fear through Neuroticism, were observed.

Specifically, in Table 14A, the Chinese group was estimated to exhibit greater sensitivity to happiness compared to the Western group, with an estimated difference of

0.683 units through the direct c' path (confidence interval: [0.438, 0.927]). However, the difference through any of the Big Five personality dimensions was not statistically significant. Consequently, the total indirect effects of cultural background through the Big Five were too small to be significant, with a value of -0.054 and a confidence interval ranging from -0.152 to 0.039.

Similarly, Table 14B shows that the Chinese group was estimated to be more sensitive than the Western group by 0.576 units to the recognition of sadness through the direct c' path [0.337, 0.815]. However, the difference through any of the Big Five was not significant, resulting in the total indirect effects of cultural background through the Big Five being too small (0.018) to be significant [-0.061, 0.095].

Conversely, Table 14C shows no direct effect of cultural background [-0.401, 0.042] and no indirect effects through any of the Big Five on the recognition sensitivity of peacefulness, resulting in the total indirect effects being non-significant [-0.157, 0.016].

Table 14D shows that the Chinese group was estimated to be 0.361 units less sensitive to anger than the Western group through the direct c' path [-0.618, -0.105]. However, no statistically significant differences were observed through any of the Big Five dimensions. Thus, the total indirect effects of cultural background through the Big Five were too small (-0.039) to be significant [-0.121, 0.043].

In Table 14E, it is found that the Chinese group was estimated to be less sensitive to fear than the Western group, with a difference of 0.788 units through the direct c' path (confidence interval: [-1.039, -0.537]). The total indirect effects of cultural background through the Big Five were not significant, with a confidence interval of [-0.190, 0.003]. However, a specific negative indirect effect of -0.092 was observed in the path through Neuroticism [-0.168, -0.030]. Specifically, Chinese participants exhibited lower sensitivity to fear by 0.092 units compared to Western participants, attributed to the lower neuroticism in Chinese participants ($a_{cfn} = -0.355, p < .001$), which positively correlated with one's recognition sensitivity of fear ($b_{cfn} = 0.259, p = 0.002$).

7.3.1.2 Western music

Table 15 (F, G, H, I, J). Total, direct, and indirect effects of cultural background on recognition sensitivity for each emotion in Western Music.

F. Happiness				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	-0.310	0.140	-0.585	-0.035
Direct	-0.161	0.139	-0.433	0.111
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.149	0.062	-0.276	-0.031
Extraversion	-0.010	0.015	-0.045	0.014
Agreeableness	-0.044	0.026	-0.101	0.001
Conscientiousness	-0.021	0.019	-0.066	0.007
Neuroticism	-0.104	0.041	-0.193	-0.034
Openness	0.029	0.040	-0.046	0.115
G. Sadness				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	-0.218	0.124	-0.461	0.025
Direct	-0.115	0.125	-0.362	0.131
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.103	0.050	-0.205	-0.009
Extraversion	-0.016	0.021	-0.063	0.022
Agreeableness	-0.028	0.019	-0.074	0.001
Conscientiousness	-0.007	0.015	-0.044	0.018
Neuroticism	-0.072	0.032	-0.141	-0.015
Openness	0.020	0.028	-0.033	0.082
H. Peacefulness				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	-0.156	0.115	-0.382	0.070
Direct	-0.109	0.118	-0.341	0.122
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.046	0.044	-0.138	0.040
Extraversion	-0.007	0.012	-0.036	0.012

Agreeableness	-0.024	0.017	-0.064	0.003
Conscientiousness	0.012	0.015	-0.013	0.047
Neuroticism	-0.046	0.030	-0.113	0.005
Openness	0.018	0.026	-0.029	0.076
I. Anger				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	-0.198	0.120	-0.433	0.037
Direct	-0.149	0.124	-0.393	0.095
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.049	0.046	-0.141	0.040
Extraversion	-0.013	0.018	-0.054	0.018
Agreeableness	-0.002	0.014	-0.032	0.029
Conscientiousness	-0.019	0.017	-0.058	0.006
Neuroticism	-0.030	0.031	-0.099	0.027
Openness	0.015	0.021	-0.024	0.063
J. Fear				
Total & Direct				
	Effect	SE	LLCT	ULCI
Total	-0.938	0.116	-1.166	-0.711
Direct	-0.852	0.119	-1.086	-0.618
Indirect				
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.087	0.045	-0.175	-0.000
Extraversion	-0.012	0.017	-0.049	0.018
Agreeableness	-0.013	0.014	-0.047	0.011
Conscientiousness	-0.003	0.013	-0.032	0.025
Neuroticism	-0.074	0.033	-0.147	-0.017
Openness	0.015	0.021	-0.026	0.061

In Western music, a direct effect of cultural background was only observed on the recognition sensitivity of fear, while a (total) indirect effect of cultural background, all through Neuroticism, on the recognition sensitivity of happiness, sadness, and fear, was found, respectively.

Specifically, in Table 15F, a direct effect of cultural background on the recognition sensitivity of happiness was not observed [-0.433, 0.111]. However, a significant total indirect effect of cultural background through the Big Five was significant [-0.276, -0.031],

primarily driven by a negative specific indirect effect of -0.104 through Neuroticism [-0.193, -0.034]. Specifically, Chinese participants were less sensitive than Western participants by 0.104 units in recognising happiness. This difference was caused by Chinese participants' lower neuroticism ($a_{whn} = -0.355, p < .001$), which, in turn, was positively related to one's recognition sensitivity of happiness ($b_{whn} = 0.291, p = .002$).

Similarly, in Table 15G, there was no direct effect of cultural background on the recognition sensitivity of sadness [-0.362, 0.131]. However, a significant total indirect effect of cultural background through the Big Five was observed [-0.205, -0.009]. The specific indirect effect contributing to this total effect was negative, with a value of -0.007, through Neuroticism [-0.141, -0.015]. Specifically, Chinese participants were less sensitive than Western participants by 0.007 units in recognising sadness. This difference was attributed to Chinese participants' lower neuroticism ($a_{wsn} = -0.355, p < .001$), which was positively related to one's recognition sensitivity of sadness ($b_{wsn} = 0.202, p = .015$).

In Table 15H, there was no direct effect of cultural background on the recognition sensitivity of peacefulness, with a confidence interval of [-0.341, 0.122]. Additionally, no indirect effects through any of the Big Five personality dimensions were observed, leading to non-significant total indirect effects [-0.138, 0.040].

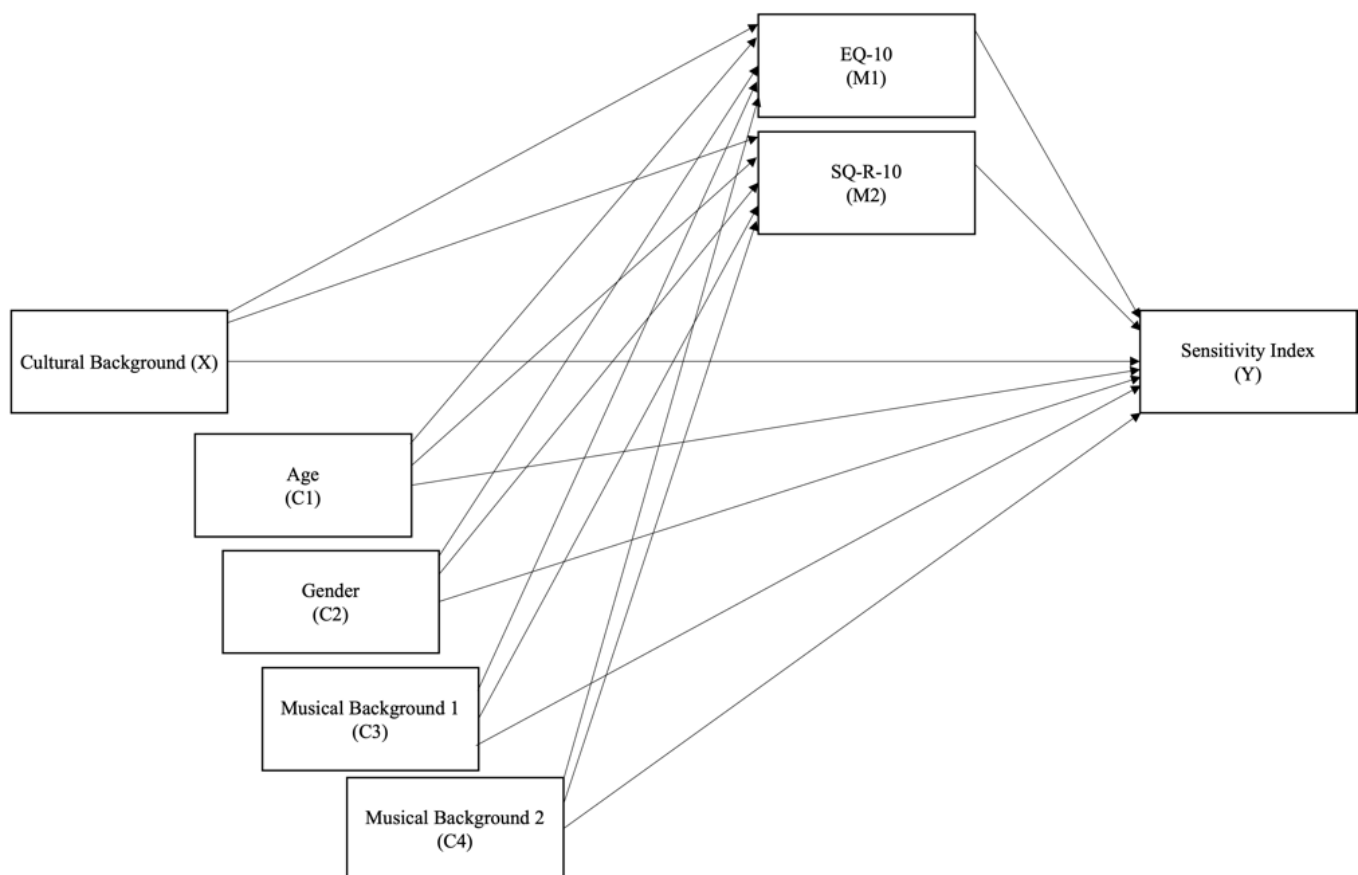
Similarly, in Table 15I, no direct effect of cultural background on the recognition sensitivity of anger was identified, with a confidence interval of [-0.393, 0.095]. The analysis revealed no indirect effects through any of the Big Five, resulting in non-significant total indirect effects [-0.141, 0.040].

Table 15J shows that the Chinese group was estimated to be less sensitive than the Western group by 0.852 units to the recognition of fear through the direct c' path [-1.086, -0.618]. The total indirect effects of cultural background through the Big Five was significant [-0.175, -0.0003], with the only specific indirect effect shown as negative (-0.074) in the path through Neuroticism [-0.147, -0.017]. Specifically, Chinese participants were less sensitive than Western participants by 0.074 units to the recognition of fear, as a result of Chinese participants' lower neuroticism ($a_{wfn} = -0.355, p < .001$), which was positively related to one's recognition sensitivity of fear ($b_{wfn} = 0.208, p = .009$).

7.3.2 Correlation of the empathising-systemising cognitive styles with emotion recognition sensitivity

To investigate the influence of the empathising-systemising cognitive styles, I first conducted a parallel multiple mediator model for the average emotion recognition sensitivity index for Chinese and Western music respectively, with the Empathy Quotient (EQ-10) and the Systemising Quotient-Revised (SQ-R-10) as mediators, following the statistical diagram illustrated in Figure 11.

Figure 11. Statistical diagram of the parallel multiple mediator model, with cultural background as antecedent variable X (Westerner = 0, Chinese = 1), sensitivity index as consequent variable Y , the Empathy Quotient (EQ-10) and the Systemising Quotient-Revised (SQ-R-10) as mediators M s, and age, gender, dummy coded musical background setting professional musician as the reference group, as covariates C s.



The analysis of the indirect effects of the Empathy Quotient (EQ-10) and the Systemising Quotient-Revised (SQ-R-10) was based on 5000 bootstrap samples for percentile bootstrap confidence intervals at a level of 95% (Hayes, 2013). The existence of indirect effects was determined through 0 not being covered by the 95% bootstrap confidence interval.

Table 16. Total, direct, and indirect effects of cultural background on the average emotion recognition sensitivity for Chinese and Western music respectively.

Chinese Music				
	Total & Direct			
	Effect	SE	LLCT	ULCI
Total	-0.061	0.076	-0.210	0.089
Direct	-0.041	0.075	-0.188	0.106
	Indirect			
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.019	0.018	-0.058	0.017
EQ-10	-0.020	0.017	-0.055	0.011
SQ-R-10	0.001	0.006	-0.012	0.015
Western Music				
	Total & Direct			
	Effect	SE	LLCT	ULCI
Total	-0.364	0.087	-0.534	-0.194
Direct	-0.345	0.085	-0.512	-0.178
	Indirect			
	Effect	BootSE	BootLLCI	BootULCI
Total	-0.019	0.020	-0.061	0.020
EQ-10	-0.020	0.017	-0.057	0.012
SQ-R-10	0.001	0.009	-0.018	0.020

From Table 16, it can be seen that there was no indirect effect of cultural background on the average emotion recognition sensitivity for Chinese music, through EQ-10 [-0.055, 0.011] or SQ-R-10 [-0.012, 0.015]. Likewise, for the average emotion recognition sensitivity for Western music, there was also no indirect effect of cultural background through EQ-10 [-0.057, 0.012] or SQ-R-10 [-0.018, 0.020]. Overall, neither the Empathy Quotient (EQ-10) nor the Systemising Quotient-Revised (SQ-R-10) mediated the relationship between cultural

background and the average emotion recognition sensitivity for Chinese and Western music. However, upon examining the coefficients of EQ-10 and SQ-R-10, it was found that EQ-10 positively influenced the average emotion recognition sensitivity for both Chinese ($b_{ceq} = 0.032, p < .001$) and Western music ($b_{weq} = 0.032, p < .001$), while SQ-R-10 did not have an effect on both Chinese ($b_{csq} = 0.012, p = .168$) and Western music ($b_{wsq} = 0.020, p = .053$).

Table 17. Correlations between EQ-10 and SQ-R-10, and the average emotion recognition sensitivity for Chinese (c_sen) and Western music (w_sen) respectively.

Cultural Background			c_sen	w_sen
Chinese	EQ-10	Pearson Correlation	.247**	.239**
		Sig.	<.001	<.001
	SQ-R-10	Pearson Correlation	.025	.071
		Sig.	.726	.310
Westerner	EQ-10	Pearson Correlation	.201**	.190**
		Sig.	.003	.005
	SQ-R-10	Pearson Correlation	.139*	.130
		Sig.	.042	.057

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

A correlation analysis between EQ-10 and SQ-R-10, and the average emotion recognition sensitivity for Chinese (c_sen) and Western music (w_sen), respectively, was further conducted to investigate the effect of the empathising-systemising cognitive styles, ruling out the redundant factor—cultural background (as discussed above). The results are presented in Table 17. It shows that for the Chinese participants, those scoring higher in the Empathy Quotient may be more sensitive to the recognition of emotion in both Chinese ($r = .247, p < .001$) and Western music ($r = .239, p < .001$) compared to those scoring lower, while participants differing in the Systemising Quotient-Revised performed indifferently in the recognition of emotion in both Chinese and Western music (both $p > .05$). For the Western participants, those scoring higher in the Empathy Quotient may also be more sensitive to the recognition of emotion in both Chinese ($r = .201, p = .003$) and Western music ($r = .190, p = .005$), while participants scoring higher in the Systemising Quotient-Revised were only more sensitive to the recognition of emotion in Chinese music ($r = .139, p = .042$), but made no difference for Western music ($p = .057$), compared to those scoring lower.

7.3.3 Cultural difference in the association between psychoacoustic features and emotion recognition sensitivity

To analyse how psychoacoustic features may associate with listeners' recognition sensitivity to musically expressed emotions cross-culturally, I followed the method employed in Egermann et al. (2015) and Lyu and Egermann (in press). All psychoacoustic descriptors, including pitch, event density, roughness, the centroid of the frequency spectrum, RMS energy, brightness, and mode, were extracted from all 18 music excerpts using the MIR Toolbox 1.8.1 (Lartillot et al., 2008), and tempo was obtained using the web-based BPM-tracker, as described in Study 1 (Chapter 5). All psychoacoustic descriptors estimated for each of the 18 musical stimuli can be found in Appendix 1 (also available in Lyu and Egermann, in press). To balance the recognition sensitivity parameters for Chinese and Western music in the subsequent regression analysis, the psychoacoustic descriptors for Chinese angry music were also applied to the music corresponding to the recognition sensitivity of fear in Chinese music. This decision is based on the findings from Study 1 (Chapter 5), which showed similarly high ratings of both anger and fear for Chinese angry music. These findings suggest that music labelled as "angry" could, in practice, be classified as either angry or fearful. Subsequently, all the estimated psychoacoustic parameters were entered into a principal component analysis to reduce the number of predictor variables and their collinearity. The resulting component loadings for the principal component analysis are shown in Table 18.

Table 18. Component Loadings for the Principal Component Analyses of Psychoacoustic Features for Emotion Sensitivity Indices for all emotions in both Chinese and Western music ($n = 20$).

Rotated Component Matrix ^a						
	Component					
	1	2	3	4	5	6
Centroid	.969				-.104	.169
Brightness	.952				-.263	
Roughness		.966	.149			
RMS Energy		.942				.265
Event Density		.112	.991			
Mode				.995		
Pitch	-.339				.925	.153
BPM	.173	.358			.165	.896

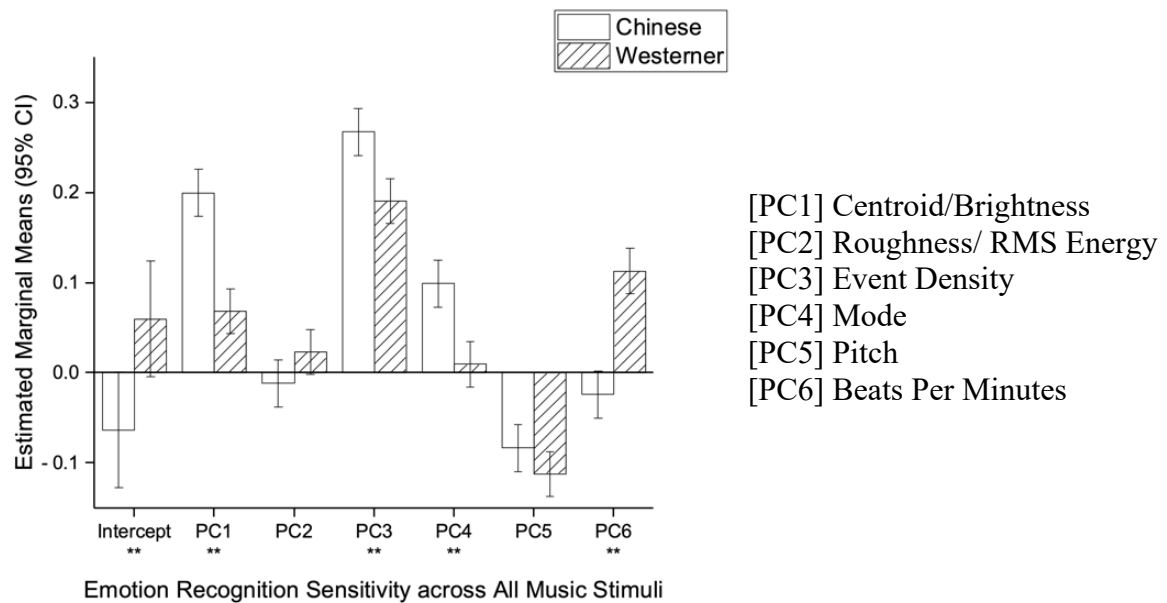
Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.^a

a. Rotation converged in 5 iterations.

Third, a hierarchical linear regression was conducted for all musical stimuli separately for the Chinese and Western group. The six obtained principal components [PC1-6] were used as predictor variables, and the emotion recognition sensitivity index served as the outcome variable. All variables were z-standardised before the regression. Additionally, a third regression model was run, incorporating the dummy-coded variable cultural background, with the Western group as the reference group. This was done to estimate significant cultural differences through the interaction effects between cultural background and all other predictors. Figure 12 presents the estimated fixed effect coefficients for the psychoacoustic PCs. The significance of the predictors was determined by that the 95% confidence interval (error bar) did not cross the zero line. Asterisks were used to indicate significant differences in the fixed effects estimated for the Chinese and Western groups.

Figure 12. Error bar graphs of the fixed effects estimated for the psychoacoustic PCs for all the musical stimuli. Asterisks indicate the significance of fixed effect differences between the Chinese and Western groups: $*p < .05$, $**p < .01$ (two-sided independent samples *t*-tests).



Through reference to Figure 12, the number of psychoacoustic PCs associated with listeners' emotion recognition sensitivity was equal between the Chinese and Western group. Significant associations were observed between PC1, PC3, PC4, and PC5, and the emotion recognition sensitivity of the Chinese group. For the Western group, the associations were significant for PC1, PC3, PC5, and PC6. The Chinese group generally exhibited stronger responses to these psychoacoustic features than the Western group, showing larger effect sizes in PC1, PC3, and PC4, while smaller effect sizes in PC6, compared to the Western group.

7.3.4 Empathising cognitive style relates to the cultural difference in the association between psychoacoustic features and emotion recognition sensitivity

To investigate the hypothesis that the cultural difference in the association between psychoacoustic features and emotion recognition sensitivity is attributable to the effect of cognitive styles, a mediation analysis with the cognitive style component as the mediator of

the relationship between cultural background and the association between psychoacoustic features and emotion recognition sensitivity was intended to be carried out. Given the recognition sensitivity repeatedly measured against each musical excerpt featuring all the psychoacoustic PCs analysed above, a 2-2-1 designed multilevel mediation analysis was conducted, with the Level 2 variable cultural background (with the Western group as the reference group) as the antecedent variable, the Level 1 variable—the correlation between the psychoacoustic features and the recognition sensitivity—as the outcome variable, and the Level 2 variables, including the AHS Locus of Attention (LOA), and the Empathising Quotient (EQ-10) and the Systemising Quotient-Revised (SQ-R-10), separately considered as the mediator. This analysis was carried out using the two-step approach (Preacher et al., 2010), also known as the product-of-coefficients approach (Zhang et al., 2009). To implement this approach, the recognition sensitivity was first divided by each psychoacoustic feature to obtain a new variable, COE (coefficient), representing the correlation between the psychoacoustic feature and the recognition sensitivity. In the two-step approach, the first step was to obtain the coefficient a through estimating the 2-2 part of the 2-2-1 design using OLS (ordinary least squared) regression on the cognitive style component by cultural background, and the second step was to obtain the coefficient b using a hierarchical linear model, with cultural background and the cognitive style component both as predictor variables, and COE as the outcome variable. All the cognitive style scores were grand-mean centred (Zhang et al., 2009). To control the other-than-cultural factors, Level 2 variables, age, gender, and musical background, were also included into the analysis as covariates.

The results of the OLS regression revealed that cultural background (unstandardised B: 0.071, $SE = 0.124$, $p = .568$) did not have an effect on the LOA score, suggesting there was no cultural difference found in the LOA in this study. Similarly, there was also no cultural difference in the SQ-R-10 (unstandardised B: 0.047, $SE = 0.091$, $p = .603$). However, a significant cultural difference in the EQ-10 (unstandardised B: -0.633, $SE = 0.107$, $p < .001$). Based on this, the second step was continuously tested with the EQ-10 as the Level 2 mediator of the relationship between cultural background and the association between psychoacoustic features and emotion recognition sensitivity. The indirect effect $a \times b$ was calculated using the Sobel test (Sobel, 1982) via an online interactive calculator for Sobel test developed by Kristopher J. Preacher and Geoffrey J. Leonardelli. The coefficient a for the cultural background in the OLS regression, and the coefficient c' for the cultural background and b for all the psychoacoustic features are displayed in Table 19.

Table 19. The unstandardised coefficients representing path *a* and path *b* of the indirect effect, and path *c* ' of the direct effect of cultural background on COE for each psychoacoustic PC via EQ-10.

OLS				HLM							Sobel Test			Indirect Effect
DV	<i>a</i>	Std. Error	<i>p</i> -value	DV	<i>c'</i>	Std. Error	<i>p</i> -value	<i>b</i>	Std. Error	<i>p</i> -value	statistic	Std. Error	<i>p</i> -value	<i>a</i> x <i>b</i>
EQ-10	-0.633	0.107	<.001	COE_PC1	0.274	0.061	<.001	-0.018	0.006	.004	2.615	0.004	.009	0.012
				COE_PC2	0.154	0.117	.187	-0.050	0.012	<.001	3.436	0.009	<.001	0.032
				COE_PC3	0.169	0.055	.002	-0.014	0.006	.014	2.273	0.004	.023	0.009
				COE_PC4	0.281	0.053	<.001	-0.019	0.005	<.001	3.042	0.004	.002	0.012
				COE_PC5	0.104	0.051	.042	-0.021	0.005	<.001	3.339	0.004	<.001	0.013
				COE_PC6	-0.191	0.047	<.001	0.003	0.005	.604	-0.517	0.003	.605	-0.002

Table 19 indicates that cultural background had a positive indirect effect on the association between emotion recognition sensitivity and each psychoacoustic PCs (all $a \times b > 0$, $p < .05$), except for PC6 ($a \times b = -0.002$, $p = .605$), through empathising cognitive style. Specifically, it can be seen that Chinese group scored lower empathy than the Western group ($a = -0.633$, $p < .001$), while lower empathy resulted in stronger association between emotion recognition sensitivity and the psychoacoustic PC1-PC5 (all $b < 0$, all $p < .05$), and thus the corresponding recognition-psychoacoustic association was presented stronger in the Chinese group than the Western group (all $c' > 0$, all $p < .05$, except for PC2).

7.4 Discussion

The results of the parallel multiple mediation analysis examining the relationship between the cultural difference in personality traits and the cultural difference in emotion recognition in music showed both similarities and differences between Chinese and Western music. Firstly, the direct effects of cultural background on emotion recognition sensitivity, as observed in happiness, sadness, anger, and fear in Chinese music, and fear in Western music, were in line with the findings in Study 2 (Chapter 6), indicating significant cultural differences in the recognition sensitivity to happiness, sadness, anger, and fear in Chinese music, and to fear in Western music. This indicated a cultural difference in recognising different emotions across different cultures of the music. Additionally, the indirect effect of cultural background was only observed in the recognition of fear in Chinese music, while in Western music, the indirect effect was found in happiness, sadness, and fear. Remarkably, all these indirect effects were mediated by Neuroticism. Specifically, these results suggested that the lower recognition sensitivity to fear in Chinese music, and to happiness, sadness, and fear in Western music for the Chinese group, can be attributed to their lower neuroticism. This is because neuroticism was found to be positively correlated with the recognition sensitivity of these emotions, as compared to the Western group. The correlation between neuroticism and recognition sensitivity of happiness appeared to be not trait-congruent, as also observed in Vuoskoski and Eerola (2011a), in which extraversion was found to be positively associated with the experienced sadness. According to personality theory, it was previously suggested that extraversion indicates a tendency to experience positive emotions, while neuroticism refers to a tendency to experience negative emotions (John & Srivastava, 1999; Larsen &

Ketelaar, 1991; Matthews et al., 1990; Rusting & Larsen, 1997). Previous researchers also interpreted this phenomenon as being related to the notion that extraverted participants seemed to find better applicability of discrete emotion scales for their experienced emotions, compared to other emotion scales tested (e.g., dimensional), reflecting a high valence focus. However, in this current study, a more plausible explanation would be the positive correlation between Neuroticism and Sensory Processing Sensitivity found in both children and adults (Lionetti et al., 2019). Sensory Processing Sensitivity is defined as a personality trait that captures individual differences in sensitivity to negative and positive environmental stimuli, and it is linked to brain regions related to empathy (Bas et al., 2021; Lionetti et al., 2019). This suggests that higher neuroticism may lead to a generally heightened sensitivity to emotional changes, as reflected in the mediating effect of neuroticism on the association between cultural background and emotion recognition sensitivity discussed above. In contrast to this, Juslin et al.'s (2011) statement regarding the higher predictive power of Emotional Stability (i.e., Neuroticism) in predicting specific emotions, which was hypothesised to be linked to its ability to distinguish between positive and negative emotions, did not align with the findings in the current study. This discrepancy arises as all the observed indirect effects of Neuroticism in this study were negative, irrespective of the type of emotions.

The parallel multiple mediation analysis showed that empathising and systemising cognitive styles both did not mediate the relationship between cultural background and emotion recognition sensitivity. However, correlation analysis indicated a positive correlation between the average emotion recognition sensitivity and empathising cognitive style for both cultural groups in both Chinese and Western music, and a positive correlation with systemising cognitive style for the Western group in Chinese music. This shows that listeners' bias towards empathising cognitive style, regardless of their cultural background, were generally more sensitive to the recognition of emotions represented in both Chinese and Western music. This suggests that the positive correlation between empathy and general emotional sensitivity (Baron-Cohen et al., 2003; Baron-Cohen & Wheelwright, 2004), is also applicable to musically-expressed emotions. Although the correlation between systemising cognitive style and emotion recognition sensitivity was only significant in Chinese music for the Western group, it was also close to statistical significance in Western music. This suggests a higher tendency for Western listeners to decode emotions from music by analysing musical structures, especially when listening to the music of another culture, such as Chinese music in this case. This phenomenon may be interpreted in relation to the perceptual habits of

Western listeners, who utilise the structural characteristics to process information conveyed in music. These habits are shaped through their long-term immersion in the Western music tradition, characterised by rigorous structure (Wang et al., 2022; Yin, 2010), and the emphasis on Western culture-specific features, such as the major-minor mode (Lyu & Egermann, in press; Study 1, Chapter 5).

This study also explored how psychoacoustic features in music are associated with listeners' emotion recognition sensitivity. Through hierarchical linear regression, it was found that the number of psychoacoustic features associated with listeners' emotion recognition sensitivity was the same between Chinese and Western groups. However, the correlation between psychoacoustic features and emotion recognition sensitivity appeared to be stronger for the Chinese group than for the Western group. This reflects both similarities and differences with the findings in Lyu and Egermann (in press) (Study 1, Chapter 5), where Chinese listeners responded to a greater number and higher level of psychoacoustic features when recognising emotions through music, regardless of the culture of the music. In this study, the prerequisite for examining the potential effect of holistic-analytic cognitive styles on the cultural difference in the association between psychoacoustic features and emotion recognition sensitivity in music disappeared, as the number of psychoacoustic features associated with emotion recognition was equal between the Chinese and Western groups. Furthermore, the regression analysis revealed no cultural difference in the holistic-analytic or systemising cognitive styles in this study. However, a cultural difference was observed in the empathising cognitive style. The subsequent multilevel mediation analysis showed that the empathising cognitive style mediated the relationship between cultural background and the association between emotion recognition sensitivity and all the psychoacoustic PCs, except for PC6. Coefficients in the equations involved with the corresponding psychoacoustic PC1 to PC5, indicated that the stronger recognition-psychoacoustic association in the Chinese group was linked to their lower empathising cognitive style, compared to the Western group. According to the Music-empathising-systemising (ME-MS) theory (Kreutz, Schubert, et al., 2008), empathisers favour the perception of emotional content over the perception of musical structure and technical aspects, while systemisers do the opposite. While the effect of systemising cognitive style on the recognition-psychoacoustic association was not observed, primarily because there was no cultural difference in systemising found in this study, the negative correlation of the empathising cognitive style may serve as an indirect indicator of a

potential positive correlation with the systemising cognitive style. However, this warrants further research.

7.5 Limitations

The sample size was still too small to enable generalising the findings based on the cultural differences observed in personality traits or cognitive styles from this study, though the results had already demonstrated the significance of considering individual differences in personality traits and cognitive styles in the exploration of cross-cultural studies on music emotion recognition.

7.6 Conclusion

This study suggested that the cultural difference in emotion recognition in music may be explained by the personality trait Neuroticism. The empathising-systemising cognitive styles were also related to listeners' recognition of musically expressed emotions, though the correlations differed between different cultural groups and music cultures. The psychoacoustic features associated with emotion recognition in music were different cross-culturally in quality, but not in quantity. The cultural difference in the association between psychoacoustic features and emotion recognition was related to the cultural difference in the empathising cognitive style. Overall, this study helps to find a research direction for explaining the cultural differences in music emotion recognition from the perspectives of personality traits and cognitive styles.

Chapter 8. General Discussion

This thesis consists of three main experimental studies, accompanied by two pilot studies. Studies 2 and 3 built upon the findings of Study 1, aiming to re-test certain results, explore potential explanations, and examine interpretations and hypotheses raised in Study 1. This thesis first identifies notable cultural differences in the recognition of musically expressed emotions and the associated psychoacoustic features, and subsequently explores potential explanations for these differences based on individual factors. More broadly, the cultural differences observed in this thesis have important implications for the cross-cultural understanding of emotions in music, as they highlight the role of cultural background in shaping emotional responses. Such knowledge can foster greater awareness and respect for musical expressions from different cultures. Recognising these disparities encourages a more patient and open-minded engagement with unfamiliar musical traditions. It prompts us to ask questions and seek to understand the cultural contexts that give rise to these differences, similar to how this thesis explores the influence of individualist and collectivist cultures, as reflected in personality traits and cognitive styles. This exploration can lead to deeper conversations and connections, as we share our own musical experiences and learn from those of others. At a practical level, recognising these differences can be applied in music therapy to tailor culturally sensitive interventions, thereby improving their effectiveness in diverse settings. Additionally, music education programs can integrate these insights to develop curricula that respect and address different emotional interpretations, promoting greater intercultural competence or facilitating appropriate assessments of music perception abilities among students, particularly in international education contexts. For composers, an awareness of these cultural differences can guide the selection of musical elements that express specific emotions, enhancing the intercultural communication of diverse musical styles. In this chapter, the key findings from all three studies will be discussed, synthesised, and summarised thematically, where appropriate.

8.1 Universality of Basic Emotions

The analysis of emotion recognition in music in both Study 1 and 2 indicated that the four or five target emotions could be recognised from the corresponding musical expressions in both

Chinese and Western music, despite some confusion between anger and fear. This has been interpreted in relation to the shared negative valence and high arousal between anger and fear (Russell, 1980), as well as the similar psychoacoustic features and musical characteristics involved in the expression of these two emotions in music (Coutinho & Dibben, 2013b; Hailstone et al., 2009). Results from both studies indicated that, despite nuanced confusion between anger and fear as mentioned above, basic emotions represented through music can be recognised cross-culturally. In other words, both Chinese and Western listeners demonstrated an overall sensitivity to the investigated basic emotions conveyed by both Chinese and Western music. In Study 1, listeners' sensitivity to an emotion was determined by whether their highest ratings lay on the corresponding emotional music. In contrast, in Study 2, listeners' sensitivity to an emotion was measured through the sensitivity index. This index was obtained by subtracting the mean of the non-target emotions from the rating of the target emotion, and one's sensitivity to an emotion was determined by the sensitivity index being larger than zero. This has been discussed in *Section 6.3* of Study 2 (Chapter 6), although the focus of this analysis conducted in Study 2 was to re-test the existence of the in-group advantage assumption, similar to Study 1.

An interesting finding related to the universality of basic emotions is that the average recognition sensitivity for different emotions demonstrated different patterns between Chinese and Western music, as illustrated in Study 2 (Chapter 6). Regardless of the type of groups separated, the average recognition sensitivity for happiness, sadness, peacefulness, anger, and fear shows distinct patterns in Chinese and Western music: a “U” shape for Chinese music, characterised by a decrease from happiness to peacefulness, followed by a slight increase for anger and fear; and an overall linear downward trend for Western music, reflecting a consistent reduction across these emotions. These results are partially in line with previous findings. For example, peacefulness conveyed in Hindustani ragas was reported to be less recognisable for Canadian listeners, compared to joy, sadness, or anger (Balkwill & Thompson, 1999; Ma, Yang, et al., 2017). This can be analogous to the relatively lower sensitivity to peacefulness for Western listeners in Chinese music observed in Study 2 of this thesis. As discussed above, the relatively lower sensitivity to peacefulness was observed in Chinese music across all groups categorised by cultural background, gender, and musical background. Similarly, in Western music, all groups, whether categorised by cultural background, gender, or musical background, demonstrated relatively lower sensitivity to fear. However, in both Chinese and Western music, listeners, on average, were shown to

demonstrate an overall higher sensitivity to happiness. All the above findings imply different abilities of Chinese and Western music in expressing different emotions, though both are proficient at communicating happiness.

This thesis is grounded in the basic emotion theory, and the findings from empirical Studies 1 and 2, as summarised above, have provided additional evidence in support of this theory. Overall, it can be concluded that the basic emotions investigated, as expressed in Chinese and Western music, can be recognised cross-culturally, although the recognition may vary depending on the emotion and the musical culture. This supports the basic emotion theory in the sense that the so-called basic emotions are shown to be universally recognisable and categorically perceivable (Juslin, 2013b). However, it should be noted that the support for this theory in this thesis is far from all-encompassing, as it considers basic emotions only in terms of their discrete or categorical conception, without claiming that the basic emotion theory is impeccable. Particularly in response to criticisms of basic emotion theory (e.g., Barrett, 2006; Barrett & Kensinger, 2010; Colombetti, 2014; Ortony, 2022; Ortony & Turner, 1990), I must acknowledge that this thesis does not address several key points of contention, such as the existence of “a limited number of innate and universal emotion categories, which are more biologically fundamental than others” (Juslin, 2013b, p. 5), that basic emotions have evolved due to adaptive goals for facing life tasks (Ekman, 1992a), or that they correspond to discrete brain regions (Kumfor et al., 2013; Saarimäki et al., 2016). These issues are beyond the scope of this thesis. Although many criticisms of basic emotion theory are not addressed in this thesis, I am convinced that there is still good reason to retain it in research on emotion (particularly in the field of music). This is because, as discussed above, this thesis has demonstrated that discrete and categorised emotions can be recognised across cultures. This finding aligns with the views of many proponents of the theory (Hutto et al., 2018; Scarantino & Griffiths, 2011) that the concept of basic emotions—subject to appropriate revisions or adjustments—still holds scientific value in constructing frameworks to understand emotions. Juslin (2013b) argued that, compared to the basic emotion approach, “no other emotion approach can nearly as convincingly account for” (p. 9) findings such as the higher cross-cultural agreement for basic emotions in music compared to non-basic emotions. This poses a challenge for other approaches, such as the dimensional approach, to explain “why some emotions are more easily expressed and recognized than others, if all emotions can be placed along the same continuous dimensions” (p. 9).

8.2 Cultural Advantage instead of In-group Advantage

As mentioned earlier, Study 1, using repeated measures ANOVA, showcased a cultural advantage for Chinese listeners in the recognition of happiness and sadness, and a cultural advantage for Western listeners in fear, compared to their respective counterparts, regardless of the cultural origin of the music. The significance of a cultural difference in the recognition of an emotion was determined by whether the group difference in the corresponding emotional music was significant. In contrast, the repeated measures ANOVA used in Study 2 was based on the sensitivity index, as described above, which included the calculation of ratings for both target and non-target emotions. The significance of a cultural difference in the recognition of an emotion was determined based on the indices calculated for each cultural group. Although the consistent cultural advantage in the recognition of happiness and sadness for the Chinese listeners found in Study 1 was not evident in Study 2, a cultural advantage in the recognition of fear for Western listeners was still observable. An incidental yet pertinent finding, although not the primary focus of Study 3, further supports this conclusion. Specifically, in Study 3, the mediation analysis examining the influence of personality traits on the relationship between cultural background and emotion recognition sensitivity uncovered direct effects of cultural background in specific instances. In Chinese music, Chinese participants exhibited higher sensitivity to happiness and sadness and lower sensitivity to anger and fear. Conversely, in Western music, Western participants demonstrated higher sensitivity to fear. In summary, the overall conclusion regarding the testing of the assumption of the existence of the in-group advantage remained unchanged—an in-group advantage could not be confirmed between the Chinese and Western contexts; instead, a cultural advantage for different emotions was observed. In addition, this finding aligns with the observation and conclusion made by Laukka and Elfenbein (2020). They conducted a meta-analysis of 37 cross-cultural studies on emotion recognition in vocal expression, suggesting that the in-group advantage varies across emotions.

Compared to the correct hit and accuracy rate analyses used in previous studies on the in-group advantage of cross-cultural music emotion recognition (e.g., Argstatter, 2016; Fritz et al., 2009), the method employed in the three studies of this thesis is more rigorous. Participants were tasked with evaluating each of the five provided emotions instead of selecting only one. This approach enabled participants to report on their perception of a broader range of emotions, expanding the potential for higher ratings in non-target emotions.

Consequently, it contributed to an enhancement of the standard for determining the existence of the in-group advantage. Additionally, comparing different types of ratings instead of simply calculating accuracy rates for target emotions represents a step forward beyond the baseline, capturing more nuanced advantages for a specific cultural group. In essence, my measurement of the in-group advantage in this study, utilising the concept of sensitivity instead of accuracy, is rooted in the significant gap between a passing level and a distinction level. This is because the analysis is not limited to whether recognition occurs but extends further to explore specific group differences, even when both groups achieve recognition.

8.3 Cultural Difference in Psychoacoustic Features

Involved

It has been suggested that, at the level of musical emotion perception, the impact of musical cultural experience depends primarily on the characteristics of the musical cues employed to express emotions in musical works (Ma, Yang, et al., 2017). Thus, in addition to the recognition of music emotions itself, this thesis places emphasis on psychoacoustic features associated with the process of recognising emotions in music. Overall, the findings of this thesis have shown cultural differences in the type, degree, and number of psychoacoustic features involved with emotion recognition.

In Study 1, the hierarchical linear regression showed a cultural difference in the psychoacoustic features associated with emotion recognition in music between Chinese and Western listeners. Specifically, participants of different cultures demonstrated the strongest responses to different psychoacoustic features, with the Chinese participants for timbre/loudness [PC2] and the Western participants for mode [PC4]. Cultural differences in the reliance on different psychoacoustic features have also been observed in previous studies, such as Midya et al. (2019), in which tonality was found to be able to best explain emotion ratings of the Indian listeners whereas rhythm was the primary predictor in non-Indian listeners. This has been interpreted in relation to the different uses of psychoacoustic attributes in the expression of emotions between Chinese and Western music, according to the explanation by Wang et al. (2022). They proposed that this cultural difference may be associated with the higher flexibility of the composition structure, represented in the more flexible uses of rhythmic and loudness-related psychoacoustic features in Chinese music,

compared to Western music. Similarly, the notably stronger responses to mode observed in this study among Western participants can also be linked to the musical features inherent in Western music. Specifically, in Western tonal music, consonance, often associated with major modes, typically indicates stability and a positive emotional tone, while dissonance, often associated with minor modes, is linked to tension, instability, and a negative emotional quality (Lahdelma & Eerola, 2020; Thompson & Balkwill, 2010). An ascending major third is described as conveying an enthusiastic, active expression of joy, while its minor counterpart is characterised as expressing feelings of pain, sorrow, and a protest against misfortune (Livingstone, 2021). This notion also originates from Western music culture.

Study 1 did not aim to examine the emotion-specific patterns of psychoacoustic cues employed to convey various emotions, as outlined by Juslin and Laukka (2003). Instead, the focus was on exploring more general distinctions among diverse cultural groups, music cultures, or genres in terms of the psychoacoustic features associated with music emotion recognition. For this, the analysis of psychoacoustic features in Study 1 included all music stimuli instead of conducting a separate analysis for different emotional music sets. Therefore, it was not surprising to find that, for example, Tempo [PC6] exhibited a negative correlation with the happiness ratings of both cultural groups. This is because happiness was also rated for angry music stimuli, but anger is characterised by a fast tempo. This reflects the fact that the same cue can be used in the same way in different emotional expressions, indicating that a single cue cannot be a perfect indicator of a specific emotion (Juslin & Laukka, 2003). In this regard, the analysis of psychoacoustic features in Study 1 was not suitable for drawing any conclusions about the association between specific psychoacoustic features and emotions. However, this analysis enabled the identification of a general group difference in the associations between listeners' emotion recognition and the psychoacoustic cues involved. This can be viewed as an indicator for the issue regarding listeners' use of psychoacoustic cues in the recognition of musically expressed emotions. As discussed above, Chinese and Western participants, respectively, have appeared to particularly rely on specific psychoacoustic features when recognising emotions in music. This seems to reflect the previously proposed characteristic of cue redundancy, whether it is in the cue-redundancy model proposed by Balkwill and Thompson (1999), or the lens model of music performance proposed by (Juslin, 1997b, 2000). The redundancy or intercorrelations among acoustic cues could explain why listeners are able to recognise emotions from music, despite having different usages of cues in this process. This is because, according to Juslin and Laukka

(2003, p. 802), “multiple cues that are partly redundant yield a robust communicative system that is forgiving of deviations from optimal code usage”.

Hierarchical linear regression was performed on the raw emotion ratings for Chinese and Western music separately in Study 1. The results indicated that Chinese participants exhibited a generally stronger response to psychoacoustic features. Moreover, the number of psychoacoustic features involved in emotion recognition in music for Chinese participants was greater compared to Western participants. This phenomenon was assumed to be attributed to cultural differences in the holistic-analytic cognitive styles, as suggested by previous findings (Balkwill, 2006; Thompson & Balkwill, 2010). This assumption has been subsequently tested in Study 3, which will be discussed later. Contrary to the findings in Study 1, hierarchical linear regression conducted in Study 2 on the average emotion recognition sensitivity across all music stimuli revealed no cultural difference in the number of psychoacoustic features involved between the Chinese and Western participants. However, similar to the results in Study 1, Chinese participants were also observed to exhibit a generally stronger response to the examined psychoacoustic features compared to Western participants. These findings have been linked to cultural differences in empathising cognitive styles rather than the hypothesised holistic-analytic cognitive styles. Further details about these interpretations have been provided in *Section 7.4*.

8.4 Distinct Cultural Differences between Chinese and Western Music

Additionally, as discussed in Chapter 5 and 6, both Study 1 and 2 revealed more cultural differences in Chinese music than in Western music, whether in the recognition of emotions or the psychoacoustic features involved. I have attempted to interpret these findings from historical and musicological perspectives. For example, according to Liu (2013), traditional Chinese music aesthetics has been profoundly shaped by the philosophical thinking of Confucianism and Taoism. This forms the foundation of the classical aesthetic consciousness of Chinese people, emphasising emotions without wildness, desire coupled with subtlety. In contrast, Western music pursues typicality, imagery, and climaxes. It is concerned with emotional catharsis, distinctive imagery, and clear structure. This perspective aligns partially with the interpretation proposed by Wang et al. (2022), regarding the distinct emotional

predictive abilities of different psychoacoustic features in different music cultures. Compared to Western music, Chinese music is characterised by more flexible rhythmic patterns used in composition, as discussed above. Overall, the implicit emotional expressions and loose structure of Chinese music, in contrast to the direct emotional expressions and the unified, systemised characteristics of Western music (Yin, 2010), might lead to more difficult acquisition and understanding of the emotional affective content communicated by Chinese music, especially for those not immersed in Chinese culture and music.

The explanation for distinct results in cultural differences between Chinese and Western music may also be enriched by incorporating insights from musicological discourses on the varied constructions of emotional expression characterised by these two music cultures. Although in both Chinese and Western cultures, music has long been believed to have the capacity to communicate emotions, as discussed in *Section 2.10*, the reasons or purposes behind the formation of the characteristic of emotional expressiveness differ between Chinese and Western music. It has been suggested that the prevalence of emotional expression in Western music can be traced back to its prolonged cultural integration. This integration likely improved the cultural transmission of musical features that serve as shared traits among diverse music cultures, making them more universally comprehensible (Fritz, 2013). In contrast, Chinese music initially served as a tool for promoting indoctrination and social stability, deeply influenced by the ideas of ritual and music in Confucianism (Lin, 2010; Liu, 2013), which exclusively takes root in Chinese culture. In summary, the construction of emotional expression in Western music aims to promote the integration of a wider range of cultures or sub-cultures, while the emotional expression in Chinese music originates from the reinforcement and consolidation of Chinese culture. Therefore, the different functions of the emotional expressiveness in Chinese and Western music may lead to more cultural differences in Chinese music, and accordingly less cultural differences in Western music, in the recognition of musically expressed emotions.

8.5 Advantage of Musical Background

Both Study 1 and Study 2 have demonstrated certain influences of musical background on cross-cultural emotion recognition in music. In Study 1, participants were categorised as either musicians or non-musicians based on whether they pursued a music-related major or

job, or had received at least ten years of musical training. The results in Study 1 indicated that Chinese participants were less sensitive to the recognition of fear than Western participants, but this difference was observed only in non-musicians, while no cultural difference was observed in musicians. This suggests an advantage in recognising fear for listeners with a Western cultural background; however, musical expertise may counteract this advantage. This finding has been interpreted as an advantage for musicianship in recognising emotions from a set of ambiguous musical expressions. Additionally, it is worth noting that, similar to Study 1 in this thesis, Argstatter (2016) also reported that the advantage for musicians in the recognition of emotional qualities in music was limited to specific music examples and thus could not represent a general pattern. Specifically, their study demonstrated higher correct hit rates for musicians in the recognition of some examples conveying happiness, sadness, and anger.

By more specifically categorising participants into non-musicians, amateur musicians, and professional musicians, based on their self-identification and years of music training, Study 2 re-examined the influence of musical background on the recognition of musically expressed emotions among a different cross-cultural sample. The influence of musical background was found to be more pronounced in Western music than in Chinese music. Specifically, in Western music, the advantage for professional musicians was observed in the recognition of all five investigated emotions, except for sadness, when compared to both amateur musicians and non-musicians. In contrast, in Chinese music, the only advantage for musical expertise was observed in the recognition of sadness, where the sensitivity of amateur musicians was higher compared to non-musicians.

The overall findings observed in both Study 1 and Study 2 have demonstrated that the advantage for musical expertise in the recognition of musically expressed emotions varies among different emotions and across different music cultures. These findings, on one hand, have added more evidence for better performance in emotional judgments in music among those with more years of musical training, as discussed in the literature review (e.g., Lima & Castro, 2011). On the other hand, these findings also emphasise the importance of being cautious in generalising conclusions about the influence of musical background, as it may not always be evident in some emotions or music cultures, as discussed above. More specifically, the emotion-specific advantage for musical expertise observed in the two studies of this thesis also partially reflects some neural evidence from previous studies. For example, using functional magnetic resonance imaging, Park et al. (2014) identified differences between

musicians and non-musicians in the neuro-affective processing of sadness and fear expressed in music, while no difference in neural activation between musicians and non-musicians was observed in response to happiness in music.

It is also possible to find an explanation for the difference between musicians and non-musicians in the perceived emotionality from the varied associations between acoustic parameters and their perception of emotional expression in music performance. For instance, Bhatarar et al. (2011) found that musicians were more likely to give higher ratings than non-musicians when timing was varied, but no significant group difference was observed when amplitude was varied. Regarding the effects of musical training, they identified that judgments of non-musicians' perceived emotionality of the stimuli were more influenced by the tonality of the piece, while musicians' judgments were more influenced by the expressivity levels, the performances' variations in timing, and amplitude. However, the association between psychoacoustic features and listeners' emotion recognition in music among musicians and non-musicians, and even among musicians in different genres or music cultures, was not examined in this thesis. Therefore, this aspect is worth further exploration in future research using stimuli that are more systematically manipulated.

Furthermore, I have sought explanations for the more significant influence of musical background in Western music compared to in Chinese music, as identified above. This phenomenon, as discussed in Study 2 (Chapter 6), can be associated with the generally higher representation of Western classical professional and amateur musicians compared to Chinese traditional professional and amateur musicians in Study 2. This imbalance between Western classical and non-Western classical musicians may have contributed to the greater apparent advantage of musicianship in Western music. This emphasises the benefit of using a balanced sample in the future to better control influencing factors and identify the effects of the focal factor.

8.6 Minimal Effect of Gender

The effect of gender on cross-cultural music emotion recognition was explored in both Study 1 and Study 2 of this thesis. Findings from both studies revealed minimal gender differences in the recognition of musically expressed emotions. Gender's effect on the recognition of musically expressed emotions was only notable in specific instances: in Study 1, when

listening to Western music, Chinese participants exhibited significantly higher ratings for happiness than Western participants, and this difference was observed only in males, not in females; in Study 2, females displayed significantly higher sensitivities to fear than males in Chinese music, whereas no gender differences were identified in Western music. These results suggest an overall minimal effect of gender on the emotion recognition of music and underscore the importance of identifying the influence of gender in specific emotions, music cultures, or genres. As discussed in the literature review, previous findings on the role of gender in emotional judgments in music have been mixed. For instance, Balkwill and Thompson (1999) reported that females were significantly more sensitive to joy expressed in the ragas, though no other gender differences were observed. Laukka et al. (2021) identified small but significant effects of sex on emotion recognition accuracy in music, with an overall better performance for female listeners. In contrast, some studies found no significant gender difference in the affective response to music (Gregory & Varney, 1996), or the perceived intensity of musical emotions (Shen et al., 2018).

Following on the earlier research, the results from the two studies in this thesis suggest a minimal overall effect of gender on the recognition of musically expressed emotions, even within a cross-cultural context. However, some emotion- or music-culture-specific influences of gender were also identified. Overall, based on the findings of this thesis and the mixed results from previous studies discussed above, there is a clear need for further exploration into the role of gender in music emotion recognition. It is crucial to interpret its influence in an emotion- or music-culture-specific manner. Additionally, considering gender as a potential moderating factor in the relationship between cultural background and the recognition of emotions in music has shown to be important.

8.7 The Moderating Effects of Current Mood, Familiarity with and Preference for Music Stimuli, and Preferences for Musical Genres

As demonstrated earlier, Study 2 was built upon the findings of Study 1, with a specific focus on further exploring and understanding the cultural differences observed in the recognition of emotions expressed through Chinese and Western music. In addition to re-testing the

influences of gender and musical background on cross-cultural music emotion recognition, Study 2 also delved into the exploration of four potential moderators in the relationship between cultural background and emotion recognition sensitivity. These included *current mood*, *familiarity with* and *preference for music stimuli*, as well as *preferences for musical genres*. As discussed in the Literature Review (Chapter 2), prior research has indicated a relationship between these factors and emotions in music. For instance, previous findings have suggested that one's current mood can influence their perception of a piece of music in terms of its affective qualities (Garrido, 2021; Vuoskoski & Eerola, 2011b). Familiarity with the presented music is reported to influence experienced pleasure (Freitas et al., 2018; Schellenberg, 2008; van den Bosch et al., 2013). While previous findings regarding the effect of music preference or liking are mixed, there is evidence suggesting that preferred music can enhance the experience of pleasure (Fuentes-Sánchez et al., 2022). It has also been suggested that preferences for a particular musical genre may influence how individuals perceive not only the music of that genre but also music from other genres (Thompson & Olsen, 2021). Previous studies, such as those mentioned, have highlighted the importance of considering various factors in research on the perception of emotions in music. In this case, this consideration becomes particularly crucial when investigating music emotion recognition at a more complex level, specifically within a cross-cultural context. In this thesis, the aforementioned factors were considered and examined as potential moderators in the relationship between cultural background and recognition sensitivity to musically expressed emotions. The purpose of this examination was to investigate whether and how the tested factors played a moderating role in the relationship between cultural background and music emotion recognition. In other words, the aim was to further identify the relationship between cultural background and the recognition of emotions represented in music while controlling for factors other than culture.

The correlation and moderation analysis of current mood revealed that negative affect exhibited a negative correlation with the recognition sensitivity of most emotions in both Chinese and Western music, regardless of the influences of positive affect and age. This implies that, in a general pattern, participants with a negative mood may experience a decrease in their recognition sensitivity to musically expressed emotions. This finding underscores the importance of avoiding negative moods in participants when they are tasked with music emotion recognition. However, the visual representation of the moderation analysis further demonstrated that negative affect moderated the relationship between cultural

background and recognition sensitivity differently across different emotions. Detailed comparisons of the moderating effect of negative affect have been outlined earlier and will not be reiterated here. Nevertheless, it is worth noting an interesting finding: the relationship between negative affect and recognition sensitivity was positive in some cases. For example, when listening to Chinese music, negative affect positively correlated with the recognition of both negative emotions (anger and fear) among Chinese participants. A similar phenomenon was observed in the case of recognising anger, fear, and peacefulness in the context of Western music. However, it is important to note that these positive correlations were generally not strong. In contrast to Chinese participants, Western participants consistently showed a negative correlation between negative affect and recognition sensitivity across all emotions in both Chinese and Western music. This suggests that while both cultural groups experience reduced recognition sensitivity due to negative affect, Western listeners may be affected by distraction or emotional overload, whereas Chinese listeners are more likely to exhibit mood-congruent recognition, showing heightened sensitivity to emotions that align with their current affective state. Overall, the above findings underscore the differing moderating effects of negative affect on the relationship between cultural background and emotion recognition in Chinese and Western music. Additionally, it is noteworthy that, in general, the relationship between negative affective status and the recognition of musically expressed emotions did not conform to the previously observed mood-congruent pattern in Vuoskoski and Eerola's (2011b) study. As discussed earlier, a general negative correlation between negative affect and emotion recognition sensitivity was evident. In summary, these findings collectively highlight the moderating role of negative affect in the relationship between cultural background and emotion recognition sensitivity in music.

The estimated marginal means for average familiarity and preference for each emotion revealed that both Chinese and Western participants were more familiar with their own culture's music. Additionally, Western participants generally exhibited higher preferences than their Chinese counterparts across all emotional music. The subsequent correlation analysis indicated a general positive correlation between familiarity, preference, and the recognition sensitivity to musically expressed emotions. However, some exceptions were noted. The most surprising finding was that, for Western participants, higher familiarity correlated negatively with recognition sensitivity in both Chinese and Western music. Several potential explanations for this phenomenon can be considered. First, increased familiarity through repeated exposure does not necessarily lead to a better understanding of the affective

content of the music. Second, higher familiarity with music might result in overfamiliarity, where listeners become less attentive to subtle emotional cues or engage in less deliberate processing of the music. Third, increased familiarity may involve previous episodic memories related to the music, which could influence recognition based on past experiences rather than the music itself. Fourth, greater familiarity might lead to stronger cognitive biases or expectations regarding how the music should progress or what emotions it should convey, causing listeners to overlook or misinterpret emotional cues that deviate from these expectations. Finally, the relatively limited size and representativeness of the sample could also affect the findings. In summary, the findings indicate that both Chinese and Western participants' familiarity and preferences significantly correlated with their recognition sensitivity to musically expressed emotions, either positively or negatively.

The analysis of the potential influence of musical genre preferences began with a correlation analysis, revealing a significant positive correlation solely between the Reflective and Complex dimension and the average emotion recognition sensitivity in both Chinese and Western music. Subsequently, a moderation analysis was conducted, unveiling the moderating impact of preferences for the Reflective and Complex dimension on the relationship between cultural background and music emotion recognition sensitivity in both Chinese and Western music. The visual representation of this moderation consistently depicted a positive correlation between preferences for the Reflective and Complex dimension and recognition sensitivity in both Chinese and Western music.

In conclusion, the aforementioned results have highlighted the modulatory roles of negative affect, familiarity with and preference to musical stimuli, and the preferences for the Reflective and Complex musical genre dimension, in moderating the relationship between cultural background and the recognition sensitivity to musically expressed emotions. These findings underscore the significance of taking into account or controlling for influencing factors, such as the aforementioned ones, when exploring music emotion recognition within a cross-cultural context. Doing so can contribute to a more accurate identification of the role of cultural background and facilitate the interpretation of cultural differences observed in the recognition of emotions in music.

8.8 Neuroticism Mediates the Relationship between Cultural Background and Emotion Recognition Sensitivity

Study 3 was also built upon the findings of Study 1, primarily focusing on exploring whether and how personality traits and cognitive styles can explain the observed cultural differences in the recognition of musically expressed emotions. As discussed earlier, Study 1 revealed a cultural advantage in specific emotions, contrary to the initially hypothesised in-group advantage. This discovery prompted us, as researchers, to consider the influence of average individual differences (Juslin et al., 2016) between different cultures. Therefore, in Study 1, the observed cultural differences in the recognition of musically expressed emotions were hypothetically associated with variations in average personality traits between Western individualist cultures and Eastern collectivist cultures. For instance, Europeans and Americans scored higher in Extraversion and Openness to experience, and lower in Agreeableness compared to their Asian and African counterparts (Allik & McCrae, 2004). Previous research on personality has identified a trait-congruent bias in experienced emotions—specifically, extroverts tend to experience positive affects, while individuals with neuroticism tend to experience negative affects (Fleeson et al., 2002; Lucas et al., 2008; Matthews et al., 1990; McNiel & Fleeson, 2006; Miller et al., 2009; Smillie et al., 2015; Widiger & Oltmanns, 2017; Wilt et al., 2012). Furthermore, Vuoskoski and Eerola (2011b) identified a robust link between personality traits and preferences for music expressing different emotions. For instance, agreeableness was associated with a liking for happy and tender music, while correlating with a disliking for angry and fearful music. These previous findings appear to partially explain the higher sensitivity of the Chinese to the recognition of happiness and sadness (aesthetic enjoyment in music, analogous to tender music to some extent), and their lower sensitivity to fear. Conversely, the Westerners, as observed in Study 1, exhibited the opposite pattern.

With the aforementioned findings, I hypothesised that the cultural differences in the recognition of musically expressed emotions could be explained by the variations in average personality traits between Chinese and Western cultures. Thus, the mediating role of personality traits was explored in Study 3.

Specifically, I employed one of the most widely recognised methods for assessing personality traits—the Big Five Inventory (BFI) (John et al., 2008). The BFI comprises five

dimensions (Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness) to characterise individuals' personality traits. In Study 3, this instrument was used to measure the personality traits of both Chinese and Western participants. The mediation analysis revealed an indirect impact of cultural background on the recognition of fear in Chinese music and on happiness, sadness, and fear in Western music, all mediated by Neuroticism. This finding has been interpreted in light of the positive correlation between Neuroticism and Sensory Processing Sensitivity (Lionetti et al., 2019). Sensory Processing Sensitivity is a personality trait that characterises an individual's sensitivity to both positive and negative environmental stimuli; it is associated with brain regions related to empathy (Bas et al., 2021; Lionetti et al., 2019). This suggests that higher neuroticism is linked to increased sensitivity to emotional changes. This association is reflected in the mediating role of neuroticism in the relationship between cultural background and the recognition sensitivity to fear in Chinese music, as well as to happiness, sadness, and fear in Western music. In these instances, the recognition sensitivity was lower for Chinese participants due to their lower neuroticism compared to Western participants.

8.9 The Empathising-Systemising Cognitive Styles Correlate with Emotion Recognition Sensitivity

Apart from personality traits, cognitive styles were also considered for their potential role in the cultural differences in the recognition sensitivity of musically expressed emotions. Two types of cognitive styles have been investigated in relation to the recognition of musically expressed emotions in this thesis. This section specifically focused on the relationship between the empathising-systemising (E-S) cognitive styles (Baron-Cohen et al., 2003; Baron-Cohen & Wheelwright, 2004) and emotion recognition sensitivity. According to previous research, individuals with an empathising cognitive style are considered empathic and tend to appreciate the emotional content of stimuli, whereas those with a systemising cognitive style focus on analytic structures (Villarreal et al., 2012). The distinction between these two cognitive styles has been explored and reaffirmed in the field of music. Music empathisers are more likely to appreciate and respond strongly to the emotional content of the music, whereas music systemisers tend to focus on the structural features of the musical work (Kreutz, Schubert, et al., 2008). The literature review has discussed the relationship between

musicality, gender, and musical preferences (Greenberg, Baron-Cohen, et al., 2015), and the empathising-systemising cognitive styles. Although subtle cultural differences in the empathising-systemising cognitive styles between individualist and collectivist cultures have been observed in previous research (Groen et al., 2015; Wakabayashi et al., 2007), there had been limited investigation into its role in the study of cultural differences in the recognition of musically expressed emotions. Therefore, one of the aims of Study 3 was to explore the potential mediating role of empathising-systemising cognitive styles in the relationship between cultural background and the recognition of emotions expressed in music.

The mediation analysis was initially conducted, and the results indicated no mediating effects of both empathising and systemising cognitive styles on the relationship between cultural background and emotion recognition sensitivity. However, subsequent correlation analysis revealed a positive correlation between the average emotion recognition sensitivity and empathising cognitive style for both cultural groups in both Chinese and Western music. Additionally, a positive correlation was found with systemising cognitive style for the Western group in Chinese music. This suggests that empathisers were generally more sensitive to musically expressed emotions, irrespective of their cultural background. It is noteworthy that, for Western participants, besides the significant positive correlation between systemising cognitive style and emotion recognition sensitivity in Chinese music, the relative correlation in Western music also nearly reached statistical significance. In Contrast, no correlation with systemising cognitive style was found for Chinese participants. This indicates that the advantage of a systemising cognitive style—characterised by processing musically expressed emotions through the analysis of structural characteristics of the music—is more pronounced in Western listeners, particularly when they are listening to culturally unfamiliar music.

Culture-specific cognitive styles are suggested to be shaped by culture-specific display rules (Engelmann & Pogosyan, 2013), which involve norms regarding when, how, to whom, and which emotions should or should not be displayed. The exploration of display rules originates from studies on the perception of facial expressions (Engelmann & Pogosyan, 2013; Matsumoto et al., 2008). In the context of perceiving musically expressed emotions, I propose that specific musical systems or composition rules are analogous to the “display rules” extracted from the perception of facial expressions. Different cultures shape their own music traditions through the use of culturally determined composition techniques and expression methods, such as musical systems (Scherer & Zentner, 2001). Listeners exposed

to or immersed in such music traditions may thus establish culturally specific ways of interpreting emotional expressions in music. This occurs through cognitive style-related attentional biases toward different musical or psychoacoustic features. In light of this, theoretically, listeners from different cultures may utilise psychoacoustic features in varying ways to decode emotional information embedded in music. Conversely, this suggests that different psychoacoustic features may carry varying weight in contributing to the interpretation of emotions in music across different cultures or music traditions. Overall, it can be proposed that the perceptual habits or tendencies of Western listeners to use musical structures to process emotional information in music are more appropriately associated with their sustained exposure to music composed under Western composition rules. The characteristics of Western music, with its rigorous structure and differences from Chinese music, have been discussed earlier (*Section 6.4*).

8.10 Not Holistic-analytic, but Empathising Cognitive style Mediates the Effect of Cultural Background

As indicted above, psychoacoustic features are another focus of this thesis, in addition to the recognition of musically expressed emotions. The issue concerning psychoacoustic features investigated in Study 3, once again, originated from the reflection and interpretation of the findings in Study 1. Study 1 has revealed cultural differences in the psychoacoustic features associated with emotion recognition. Specifically, for instance, Chinese participants were found to respond to more psychoacoustic features than Western participants in both Chinese and Western music. This finding is line with Balkwill's (2006) study involving Japanese and Canadian listeners, which has been interpreted in relation to cultural differences in attention focus or cognitive styles among different cultures (Thompson & Balkwill, 2010). The cognitive styles referred to here specifically relate to holistic-analytic cognitive styles. The distinction between these two cognitive styles primarily arises from research on visual perception. It has been suggested that Westerners tend to perceive objects and process information in a more analytical and focused manner, while East Asians tend to consider the context and perceive a scene in a more holistic way (Choi et al., 2007; Chua et al., 2005; Martin et al., 2013; Nisbett et al., 2001). However, to the best of my knowledge, in the field of music, Thompson and Balkwill's (2010) hypothesis that cultural differences in

psychoacoustic features could be associated with cultural differences in holistic-analytic cognitive styles had not yet been examined. Thus, in Study 3 of this thesis, I aimed to test this hypothesis.

Another pair of cognitive styles—empathising-systemising cognitive styles—was also investigated in terms of its potential mediating role in the psychoacoustic features involved in the recognition of musically expressed emotions. In both Study 1 and Study 3, it was found that Chinese participants exhibited generally stronger responses to the tested psychoacoustic features compared to Western participants. As discussed earlier, previous research has suggested subtle cultural differences in empathising-systemising cognitive styles between individualist and collectivist cultures (Groen et al., 2015; Wakabayashi et al., 2007). Therefore, I considered the possibility that the observed cultural differences in emotion recognition and psychoacoustic features involved were attributed to cultural differences in empathising-systemising cognitive styles between Chinese and Western participants.

To test the above two hypotheses, in Study 3, the AHS Locus of Attention (LOA), and the Empathising Quotient (EQ-10) and the Systemising Quotient-Revised (SQ-R-10) were respectively included in the mediating analysis. The results revealed no cultural difference in the holistic-analytic or systemising cognitive styles. However, a cultural difference in the empathising cognitive style was observed, and subsequent multilevel mediation analysis was conducted. The results showed that the empathising cognitive style mediated the relationship between cultural background and the association between emotion recognition sensitivity and the examined psychoacoustic features. It was found that the association between recognition and psychoacoustic features was stronger in Chinese participants compared to Western participants. According to the statistical analysis, this seemed to be attributed to the observed lower empathising cognitive style in the former. This may seem difficult to interpret. However, it appears reasonable to view the lower empathising cognitive style in Chinese participants as an indirect indicator of a potentially higher systemising cognitive style, despite no statistically significant cultural difference being observed in the systemising cognitive style in this study. The notion that systemisers pay more attention to the structural features of the music than to its emotional content, according to the Music-Empathising-Systemising (ME-MS) theory (Kreutz, Schubert, et al., 2008), may explain this finding.

8.11 Theoretical Interpretation about Alexithymia

As indicated in *Section 2.11.6.2*, alexithymia is a personality dimension that is related to individuals' abilities to recognise emotions (Mamatova & Wille, 2012). In addition, previous research has suggested that Eastern cultural groups or individuals of Asian heritage tend to score higher in alexithymia compared to Western cultural groups or individuals of non-Asian heritage (Dion, 1996; Le et al., 2002; Lo, 2014; Zhu et al., 2007). Therefore, alexithymia was initially considered to be associated with the cultural differences in music emotion recognition in this thesis.

As discussed in Chapter 7 (specifically, *Section 7.2.3*), statistical analysis could not be conducted due to the very small sample that completed the Toronto Alexithymia Scale (TAS-20). Nevertheless, I find it valuable to relate some findings observed in this study to alexithymia by consulting existing literature on alexithymia and culture. For example, in both Study 1 and Study 2, Chinese participants consistently exhibited lower recognition sensitivity to fearful emotions expressed in both Chinese and Western music, compared to Western participants. This observation aligns with the findings in Lo's (2014) study examining the relationship between Confucian values, ethnicity, and alexithymia. The study found that Asian Canadians scored higher in alexithymia compared to non-Asian Canadians. This difference was attributed to the former group's preference not to reflect on emotions related to impurity or social disorder. In this thesis, fear can be seen as this kind of negative emotion that may explain the lower sensitivity of Chinese participants to it. It is reasonable for us to assume that this can be attributed to the reluctance towards emotions associated with impurity and social disruptiveness, such as fear in this case, which contradicts the values of social harmony inherent in collectivist cultures and the Confucian value system (The Chinese Culture Connection, 1987; Yao, 2000). A recent study by Xu et al. (2023), examining how music emotions have been described in millions of Google books, has provided some empirical evidence for this assumption. The study found that negative adjectives were significantly less frequently used to describe music in simplified Chinese books compared to English books.

Chapter 9. General Limitations

Chapters 5, 6, and 7 have discussed limitations associated with each study. This chapter, in particular, focuses on two main limitations of this research. The primary limitation is the limited sample size. While not classified as “small”, especially in comparison to previous studies in this field (e.g., Balkwill et al., 2004; Balkwill & Thompson, 1999; Fritz et al., 2009), there remains significant room for a larger sample size to generate findings with increased generalisability or that can be considered conclusive (Noraini & Halimahtun, 2015). Furthermore, the quasi-experimental nature of this research introduces the potential for random errors. In this case, participants were categorised into treatment and control groups based on certain pre-existing criteria (e.g., classifying individuals as musicians or non-musicians according to their self-reported years of music training) rather than employing a systematic manipulation of the examined factors (e.g., selecting participants without any musical training as non-musicians) as traditional experimental designs typically do. Moreover, since all questionnaires (except the one with TAS-20 due to copyright concerns) were distributed publicly, and participants were solely those who expressed interest in the research, the sample of listeners may not be fully representative (Juslin et al., 2016). The issue of a limited sample size becomes more pronounced, particularly in cross-cultural studies like this one. Consequently, the identified cultural differences in personality traits or cognitive styles should not be deemed conclusive; rather, they should be considered influential factors or predictors for cultural variations in emotion recognition and associated psychoacoustic features within the specific context of this research. The limitation in sample size was particularly evident in the analysis of alexithymia.

Another limitation pertains to the use of music stimuli. It is important to clarify that the limitation lies not in the quality of the stimuli but in the absence of Chinese fearful music, with the reasons for this choice remaining unexplored. To some extent, this limitation is also linked to the constrained sample size in pilot studies, which included musicians from both Chinese traditional and Western classical backgrounds. The absence of Chinese fearful music can be attributed to the top-to-bottom method employed in the music selection process. This approach prioritises efficiency, avoiding the need for a large group of musicians to spend extensive time selecting stimuli from a vast music sample pool in the initial stages. However, combining the results from both Study 1 and Study 2, which indicated Chinese participants’

lower sensitivity to the recognition of fear in both Chinese and Western music compared to their Western counterparts, I hypothesise that this phenomenon may also be linked to the limited attention given to the identification and categorisation of fear in Chinese traditional music. This influence is rooted in the previously discussed societal prevention of emotions associated with social disorder in Chinese culture (Lo, 2014; *The Chinese Culture Connection*, 1987; Yao, 2000). In different cultures, emotions can be understood, interpreted, and categorised in different ways, even for so-called basic, pancultural emotion categories. While listeners can recognise emotions that are even not represented in their own traditional music when exposed to unfamiliar music (Fritz, 2013; Fritz et al., 2009), their sensitivity to these emotional expressions may not be as acute as that of listeners from that culture. Russell (1991) concluded that significant differences exist in emotion-related languages, encompassing variations in the number of emotion words across different languages and cultures, as well as differences in translation equivalents, with distinctions also noted between Indo-European and non-Indo-European languages in the categorisation of facial expressions. Consequently, the importance of studies that bridge languages and emotion lexicons is underscored in the exploration of the expression and recognition of emotions.

Chapter 10. Implications for Future Research

For cross-cultural studies, the suitability of media broadcasting of music and the development of globalisation (Fritz, 2013), have been thought to profoundly influence researchers' perspectives on which cultures and musical styles are worth investigating. Although, for the exploration of cross-cultural emotion recognition, it has been suggested to involve participants who are entirely naïve to the investigated musical tradition, there is also ample evidence that different cultural traditions are robust enough to predict intriguing differences in this regard, even when the tested groups are sub-groups within a higher-order cultural context (e.g., British participants with an Indian cultural background and British participants with a Western cultural background; Gregory & Varney, 1996). However, I believe that testing participants in a completely unfamiliar musical system can provide additional benefits, as it mitigates the complex issue of measuring their familiarity with the music. Therefore, I acknowledge the additional advantage of investigating completely unfamiliar music among entirely naïve participants. I also advocate for swift actions in studying societies that have had little or no exposure to Western media before such societies disappear (Fritz, 2013; Thompson & Olsen, 2021).

According to Martin et al. (2013, p. 207), "Different nations and different cultures as well as groups within those nations and cultures can also produce art that can be as similar as it is different". Having shown and discussed in this thesis, Western classical and Chinese traditional music, originating from different histories and cultures, share both universal and culture-specific expression and perception patterns of emotions. This is evident in the use of psychoacoustic cues in composers' compositions, performers' playing, and listeners' listening (Juslin & Laukka, 2003). Beyond the current research, which primarily focuses on listeners' perception, attention is also worth shifting to composers and performers in terms of their utilisation of musical cues for emotional expression. It is suggested that interactions between features associated with composition and performance can make small, yet not negligible, contributions to listeners' emotion ratings (Juslin & Laukka, 2004). It would be interesting to investigate in the future whether musical cues cooperate in an additive or interactive fashion in emotional expression (Eerola et al., 2013) within cross-cultural contexts.

Another promising future direction for the cross-cultural recognition of musically expressed emotions involves collaboration with the field of neuroscience. Building on initial findings that provide evidence from brain activations suggesting that factors such as familiarity (Daimi et al., 2020; Pereira et al., 2011), musicality (Park et al., 2014), and personality traits (Koelsch et al., 2007; Montag et al., 2011; Oudyk et al., 2019; Park et al., 2013) influence the processing of musically expressed emotions, researchers can anticipate further advancements in studies on cultural differences in emotion perception in music. This can be achieved by linking neural activity to self-report measures of emotion ratings, analogous to observations in face perception (Engelmann & Pogosyan, 2013).

Chapter 11. General Conclusions

11.1 Conclusion

In conclusion, this research challenges some previously established findings in the field of cross-cultural music emotion recognition by exploring rarely studied music cultures. This thesis delved into cross-cultural music emotion recognition, employing Chinese traditional and Western classical music for assessment among both Chinese and Western listeners. Contrary to the previously suggested in-group advantage in recognising emotions in culturally familiar music (e.g., Argstatter, 2016; Balkwill & Thompson, 1999; Fritz, 2013; Laukka et al., 2013), this research revealed a cultural advantage in recognising specific emotions in music, irrespective of the cultural origin of the music. Additionally, the previously identified cultural differences in the associated psychoacoustic features (Midya et al., 2019; Thompson & Balkwill, 2010; Wang et al., 2022) were further substantiated in this study. Furthermore, this research identified the moderating effects of negative affect, familiarity with, and preference for musical stimuli, as well as preferences for the Reflective and Complex musical genre dimension on the relationship between cultural background and the recognition of musically expressed emotions. Moreover, this research revealed the mediating effect of Neuroticism on the relationship between cultural background and the recognition of emotions in music. Additionally, cultural differences in associated psychoacoustic features were found to be related to cultural differences in the empathising cognitive style, rather than the previously hypothesised holistic-analytic cognitive styles (Balkwill, 2006). This research opens new avenues for researchers in music psychology to better identify and interpret the relationship between cultural background and the recognition of musically expressed emotions and associated psychoacoustic features. This is achieved by considering and exploring the impact of individual differences in personality traits and cognitive styles, encompassing psychological, musicological, historical, and social perspectives.

11.2 Final Remarks

Finally, I would like to refer to a discussion by Ma, Yang, et al. (2017) regarding music and culture to finalise the thesis. It was highlighted that music is both an evolutionary and a social product, thus possessing both biological and cultural significance (Cross & Morley, 2010; Trehub et al., 2015). From a biological perspective, the affective connections fostered by participation in musical activities constitute adaptive mechanisms that facilitate individual survival and development within a network, presupposed in the collective innate reactions of human beings. Thus, it is believed that listeners' understanding and perception of emotions in music need not necessarily be based on experiential acquisition (Cross & Morley, 2010; Ma, Yang, et al., 2017). In contrast, from a cultural point of view, music, in a broader sense, is a unique cultural product of an ethnic group that has evolved in the course of its social development and carries with it a set of characteristics that differentiate it from other groups, such as beliefs, behaviours, dialogues, social organisations and modes of interaction (Thompson & Balkwill, 2010; Trehub et al., 2015). In a narrower sense, music is a system of symbolic rules that develops in the course of the development of a cultural group's identity, whose rules and meanings are specific, deep and abstract, and whose decoding presupposes relevant empirical knowledge (Higgins, 2012; Ma, Yang, et al., 2017; Schoeller & Perlovsky, 2016). The above separation between identifying music as being the product of a naturally selected adaptation and as being a product of culture, known as the "nature-or-culture" dichotomy, has caused heated debate among evolutionary musicologists (Tomlinson, 2015; van der Schyff & Schiavio, 2017). Although both sides of the debate have received plausible supporting arguments (for a review, see van der Schyff & Schiavio, 2017), either of them appears to be problematic. On one hand, arguing that music is an adaptation becomes ambiguous when attempting to "specify a selective environment" (van der Schyff & Schiavio, 2017, p. 4) for the various or distinct forms of music that exist in different cultures. On the other hand, arguing that music is the product of culture may overlook the fact that many musical activities (e.g., social life, religion, and ritual) are shared across the world, reflecting universal features of human nature (MacDonald, 2021; Mehr et al., 2019; Trehub et al., 2015), and that musical skills start developing in infancy without formal training or learning (Svard, 2023). Given that music is one of the "deeply social and universal human activities that require complex cognitive functions" (van der Schyff & Schiavio, 2017, p. 4), the nature (biology)-or-culture dichotomy is replaced by a "biocultural" approach (Cross,

2003) to music's origins, which combines both perspectives. Unlike the traditional evolutionary perspective, which emphasises adaptation to a given environment, the developmental perspective views organism and environment as “mutually influencing aspects of the same integrated system” (van der Schyff & Schiavio, 2017, p. 5). The coevolution of organism and environment is illustrated in Tomlinson's (2015) epicyclic biocultural coevolution model. According to Ma, Yang, et al. (2017), the debate between biological and cultural perspectives can be clarified by examining whether the cultural experience of music and the associated cognitive processes form the crucial basis for the connection between music and emotion. The influence of music on emotions may arise either from the adaptive mechanisms of organisms or from the cognitive constructs shaped by musical knowledge and cultural experiences. The mechanisms and weighting of the effects of musical cultural experiences can vary under different conditions. It has been argued that, at the level of musical emotion perception and recognition, the influence of musical cultural experience depends primarily on the characteristics of musical cues used to express emotions in musical works (Ma, Yang, et al., 2017).

Considering the separation and integration of biological and cultural perspectives on music-related issues aptly captures the core theme concerning the universality and culture-specificity of music and the corresponding responses to it. However, given the richness and variety of cultures worldwide, and influenced by the development of cultural communication and globalisation over time, the exploration of this issue has become increasingly intriguing, yielding findings that can be both consistent and controversial. To gain a better understanding of these similarities and differences, it is essential to explore a broader range of cultures and music styles, control for confounding factors, and examine individual responses.

References

- Abbruzzese, L., Magnani, N., Robertson, I. H., & Mancuso, M. (2019). Age and gender differences in emotion recognition. *Frontiers in Psychology, 10*, 1–15.
- Agmon, E. (2013). *The languages of Western tonality*. Springer Berlin Heidelberg.
<https://doi.org/10.1007/978-3-642-39587-1>
- Al-Ababneh, M. M. (2020). Linking ontology, epistemology and research methodology. *Science & Philosophy, 8*(1), 75–91. <https://doi.org/10.23756/sp.v8i1.500>
- Ali, S. O., & Peynircioğlu, Z. F. (2010). Intensity of emotions conveyed and elicited by familiar and unfamiliar music. *Music Perception, 27*(3), 177–182.
<https://doi.org/10.1525/mp.2010.27.3.177>
- Allik, J. (2012). National differences in personality. *Personality and Individual Differences, 53*(2), 114–117. <https://doi.org/10.1016/j.paid.2011.05.011>
- Allik, J., & McCrae, R. R. (2004). Toward a geography of personality traits: Patterns of profiles across 36 cultures. *Journal of Cross-Cultural Psychology, 35*(1), 13–28.
<https://doi.org/10.1177/0022022103260382>
- Alotaibi, A., Aljuhani, A., Alqahtani, M., & Alahmari, N. (2023). Sex differences in recognition of face expressions. *Journal of Educational and Psychological Studies [JEPS], 17*(4), 384–390. <https://doi.org/10.53543/jeps.vol17iss4pp384-390>
- Altenmüller, E. (2002). Hits to the left, flops to the right: Different emotions during listening to music are reflected in cortical lateralisation patterns. *Neuropsychologia, 40*(13), 2242–2256. [https://doi.org/10.1016/S0028-3932\(02\)00107-0](https://doi.org/10.1016/S0028-3932(02)00107-0)
- Argstatter, H. (2016). Perception of basic emotions in music: Culture-specific or multicultural? *Psychology of Music, 44*(4), 674–690.
<https://doi.org/10.1177/0305735615589214>
- Bagby, R. M., Parker, J. D., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia Scale—I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research, 38*(1), 23–32. [https://doi.org/10.1016/0022-3999\(94\)90005-1](https://doi.org/10.1016/0022-3999(94)90005-1)
- Bakhchina, A. V., Apanovich, V. V., Arutyunova, K. R., & Alexandrov, Y. I. (2021). Analytic and holistic thinkers: Differences in the dynamics of heart rate complexity

- when solving a cognitive task in field-dependent and field-independent conditions. *Frontiers in Psychology*, 12.
<https://www.frontiersin.org/articles/10.3389/fpsyg.2021.762225>
- Balkwill, L.-L. (2006, May). *Perceptions of emotion in music across cultures*. Emotional Geographies: The Second International & Interdisciplinary Conference, Kingston, Canada.
- Balkwill, L.-L., & Thompson, W. F. (1999). A cross-cultural investigation of the perception of emotion in music: Psychophysical and cultural cues. *Music Perception*, 17(1), 43–64. <https://doi.org/10.2307/40285811>
- Balkwill, L.-L., Thompson, W. F., & Matsunaga, R. (2004). Recognition of emotion in Japanese, Western, and Hindustani music by Japanese listeners ¹: Recognition of emotion in music. *Japanese Psychological Research*, 46(4), 337–349.
<https://doi.org/10.1111/j.1468-5584.2004.00265.x>
- Baron-Cohen, S. (2009). Autism: The empathizing-systemizing (E-S) theory. *Annals of the New York Academy of Sciences*, 1156, 68–80. <https://doi.org/10.1111/j.1749-6632.2009.04467.x>
- Baron-Cohen, S., Knickmeyer, R. C., & Belmonte, M. K. (2005). Sex differences in the brain: Implications for explaining autism. *Science (New York, N.Y.)*, 310(5749), 819–823. <https://doi.org/10.1126/science.1115455>
- Baron-Cohen, S., Richler, J., Bisarya, D., Gurunathan, N., & Wheelwright, S. (2003). The systemizing quotient: An investigation of adults with Asperger syndrome or high-functioning autism, and normal sex differences. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 358(1430), 361–374.
<https://doi.org/10.1098/rstb.2002.1206>
- Baron-Cohen, S., & Wheelwright, S. (2004). The empathy quotient: An investigation of adults with asperger syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders*, 34(2), 163–175.
<https://doi.org/10.1023/B:JADD.0000022607.19833.00>
- Barrett, L. F. (2006). Are emotions natural kinds? *Perspectives on Psychological Science*, 1(1), 28–58. <https://doi.org/10.1111/j.1745-6916.2006.00003.x>
- Barrett, L. F., & Kensinger, E. A. (2010). Context is routinely encoded during emotion perception. *Psychological Science*, 21(4), 595–599.
<https://doi.org/10.1177/0956797610363547>

- Barrett, L. F., Mesquita, B., Ochsner, K. N., & Gross, J. J. (2007). The experience of emotion. *Annual Review of Psychology*, 58(1), 373–403.
<https://doi.org/10.1146/annurev.psych.58.110405.085709>
- Bas, S., Kaandorp, M., de Kleijn, Z. P. M., Braaksma, W. J. E., Bakx, A. W. E. A., & Greven, C. U. (2021). Experiences of adults high in the personality trait sensory processing sensitivity: A qualitative study. *Journal of Clinical Medicine*, 10(21), 4912. <https://doi.org/10.3390/jcm10214912>
- Berrios, R., Totterdell, P., & Kellett, S. (2015). Eliciting mixed emotions: A meta-analysis comparing models, types, and measures. *Frontiers in Psychology*, 6.
<https://www.frontiersin.org/articles/10.3389/fpsyg.2015.00428>
- Bhatara, A., Tirovolas, A. K., Duan, L. M., Levy, B., & Levitin, D. J. (2011). Perception of emotional expression in musical performance. *Journal of Experimental Psychology: Human Perception and Performance*, 37(3), 921–934.
<https://doi.org/10.1037/a0021922>
- Bigand, E., Vieillard, S., Madurell, F., Marozeau, J., & Dacquet, A. (2005). Multidimensional scaling of emotional responses to music: The effect of musical expertise and of the duration of the excerpts. *Cognition and Emotion*, 19(8), 1113–1139.
<https://doi.org/10.1080/02699930500204250>
- Blais, C., Jack, R. E., Scheepers, C., Fiset, D., & Caldara, R. (2008). Culture shapes how we look at faces. *PLOS ONE*, 3(8), e3022. <https://doi.org/10.1371/journal.pone.0003022>
- Boduroglu, A., Shah, P., & Nisbett, R. E. (2009). Cultural differences in allocation of attention in visual information processing. *Journal of Cross-Cultural Psychology*, 40(3), 349–360. <https://doi.org/10.1177/0022022108331005>
- Bottemanne, H., Barberousse, A., & Fossati, P. (2022). Théorie multidimensionnelle et computationnelle de l'humeur. *L'Encéphale*, 48(6), 682–699.
<https://doi.org/10.1016/j.encep.2022.02.002>
- Bradley, M. M., Codispoti, M., Sabatinelli, D., & Lang, P. J. (2001). Emotion and motivation II: Sex differences in picture processing. *Emotion (Washington, D.C.)*, 1, 300–319.
<https://doi.org/10.1037//1528-3542.1.3.300>
- Brewer, P., & Venaik, S. (2011). Individualism—Collectivism in Hofstede and GLOBE. *Journal of International Business Studies*, 42(3), 436–445.
- Brody, L. R. (1985). Gender differences in emotional development: A review of theories and research. *Journal of Personality*, 53(2), 102–149. <https://doi.org/10.1111/j.1467-6494.1985.tb00361.x>

- Brody, L. R. (1997). Gender and emotion: Beyond stereotypes. *Journal of Social Issues*, 53(2), 369–393. <https://doi.org/10.1111/j.1540-4560.1997.tb02448.x>
- Brody, L. R., & Hall, J. A. (2008). Gender and emotion in context. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (3rd ed, pp. 395–408). Guilford Press.
- Broeck, H., Vanderheyden, K., & Cools, E. (2003). Individual differences in cognitive styles: Development, validation and cross-validation of the cognitive style inventory. *Vlerick Leuven Gent Working Paper Series 2003/27*.
- Brunswik, E. (1956). *Perception and the representative design of psychological experiments*. University of California Press.
- Bryant, G., & Barrett, H. C. (2008). Vocal emotion recognition across disparate cultures. *Journal of Cognition and Culture*, 8(1–2), 135–148. <https://doi.org/10.1163/156770908X289242>
- Cai, T. (2014). Analysing the differences between Chinese and Western music cultures. *Notonly Music*, 12, 1.
- Castro, S. L., & Lima, C. F. (2014). Age and musical expertise influence emotion recognition in music. *Music Perception: An Interdisciplinary Journal*, 32(2), 125–142. <https://doi.org/10.1525/mp.2014.32.2.125>
- Cattell, R. B., & Anderson, J. C. (1953). The measurement of personality and behavior disorders by the I. P. A. T. Music Preference Test. *Journal of Applied Psychology*, 37(6), 446–454. <https://doi.org/10.1037/h0056224>
- Cattell, R. B., & Saunders, D. R. (1954). Musical preferences and personality diagnosis: I. a factorization of one hundred and twenty themes. *The Journal of Social Psychology*, 39(1), 3–24. <https://doi.org/10.1080/00224545.1954.9919099>
- Cespedes-Guevara, J., & Eerola, T. (2018). Music communicates affects, not basic emotions – A constructionist account of attribution of emotional meanings to music. *Frontiers in Psychology*, 9, 215. <https://doi.org/10.3389/fpsyg.2018.00215>
- Chen, J. (2020). *Music psychology: Cognition, brain and application*. Science Press.
- Choi, I., Koo, M., & Choi, J. A. (2007). Individual differences in analytic versus holistic thinking. *Personality and Social Psychology Bulletin*, 33(5), 691–705. <https://doi.org/10.1177/0146167206298568>
- Chua, H. F., Boland, J. E., & Nisbett, R. E. (2005). Cultural variation in eye movements during scene perception. *Proceedings of the National Academy of Sciences*, 102(35), 12629–12633. <https://doi.org/10.1073/pnas.0506162102>

- Church, A. T. (2016). Personality traits across cultures. *Current Opinion in Psychology*, 8, 22–30. <https://doi.org/10.1016/j.copsyc.2015.09.014>
- Ciuk, D., Troy, A., & Jones, M. (2015). Measuring emotion: Self-reports vs. physiological indicators. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2595359>
- Clark, D. M. (1983). On the induction of depressed mood in the laboratory: Evaluation and comparison of the velten and musical procedures. *Advances in Behaviour Research and Therapy*, 5(1), 27–49. [https://doi.org/10.1016/0146-6402\(83\)90014-0](https://doi.org/10.1016/0146-6402(83)90014-0)
- Colombetti, G. (2014). *The feeling body: Affective science meets the enactive mind*. The MIT Press.
- Coutinho, E., & Dibben, N. (2013a). Psychoacoustic cues to emotion in speech prosody and music. *Cognition & Emotion*, 27(4), 658–684. <https://doi.org/10.1080/02699931.2012.732559>
- Coutinho, E., & Dibben, N. (2013b). Psychoacoustic cues to emotion in speech prosody and music. *Cognition & Emotion*. <https://doi.org/10.1080/02699931.2012.732559>
- Cross, I. (2003). Music and biocultural evolution. In M. Clayton, T. Herbert, & R. Middleton (Eds.), *The Cultural Study of Music: A Critical Introduction* (p. 19). Routledge.
- Cross, I., & Morley, I. (2010). The evolution of music: Theories, definitions and the nature of the evidence. In *Communicative Musicality* (pp. 61–82).
- Daimi, S. N., Jain, S., & Saha, G. (2020). *Effect of familiarity on recognition of pleasant and unpleasant emotional states induced by Hindi music videos*. 227–238. https://doi.org/10.1007/978-981-15-1081-6_19
- Darwin, C. (1872). *The expression of the emotions in man and animals*. John Murray.
- Davies, S. (2011). Cross-cultural musical expressiveness: Theory and the empirical Programme. In E. Schellekens & P. Goldie (Eds.), *The aesthetic mind: Philosophy and psychology* (pp. 376–388). Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199691517.003.0023>
- Dere, J., Falk, C. F., & Ryder, A. G. (2012). Unpacking cultural differences in alexithymia: The role of cultural values among Euro-Canadian and Chinese-Canadian students. *Journal of Cross-Cultural Psychology*, 43, 1297–1312. <https://doi.org/10.1177/0022022111430254>
- Dere, J., Tang, Q., Zhu, X., Cai, L., Yao, S., & Ryder, A. G. (2013). The cultural shaping of alexithymia: Values and externally oriented thinking in a Chinese clinical sample. *Comprehensive Psychiatry*, 54(4), 362–368. <https://doi.org/10.1016/j.comppsy.2012.10.013>

- Dion, K. L. (1996). Ethnolinguistic correlates of alexithymia: Toward a cultural perspective. *Journal of Psychosomatic Research*, 41(6), 531–539. [https://doi.org/10.1016/S0022-3999\(96\)00295-4](https://doi.org/10.1016/S0022-3999(96)00295-4)
- Droit-Volet, S., Ramos, D., Bueno, J. L. O., & Bigand, E. (2013). Music, emotion, and time perception: The influence of subjective emotional valence and arousal? *Frontiers in Psychology*, 4. <https://doi.org/10.3389/fpsyg.2013.00417>
- Eerola, T., Friberg, A., & Bresin, R. (2013). Emotional expression in music: Contribution, linearity, and additivity of primary musical cues. *Frontiers in Psychology*, 4, 487. <https://doi.org/10.3389/fpsyg.2013.00487/abstract>
- Eerola, T., & Vuoskoski, J. (2021). Personality and listeners. In W. F. Thompson & K. N. Olsen (Eds.), *The science and psychology of music: From Beethoven at the office to Beyoncé at the gym* (pp. 205–212). Greenwood, an imprint of ABC-CLIO.
- Eerola, T., & Vuoskoski, J. K. (2011). A comparison of the discrete and dimensional models of emotion in music. *Psychology of Music*, 39(1), 18–49. <https://doi.org/10.1177/0305735610362821>
- Eerola, T., & Vuoskoski, J. K. (2013). A review of music and emotion studies: Approaches, emotion models, and stimuli. *Music Perception*, 30(3), 307–340. <https://doi.org/10.1525/mp.2012.30.3.307>
- Eerola, T., Vuoskoski, J. K., Peltola, H.-R., Putkinen, V., & Schäfer, K. (2018). An integrative review of the enjoyment of sadness associated with music. *Physics of Life Reviews*, 25, 100–121. <https://doi.org/10.1016/j.plrev.2017.11.016>
- Egermann, H., Fernando, N., Chuen, L., & McAdams, S. (2015). Music induces universal emotion-related psychophysiological responses: Comparing Canadian listeners to Congolese Pygmies. *Frontiers in Psychology*, 5, 1–9. <https://doi.org/10.3389/fpsyg.2014.01341>
- Ekman, P. (1992a). An argument for basic emotions. *Cognition & Emotion*, 6(3–4), 169–200. <https://doi.org/10.1080/02699939208411068>
- Ekman, P. (1992b). Are there basic emotions? *Psychological Review*, 99(3), 550–553.
- Ekman, P., & Cordaro, D. (2011). What is meant by calling emotions basic. *Emotion Review*, 3(4), 364–370. <https://doi.org/10.1177/1754073911410740>
- Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, 17(2), 124–129. <https://doi.org/10.1037/h0030377>

- Ekman, P., Sorenson, E. R., & Friesen, W. V. (1969). Pan-cultural elements in facial displays of emotion. *Science (New York, N.Y.)*, 164(3875), 86–88.
<https://doi.org/10.1126/science.164.3875.86>
- Elfenbein, H. A., & Ambady, N. (2002). On the universality and cultural specificity of emotion recognition: A meta-analysis. *Psychological Bulletin*, 128(2), 203–235.
<https://doi.org/10.1037/0033-2909.128.2.203>
- Engelmann, J., & Pogosyan, M. (2013). Emotion perception across cultures: The role of cognitive mechanisms. *Frontiers in Psychology*, 4.
<https://www.frontiersin.org/articles/10.3389/fpsyg.2013.00118>
- Engen, T., Levy, N., & Schlosberg, H. (1958). The dimensional analysis of a new series of facial expressions. *Journal of Experimental Psychology*, 55(5), 454–458.
<https://doi.org/10.1037/h0047240>
- Fischer, A. H., & Manstead, A. S. R. (2000). The relation between gender and emotion in different cultures. In A. H. Fischer (Ed.), *Gender and Emotion: Social Psychological Perspectives* (pp. 71–94). Cambridge University Press.
<https://doi.org/10.1017/CBO9780511628191.005>
- Fleeson, W., Malanos, A. B., & Achille, N. M. (2002). An intraindividual process approach to the relationship between extraversion and positive affect: Is acting extraverted as ‘good’ as being extraverted? *Journal of Personality and Social Psychology*, 83(6), 1409–1422. <https://doi.org/10.1037/0022-3514.83.6.1409>
- Franca, M., Bolognini, N., & Brysbaert, M. (2023). Seeing emotions in the eyes: A validated test to study individual differences in the perception of basic emotions. *Cognitive Research: Principles and Implications*, 8(1), 67. <https://doi.org/10.1186/s41235-023-00521-x>
- Freitas, C., Manzato, E., Burini, A., Taylor, M. J., Lerch, J. P., & Anagnostou, E. (2018). Neural correlates of familiarity in music listening: A systematic review and a neuroimaging meta-analysis. *Frontiers in Neuroscience*, 12.
<https://www.frontiersin.org/articles/10.3389/fnins.2018.00686>
- Frijda, N. H. (2016). The evolutionary emergence of what we call “emotions”. *Cognition and Emotion*, 30(4), 609–620. <https://doi.org/10.1080/02699931.2016.1145106>
- Fritz, T. (2013). The dock-in model of music culture and cross-cultural perception. *Music Perception*, 30(5), 511–516. <https://doi.org/10.1525/mp.2013.30.5.511>

- Fritz, T. H., Schmude, P., Jentschke, S., Friederici, A. D., & Koelsch, S. (2013). From understanding to appreciating music cross-culturally. *PLoS ONE*, 8(9), e72500. <https://doi.org/10.1371/journal.pone.0072500>
- Fritz, T., Jentschke, S., Gosselin, N., Sammler, D., Peretz, I., Turner, R., Friederici, A. D., & Koelsch, S. (2009). Universal recognition of three basic emotions in music. *Current Biology*, 19(7), 573–576. <https://doi.org/10.1016/j.cub.2009.02.058>
- Fuentes-Sánchez, N., Pastor, R., Eerola, T., Escrig, M. A., & Pastor, M. C. (2022). Musical preference but not familiarity influences subjective ratings and psychophysiological correlates of music-induced emotions. *Personality and Individual Differences*, 198, 111828. <https://doi.org/10.1016/j.paid.2022.111828>
- Fuentes-Sánchez, N., Pastor, R., Eerola, T., & Pastor, M. C. (2020). Spanish adaptation of a film music stimulus set (FMSS): Cultural and gender differences in the perception of emotions prompted by music excerpts. *Psychology of Music*, 49(5), 1242–1260. <https://doi.org/10.1177/0305735620958464>
- Gabrielsson, A. (2001). Emotion perceived and emotion felt: Same or different? *Musicae Scientiae*, 5(1_suppl), 123–147. <https://doi.org/10.1177/10298649020050S105>
- Gabrielsson, A., & Juslin, P. N. (1996). Emotional expression in music performance: Between the performer's intention and the listener's experience. *Psychology of Music*, 24(1), 68–91. <https://doi.org/10.1177/0305735696241007>
- Garrido, S. (2021). Who likes sad music and why? In W. F. Thompson & K. N. Olson (Eds.), *The science and psychology of music: From Beethoven at the office to Beyoncé at the gym* (pp. 324–332). Santa Barbara : Greenwood. <https://lcn.loc.gov/2020010261>
- Gowensmith, W. N., & Bloom, L. J. (1997). The effects of heavy metal music on arousal and anger. *Journal of Music Therapy*, 34(1), 33–45. <https://doi.org/10.1093/jmt/34.1.33>
- Graziano, W. G., & Eisenberg, N. (1997). Agreeableness: A dimension of personality. In R. Hogan, J. Johnson, & S. Briggs (Eds.), *Handbook of personality psychology* (pp. 795–824). Academic Press.
- Greenberg, D. M., Baron-Cohen, S., Stillwell, D. J., Kosinski, M., & Rentfrow, P. J. (2015). Musical preferences are linked to cognitive styles. *PLOS ONE*, 10(7), e0131151. <https://doi.org/10.1371/journal.pone.0131151>
- Greenberg, D. M., Rentfrow, P. J., & Baron-Cohen, S. (2015). Can music increase empathy? Interpreting musical experience through the Empathizing–Systemizing (E–S) theory: Implications for autism. *Empirical Musicology Review*, 10(1–2), Article 1–2. <https://doi.org/10.18061/emr.v10i1-2.4603>

- Greenberg, D. M., Warrier, V., Allison, C., & Baron-Cohen, S. (2018). Testing the Empathizing–Systemizing theory of sex differences and the Extreme Male Brain theory of autism in half a million people. *Proceedings of the National Academy of Sciences*, 115(48), 12152–12157. <https://doi.org/10.1073/pnas.1811032115>
- Gregory, A. H., & Varney, N. (1996). Cross-cultural comparisons in the affective response to music. *Psychology of Music*, 24(1), 47–52. <https://doi.org/10.1177/0305735696241005>
- Grimaud, A. M., & Eerola, T. (2022). Emotional expression through musical cues: A comparison of production and perception approaches. *PLOS ONE*, 17(12), e0279605. <https://doi.org/10.1371/journal.pone.0279605>
- Groen, Y., Fuermaier, A. B. M., Den Heijer, A. E., Tucha, O., & Althaus, M. (2015). The Empathy and Systemizing Quotient: The Psychometric Properties of the Dutch Version and a Review of the Cross-Cultural Stability. *Journal of Autism and Developmental Disorders*, 45(9), 2848–2864. <https://doi.org/10.1007/s10803-015-2448-z>
- Gu, S., Wang, F., Patel, N. P., Bourgeois, J. A., & Huang, J. H. (2019). A model for basic motions using observations of behavior in drosophila. *Frontiers in Psychology*, 10. <https://www.frontiersin.org/article/10.3389/fpsyg.2019.00781>
- Hailstone, J. C., Omar, R., Henley, S. M. D., Frost, C., Kenward, M. G., & Warren, J. D. (2009). It's not what you play, it's how you play it: Timbre affects perception of emotion in music. *Quarterly Journal of Experimental Psychology*, 62(11), 2141–2155. <https://doi.org/10.1080/17470210902765957>
- Hanigan, É., Bonneville-Roussy, A., Dupuis, G., & Fortin, C. (2023). Validation of the measure of emotions by music (MEM). *Psychology of Music*, 51(4), 1379–1396. <https://doi.org/10.1177/03057356221146811>
- Harasim, D., Moss, F. C., Ramirez, M., & Rohrmeier, M. (2021). Exploring the foundations of tonality: Statistical cognitive modeling of modes in the history of Western classical music. *Humanities and Social Sciences Communications*, 8(1), 1–11. <https://doi.org/10.1057/s41599-020-00678-6>
- Hevner, K. (1936). Experimental studies of the elements of expression in music. *The American Journal of Psychology*, 48(2), 246. <https://doi.org/10.2307/1415746>
- Higgins, K. M. (2012). Biology and culture in musical emotions. *Emotion Review*, 4(3), 273–282. <https://doi.org/10.1177/1754073912439762>

- Hofbauer, L. M., & Rodriguez, F. S. (2023). Emotional valence perception in music and subjective arousal: Experimental validation of stimuli. *International Journal of Psychology: Journal International De Psychologie*.
<https://doi.org/10.1002/ijop.12922>
- Hofstede, G., & McCrae, R. R. (2004). Personality and culture revisited: Linking traits and dimensions of culture. *Cross-Cultural Research*, 38(1), 52–88.
<https://doi.org/10.1177/1069397103259443>
- Howard, D. M., & Angus, J. A. S. (2009). *Acoustics and psychoacoustics* (4th ed). Elsevier.
- Hunter, P. G., & Schellenberg, E. G. (2010). Music and emotion. In M. Riess Jones, R. R. Fay, & A. N. Popper (Eds.), *Music Perception* (Vol. 36, pp. 129–164). Springer New York. https://doi.org/10.1007/978-1-4419-6114-3_5
- Huron, D. (2011). Why is sad music pleasurable? A possible role for prolactin. *Musicae Scientiae*, 15(2), 146–158. <https://doi.org/10.1177/1029864911401171>
- Huron, D., Anderson, N., & Shanahan, D. (2014). “You can’t play a sad song on the Banjo:” Acoustic factors in the judgment of instrument capacity to convey sadness. *Empirical Musicology Review*, 9(1), Article 1. <https://doi.org/10.18061/emr.v9i1.4085>
- Hutto, D. D., Robertson, I., & Kirchhoff, M. D. (2018). A new, better BET: Rescuing and revising basic emotion theory. *Frontiers in Psychology*, 9.
<https://doi.org/10.3389/fpsyg.2018.01217>
- Ilie, G., & Thompson, W. F. (2006). A comparison of acoustic cues in music and speech for three dimensions of affect. *Music Perception*, 23(4), 319–330.
<https://doi.org/10.1525/mp.2006.23.4.319>
- Izard, C. E. (1977). *Human emotions*. Springer US. <https://doi.org/10.1007/978-1-4899-2209-0>
- Izard, C. E. (2007). Basic emotions, natural kinds, emotion schemas, and a new paradigm. *Perspectives on Psychological Science*, 2(3), 260–280. <https://doi.org/10.1111/j.1745-6916.2007.00044.x>
- Izard, C. E. (2011). Forms and functions of emotions: Matters of emotion–cognition interactions. *Emotion Review*, 3(4), 371–378.
<https://doi.org/10.1177/1754073911410737>
- Izen, S. C., Cassano-Coleman, R. Y., & Piazza, E. A. (2023). Music as a window into real-world communication. *Frontiers in Psychology*, 14.
<https://doi.org/10.3389/fpsyg.2023.1012839>

- Jack, R. E., Blais, C., Scheepers, C., Schyns, P. G., & Caldara, R. (2009). Cultural confusions show that facial expressions are not universal. *Current Biology: CB*, 19(18), 1543–1548. <https://doi.org/10.1016/j.cub.2009.07.051>
- Jack, R. E., Garrod, O. G. B., & Schyns, P. G. (2014). Dynamic facial expressions of emotion transmit an evolving hierarchy of signals over time. *Current Biology*, 24(2), 187–192. <https://doi.org/10.1016/j.cub.2013.11.064>
- John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm shift to the integrative big-five trait taxonomy: History, measurement, and conceptual issues. In O. P. John, R. W. Robinson, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (pp. 114–158). NY: Guilford Press.
- John, O. P., & Srivastava, S. (1999). The Big Five Trait taxonomy: History, measurement, and theoretical perspectives. In *Handbook of personality: Theory and research*, 2nd ed (pp. 102–138). Guilford Press.
- Juslin, P. N. (1997a). Can results from studies of perceived expression in musical performances be generalized across response formats? *Psychomusicology: A Journal of Research in Music Cognition*, 16(1–2), 77–101. <https://doi.org/10.1037/h0094065>
- Juslin, P. N. (1997b). Emotional communication in music performance: A functionalist perspective and some data. *Music Perception*, 14(4), 383–418. <https://doi.org/10.2307/40285731>
- Juslin, P. N. (2000). Cue utilization in communication of emotion in music performance: Relating performance to perception. *Journal of Experimental Psychology: Human Perception and Performance*, 26(6), 1797–1812. <https://doi.org/10.1037/0096-1523.26.6.1797>
- Juslin, P. N. (2001a). A Brunswikian approach to emotional communication in music performance. In K. R. Hammond & T. R. Stewart (Eds.), *The Essential Brunswik: Beginnings, Explications, Applications* (pp. 426–430). Oxford University Press New York, NY. <https://doi.org/10.1093/oso/9780195130133.001.0001>
- Juslin, P. N. (2001b). Communicating emotion in music performance: A review and a theoretical framework. In P. N. Juslin & J. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 309–337). Oxford University Press. <https://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-38432>
- Juslin, P. N. (2012). Are musical emotions invariant across cultures? *Emotion Review*, 4(3), 283–284. <https://doi.org/10.1177/1754073912439773>

- Juslin, P. N. (2013a). From everyday emotions to aesthetic emotions: Towards a unified theory of musical emotions. *Physics of Life Reviews*, 10(3), 235–266.
<https://doi.org/10.1016/j.plrev.2013.05.008>
- Juslin, P. N. (2013b). What does music express? Basic emotions and beyond. *Frontiers in Psychology*, 4, 1–14. <https://doi.org/10.3389/fpsyg.2013.00596>
- Juslin, P. N., Barradas, G. T., Ovsianikow, M., Limmo, J., & Thompson, W. F. (2016). Prevalence of emotions, mechanisms, and motives in music listening: A comparison of individualist and collectivist cultures. *Psychomusicology: Music, Mind, and Brain*, 26(4), 293–326. <https://doi.org/10.1037/pmu0000161>
- Juslin, P. N., & Laukka, P. (2003). Communication of emotions in vocal expression and music performance: Different channels, same code? *Psychological Bulletin*, 129(5), 770–814. <https://doi.org/10.1037/0033-2909.129.5.770>
- Juslin, P. N., & Laukka, P. (2004). Expression, perception, and induction of musical Emotions: A review and a questionnaire study of everyday listening. *Journal of New Music Research*, 33(3), 217–238. <https://doi.org/10.1080/0929821042000317813>
- Juslin, P. N., Liljeström, S., Laukka, P., Västfjäll, D., & Lundqvist, L.-O. (2011). Emotional reactions to music in a nationally representative sample of Swedish adults: Prevalence and causal influences. *Musicae Scientiae*, 15(2), 174–207.
<https://doi.org/10.1177/1029864911401169>
- Juslin, P. N., Liljeström, S., Västfjäll, D., & Lundqvist, L.-O. (2010). How does music evoke emotions? Exploring the underlying mechanisms. In *Handbook of music and emotion: Theory, research, applications* (pp. 605–642). Oxford University Press.
- Juslin, P. N., & Lindström, E. (2010). Musical expression of emotions: Modelling listeners' judgements of composed and performed features. *Music Analysis*, 29(1–3), 334–364.
<https://doi.org/10.1111/j.1468-2249.2011.00323.x>
- Juslin, P. N., & Sloboda, J. A. (Eds.). (2010). *Handbook of music and emotion: Theory, research, applications*. Oxford University Press.
- Juslin, P. N., & Västfjäll, D. (2008a). All emotions are not created equal: Reaching beyond the traditional disputes. *Behavioral and Brain Sciences*, 31(5), 600–621.
<https://doi.org/10.1017/S0140525X08005554>
- Juslin, P. N., & Västfjäll, D. (2008b). Emotional responses to music: The need to consider underlying mechanisms. *Behavioral and Brain Sciences*, 31(5), 559–575.
<https://doi.org/10.1017/S0140525X08005293>

- Kallinen, K., & Ravaja, N. (2006). Emotion perceived and emotion felt: Same and different: *Musicae Scientiae*. <https://doi.org/10.1177/102986490601000203>
- Kawakami, A., Furukawa, K., Katahira, K., & Okanoya, K. (2013). Sad music induces pleasant emotion. *Frontiers in Psychology*. <https://doi.org/10.3389/fpsyg.2013.00311>
- Kawase, S., & Obata, S. (2016). Psychological responses to recorded music as predictors of intentions to attend concerts: Emotions, liking, performance evaluations, and monetary value. *Musicae Scientiae*, 20(2), 163–172. <https://doi.org/10.1177/1029864915608682>
- Koelsch, S., Rempis, A., Sammler, D., Jentschke, S., Mietchen, D., Fritz, T., Bonnemeier, H., & Siebel, W. A. (2007). A cardiac signature of emotionality. *European Journal of Neuroscience*, 26(11), 3328–3338. <https://doi.org/10.1111/j.1460-9568.2007.05889.x>
- Kohn, K. (1981). The renotation of polyphonic music. *The Musical Quarterly*, LXVII(1), 29–49. <https://doi.org/10.1093/mq/LXVII.1.29>
- Konečni, V. (2008). Does music induce emotion? A theoretical and methodological analysis. *Psychology of Aesthetics, Creativity, and the Arts*, 2, 115. <https://doi.org/10.1037/1931-3896.2.2.115>
- Konstan, D. (Ed.). (2022). *Emotions across cultures: Ancient China and Greece*. De Gruyter.
- Kowalska, M., & Wróbel, M. (2017). Basic emotions. In V. Zeigler-Hill & T. K. Shackelford (Eds.), *Encyclopedia of personality and individual differences* (pp. 1–6). Springer International Publishing. https://doi.org/10.1007/978-3-319-28099-8_495-1
- Kravitz, E. A., & Fernandez, M. D. L. P. (2015). Aggression in drosophila. *Behavioral Neuroscience*, 129(5), 549–563. <https://doi.org/10.1037/bne0000089>
- Kreutz, G., Ott, U., Teichmann, D., Osawa, P., & Vaitl, D. (2008). Using music to induce emotions: Influences of musical preference and absorption. *Psychology of Music*, 36(1), 101–126. <https://doi.org/10.1177/0305735607082623>
- Kreutz, G., Schubert, E., & Mitchell, L. A. (2008). Cognitive styles of music listening. *Music Perception: An Interdisciplinary Journal*, 26(1), 57–73. <https://doi.org/10.1525/mp.2008.26.1.57>
- Kumfor, F., Irish, M., Hodges, J. R., & Piguet, O. (2013). Discrete neural correlates for the recognition of negative emotions: Insights from frontotemporal dementia. *PLoS ONE*, 8(6), e67457. <https://doi.org/10.1371/journal.pone.0067457>
- Lahdelma, I., & Eerola, T. (2020). Cultural familiarity and musical expertise impact the pleasantness of consonance/dissonance but not its perceived tension. *Scientific Reports*, 10(1), Article 1. <https://doi.org/10.1038/s41598-020-65615-8>

- Lang, P. J. (1995). The emotion probe: Studies of motivation and attention. *The American Psychologist*, 50(5), 372–385. <https://doi.org/10.1037//0003-066x.50.5.372>
- Larsen, R. J., & Ketelaar, T. (1991). Personality and susceptibility to positive and negative emotional states. *Journal of Personality and Social Psychology*, 61(1), 132–140. <https://doi.org/10.1037//0022-3514.61.1.132>
- Lartillot, O., & Toivainen, P. (2007). MIR in Matlab (II): A toolbox for musical feature extraction from audio. In S. Dixon, D. Bainbridge, & R. Typke (Eds.), *Proceedings of the 8th International Conference on Music Information Retrieval* (pp. 237–244). Austrian Computer Society.
- Lartillot, O., Toivainen, P., & Eerola, T. (2008). A Matlab toolbox for music information retrieval. In C. Preisach, H. Burkhardt, L. Schmidt-Thieme, & R. Decker (Eds.), *Data analysis, machine learning and applications* (pp. 261–268). Springer. https://doi.org/10.1007/978-3-540-78246-9_31
- Laukka, P., Bänziger, T., Israelsson, A., Cortes, D. S., Tornberg, C., Scherer, K. R., & Fischer, H. (2021). Investigating individual differences in emotion recognition ability using the ERAM test. *Acta Psychologica*, 220, 103422. <https://doi.org/10.1016/j.actpsy.2021.103422>
- Laukka, P., Eerola, T., Thingujam, N. S., Yamasaki, T., & Beller, G. (2013). Universal and culture-specific factors in the recognition and performance of musical affect expressions. *Emotion*, 13(3), 434–449. <https://doi.org/10.1037/a0031388>
- Laukka, P., & Elfenbein, H. A. (2020). Cross-cultural emotion recognition and in-group advantage in vocal expression: A meta-analysis. *Emotion Review*, 13(1), 1–9. <https://doi.org/10.1177/1754073919897295>
- Le, H.-N., Berenbaum, H., & Raghavan, C. (2002). Culture and alexithymia: Mean levels, correlates and the role of parental socialization of emotions. *Emotion*, 2, 341–360. <https://doi.org/10.1037/1528-3542.2.4.341>
- Ledoux, J., & Hofmann, S. (2018). The subjective experience of emotion: A fearful view. *Current Opinion in Behavioral Sciences*, 19, 67–72. <https://doi.org/10.1016/j.cobeha.2017.09.011>
- Lemaitre, G., Grimault, N., & Suied, C. (2018). Acoustics and psychoacoustics of sound scenes and events. In T. Virtanen, M. D. Plumbley, & D. Ellis (Eds.), *Computational analysis of sound scenes and events* (pp. 41–67). Springer International Publishing. https://doi.org/10.1007/978-3-319-63450-0_3

- Levenson, R. W. (2011). Basic emotion questions. *Emotion Review*, 3(4), 379–386.
<https://doi.org/10.1177/1754073911410743>
- Li, R.-H., & Chung, H.-Y. (2020). The development of a Chinese shortened version of the Big Five Inventory (BFI). *Journal of Testing*, 67(4), 271–299.
- Liljeström, S., Juslin, P. N., & Västfjäll, D. (2012). Experimental evidence of the roles of music choice, social context, and listener personality in emotional reactions to music. *Psychology of Music*, 41(5), 579–599. <https://doi.org/10.1177/0305735612440615>
- Lima, C. F., & Castro, S. L. (2011). Emotion recognition in music changes across the adult life span. *Cognition & Emotion*, 25(4), 585–598.
<https://doi.org/10.1080/02699931.2010.502449>
- Lin, H. (2010). *Music aesthetics and national psychology (Chinese)*. Shanghai Conservatory of Music Press.
- Lin, Y. (1936). *My country and my people*. William Heinemann.
- Lin, Y., Ding, H., & Zhang, Y. (2021). Gender differences in identifying facial, prosodic, and semantic emotions show category- and channel-specific effects mediated by encoder's gender. *Journal of Speech, Language, and Hearing Research*, 64(8), 2941–2955.
https://doi.org/10.1044/2021_JSLHR-20-00553
- Lionetti, F., Pastore, M., Moscardino, U., Nocentini, A., Pluess, K., & Pluess, M. (2019). Sensory Processing Sensitivity and its association with personality traits and affect: A meta-analysis. *Journal of Research in Personality*, 81, 138–152.
<https://doi.org/10.1016/j.jrp.2019.05.013>
- Liu, J. (2013). *Analysis of the differences between Chinese and Western music culture*.
[https://doi.org/1005-5312\(2013\)36-0069-01](https://doi.org/1005-5312(2013)36-0069-01)
- Liu, J.-D., You, R.-H., Liu, H., & Chung, P.-K. (2020). Chinese version of the international positive and negative affect schedule short form: Factor structure and measurement invariance. *Health and Quality of Life Outcomes*, 18(1), 285.
<https://doi.org/10.1186/s12955-020-01526-6>
- Livingstone, Steven. R. (2021). Why is music emotional? Theories of music and emotion. In W. F. Thompson & K. N. Olsen (Eds.), *The science and psychology of music: From Beethoven at the office to Beyoncé at the gym* (pp. 324–332). Santa Barbara : Greenwood. <https://lcn.loc.gov/2020010261>
- Lo, C. (2014). Cultural values and alexithymia. *SAGE Open*, 4(4), 1–6.
<https://doi.org/10.1177/2158244014555117>

- Loui, P., & Wessel, D. (2007). Harmonic expectation and affect in Western music: Effects of attention and training. *Perception & Psychophysics*, 69(7), 1084–1092.
<https://doi.org/10.3758/BF03193946>
- Lucas, R. E., Le, K., & Dyrenforth, P. S. (2008). Explaining the extraversion/positive affect relation: Sociability cannot account for extraverts' greater happiness. *Journal of Personality*, 76(3), 385–414. <https://doi.org/10.1111/j.1467-6494.2008.00490.x>
- Luo, X., & Huang, H. (2017). *Music Psychology (Chinese)* (2nd ed.). Shanghai Conservatory of Music Press.
- Lux, A. A., Grover, S. L., & Teo, S. T. T. (2021). Development and validation of the holistic cognition scale. *Frontiers in Psychology*, 12.
<https://www.frontiersin.org/articles/10.3389/fpsyg.2021.551623>
- Lynch, M. P., & Eilers, R. E. (1991). Children's Perception of Native and Nonnative Musical Scales. *Music Perception*, 9(1), 121–131. <https://doi.org/10.2307/40286162>
- Lyu, M., & Egermann, H. (2023). A cross-cultural study in Chinese and Western music: Cultural advantages in recognition of emotions. *[Manuscript Submitted for Publication]*.
- Ma, X., Tao, Y., & Bai, X. (2017). Development on the perception of Chinese and Western music emotion in children. *Studies of Psychology and Behavior*, 15(2), 233–239.
- Ma, X., Yang, Y., Tao, Y., & Cao, Y. (2017). Effects of musical cultural experience on music emotion processing (Chinese). *Chinese Science Bulletin*, 62(20), 2287–2300.
<https://doi.org/10.1360/N972017-00340>
- MacDonald, R. (2021). The social functions of music: Communication, Wellbeing, Art, Ritual, Identity and Social networks (C-WARIS). In *Routledge International Handbook of Music Psychology in Education and the Community* (pp. 5–20). Routledge.
- Mäkäräinen, M., Kätsyri, J., & Takala, T. (2018). Perception of basic emotion blends from facial expressions of virtual characters: Pure, mixed, or complex. *Computer Science Research Notes*. <https://doi.org/10.24132/CSRN.2018.2802.17>
- Mamatova, M., & Wille, D. E. (2012). Cross-cultural study of emotional expression: The problem of alexithymia. *Journal of Psychology Research*, 2(3), 196–200.
<https://doi.org/10.17265/2159-5542/2012.03.007>
- Marin, M. M., & Bhattacharya, J. (2011). Music induced emotions: Some current issues and cross-modal comparisons. In J. Hermida & M. Ferreo (Eds.), *Music education* (pp. 1–38). Nova Science, Nova Science Publishers, Inc.

- Martin, G. N., Carlson, N. R., & Buskist, W. (2013). *Psychology* (5th ed.). Pearson.
- Masuda, T., Gonzalez, R., Kwan, L., & Nisbett, R. E. (2008). Culture and aesthetic preference: Comparing the attention to context of East Asians and Americans. *Personality & Social Psychology Bulletin*, 34(9), 1260–1275. <https://doi.org/10.1177/0146167208320555>
- Masuda, T., & Nisbett, R. E. (2006). Culture and change blindness. *Cognitive Science*, 30(2), 381–399. https://doi.org/10.1207/s15516709cog0000_63
- Matsumoto, D., Consolacion, T., Yamada, H., Suzuki, R., Franklin, B., Paul, S., Ray, R., & Uchida, H. (2002). American-Japanese cultural differences in judgements of emotional expressions of different intensities. *Cognition and Emotion*, 16(6), 721–747. <https://doi.org/10.1080/02699930143000608>
- Matsumoto, D., Seung Hee Yoo, & Fontaine, J. (2008). Mapping expressive differences around the world: The relationship between emotional display rules and individualism versus collectivism. *Journal of Cross-Cultural Psychology*, 39(1), 55–74. <https://doi.org/10.1177/0022022107311854>
- Matthews, G., Jones, D. M., & Chamberlain, A. G. (1990). Refining the measurement of mood: The UWIST Mood Adjective Checklist. *British Journal of Psychology*, 81(1), 17–42. <https://doi.org/10.1111/j.2044-8295.1990.tb02343.x>
- McCrae, R. R. (2002). Cross-cultural research on the five-factor model of personality. *Online Readings in Psychology and Culture*, 4(4). <https://doi.org/10.9707/2307-0919.1038>
- McCrae, R. R. (2007). Aesthetic chills as a universal marker of openness to experience. *Motivation and Emotion*, 31, 5–11. <https://doi.org/10.1007/s11031-007-9053-1>
- McCrae, R. R., & Allik, J. (Eds.). (2002). *The five-factor model of personality across cultures*. Springer US. <https://doi.org/10.1007/978-1-4615-0763-5>
- McCrae, R. R., & John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, 60(2), 175–215. <https://doi.org/10.1111/j.1467-6494.1992.tb00970.x>
- McCrae, R. R., Terracciano, A., & 79 Members of the Personality Profiles of Cultures Project. (2005). Personality profiles of cultures: Aggregate personality traits. *Journal of Personality and Social Psychology*, 89(3), 407–425. <https://doi.org/10.1037/0022-3514.89.3.407>
- McNiel, J. M., & Fleeson, W. (2006). The causal effects of extraversion on positive affect and neuroticism on negative affect: Manipulating state extraversion and state

- neuroticism in an experimental approach. *Journal of Research in Personality*, 40(5), 529–550. <https://doi.org/10.1016/j.jrp.2005.05.003>
- Mehr, S. A., Singh, M., Knox, D., Ketter, D. M., Pickens-Jones, D., Atwood, S., Lucas, C., Jacoby, N., Egner, A. A., Hopkins, E. J., Howard, R. M., Hartshorne, J. K., Jennings, M. V., Simson, J., Bainbridge, C. M., Pinker, S., O'Donnell, T. J., Krasnow, M. M., & Glowacki, L. (2019). Universality and diversity in human song. *Science*, 366(6468), eaax0868. <https://doi.org/10.1126/science.aax0868>
- Messick, S. (1984). The nature of cognitive styles: Problems and promise in educational practice. *Educational Psychologist*, 19(2), 59–74. <https://doi.org/10.1080/00461528409529283>
- Midya, V., Valla, J. M., Jeffrey M. Valla, Balasubramanian, H., Mathur, A., & Singh, N. C. (2019). Cultural differences in the use of acoustic cues for musical emotion experience. *PLOS ONE*, 14(9), 1–17. <https://doi.org/10.1371/journal.pone.0222380>
- Miller, D. J., Vachon, D. D., & Lynam, D. R. (2009). Neuroticism, negative affect, and negative affect instability: Establishing convergent and discriminant validity using ecological momentary assessment. *Personality and Individual Differences*, 47(8), 873–877. <https://doi.org/10.1016/j.paid.2009.07.007>
- Miyamoto, Y., Nisbett, R. E., & Masuda, T. (2006). Culture and the physical environment: Holistic versus analytic perceptual affordances. *Psychological Science*, 17(2), 113–119. <https://doi.org/10.1111/j.1467-9280.2006.01673.x>
- Mohn, C., Argstatter, H., & Wilker, F.-W. (2011). Perception of six basic emotions in music. *Psychology of Music*, 39(4), 503–517. <https://doi.org/10.1177/0305735610378183>
- Montag, C., Reuter, M., & Axmacher, N. (2011). How one's favorite song activates the reward circuitry of the brain: Personality matters! *Behavioural Brain Research*, 225(2), 511–514. <https://doi.org/10.1016/j.bbr.2011.08.012>
- Nair, D. G., Large, E. W., Steinberg, F., & Kelso, J. A. S. (2002). Perceiving emotion in expressive performance: A functional MRI study. In K. Stevens, D. Burnham, G. McPherson, E. Schubert, & J. Renwick. Causal (Eds.), *Proceedings of the 7th International Conference on Music Perception and Cognition*.
- Nineuil, C., Dellacherie, D., & Samson, S. (2021). French adaptation of a film music stimulus set: Normative emotional ratings of valence and arousal prompted by music excerpts. *Psychology of Music*, 50(5), 1–9. <https://doi.org/10.1177/03057356211050683>

- Nisbett, R. E., & Miyamoto, Y. (2005). The influence of culture: Holistic versus analytic perception. *Trends in Cognitive Sciences*, 9(10), 467–473.
<https://doi.org/10.1016/j.tics.2005.08.004>
- Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review*, 108(2), 291–310.
<https://doi.org/10.1037/0033-295x.108.2.291>
- Niven, K. (2013). Affect. In M. D. Gellman & J. R. Turner (Eds.), *Encyclopedia of behavioral medicine* (pp. 49–50). Springer. https://doi.org/10.1007/978-1-4419-1005-9_1088
- Noraini, M. N., & Halimahtun, M. K. (2015). Measuring cognitive differences among three cultural groups: An exploratory study. *I, IO, International Journal of Behavioral Science*. <https://doi.org/10.14456/IJBS.2015.6>
- Oatley, K., & Johnson-laird, P. N. (1987). Towards a cognitive theory of emotions. *Cognition and Emotion*, 1(1), 29–50. <https://doi.org/10.1080/02699938708408362>
- Oh, V. Y. S., & Tong, E. M. W. (2022). Specificity in the study of mixed emotions: A theoretical framework. *Personality and Social Psychology Review*, 26(4), 283–314.
<https://doi.org/10.1177/10888683221083398>
- Orr, M. G., & Ohlsson, S. (2005). Relationship between complexity and liking as a function of expertise. *Music Perception: An Interdisciplinary Journal*, 22(4), 583–611.
<https://doi.org/10.1525/mp.2005.22.4.583>
- Ortony, A. (2022). Are all “basic emotions” emotions? A problem for the (basic) emotions construct. *Perspectives on Psychological Science*, 17(1), 41–61.
<https://doi.org/10.1177/1745691620985415>
- Ortony, A., & Turner, T. J. (1990). What’s basic about basic emotions? *Psychological Review*, 97(3), 315–331. <https://doi.org/10.1037/0033-295X.97.3.315>
- Oudyk, K., Burunat, I., Brattico, E., & Toiviainen, P. (2019). *Personality modulates brain responses to emotion in music: Comparing whole-brain and regions-of-variance approaches*. bioRxiv. <https://doi.org/10.1101/651133>
- Pae, H. K. (2020). The East and the West. In H. K. Pae, *Script effects as the hidden drive of the mind, cognition, and culture* (Vol. 21, pp. 107–134). Springer International Publishing. https://doi.org/10.1007/978-3-030-55152-0_6
- Panksepp, J., & Watt, D. (2011). What is basic about basic emotions? Lasting lessons from affective neuroscience. *Emotion Review*, 3(4), 387–396.
<https://doi.org/10.1177/1754073911410741>

- Park, M., Gutyrchik, E., Bao, Y., Zaytseva, Y., Carl, P., Welker, L., Pöppel, E., Reiser, M., Blautzik, J., & Meindl, T. (2014). Differences between musicians and non-musicians in neuro-affective processing of sadness and fear expressed in music. *Neuroscience Letters*, 566, 120–124. <https://doi.org/10.1016/j.neulet.2014.02.041>
- Park, M., Hennig-Fast, K., Bao, Y., Carl, P., Pöppel, E., Welker, L., Reiser, M., Meindl, T., & Gutyrchik, E. (2013). Personality traits modulate neural responses to emotions expressed in music. *Brain Research*, 1523, 68–76. <https://doi.org/10.1016/j.brainres.2013.05.042>
- Parncutt, R., Reisinger, D., Fuchs, A., & Kaiser, F. (2019). Consonance and prevalence of sonorities in Western polyphony: Roughness, harmonicity, familiarity, evenness, diatonicity. *Journal of New Music Research*, 48(1), 1–20. <https://doi.org/10.1080/09298215.2018.1477804>
- Pereira, C. S., Teixeira, J., Figueiredo, P., Xavier, J., Castro, S. L., & Brattico, E. (2011). Music and emotions in the brain: Familiarity matters. *PLoS ONE*, 6(11), e27241. <https://doi.org/10.1371/journal.pone.0027241>
- Plutchik, R. (1980). A general psychoevolutionary theory of emotion. In R. Plutchik & H. Kellerman (Eds.), *Emotion: Theory, research, and experience: Vol. 1. Theories of emotion* (pp. 3–33). Elsevier. <https://doi.org/10.1016/B978-0-12-558701-3.50007-7>
- Plutchik, R. (1982). A psychoevolutionary theory of emotions. *Social Science Information*, 21(4–5), 529–553. <https://doi.org/10.1177/053901882021004003>
- Preacher, K. J., Zyphur, M. J., & Zhang, Z. (2010). A general multilevel SEM framework for assessing multilevel mediation. *Psychological Methods*, 15(3), 209–233. <https://doi.org/10.1037/a0020141>
- Price, P. C., Jhangiani, R. S., & Chiang, I.-C. A. (2015). *Research methods in psychology* (2nd Canadian ed.). BCcampus Open Education. <https://opentextbc.ca/researchmethods/chapter/quasi-experimental-research/>
- Qin, Y., & Zhang, D.-W. (2024). Characterizing Chinese undergraduate students' empathizing-systemizing profiles: A person-centered approach. *Frontiers in Psychology*, 15, 1–12. <https://doi.org/10.3389/fpsyg.2024.1395560>
- Qing, Z. (2023). *Empathy Quotient (EQ-60)—Simplified Chinese*. Empathy Quotient (EQ) for Adults. Autism Research Centre. <https://www.autismresearchcentre.com/tests/empathy-quotient-eq-for-adults/>

- Quinto, L., & Thompson, W. F. (2013). Composers and performers have different capacities to manipulate arousal and valence. *Psychomusicology: Music, Mind, and Brain*, 23(3), 137–150. <https://doi.org/10.1037/a0034775>
- Rafiee, Y., & Schacht, A. (2023). Sex differences in emotion recognition: Investigating the moderating effects of stimulus features. *Cognition and Emotion*, 37(5), 863–873. <https://doi.org/10.1080/02699931.2023.2222579>
- Rentfrow, P. J., Goldberg, L. R., & Levitin, D. J. (2011). The structure of musical preferences: A five-factor model. *Journal of Personality and Social Psychology*, 100(6), 1139–1157. <https://doi.org/10.1037/a0022406>
- Rentfrow, P. J., Goldberg, L. R., Stillwell, D. J., Kosinski, M., Gosling, S. D., & Levitin, D. J. (2012). The song remains the same: A replication and extension of the MUSIC model. *Music Perception*, 30(2), 161–185. <https://doi.org/10.1525/mp.2012.30.2.161>
- Rentfrow, P. J., & Gosling, S. D. (2003). The do re mi's of everyday life: The structure and personality correlates of music preferences. *Journal of Personality and Social Psychology*, 84(6), 1236–1256. <https://doi.org/10.1037/0022-3514.84.6.1236>
- Rentfrow, P. J., & McDonald, J. A. (2010). Preference, personality, and emotion. In P. N. Juslin & J. A. Sloboda (Eds.), *Handbook of music and emotion: Theory, research, applications* (pp. 669–695). Oxford University Press.
- Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39(6), 1161–1178. <https://doi.org/10.1037/h0077714>
- Russell, J. A. (1991). Culture and the categorization of emotions. *Psychological Bulletin*, 110(3), 426.
- Russell, J. A. (1994). Is there universal recognition of emotion from facial expression? A review of the cross-cultural studies. *Psychological Bulletin*, 115(1), 102–141. <https://doi.org/10.1037/0033-2909.115.1.102>
- Rusting, C. L., & Larsen, R. J. (1997). Extraversion, neuroticism, and susceptibility to positive and negative affect: A test of two theoretical models. *Personality and Individual Differences*, 22(5), 607–612. [https://doi.org/10.1016/S0191-8869\(96\)00246-2](https://doi.org/10.1016/S0191-8869(96)00246-2)
- Saarimäki, H., Gotsopoulos, A., Jääskeläinen, I. P., Lampinen, J., Vuilleumier, P., Hari, R., Sams, M., & Nummenmaa, L. (2016). Discrete neural signatures of basic emotions. *Cerebral Cortex*, 26(6), 2563–2573. <https://doi.org/10.1093/cercor/bhv086>
- Sacrey, L.-A. R., Raza, S., Armstrong, V., Brian, J. A., Kushki, A., Smith, I. M., & Zwaigenbaum, L. (2021). Physiological measurement of emotion from infancy to

- preschool: A systematic review and meta-analysis. *Brain and Behavior*, 11(2), e01989. <https://doi.org/10.1002/brb3.1989>
- Saitis, C., & Siedenburg, K. (2020). Brightness perception for musical instrument sounds: Relation to timbre dissimilarity and source-cause categories. *The Journal of the Acoustical Society of America*, 148(4), 2256–2266. <https://doi.org/10.1121/10.0002275>
- Scarantino, A., & Griffiths, P. (2011). Don't give up on basic emotions. *Emotion Review*, 3(4), 444–454. <https://doi.org/10.1177/1754073911410745>
- Schellenberg, E. G. (2008). The role of exposure in emotional responses to music. *Behavioral and Brain Sciences*, 31(5), 594–595. <https://doi.org/10.1017/S0140525X08005499>
- Scherer, K. R. (2004). Which emotions can be induced by music? What are the underlying mechanisms? And how can we measure them? *Journal of New Music Research*, 33(3), 239–251. <https://doi.org/10.1080/0929821042000317822>
- Scherer, K. R., & Coutinho, E. (2013). How music creates emotion: A multifactorial process approach. In T. Cochrane, B. Fantini, & K. R. Scherer (Eds.), *The emotional power of music: Multidisciplinary perspectives on musical arousal, expression, and social control* (pp. 121–145). Oxford University Press.
- Scherer, K. R., & Oshinsky, J. S. (1977). Cue utilization in emotion attribution from auditory stimuli. *Motivation and Emotion*, 1(4), 331–346. <https://doi.org/10.1007/BF00992539>
- Scherer, K. R., & Zentner, M. R. (2001). Emotional effects of music: Production rules. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 361–392). Oxford University Press.
- Scherer, K., & Zentner, M. (2008a). Music evoked emotions are different – more often aesthetic than utilitarian. *Behavioral and Brain Sciences*, 31(5), 595–596. <https://doi.org/10.1017/S0140525X08005505>
- Scherer, K., & Zentner, M. (2008b). Music evoked emotions are different—more often aesthetic than utilitarian. *Behavioral and Brain Sciences*, 31(5), 595–596. <https://doi.org/10.1017/S0140525X08005505>
- Schlosberg, H. (1954). Three dimensions of emotion. *Psychological Review*, 61, 81–88. <https://doi.org/10.1037/h0054570>
- Schmitt, D. P., Allik, J., McCrae, R. R., & Benet-Martínez, V. (2007). The geographic distribution of Big Five personality traits: Patterns and profiles of human self-description across 56 nations. *Journal of Cross-Cultural Psychology*, 38(2), 173–212. <https://doi.org/10.1177/0022022106297299>

- Schoeller, F., & Perlovsky, L. (2016). Aesthetic chills: Knowledge-acquisition, meaning-making, and aesthetic emotions. *Frontiers in Psychology*, 7, 1–16.
- Schubert, E. (2007). The influence of emotion, locus of emotion and familiarity upon preference in music. *Psychology of Music*, 35(3), 499–515.
<https://doi.org/10.1177/0305735607072657>
- Schutz, M., Huron, D., Keeton, K., & Loewer, G. (2008). The happy xylophone: Acoustics affordances restrict an emotional palate. *Empirical Musicology Review*, 3(3), 126–135. <https://doi.org/10.18061/1811/34103>
- Scotland, J. (2012). Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching*, 5(9), 9–16.
<https://doi.org/10.5539/elt.v5n9p9>
- Sethares, W. A. (1998). *Tuning, timbre, spectrum, scale*. Springer London.
<https://doi.org/10.1007/978-1-4471-4177-8>
- Shen, C., Wang, M., Ding, T., Yang, Y., Cabanyes-Truffino, J., Sun, L., Wang, C., & Wang, W. (2018). Basic emotions expressed in music: Factor analyses on intensity ratings by non-musical professional Chinese university students. *Psychology Research and Behavior Management*, 11, 617–629. <https://doi.org/10.2147/PRBM.S190038>
- Siedenburg, K., Jones-Mollerup, K., & McAdams, S. (2016). Acoustic and categorical dissimilarity of musical timbre: Evidence from asymmetries between acoustic and chimeric sounds. *Frontiers in Psychology*, 6, 1–17.
- Siedlecka, E., & Denson, T. F. (2019). Experimental methods for inducing basic emotions: A qualitative review. *Emotion Review*, 11(1), 87–97.
<https://doi.org/10.1177/1754073917749016>
- Sievers, B., Polansky, L., Casey, M. A., & Wheatley, T. (2013). Music and movement share a dynamic structure that supports universal expressions of emotion. *Proceedings of the National Academy of Sciences*, 110(1), 70–75.
<https://doi.org/10.1073/pnas.1209023110>
- Smaldino, P. E., Lukaszewski, A., von Rueden, C., & Gurven, M. (2019). Niche diversity can explain cross-cultural differences in personality structure. *Nature Human Behaviour*, 3(12), Article 12. <https://doi.org/10.1038/s41562-019-0730-3>
- Smillie, L. D., DeYoung, C. G., & Hall, P. J. (2015). Clarifying the relation between extraversion and positive affect. *Journal of Personality*, 83(5), 564–574.
<https://doi.org/10.1111/jopy.12138>

- Smit, E. A., Dobrowohl, F. A., Schaal, N. K., Milne, A. J., & Herff, S. A. (2020). Perceived emotions of harmonic cadences. *Music & Science*, 3, 1–13.
<https://doi.org/10.1177/2059204320938635>
- Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological Methodology*, 13, 290–312.
<https://doi.org/10.2307/270723>
- Song, Y., Dixon, S., Pearce, M. T., & Halpern, A. R. (2016). Perceived and induced emotion responses to popular music: Categorical and dimensional models. *Music Perception*, 33(4), 472–492. <https://doi.org/10.1525/mp.2016.33.4.472>
- Soto, C. J., & Jackson, J. J. (2020). Five-factor model of personality. In Dana. S. Dunn, *Oxford bibliographies in psychology*. Oxford University Press.
<https://doi.org/10.1093/obo/9780199828340-0120>
- Sulem, A., Bodner, E., & Amir, N. (2022). Perception of violin performance expression through expressive musical terms. *Musicae Scientiae*, 1–29.
<https://doi.org/10.1177/10298649211051018>
- Sun, L.-H. (2011). *The association between personality and music preferences, and the psychological mechanism of music preferences* [Master's thesis, National Taiwan University]. NTU Theses and Dissertations Repository.
<https://tdr.lib.ntu.edu.tw/bitstream/123456789/10228/1/ntu-100-1.pdf>
- Susino, M., & Schubert, E. (2016). Cross-cultural anger communication in music: Towards a stereotype theory of emotion in music. *Musicae Scientiae*, 21(1), 60–74.
<https://doi.org/10.1177/1029864916637641>
- Svard, L. (2023). Born for music. In L. Svard (Ed.), *The musical brain: What students, teachers, and performers need to know* (pp. 33–54). Oxford University Press.
<https://doi.org/10.1093/oso/9780197584170.003.0003>
- Taruffi, L., Allen, R., Downing, J., & Heaton, P. (2017). Individual differences in music-perceived emotions: The influence of externally oriented thinking. *Music Perception*, 34(3), 253–266. <https://doi.org/10.1525/mp.2017.34.3.253>
- Thammasan, N., Moriyama, K., Fukui, K., & Numao, M. (2017). Familiarity effects in EEG-based emotion recognition. *Brain Informatics*, 4(1), 39–50.
<https://doi.org/10.1007/s40708-016-0051-5>
- The Chinese Culture Connection. (1987). Chinese values and the search for culture-free dimensions of culture. *Journal of Cross-Cultural Psychology*, 18(2), 143–164.
<https://doi.org/10.1177/0022002187018002002>

- Thompson, E. R. (2007). Development and validation of an internationally reliable short-form of the positive and negative affect schedule (PANAS). *Journal of Cross-Cultural Psychology*, 38(2), 227–242. <https://doi.org/10.1177/0022022106297301>
- Thompson, W. F., & Balkwill, L.-L. (2010). Cross-cultural similarities and differences. In P. N. Juslin & J. A. Sloboda (Eds.), *Handbook of music and emotions* (pp. 755–788). Oxford University Press.
<https://doi.org/10.1093/acprof:oso/9780199230143.003.0027>
- Thompson, W. F., & Coltheart, M. (2008). The role of signal detection and amplification in the induction of emotion by music. *Behavioral and Brain Sciences*, 31(5), 597–598. <https://doi.org/10.1017/S0140525X08005529>
- Thompson, W. F., & Olsen, K. N. (2021). Cross-cultural research in music psychology. In W. F. Thompson & K. N. Olsen (Eds.), *The science and psychology of music: From Beethoven at the office to Beyoncé at the gym* (pp. 62–69). Greenwood, an imprint of ABC-CLIO.
- Thormählen, W. (2022). Music and emotions. In K. Barclay & P. N. Stearns, *The Routledge history of emotions in the modern world* (1st ed., pp. 345–359). Routledge.
<https://doi.org/10.4324/9781003023326-27>
- Tomkins, S. S. (1962). *Affect, imagery, consciousness, Vol. 1. The positive affects* (pp. xv, 522). Springer. <https://doi.org/10.1037/14351-000>
- Tomlinson, G. (2015). *A million years of music: The emergence of human modernity* (1st ed.). Zone Books.
https://www.dirzon.com/file/telegram/yafelesefenaa%20matzehhafete/Gary_Tomlinson_A_Million_Years_of_Music_The_Emergence_of_Human_Modernity.pdf
- Tracy, J. L., & Randles, D. (2011). Four models of basic emotions: A review of Ekman and Cordaro, Izard, Levenson, and Panksepp and Watt. *Emotion Review*, 3(4), 397–405. <https://doi.org/10.1177/1754073911410747>
- Trehub, S. E., Becker, J., & Morley, I. (2015). Cross-cultural perspectives on music and musicality. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 370(1664), 20140096. <https://doi.org/10.1098/rstb.2014.0096>
- Triandis, H. C. (2001). Individualism-collectivism and personality. *Journal of Personality*, 69(6), 907–924. <https://doi.org/10.1111/1467-6494.696169>
- Triandis, H. C., Bontempo, R., Villareal, M. J., Asai, M., & Lucca, N. (1988). Individualism and collectivism: Cross-cultural perspectives on self-ingroup relationships. *Journal of*

- Personality and Social Psychology*, 54(2), 323–338. <https://doi.org/10.1037/0022-3514.54.2.323>
- Triandis, H. C., & Gelfand, M. (1998). Converging measurement of horizontal and vertical individualism and collectivism. *Journal of Personality and Social Psychology*, 74, 118–128. <https://doi.org/10.1037/0022-3514.74.1.118>
- Trilla, I., Weigand, A., & Dziobek, I. (2021). Affective states influence emotion perception: Evidence for emotional egocentricity. *Psychological Research*, 85(3), 1005–1015. <https://doi.org/10.1007/s00426-020-01314-3>
- Tyng, C. M., Amin, H. U., Saad, M. N. M., & Malik, A. S. (2017). The Influences of Emotion on Learning and Memory. *Frontiers in Psychology*, 8, 1454. <https://doi.org/10.3389/fpsyg.2017.01454>
- van den Bosch, I., Salimpoor, V., & Zatorre, R. (2013). Familiarity mediates the relationship between emotional arousal and pleasure during music listening. *Frontiers in Human Neuroscience*, 7. <https://www.frontiersin.org/articles/10.3389/fnhum.2013.00534>
- van der Gaag, C., Minderaa, R. B., & Keyzers, C. (2007). Facial expressions: What the mirror neuron system can and cannot tell us. *Social Neuroscience*, 2(3–4), 179–222. <https://doi.org/10.1080/17470910701376878>
- van der Schyff, D., & Schiavio, A. (2017). Evolutionary musicology meets embodied cognition: Biocultural coevolution and the enactive origins of human musicality. *Frontiers in Neuroscience*, 11, 519. <https://doi.org/10.3389/fnins.2017.00519>
- Vieillard, S., Peretz, I., Gosselin, N., Khalfa, S., Gagnon, L., & Bouchard, B. (2008). Happy, sad, scary and peaceful musical excerpts for research on emotions. *Cognition & Emotion*, 22(4), 720–752. <https://doi.org/10.1080/02699930701503567>
- Villarréal, E. A. G., Brattico, E., Vase, L., Østergaard, L., & Vuust, P. (2012). Superior analgesic effect of an active distraction versus pleasant unfamiliar sounds and music: The influence of emotion and cognitive style. *PLOS ONE*, 7(1), e29397. <https://doi.org/10.1371/journal.pone.0029397>
- Vuoskoski, J. K., & Eerola, T. (2011a). Measuring music-induced emotion: A comparison of emotion models, personality biases, and intensity of experiences. *Musicae Scientiae*, 15(2), 159–173. <https://doi.org/10.1177/1029864911403367>
- Vuoskoski, J. K., & Eerola, T. (2011b). The role of mood and personality in the perception of emotions represented by music. *Cortex*, 47(9), 1099–1106. <https://doi.org/10.1016/j.cortex.2011.04.011>

- Wakabayashi, A., Baron-Cohen, S., Uchiyama, T., Yoshida, Y., Kuroda, M., & Wheelwright, S. (2007). Empathizing and systemizing in adults with and without autism spectrum conditions: Cross-cultural stability. *Journal of Autism and Developmental Disorders*, 37(10), 1823–1832. <https://doi.org/10.1007/s10803-006-0316-6>
- Wang, X., Wang, L., & Xie, L. (2022). Comparison and analysis of acoustic features of Western and Chinese classical music emotion recognition based on V-A model. *Applied Sciences*, 12(12), 5787. <https://doi.org/10.3390/app12125787>
- Wang, Y., & Du, Y. (2004). *Introduction to Chinese traditional music* (2nd ed.). Fujian Education Press.
- Wang, Z., Zhang, D., & Zheng, Z. (2023). Cross-cultural differences in empathy and relevant factors. *Journal of Education, Humanities and Social Sciences*, 10, 197–202. <https://doi.org/10.54097/ehss.v10i.6919>
- Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin*, 98(2), 219–235. <https://doi.org/10.1037/0033-2909.98.2.219>
- Widiger, T. A., & Oltmanns, J. R. (2017). Neuroticism is a fundamental domain of personality with enormous public health implications. *World Psychiatry*, 16(2), 144–145. <https://doi.org/10.1002/wps.20411>
- Wilt, J., Nofle, E. E., Fleeson, W., & Spain, J. S. (2012). The dynamic role of personality states in mediating the relationship between extraversion and positive affect. *Journal of Personality*, 80(5), 1205–1236. <https://doi.org/10.1111/j.1467-6494.2011.00756.x>
- Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P. W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. *Review of Educational Research*, 47(1), 1–64. <https://doi.org/10.2307/1169967>
- Wundt, W. M. (1897). *Outlines of psychology* (C. H. Judd, Trans.). Williams and Norgate; Wilhelm Engelmann; <http://archive.org/details/cu31924014474534>. <https://doi.org/10.1037/12908-000>
- Xu, L., Xu, M., Jiang, Z., Wen, X., Liu, Y., Sun, Z., Li, H., & Qian, X. (2023). How have music emotions been described in Google books? Historical trends and corpus differences. *Humanities and Social Sciences Communications*, 10(1), 1–11. <https://doi.org/10.1057/s41599-023-01853-1>
- Yang, S., Reed, C. N., Chew, E., & Barthet, M. (2021). Examining emotion perception agreement in live music performance. *IEEE Transactions on Affective Computing*. <https://doi.org/10.1109/TAFFC.2021.3093787>

- Yao, X. (2000). *An introduction to Confucianism*. Cambridge University Press.
<https://doi.org/10.1017/CBO9780511800887>
- Yin, L. (2010). A study on tonal styles in Chinese and Western musical cultures. *Art Education*, 2, 61, 76.
- Zacharopoulou, K., & Kyriakidou, A. (2009). A cross-cultural comparative study of the role of musical structural features in the perception of emotion in Greek traditional music. *Journal of Interdisciplinary Music Studies*, 3(1 & 2), 1–15.
- Zentner, M., & Eerola, T. (2010). Self-report measures and models. In P. N. Juslin (Ed.), *Handbook of music and emotion: Theory, research, applications* (pp. 187–221). Oxford University Press.
<https://doi.org/10.1093/acprof:oso/9780199230143.003.0008>
- Zentner, M., Grandjean, D., & Scherer, K. R. (2008). Emotions evoked by the sound of music: Characterization, classification, and measurement. *Emotion*, 8(4), 494–521.
<https://doi.org/10.1037/1528-3542.8.4.494>
- Zentner, M. R., & Kagan, J. (1996). Perception of music by infants. *Nature*, 383(6595), 29–29. <https://doi.org/10.1038/383029a0>
- Zhang, H., Sun, Y., & Shi, S. (Eds.). (2006). *Modern English to Chinese—Chinese to English glossary of psychology* (Rev. ed.). China Light Industry Press.
- Zhang, J., & Han, T. (2023). Individualism and collectivism orientation and the correlates among Chinese college students. *Current Psychology*, 42(5), 3811–3821.
<https://doi.org/10.1007/s12144-021-01735-2>
- Zhang, L., Sun, S., Xing, B., Luo, R., & Zhang, K. (2019). Using psychophysiological measures to recognize personal music emotional experience. *Frontiers of Information Technology & Electronic Engineering*, 20(7), 964–974.
<https://doi.org/10.1631/FITEE.1800101>
- Zhang, Z., Zyphur, M. J., & Preacher, K. J. (2009). Testing multilevel mediation using hierarchical linear models: Problems and solutions. *Organizational Research Methods*, 12(4), 695–719. <https://doi.org/10.1177/1094428108327450>
- Zhu, X., Yi, J., Yao, S., Ryder, A. G., Taylor, G. J., & Bagby, R. M. (2007). Cross-cultural validation of a Chinese translation of the 20-item Toronto Alexithymia Scale. *Comprehensive Psychiatry*, 48(5), 489–496.
<https://doi.org/10.1016/j.comppsy.2007.04.007>

Zweigenhaft, R. L. (2008). A Do Re Mi Encore: A closer look at the personality correlates of music preferences. *Journal of Individual Differences*, 29(1), 45–55.
<https://doi.org/10.1027/1614-0001.29.1.45>

Appendix 1.

List of Musical Stimuli ($n=18$): Culture Origin, Emotion Label, Source, Duration, and Psychoacoustic Descriptors

Culture	Excerpt Number	Emotion	Source	Duration (seconds)	Average BPM	Pitch (in Hz)_mean	Event Density	Roughness _mean	Centroid	RMS Energy	Brightness	Mode
Chinese	Excerpt 1	Happiness	Wild Dance of the Golden Snake (金蛇狂舞, <i>Jīnshé kuángwǔ</i>)	19	157.87	399.5971	2.0665	136.8748	3971.1068	0.067109	0.66896	-0.020858
	Excerpt 2	Happiness	Amazing Jiangnan (江南好, <i>Jiāngnán hǎo</i>)	15	129.63	546.5404	3.1291	13.4188	2789.8842	0.022098	0.5535	0.27662
	Excerpt 3	Sadness	The Regret of Linan (临安遗恨, <i>Línān yihèn</i>)	20	42.59	644.8772	0.88063	193.7933	2044.3166	0.10908	0.39414	0.18021
	Excerpt 4	Sadness	The Sorrow of the River (江怨, <i>Jiāngyuàn</i>)	16	58.72	88.7845	3.1287	75.594	2104.1856	0.04398	0.48269	-0.23265
	Excerpt 5	Peacefulness	Spring Flowers on the Moonlit River (春江花月夜, <i>Chūnjiāng huāyuè yè</i>)	19	49.1	557.6281	1.9447	211.3086	1652.2498	0.1051	0.36452	-0.02252
	Excerpt 6	Peacefulness	Spring Flowers on the Moonlit River (春江花月夜, <i>Chūnjiāng huāyuè yè</i>)	19	58.72	601.947	3.1024	60.4728	1417.2717	0.07345	0.23271	0.10069
	Excerpt 7	Anger	Ambushed From All Sides (十面埋伏, <i>Shímiàn Mǎifú</i>)	18	172.5	87.8064	1.0787	712.071	2562.3844	0.14747	0.45942	-0.077838
	Excerpt 8	Anger	Ambushed From All Sides (十面埋伏, <i>Shímiàn Mǎifú</i>)	21	245.34	1005.6525	1.8744	740.7627	1641.0511	0.16492	0.24849	-0.072175
Western	Excerpt 9	Happiness	St. Paul's Suite IV.Finale (The Dargasson)	20	148.17	174.1199	3.18	3094.5031	2211.844	0.28346	0.41262	0.005166
	Excerpt 10	Happiness	Carl Philipp Emanuel Bach. Cello Concerto No. 3 in A major, Wq. 172	14	144.41	116.2458	1.4957	79.7317	2140.3159	0.063179	0.41703	0.072734
	Excerpt 11	Sadness	Symphony No. 6 in B Minor, Op. 74 Pathétique IV. Finale - Adagio lamentoso	19	35.29	187.4912	1.4826	14.0195	1751.2699	0.021833	0.38098	-0.16305
	Excerpt 12	Sadness	Symphony No. 6 in B Minor, Op. 74 Pathétique IV. Finale - Adagio lamentoso	18	45.26	250.1159	2.8357	49.6657	1323.3306	0.042523	0.23311	-0.13029
	Excerpt 13	Peacefulness	J.S. Bach, Andante and Allegro from Sonata in E Minor	20	86.78	942.8985	1.0763	35.5376	1586.0906	0.04674	0.24488	0.091303
	Excerpt 14	Peacefulness	Tosca "Vissi d'arte"	16	60.79	78.4005	0.97919	5.8177	1675.8855	0.017809	0.36076	0.28364
	Excerpt 15	Anger	Mussorgsky - Pictures at an Exhibition	19	174.72	123.4083	1.3001	341.83	2685.3109	0.094412	0.51271	-0.042915
	Excerpt 16	Anger	Bartok - The Miraculous Mandarin, Suite	20	136.73	98.2503	1.2481	681.3045	2579.5801	0.1182	0.51416	-0.020985
	Excerpt 17	Fear	Igor Stravinsky, Rite of Spring - Part 1	19	105.18	93.9767	1.6555	55.8749	3422.3253	0.040644	0.55333	-0.025985
	Excerpt 18	Fear	Beethoven Symphony No 6, 4th movement	13	92.31	697.1903	0.98935	48.5847	1771.8628	0.037629	0.36046	-0.1896

Appendix 2.

Chinese Music: Pairwise Comparisons of Repeated Measures ANOVA for Each Type of Rating, with the Within-subjects Factor Emotion of Music, and the Between-subjects Factor Cultural Background

Pairwise Comparisons for Happiness Ratings for Chinese Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	0.633*	0.067	<.001	0.502	0.764
	Westerners	Chinese	-0.633*	0.067	<.001	-0.764	-0.502
Sad Music	Chinese	Westerners	-0.627*	0.073	<.001	-0.771	-0.483
	Westerners	Chinese	0.627*	0.073	<.001	0.483	0.771
Peaceful Music	Chinese	Westerners	-0.426*	0.092	<.001	-0.608	-0.245
	Westerners	Chinese	0.426*	0.092	<.001	0.245	0.608

Angry Music	Chinese	Westerners	-0.104	0.075	0.163	-0.251	0.042
	Westerners	Chinese	0.104	0.075	0.163	-0.042	0.251
Based on estimated marginal means							
*. The mean difference is significant at the 0.05 level.							
b. Adjustment for multiple comparisons: LSD.							

Pairwise Comparisons for Sadness Ratings for Chinese Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	-0.326*	0.054	<.001	-0.431	-0.220
	Westerners	Chinese	0.326*	0.054	<.001	0.220	0.431
Sad Music	Chinese	Westerners	0.498*	0.095	<.001	0.311	0.685
	Westerners	Chinese	-0.498*	0.095	<.001	-0.685	-0.311
Peaceful Music	Chinese	Westerners	-0.085	0.107	0.425	-0.295	0.125
	Westerners	Chinese	0.085	0.107	0.425	-0.125	0.295
Angry Music	Chinese	Westerners	-0.093	0.095	0.330	-0.280	0.095

	Westerners	Chinese	0.093	0.095	0.330	-0.095	0.280
Based on estimated marginal means							
*. The mean difference is significant at the 0.05 level.							
b. Adjustment for multiple comparisons: LSD.							

Pairwise Comparisons for Peacefulness Ratings for Chinese Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	-0.667*	0.081	<.001	-0.826	-0.507
	Westerners	Chinese	0.667*	0.081	<.001	0.507	0.826
Sad Music	Chinese	Westerners	-0.451*	0.083	<.001	-0.614	-0.289
	Westerners	Chinese	0.451*	0.083	<.001	0.289	0.614
Peaceful Music	Chinese	Westerners	-0.049	0.091	0.593	-0.228	0.130
	Westerners	Chinese	0.049	0.091	0.593	-0.130	0.228
Angry Music	Chinese	Westerners	-0.216*	0.066	0.001	-0.345	-0.086
	Westerners	Chinese	0.216*	0.066	0.001	0.086	0.345
Based on estimated marginal means							

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: LSD.

Pairwise Comparisons for Anger Ratings for Chinese Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	-0.473*	0.062	<.001	-0.596	-0.351
	Westerners	Chinese	0.473*	0.062	<.001	0.351	0.596
Sad Music	Chinese	Westerners	0.048	0.082	0.556	-0.113	0.209
	Westerners	Chinese	-0.048	0.082	0.556	-0.209	0.113
Peaceful Music	Chinese	Westerners	-0.230*	0.064	<.001	-0.356	-0.104
	Westerners	Chinese	0.230*	0.064	<.001	0.104	0.356
Angry Music	Chinese	Westerners	-0.154	0.099	0.120	-0.348	0.040
	Westerners	Chinese	0.154	0.099	0.120	-0.040	0.348
Based on estimated marginal means							
*. The mean difference is significant at the 0.05 level.							
b. Adjustment for multiple comparisons: LSD.							

Pairwise Comparisons for Fear Ratings for Chinese Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	-0.408*	0.060	<.001	-0.525	-0.291
	Westerners	Chinese	0.408*	0.060	<.001	0.291	0.525
Sad Music	Chinese	Westerners	-0.173*	0.080	0.030	-0.330	-0.017
	Westerners	Chinese	0.173*	0.080	0.030	0.017	0.330
Peaceful Music	Chinese	Westerners	-0.386*	0.069	<.001	-0.521	-0.251
	Westerners	Chinese	0.386*	0.069	<.001	0.251	0.521
Angry Music	Chinese	Westerners	-0.349*	0.106	0.001	-0.556	-0.141
	Westerners	Chinese	0.349*	0.106	0.001	0.141	0.556
Based on estimated marginal means							
*. The mean difference is significant at the 0.05 level.							
b. Adjustment for multiple comparisons: LSD.							

Western Music: Pairwise Comparisons of Repeated Measures ANOVA for Each Type of Rating, with the Within-subjects Factor Emotion of Music, and the Between-subjects Factor Cultural Background

Pairwise Comparisons for Happiness Ratings for Western Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	0.204*	0.087	0.020	0.032	0.375
	Westerners	Chinese	-0.204*	0.087	0.020	-0.375	-0.032
Sad Music	Chinese	Westerners	-0.384*	0.069	<.001	-0.519	-0.249
	Westerners	Chinese	0.384*	0.069	<.001	0.249	0.519
Peaceful Music	Chinese	Westerners	-0.248*	0.088	0.005	-0.421	-0.075
	Westerners	Chinese	0.248*	0.088	0.005	0.075	0.421
Angry Music	Chinese	Westerners	-0.151	0.078	0.055	-0.304	0.003
	Westerners	Chinese	0.151	0.078	0.055	-0.003	0.304
Fearful Music	Chinese	Westerners	-0.186*	0.078	0.018	-0.340	-0.032
	Westerners	Chinese	0.186*	0.078	0.018	0.032	0.340

Based on estimated marginal means
 *. The mean difference is significant at the 0.05 level.
 b. Adjustment for multiple comparisons: LSD.

Pairwise Comparisons for Sadness Ratings for Western Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	-0.255*	0.065	<.001	-0.383	-0.127
	Westerners	Chinese	0.255*	0.065	<.001	0.127	0.383
Sad Music	Chinese	Westerners	0.173	0.088	0.050	0.000	0.346
	Westerners	Chinese	-0.173	0.088	0.050	-0.346	0.000
Peaceful Music	Chinese	Westerners	-0.558*	0.091	<.001	-0.736	-0.380
	Westerners	Chinese	0.558*	0.091	<.001	0.380	0.736
Angry Music	Chinese	Westerners	-0.123	0.091	0.178	-0.302	0.056
	Westerners	Chinese	0.123	0.091	0.178	-0.056	0.302
Fearful Music	Chinese	Westerners	-0.002	0.090	0.981	-0.179	0.175
	Westerners	Chinese	0.002	0.090	0.981	-0.175	0.179
Based on estimated marginal means *. The mean difference is significant at the 0.05 level. b. Adjustment for multiple comparisons: LSD.							

Pairwise Comparisons for Peacefulness Ratings for Western Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	-0.439*	0.087	<.001	-0.610	-0.268
	Westerners	Chinese	0.439*	0.087	<.001	0.268	0.610
Sad Music	Chinese	Westerners	0.009	0.097	0.924	-0.181	0.199
	Westerners	Chinese	-0.009	0.097	0.924	-0.199	0.181
Peaceful Music	Chinese	Westerners	0.103	0.094	0.273	-0.082	0.287
	Westerners	Chinese	-0.103	0.094	0.273	-0.287	0.082
Angry Music	Chinese	Westerners	-0.242*	0.064	<.001	-0.367	-0.117
	Westerners	Chinese	0.242*	0.064	<.001	0.117	0.367
Fearful Music	Chinese	Westerners	-0.275*	0.071	<.001	-0.415	-0.136
	Westerners	Chinese	0.275*	0.071	<.001	0.136	0.415
Based on estimated marginal means							
*. The mean difference is significant at the 0.05 level.							
b. Adjustment for multiple comparisons: LSD.							

Pairwise Comparisons for Anger Ratings for Western Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	-0.303*	0.074	<.001	-0.448	-0.158
	Westerners	Chinese	0.303*	0.074	<.001	0.158	0.448
Sad Music	Chinese	Westerners	0.038	0.080	0.633	-0.119	0.195
	Westerners	Chinese	-0.038	0.080	0.633	-0.195	0.119
Peaceful Music	Chinese	Westerners	-0.227*	0.062	<.001	-0.348	-0.105
	Westerners	Chinese	0.227*	0.062	<.001	0.105	0.348
Angry Music	Chinese	Westerners	-0.050	0.103	0.626	-0.253	0.153
	Westerners	Chinese	0.050	0.103	0.626	-0.153	0.253
Fearful Music	Chinese	Westerners	-0.044	0.103	0.669	-0.247	0.159
	Westerners	Chinese	0.044	0.103	0.669	-0.159	0.247
Based on estimated marginal means							
*. The mean difference is significant at the 0.05 level.							
b. Adjustment for multiple comparisons: LSD.							

Pairwise Comparisons for Fear Ratings for Western Music							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerners	-0.262*	0.066	<.001	-0.391	-0.132
	Westerners	Chinese	0.262*	0.066	<.001	0.132	0.391
Sad Music	Chinese	Westerners	-0.300*	0.092	0.001	-0.481	-0.118
	Westerners	Chinese	0.300*	0.092	0.001	0.118	0.481
Peaceful Music	Chinese	Westerners	-0.261*	0.064	<.001	-0.386	-0.135
	Westerners	Chinese	0.261*	0.064	<.001	0.135	0.386
Angry Music	Chinese	Westerners	-0.277*	0.112	0.014	-0.497	-0.057
	Westerners	Chinese	0.277*	0.112	0.014	0.057	0.497
Fearful Music	Chinese	Westerners	-0.424*	0.105	<.001	-0.632	-0.217
	Westerners	Chinese	0.424*	0.105	<.001	0.217	0.632
Based on estimated marginal means							
*. The mean difference is significant at the 0.05 level.							
b. Adjustment for multiple comparisons: LSD.							

Appendix 3.

Chinese Music: Multivariate Tests, and Tests of Between-subjects Effects for Repeated Measures ANOVA for Each Type of Rating, with the Within-subjects Factor Emotion of Music, and the Between-subjects Factor Cultural Background, Gender, and Musical Background

Happiness Ratings for Chinese Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	787.870	3	404	<.001	0.854
	Emotion of Music * Cultural Background	41.657	3	404	<.001	0.236
	Emotion of Music * Gender	1.317	3	404	0.268	0.010
	Emotion of Music * Musical Background	4.405	3	404	0.005	0.032
	Emotion of Music * Cultural Background * Gender	0.683	3	404	0.563	0.005
	Emotion of Music * Cultural Background * Musical Background	1.870	3	404	0.134	0.014
	Emotion of Music * Gender * Musical Background	3.270	3	404	0.021	0.024
	Emotion of Music * Cultural Background * Gender * Musical Background	0.260	3	404	0.854	0.002

Tests of Between-subjects Effects	Cultural Background	3.344	1	406	0.068	0.008
	Gender	0.035	1	406	0.852	0.000
	Musical Background	6.290	1	406	0.013	0.015
	Cultural Background * Gender	0.486	1	406	0.486	0.001
	Cultural Background * Musical Background	0.463	1	406	0.497	0.001
	Gender * Musical Background	0.019	1	406	0.889	0.000
	Cultural Background * Gender * Musical Background	0.517	1	406	0.473	0.001

Sadness Ratings for Chinese Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	414.742	3	404	<.001	0.755
	Emotion of Music * Cultural Background	14.045	3	404	<.001	0.094
	Emotion of Music * Gender	1.548	3	404	0.202	0.011
	Emotion of Music * Musical Background	0.470	3	404	0.704	0.003
	Emotion of Music * Cultural Background * Gender	3.649	3	404	0.013	0.026
	Emotion of Music * Cultural Background * Musical Background	2.101	3	404	0.100	0.015
	Emotion of Music * Gender * Musical Background	0.955	3	404	0.414	0.007
	Emotion of Music * Cultural Background * Gender * Musical Background	1.765	3	404	0.153	0.013
	Cultural Background	0.017	1	406	0.898	0.000

Tests of Between-subjects Effects	Gender	0.975	1	406	0.324	0.002
	Musical Background	6.547	1	406	0.011	0.016
	Cultural Background * Gender	0.003	1	406	0.955	0.000
	Cultural Background * Musical Background	2.525	1	406	0.113	0.006
	Gender * Musical Background	0.709	1	406	0.400	0.002
	Cultural Background * Gender * Musical Background	1.544	1	406	0.215	0.004

Peacefulness Ratings for Chinese Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	323.841	3	404	<.001	0.706
	Emotion of Music * Cultural Background	13.154	3	404	<.001	0.089
	Emotion of Music * Gender	0.201	3	404	0.896	0.001
	Emotion of Music * Musical Background	1.177	3	404	0.318	0.009
	Emotion of Music * Cultural Background * Gender	0.391	3	404	0.760	0.003
	Emotion of Music * Cultural Background * Musical Background	3.469	3	404	0.016	0.025
	Emotion of Music * Gender * Musical Background	1.879	3	404	0.132	0.014
	Emotion of Music * Cultural Background * Gender * Musical Background	0.620	3	404	0.602	0.005
Tests of Between-subjects Effects	Cultural Background	25.224	1	406	<.001	0.058
	Gender	6.649	1	406	0.010	0.016
	Musical Background	8.431	1	406	0.004	0.020

	Cultural Background * Gender	0.878	1	406	0.349	0.002
	Cultural Background * Musical Background	0.010	1	406	0.921	0.000
	Gender * Musical Background	0.246	1	406	0.621	0.001
	Cultural Background * Gender * Musical Background	2.692	1	406	0.102	0.007

Anger Ratings for Chinese Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	313.205	3	404	<.001	0.699
	Emotion of Music * Cultural Background	11.188	3	404	<.001	0.077
	Emotion of Music * Gender	0.622	3	404	0.601	0.005
	Emotion of Music * Musical Background	0.990	3	404	0.397	0.007
	Emotion of Music * Cultural Background * Gender	1.590	3	404	0.191	0.012
	Emotion of Music * Cultural Background * Musical Background	2.348	3	404	0.072	0.017
	Emotion of Music * Gender * Musical Background	0.651	3	404	0.583	0.005
	Emotion of Music * Cultural Background * Gender * Musical Background	1.524	3	404	0.208	0.011
Tests of Between-subjects Effects	Cultural Background	7.019	1	406	0.008	0.017
	Gender	5.877	1	406	0.016	0.014
	Musical Background	22.173	1	406	<.001	0.052
	Cultural Background * Gender	0.865	1	406	0.353	0.002
	Cultural Background * Musical Background	3.930	1	406	0.048	0.010

	Gender * Musical Background	3.955	1	406	0.047	0.010
	Cultural Background * Gender * Musical Background	0.003	1	406	0.959	0.000

Fear Ratings for Chinese Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	329.256	3	404	<.001	0.710
	Emotion of Music * Cultural Background	2.849	3	404	0.037	0.021
	Emotion of Music * Gender	0.594	3	404	0.619	0.004
	Emotion of Music * Musical Background	4.346	3	404	0.005	0.031
	Emotion of Music * Cultural Background * Gender	0.364	3	404	0.779	0.003
	Emotion of Music * Cultural Background * Musical Background	2.997	3	404	0.031	0.022
	Emotion of Music * Gender * Musical Background	0.899	3	404	0.442	0.007
	Emotion of Music * Cultural Background * Gender * Musical Background	0.798	3	404	0.496	0.006
Tests of Between-subjects Effects	Cultural Background	23.750	1	406	<.001	0.055
	Gender	5.924	1	406	0.015	0.014
	Musical Background	8.673	1	406	0.003	0.021
	Cultural Background * Gender	0.177	1	406	0.674	0.000
	Cultural Background * Musical Background	1.895	1	406	0.169	0.005
	Gender * Musical Background	6.415	1	406	0.012	0.016
	Cultural Background * Gender * Musical Background	0.443	1	406	0.506	0.001

Western Music: Multivariate Tests, and Tests of Between-subjects Effects for Repeated Measures ANOVA for Each Type of Rating, with the Within-subjects Factor Emotion of Music, and the Between-subjects Factor Cultural Background, Gender, and Musical Background

Happiness Ratings for Western Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	410.033	4	403	<.001	0.803
	Emotion of Music * Cultural Background	7.906	4	403	<.001	0.073
	Emotion of Music * Gender	2.796	4	403	0.026	0.027
	Emotion of Music * Musical Background	0.814	4	403	0.517	0.008
	Emotion of Music * Cultural Background * Gender	3.027	4	403	0.018	0.029
	Emotion of Music * Cultural Background * Musical Background	0.980	4	403	0.418	0.010
	Emotion of Music * Gender * Musical Background	1.184	4	403	0.317	0.012
	Emotion of Music * Cultural Background * Gender * Musical Background	1.518	4	403	0.196	0.015
Tests of Between-subjects Effects	Cultural Background	3.538	1	406	0.061	0.009
	Gender	1.416	1	406	0.235	0.003
	Musical Background	9.437	1	406	0.002	0.023

	Cultural Background * Gender	1.378	1	406	0.241	0.003
	Cultural Background * Musical Background	0.044	1	406	0.833	0.000
	Gender * Musical Background	0.816	1	406	0.367	0.002
	Cultural Background * Gender * Musical Background	0.317	1	406	0.574	0.001

Sadness Ratings for Western Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	400.783	4	403	<.001	0.799
	Emotion of Music * Cultural Background	9.135	4	403	<.001	0.083
	Emotion of Music * Gender	0.879	4	403	0.476	0.009
	Emotion of Music * Musical Background	1.506	4	403	0.199	0.015
	Emotion of Music * Cultural Background * Gender	0.585	4	403	0.673	0.006
	Emotion of Music * Cultural Background * Musical Background	0.606	4	403	0.658	0.006
	Emotion of Music * Gender * Musical Background	1.327	4	403	0.259	0.013
	Emotion of Music * Cultural Background * Gender * Musical Background	2.414	4	403	0.048	0.023
Tests of Between-subjects Effects	Cultural Background	3.941	1	406	0.048	0.010
	Gender	5.597	1	406	0.018	0.014
	Musical Background	14.897	1	406	<.001	0.035
	Cultural Background * Gender	0.132	1	406	0.717	0.000
	Cultural Background * Musical Background	0.193	1	406	0.661	0.000

	Gender * Musical Background	1.446	1	406	0.230	0.004
	Cultural Background * Gender * Musical Background	4.888	1	406	0.028	0.012

Peacefulness Ratings for Western Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	357.605	4	403	<.001	0.780
	Emotion of Music * Cultural Background	4.503	4	403	0.001	0.043
	Emotion of Music * Gender	1.692	4	403	0.151	0.017
	Emotion of Music * Musical Background	0.984	4	403	0.416	0.010
	Emotion of Music * Cultural Background * Gender	0.377	4	403	0.825	0.004
	Emotion of Music * Cultural Background * Musical Background	1.732	4	403	0.142	0.017
	Emotion of Music * Gender * Musical Background	1.072	4	403	0.370	0.011
	Emotion of Music * Cultural Background * Gender * Musical Background	0.697	4	403	0.595	0.007
Tests of Between-subjects Effects	Cultural Background	4.333	1	406	0.038	0.011
	Gender	3.054	1	406	0.081	0.007
	Musical Background	11.010	1	406	<.001	0.026
	Cultural Background * Gender	2.221	1	406	0.137	0.005
	Cultural Background * Musical Background	0.439	1	406	0.508	0.001
	Gender * Musical Background	0.029	1	406	0.864	0.000
	Cultural Background * Gender * Musical Background	0.378	1	406	0.539	0.001

Anger Ratings for Western Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	313.794	4	403	<.001	0.757
	Emotion of Music * Cultural Background	3.923	4	403	0.004	0.037
	Emotion of Music * Gender	3.031	4	403	0.018	0.029
	Emotion of Music * Musical Background	1.265	4	403	0.283	0.012
	Emotion of Music * Cultural Background * Gender	1.294	4	403	0.272	0.013
	Emotion of Music * Cultural Background * Musical Background	1.685	4	403	0.153	0.016
	Emotion of Music * Gender * Musical Background	2.283	4	403	0.060	0.022
	Emotion of Music * Cultural Background * Gender * Musical Background	0.803	4	403	0.524	0.008
Tests of Between-subjects Effects	Cultural Background	0.844	1	406	0.359	0.002
	Gender	5.077	1	406	0.025	0.012
	Musical Background	20.980	1	406	<.001	0.049
	Cultural Background * Gender	1.284	1	406	0.258	0.003
	Cultural Background * Musical Background	0.765	1	406	0.382	0.002
	Gender * Musical Background	1.532	1	406	0.217	0.004
	Cultural Background * Gender * Musical Background	1.692	1	406	0.194	0.004

Fear Ratings for Western Music						
	Effect	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Multivariate Tests	Emotion of Music	294.692	4	403	<.001	0.745
	Emotion of Music * Cultural Background	0.739	4	403	0.566	0.007
	Emotion of Music * Gender	2.525	4	403	0.040	0.024
	Emotion of Music * Musical Background	2.447	4	403	0.046	0.024
	Emotion of Music * Cultural Background * Gender	1.759	4	403	0.136	0.017
	Emotion of Music * Cultural Background * Musical Background	3.293	4	403	0.011	0.032
	Emotion of Music * Gender * Musical Background	1.158	4	403	0.329	0.011
	Emotion of Music * Cultural Background * Gender * Musical Background	0.853	4	403	0.492	0.008
Tests of Between-subjects Effects	Cultural Background	23.043	1	406	<.001	0.054
	Gender	3.027	1	406	0.083	0.007
	Musical Background	2.868	1	406	0.091	0.007
	Cultural Background * Gender	0.061	1	406	0.805	0.000
	Cultural Background * Musical Background	0.948	1	406	0.331	0.002
	Gender * Musical Background	0.906	1	406	0.342	0.002
	Cultural Background * Gender * Musical Background	0.641	1	406	0.424	0.002

Chinese Music: Pairwise Comparisons of Repeated Measures ANOVA for Each Type of Rating, with the Within-subjects Factor Emotion of Music, and the Between-subjects Factor Cultural Background, Gender, and Musical Background

Happiness Rating for Chinese Music

Emotion of Music * Cultural Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerner	0.621*	0.073	<.001	0.477	0.765
	Westerner	Chinese	-0.621*	0.073	<.001	-0.765	-0.477
Sad Music	Chinese	Westerner	-0.555*	0.079	<.001	-0.711	-0.399
	Westerner	Chinese	0.555*	0.079	<.001	0.399	0.711

Peaceful Music	Chinese	Westerner	-0.380*	0.101	<.001	-0.578	-0.182
	Westerner	Chinese	0.380*	0.101	<.001	0.182	0.578
Angry Music	Chinese	Westerner	-0.066	0.081	0.414	-0.226	0.093
	Westerner	Chinese	0.066	0.081	0.414	-0.093	0.226
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Musical Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Musical Background	Musical Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound

Happy Music	Musician	Non-Musician	-0.081	0.073	0.270	-0.225	0.063
	Non-Musician	Musician	0.081	0.073	0.270	-0.063	0.225
Sad Music	Musician	Non-Musician	0.275*	0.079	<.001	0.119	0.431
	Non-Musician	Musician	-0.275*	0.079	<.001	-0.431	-0.119
Peaceful Music	Musician	Non-Musician	0.060	0.101	0.552	-0.138	0.258
	Non-Musician	Musician	-0.060	0.101	0.552	-0.258	0.138
Angry Music	Musician	Non-Musician	0.267*	0.081	0.001	0.107	0.426
	Non-Musician	Musician	-0.267*	0.081	0.001	-0.426	-0.107
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Gender * Musical Background

Pairwise Comparisons								
Measure:								
Musical Background	Emotion of Music	Gender	Gender	Mean Difference	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
							Lower Bound	Upper Bound
Musician	Happy Music	Male	Female	-0.182	0.111	0.102	-0.399	0.036
		Female	Male	0.182	0.111	0.102	-0.036	0.399
	Sad Music	Male	Female	0.206	0.120	0.087	-0.030	0.442
		Female	Male	-0.206	0.120	0.087	-0.442	0.030
	Peaceful Music	Male	Female	-0.181	0.152	0.234	-0.481	0.118
		Female	Male	0.181	0.152	0.234	-0.118	0.481
	Angry Music	Male	Female	0.225	0.123	0.067	-0.016	0.466
		Female	Male	-0.225	0.123	0.067	-0.466	0.016
Non-Musician	Happy Music	Male	Female	-0.009	0.096	0.922	-0.198	0.179

		Female	Male	0.009	0.096	0.922	-0.179	0.198
	Sad Music	Male	Female	-0.022	0.104	0.836	-0.226	0.183
		Female	Male	0.022	0.104	0.836	-0.183	0.226
	Peaceful Music	Male	Female	0.103	0.132	0.438	-0.157	0.362
		Female	Male	-0.103	0.132	0.438	-0.362	0.157
	Angry Music	Male	Female	-0.062	0.106	0.562	-0.270	0.147
		Female	Male	0.062	0.106	0.562	-0.147	0.270
	Based on estimated marginal means							
a. Adjustment for multiple comparisons: LSD.								

Pairwise Comparisons							
Measure:							
Gender	Emotion of Music	Musical Background	Musical Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b

							Lower Bound	Upper Bound
Male	Happy Music	Musician	Non-Musician	-0.167	0.120	0.165	-0.403	0.069
		Non-Musician	Musician	0.167	0.120	0.165	-0.069	0.403
	Sad Music	Musician	Non-Musician	0.389*	0.130	0.003	0.133	0.644
		Non-Musician	Musician	-0.389*	0.130	0.003	-0.644	-0.133
	Peaceful Music	Musician	Non-Musician	-0.082	0.165	0.619	-0.406	0.242
		Non-Musician	Musician	0.082	0.165	0.619	-0.242	0.406
	Angry Music	Musician	Non-Musician	0.410*	0.133	0.002	0.149	0.671
		Non-Musician	Musician	-0.410*	0.133	0.002	-0.671	-0.149
Female	Happy Music	Musician	Non-Musician	0.005	0.084	0.951	-0.160	0.171
		Non-Musician	Musician	-0.005	0.084	0.951	-0.171	0.160
	Sad Music	Musician	Non-Musician	0.161	0.091	0.078	-0.018	0.341
		Non-Musician	Musician	-0.161	0.091	0.078	-0.341	0.018
	Peaceful Music	Musician	Non-Musician	0.202	0.116	0.082	-0.026	0.430

		Non-Musician	Musician	-0.202	0.116	0.082	-0.430	0.026
	Angry Music	Musician	Non-Musician	0.123	0.093	0.186	-0.060	0.307
		Non-Musician	Musician	-0.123	0.093	0.186	-0.307	0.060
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Sadness Rating for Chinese Music

Emotion of Music * Cultural Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound

Happy Music	Chinese	Westerner	-0.258*	0.058	<.001	-0.372	-0.145
	Westerner	Chinese	0.258*	0.058	<.001	0.145	0.372
Sad Music	Chinese	Westerner	0.524*	0.105	<.001	0.318	0.730
	Westerner	Chinese	-0.524*	0.105	<.001	-0.730	-0.318
Peaceful Music	Chinese	Westerner	-0.063	0.115	0.585	-0.289	0.163
	Westerner	Chinese	0.063	0.115	0.585	-0.163	0.289
Angry Music	Chinese	Westerner	-0.170	0.104	0.103	-0.375	0.034
	Westerner	Chinese	0.170	0.104	0.103	-0.034	0.375
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Cultural Background * Gender

Pairwise Comparisons								
Measure:								
Gender	Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Male	Happy Music	Chinese	Westerner	-0.194*	0.095	0.040	-0.380	-0.009
		Westerner	Chinese	0.194*	0.095	0.040	0.009	0.380
	Sad Music	Chinese	Westerner	0.585*	0.171	<.001	0.248	0.922
		Westerner	Chinese	-0.585*	0.171	<.001	-0.922	-0.248
	Peaceful Music	Chinese	Westerner	0.043	0.188	0.821	-0.328	0.413
		Westerner	Chinese	-0.043	0.188	0.821	-0.413	0.328
	Angry Music	Chinese	Westerner	-0.415*	0.171	0.015	-0.750	-0.080
		Westerner	Chinese	0.415*	0.171	0.015	0.080	0.750
Female	Happy Music	Chinese	Westerner	-0.322*	0.066	<.001	-0.453	-0.192
		Westerner	Chinese	0.322*	0.066	<.001	0.192	0.453

	Sad Music	Chinese	Westerner	0.463*	0.120	<.001	0.226	0.700
		Westerner	Chinese	-0.463*	0.120	<.001	-0.700	-0.226
	Peaceful Music	Chinese	Westerner	-0.168	0.132	0.204	-0.429	0.092
		Westerner	Chinese	0.168	0.132	0.204	-0.092	0.429
	Angry Music	Chinese	Westerner	0.074	0.120	0.536	-0.161	0.310
		Westerner	Chinese	-0.074	0.120	0.536	-0.310	0.161
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Pairwise Comparisons								
Measure:								
Cultural Background	Emotion of Music	Gender	Gender	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound

Chinese	Happy Music	Male	Female	0.247*	0.074	0.001	0.100	0.393
		Female	Male	-0.247*	0.074	0.001	-0.393	-0.100
	Sad Music	Male	Female	0.011	0.135	0.933	-0.254	0.277
		Female	Male	-0.011	0.135	0.933	-0.277	0.254
	Peaceful Music	Male	Female	0.189	0.148	0.204	-0.103	0.481
		Female	Male	-0.189	0.148	0.204	-0.481	0.103
	Angry Music	Male	Female	-0.212	0.134	0.116	-0.476	0.052
		Female	Male	0.212	0.134	0.116	-0.052	0.476
Westerner	Happy Music	Male	Female	0.119	0.088	0.179	-0.055	0.292
		Female	Male	-0.119	0.088	0.179	-0.292	0.055
	Sad Music	Male	Female	-0.111	0.160	0.490	-0.425	0.204
		Female	Male	0.111	0.160	0.490	-0.204	0.425
	Peaceful Music	Male	Female	-0.022	0.176	0.900	-0.368	0.324
		Female	Male	0.022	0.176	0.900	-0.324	0.368

	Angry Music	Male	Female	0.277	0.159	0.083	-0.036	0.590
		Female	Male	-0.277	0.159	0.083	-0.590	0.036
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Peacefulness Rating for Chinese Music

Emotion of Music * Cultural Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerner	-0.593*	0.088	<.001	-0.766	-0.420

	Westerner	Chinese	0.593*	0.088	<.001	0.420	0.766
Sad Music	Chinese	Westerner	-0.394*	0.091	<.001	-0.572	-0.215
	Westerner	Chinese	0.394*	0.091	<.001	0.215	0.572
Peaceful Music	Chinese	Westerner	0.008	0.099	0.935	-0.187	0.203
	Westerner	Chinese	-0.008	0.099	0.935	-0.203	0.187
Angry Music	Chinese	Westerner	-0.174*	0.071	0.015	-0.313	-0.034
	Westerner	Chinese	0.174*	0.071	0.015	0.034	0.313
Based on estimated marginal means *. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Cultural Background * Musical Background

Pairwise Comparisons

Measure:								
Musical Background	Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Musician	Happy Music	Chinese	Westerner	-0.741*	0.133	<.001	-1.003	-0.480
		Westerner	Chinese	0.741*	0.133	<.001	0.480	1.003
	Sad Music	Chinese	Westerner	-0.338*	0.137	0.014	-0.607	-0.069
		Westerner	Chinese	0.338*	0.137	0.014	0.069	0.607
	Peaceful Music	Chinese	Westerner	0.223	0.150	0.137	-0.072	0.518
		Westerner	Chinese	-0.223	0.150	0.137	-0.518	0.072
	Angry Music	Chinese	Westerner	-0.319*	0.107	0.003	-0.529	-0.108
		Westerner	Chinese	0.319*	0.107	0.003	0.108	0.529
Non-Musician	Happy Music	Chinese	Westerner	-0.444*	0.115	<.001	-0.671	-0.218
		Westerner	Chinese	0.444*	0.115	<.001	0.218	0.671
	Sad Music	Chinese	Westerner	-0.449*	0.119	<.001	-0.683	-0.216

		Westerner	Chinese	0.449*	0.119	<.001	0.216	0.683
	Peaceful Music	Chinese	Westerner	-0.207	0.130	0.112	-0.463	0.049
		Westerner	Chinese	0.207	0.130	0.112	-0.049	0.463
	Angry Music	Chinese	Westerner	-0.028	0.093	0.759	-0.211	0.154
		Westerner	Chinese	0.028	0.093	0.759	-0.154	0.211
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Pairwise Comparisons								
Measure:								
Cultural Background	Emotion of Music	Musical Background	Musical Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Chinese	Happy Music	Musician	Non-Musician	0.073	0.113	0.517	-0.149	0.296

		Non-Musician	Musician	-0.073	0.113	0.517	-0.296	0.149
	Sad Music	Musician	Non-Musician	0.216	0.117	0.065	-0.014	0.446
		Non-Musician	Musician	-0.216	0.117	0.065	-0.446	0.014
	Peaceful Music	Musician	Non-Musician	0.244	0.128	0.057	-0.007	0.496
		Non-Musician	Musician	-0.244	0.128	0.057	-0.496	0.007
	Angry Music	Musician	Non-Musician	0.109	0.091	0.233	-0.070	0.289
		Non-Musician	Musician	-0.109	0.091	0.233	-0.289	0.070
Westerner	Happy Music	Musician	Non-Musician	0.371*	0.134	0.006	0.107	0.635
		Non-Musician	Musician	-0.371*	0.134	0.006	-0.635	-0.107
	Sad Music	Musician	Non-Musician	0.104	0.138	0.453	-0.168	0.376
		Non-Musician	Musician	-0.104	0.138	0.453	-0.376	0.168
	Peaceful Music	Musician	Non-Musician	-0.186	0.152	0.221	-0.484	0.112
		Non-Musician	Musician	0.186	0.152	0.221	-0.112	0.484
	Angry Music	Musician	Non-Musician	0.400*	0.108	<.001	0.186	0.613

		Non-Musician	Musician	-0.400*	0.108	<.001	-0.613	-0.186
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Anger Rating for Chinese Music

Emotion of Music * Cultural Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerner	-0.388*	0.067	<.001	-0.519	-0.257
	Westerner	Chinese	0.388*	0.067	<.001	0.257	0.519
Sad Music	Chinese	Westerner	0.102	0.088	0.247	-0.071	0.275

	Westerner	Chinese	-0.102	0.088	0.247	-0.275	0.071
Peaceful Music	Chinese	Westerner	-0.190*	0.068	0.006	-0.324	-0.056
	Westerner	Chinese	0.190*	0.068	0.006	0.056	0.324
Angry Music	Chinese	Westerner	-0.116	0.109	0.286	-0.329	0.097
	Westerner	Chinese	0.116	0.109	0.286	-0.097	0.329
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: LSD.							

Fear Rating for Chinese Music

Emotion of Music * Cultural Background

Pairwise Comparisons
Measure:

Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerner	-0.349*	0.063	<.001	-0.473	-0.225
	Westerner	Chinese	0.349*	0.063	<.001	0.225	0.473
Sad Music	Chinese	Westerner	-0.146	0.087	0.092	-0.316	0.024
	Westerner	Chinese	0.146	0.087	0.092	-0.024	0.316
Peaceful Music	Chinese	Westerner	-0.345*	0.073	<.001	-0.488	-0.202
	Westerner	Chinese	0.345*	0.073	<.001	0.202	0.488
Angry Music	Chinese	Westerner	-0.324*	0.116	0.005	-0.552	-0.096
	Westerner	Chinese	0.324*	0.116	0.005	0.096	0.552

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: LSD.

Emotion of Music * Musical Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Musical Background	Musical Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Musician	Non-Musician	0.303*	0.063	<.001	0.179	0.426
	Non-Musician	Musician	-0.303*	0.063	<.001	-0.426	-0.179
Sad Music	Musician	Non-Musician	0.179*	0.087	0.039	0.009	0.350
	Non-Musician	Musician	-0.179*	0.087	0.039	-0.350	-0.009
Peaceful Music	Musician	Non-Musician	0.333*	0.073	<.001	0.190	0.476
	Non-Musician	Musician	-0.333*	0.073	<.001	-0.476	-0.190
Angry Music	Musician	Non-Musician	-0.111	0.116	0.337	-0.339	0.117
	Non-Musician	Musician	0.111	0.116	0.337	-0.117	0.339
Based on estimated marginal means							

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: LSD.

Emotion of Music * Cultural Background * Musical Background

Pairwise Comparisons								
Measure:								
Musical Background	Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Musician	Happy Music	Chinese	Westerner	-0.499*	0.095	<.001	-0.686	-0.311
		Westerner	Chinese	0.499*	0.095	<.001	0.311	0.686
	Sad Music	Chinese	Westerner	-0.333*	0.131	0.011	-0.590	-0.076
		Westerner	Chinese	0.333*	0.131	0.011	0.076	0.590
	Peaceful Music	Chinese	Westerner	-0.519*	0.110	<.001	-0.736	-0.303

		Westerner	Chinese	0.519*	0.110	<.001	0.303	0.736
	Angry Music	Chinese	Westerner	-0.142	0.175	0.419	-0.486	0.203
		Westerner	Chinese	0.142	0.175	0.419	-0.203	0.486
Non-Musician	Happy Music	Chinese	Westerner	-0.199*	0.083	0.016	-0.361	-0.037
		Westerner	Chinese	0.199*	0.083	0.016	0.037	0.361
	Sad Music	Chinese	Westerner	0.041	0.113	0.720	-0.182	0.264
		Westerner	Chinese	-0.041	0.113	0.720	-0.264	0.182
	Peaceful Music	Chinese	Westerner	-0.170	0.095	0.075	-0.358	0.017
		Westerner	Chinese	0.170	0.095	0.075	-0.017	0.358
	Angry Music	Chinese	Westerner	-0.507*	0.152	<.001	-0.805	-0.208
		Westerner	Chinese	0.507*	0.152	<.001	0.208	0.805
	Based on estimated marginal means							
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Pairwise Comparisons								
Measure:								
Cultural Background	Emotion of Music	Musical Background	Musical Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Chinese	Happy Music	Musician	Non-Musician	0.153	0.081	0.061	-0.007	0.312
		Non-Musician	Musician	-0.153	0.081	0.061	-0.312	0.007
	Sad Music	Musician	Non-Musician	-0.008	0.112	0.946	-0.227	0.212
		Non-Musician	Musician	0.008	0.112	0.946	-0.212	0.227
	Peaceful Music	Musician	Non-Musician	0.159	0.094	0.092	-0.026	0.343
		Non-Musician	Musician	-0.159	0.094	0.092	-0.343	0.026
	Angry Music	Musician	Non-Musician	0.071	0.150	0.635	-0.223	0.365
		Non-Musician	Musician	-0.071	0.150	0.635	-0.365	0.223
Westerner	Happy Music	Musician	Non-Musician	0.452*	0.096	<.001	0.263	0.642

		Non-Musician	Musician	-0.452*	0.096	<.001	-0.642	-0.263
Sad Music	Musician	Non-Musician		0.366*	0.132	0.006	0.106	0.626
	Non-Musician	Musician		-0.366*	0.132	0.006	-0.626	-0.106
Peaceful Music	Musician	Non-Musician		0.507*	0.111	<.001	0.288	0.726
	Non-Musician	Musician		-0.507*	0.111	<.001	-0.726	-0.288
Angry Music	Musician	Non-Musician		-0.294	0.177	0.098	-0.642	0.055
	Non-Musician	Musician		0.294	0.177	0.098	-0.055	0.642
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Western Music: Pairwise Comparisons of Repeated Measures ANOVA for Each Type of Rating, with the Within-subjects Factor Emotion of Music, and the Between-subjects Factor Cultural Background, Gender, and Musical Background

Happiness Rating for Western Music

Emotion of Music * Cultural Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerner	0.254*	0.095	0.008	0.066	0.441
	Westerner	Chinese	-0.254*	0.095	0.008	-0.441	-0.066
Sad Music	Chinese	Westerner	-0.357*	0.075	<.001	-0.504	-0.209
	Westerner	Chinese	0.357*	0.075	<.001	0.209	0.504

Peaceful Music	Chinese	Westerner	-0.191*	0.096	0.047	-0.379	-0.002
	Westerner	Chinese	0.191*	0.096	0.047	0.002	0.379
Angry Music	Chinese	Westerner	-0.047	0.085	0.579	-0.213	0.119
	Westerner	Chinese	0.047	0.085	0.579	-0.119	0.213
Fearful Music	Chinese	Westerner	-0.160	0.086	0.062	-0.328	0.008
	Westerner	Chinese	0.160	0.086	0.062	-0.008	0.328
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Gender

Pairwise Comparisons	
Measure:	

Emotion of Music	Gender	Gender	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Male	Female	-0.024	0.095	0.804	-0.211	0.164
	Female	Male	0.024	0.095	0.804	-0.164	0.211
Sad Music	Male	Female	0.103	0.075	0.173	-0.045	0.250
	Female	Male	-0.103	0.075	0.173	-0.250	0.045
Peaceful Music	Male	Female	-0.158	0.096	0.099	-0.347	0.030
	Female	Male	0.158	0.096	0.099	-0.030	0.347
Angry Music	Male	Female	0.199*	0.085	0.019	0.033	0.365
	Female	Male	-0.199*	0.085	0.019	-0.365	-0.033
Fearful Music	Male	Female	0.197*	0.086	0.022	0.029	0.365
	Female	Male	-0.197*	0.086	0.022	-0.365	-0.029
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							

b. Adjustment for multiple comparisons: LSD.

Emotion of Music * Cultural Background * Gender

Pairwise Comparisons								
Measure:								
Gender	Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Male	Happy Music	Chinese	Westerner	0.311*	0.156	0.047	0.004	0.618
		Westerner	Chinese	-0.311*	0.156	0.047	-0.618	-0.004
	Sad Music	Chinese	Westerner	-0.369*	0.123	0.003	-0.611	-0.127
		Westerner	Chinese	0.369*	0.123	0.003	0.127	0.611
	Peaceful Music	Chinese	Westerner	-0.025	0.157	0.874	-0.333	0.283
		Westerner	Chinese	0.025	0.157	0.874	-0.283	0.333
	Angry Music	Chinese	Westerner	0.108	0.138	0.435	-0.164	0.380
		Westerner	Chinese	-0.108	0.138	0.435	-0.380	0.164

		Westerner	Chinese	-0.108	0.138	0.435	-0.380	0.164
	Fearful Music	Chinese	Westerner	-0.214	0.140	0.128	-0.489	0.062
		Westerner	Chinese	0.214	0.140	0.128	-0.062	0.489
Female	Happy Music	Chinese	Westerner	0.196	0.110	0.074	-0.019	0.412
		Westerner	Chinese	-0.196	0.110	0.074	-0.412	0.019
	Sad Music	Chinese	Westerner	-0.344*	0.086	<.001	-0.514	-0.174
		Westerner	Chinese	0.344*	0.086	<.001	0.174	0.514
	Peaceful Music	Chinese	Westerner	-0.356*	0.110	0.001	-0.573	-0.140
		Westerner	Chinese	0.356*	0.110	0.001	0.140	0.573
	Angry Music	Chinese	Westerner	-0.202*	0.097	0.038	-0.393	-0.011
		Westerner	Chinese	0.202*	0.097	0.038	0.011	0.393
	Fearful Music	Chinese	Westerner	-0.107	0.098	0.279	-0.300	0.087
		Westerner	Chinese	0.107	0.098	0.279	-0.087	0.300
Based on estimated marginal means								

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: LSD.

Pairwise Comparisons								
Measure:								
Cultural Background	Emotion of Music	Gender	Gender	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Chinese	Happy Music	Male	Female	0.034	0.123	0.784	-0.208	0.276
		Female	Male	-0.034	0.123	0.784	-0.276	0.208
	Sad Music	Male	Female	0.090	0.097	0.352	-0.100	0.281
		Female	Male	-0.090	0.097	0.352	-0.281	0.100
	Peaceful Music	Male	Female	0.007	0.124	0.953	-0.236	0.250
		Female	Male	-0.007	0.124	0.953	-0.250	0.236
	Angry Music	Male	Female	0.354*	0.109	0.001	0.139	0.568
		Female	Male	-0.354*	0.109	0.001	-0.568	-0.139

	Fearful Music	Male	Female	0.144	0.110	0.194	-0.073	0.360
		Female	Male	-0.144	0.110	0.194	-0.360	0.073
Westerner	Happy Music	Male	Female	-0.081	0.146	0.579	-0.368	0.206
		Female	Male	0.081	0.146	0.579	-0.206	0.368
	Sad Music	Male	Female	0.115	0.115	0.318	-0.111	0.341
		Female	Male	-0.115	0.115	0.318	-0.341	0.111
	Peaceful Music	Male	Female	-0.324*	0.147	0.028	-0.612	-0.036
		Female	Male	0.324*	0.147	0.028	0.036	0.612
	Angry Music	Male	Female	0.044	0.129	0.735	-0.210	0.298
		Female	Male	-0.044	0.129	0.735	-0.298	0.210
	Fearful Music	Male	Female	0.250	0.131	0.056	-0.007	0.508
		Female	Male	-0.250	0.131	0.056	-0.508	0.007
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								

b. Adjustment for multiple comparisons: LSD.

Sadness Rating for Western Music

Emotion of Music * Cultural Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerner	-0.186*	0.070	0.008	-0.324	-0.048
	Westerner	Chinese	0.186*	0.070	0.008	0.048	0.324
Sad Music	Chinese	Westerner	0.213*	0.097	0.028	0.023	0.404
	Westerner	Chinese	-0.213*	0.097	0.028	-0.404	-0.023
Peaceful Music	Chinese	Westerner	-0.487*	0.098	<.001	-0.680	-0.295
	Westerner	Chinese	0.487*	0.098	<.001	0.295	0.680

Angry Music	Chinese	Westerner	-0.108	0.099	0.277	-0.303	0.087
	Westerner	Chinese	0.108	0.099	0.277	-0.087	0.303
Fearful Music	Chinese	Westerner	0.021	0.097	0.832	-0.171	0.212
	Westerner	Chinese	-0.021	0.097	0.832	-0.212	0.171
Based on estimated marginal means *. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Cultural Background * Gender * Musical Background

Pairwise Comparisons									
Measure:									
Gender	Musical Background	Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
								Lower Bound	Upper Bound

Male	Musician	Happy Music	Chinese	Westerner	-0.104	0.176	0.552	-0.449	0.241
			Westerner	Chinese	0.104	0.176	0.552	-0.241	0.449
		Sad Music	Chinese	Westerner	0.343	0.243	0.159	-0.134	0.820
			Westerner	Chinese	-0.343	0.243	0.159	-0.820	0.134
		Peaceful Music	Chinese	Westerner	0.009	0.246	0.970	-0.473	0.492
			Westerner	Chinese	-0.009	0.246	0.970	-0.492	0.473
		Angry Music	Chinese	Westerner	-0.125	0.249	0.614	-0.614	0.364
			Westerner	Chinese	0.125	0.249	0.614	-0.364	0.614
		Fearful Music	Chinese	Westerner	-0.081	0.244	0.741	-0.561	0.399
			Westerner	Chinese	0.081	0.244	0.741	-0.399	0.561
	Non-Musician	Happy Music	Chinese	Westerner	-0.208	0.148	0.160	-0.498	0.082
			Westerner	Chinese	0.208	0.148	0.160	-0.082	0.498
		Sad Music	Chinese	Westerner	0.194	0.204	0.343	-0.207	0.595
			Westerner	Chinese	-0.194	0.204	0.343	-0.595	0.207

		Peaceful Music	Chinese	Westerner	-0.743*	0.206	<.001	-1.149	-0.337
			Westerner	Chinese	0.743*	0.206	<.001	0.337	1.149
		Angry Music	Chinese	Westerner	-0.216	0.209	0.303	-0.627	0.196
			Westerner	Chinese	0.216	0.209	0.303	-0.196	0.627
		Fearful Music	Chinese	Westerner	0.037	0.205	0.858	-0.367	0.440
			Westerner	Chinese	-0.037	0.205	0.858	-0.440	0.367
		Happy Music	Chinese	Westerner	-0.229	0.118	0.053	-0.462	0.003
			Westerner	Chinese	0.229	0.118	0.053	-0.003	0.462
		Sad Music	Chinese	Westerner	0.085	0.164	0.606	-0.237	0.406
			Westerner	Chinese	-0.085	0.164	0.606	-0.406	0.237
		Peaceful Music	Chinese	Westerner	-0.872*	0.166	<.001	-1.198	-0.547
			Westerner	Chinese	0.872*	0.166	<.001	0.547	1.198
		Angry Music	Chinese	Westerner	-0.263	0.168	0.118	-0.593	0.067
			Westerner	Chinese	0.263	0.168	0.118	-0.067	0.593

		Fearful Music	Chinese	Westerner	-0.098	0.165	0.552	-0.422	0.226
			Westerner	Chinese	0.098	0.165	0.552	-0.226	0.422
	Non-Musician	Happy Music	Chinese	Westerner	-0.203	0.109	0.063	-0.418	0.011
			Westerner	Chinese	0.203	0.109	0.063	-0.011	0.418
		Sad Music	Chinese	Westerner	0.233	0.151	0.124	-0.064	0.529
			Westerner	Chinese	-0.233	0.151	0.124	-0.529	0.064
		Peaceful Music	Chinese	Westerner	-0.343*	0.153	0.025	-0.643	-0.043
			Westerner	Chinese	0.343*	0.153	0.025	0.043	0.643
		Angry Music	Chinese	Westerner	0.171	0.155	0.269	-0.133	0.475
			Westerner	Chinese	-0.171	0.155	0.269	-0.475	0.133
		Fearful Music	Chinese	Westerner	0.225	0.152	0.139	-0.073	0.524
			Westerner	Chinese	-0.225	0.152	0.139	-0.524	0.073

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: LSD.

Pairwise Comparisons									
Measure:									
Cultural Background	Musical Background	Emotion of Music	Gender	Gender	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
								Lower Bound	Upper Bound
Chinese	Musician	Happy Music	Male	Female	0.439*	0.148	0.003	0.148	0.730
			Female	Male	-0.439*	0.148	0.003	-0.730	-0.148
		Sad Music	Male	Female	0.178	0.205	0.386	-0.224	0.580
			Female	Male	-0.178	0.205	0.386	-0.580	0.224
		Peaceful Music	Male	Female	0.671*	0.207	0.001	0.264	1.078
			Female	Male	-0.671*	0.207	0.001	-1.078	-0.264
		Angry Music	Male	Female	0.200	0.210	0.340	-0.212	0.613
			Female	Male	-0.200	0.210	0.340	-0.613	0.212

		Fearful Music	Male	Female	0.206	0.206	0.318	-0.199	0.610
			Female	Male	-0.206	0.206	0.318	-0.610	0.199
	Non-Musician	Happy Music	Male	Female	0.105	0.104	0.312	-0.099	0.309
			Female	Male	-0.105	0.104	0.312	-0.309	0.099
		Sad Music	Male	Female	0.101	0.143	0.483	-0.181	0.383
			Female	Male	-0.101	0.143	0.483	-0.383	0.181
		Peaceful Music	Male	Female	-0.214	0.145	0.141	-0.499	0.071
			Female	Male	0.214	0.145	0.141	-0.071	0.499
		Angry Music	Male	Female	-0.027	0.147	0.853	-0.316	0.262
			Female	Male	0.027	0.147	0.853	-0.262	0.316
		Fearful Music	Male	Female	-0.153	0.144	0.288	-0.437	0.130
			Female	Male	0.153	0.144	0.288	-0.130	0.437
	Westerner	Musician	Happy Music	Male	Female	0.314*	0.151	0.039	0.016
			Female	Male	-0.314*	0.151	0.039	-0.612	-0.016

		Sad Music	Male	Female	-0.080	0.209	0.701	-0.492	0.331
			Female	Male	0.080	0.209	0.701	-0.331	0.492
		Peaceful Music	Male	Female	-0.210	0.212	0.321	-0.627	0.206
			Female	Male	0.210	0.212	0.321	-0.206	0.627
		Angry Music	Male	Female	0.063	0.215	0.770	-0.359	0.485
			Female	Male	-0.063	0.215	0.770	-0.485	0.359
		Fearful Music	Male	Female	0.188	0.211	0.372	-0.226	0.603
			Female	Male	-0.188	0.211	0.372	-0.603	0.226
	Non-Musician	Happy Music	Male	Female	0.109	0.151	0.471	-0.188	0.407
			Female	Male	-0.109	0.151	0.471	-0.407	0.188
		Sad Music	Male	Female	0.140	0.209	0.505	-0.272	0.551
			Female	Male	-0.140	0.209	0.505	-0.551	0.272
		Peaceful Music	Male	Female	0.187	0.212	0.379	-0.230	0.603
			Female	Male	-0.187	0.212	0.379	-0.603	0.230

		Angry Music	Male	Female	0.360	0.215	0.095	-0.062	0.782
			Female	Male	-0.360	0.215	0.095	-0.782	0.062
		Fearful Music	Male	Female	0.035	0.211	0.867	-0.379	0.450
			Female	Male	-0.035	0.211	0.867	-0.450	0.379
Based on estimated marginal means									
*. The mean difference is significant at the .05 level.									
b. Adjustment for multiple comparisons: LSD.									

Pairwise Comparisons									
Measure:									
Cultural Background	Gender	Emotion of Music	Musical Background	Musical Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
								Lower Bound	Upper Bound
Chinese	Male	Happy Music	Musician	Non-Musician	0.381*	0.158	0.016	0.071	0.691

			Non-Musician	Musician	-0.381*	0.158	0.016	-0.691	-0.071
		Sad Music	Musician	Non-Musician	0.112	0.218	0.609	-0.317	0.541
			Non-Musician	Musician	-0.112	0.218	0.609	-0.541	0.317
		Peaceful Music	Musician	Non-Musician	0.697*	0.221	0.002	0.263	1.131
			Non-Musician	Musician	-0.697*	0.221	0.002	-1.131	-0.263
		Angry Music	Musician	Non-Musician	0.257	0.224	0.252	-0.183	0.697
			Non-Musician	Musician	-0.257	0.224	0.252	-0.697	0.183
		Fearful Music	Musician	Non-Musician	0.438*	0.220	0.047	0.006	0.870
			Non-Musician	Musician	-0.438*	0.220	0.047	-0.870	-0.006
	Female	Happy Music	Musician	Non-Musician	0.047	0.088	0.593	-0.126	0.220
			Non-Musician	Musician	-0.047	0.088	0.593	-0.220	0.126
		Sad Music	Musician	Non-Musician	0.035	0.121	0.775	-0.204	0.274
			Non-Musician	Musician	-0.035	0.121	0.775	-0.274	0.204
		Peaceful Music	Musician	Non-Musician	-0.188	0.123	0.127	-0.430	0.054

			Non-Musician	Musician	0.188	0.123	0.127	-0.054	0.430
		Angry Music	Musician	Non-Musician	0.029	0.125	0.815	-0.216	0.274
			Non-Musician	Musician	-0.029	0.125	0.815	-0.274	0.216
		Fearful Music	Musician	Non-Musician	0.079	0.122	0.519	-0.161	0.319
			Non-Musician	Musician	-0.079	0.122	0.519	-0.319	0.161
		Happy Music	Musician	Non-Musician	0.278	0.166	0.096	-0.049	0.605
			Non-Musician	Musician	-0.278	0.166	0.096	-0.605	0.049
		Sad Music	Musician	Non-Musician	-0.037	0.230	0.872	-0.489	0.415
			Non-Musician	Musician	0.037	0.230	0.872	-0.415	0.489
		Peaceful Music	Musician	Non-Musician	-0.056	0.233	0.811	-0.513	0.402
			Non-Musician	Musician	0.056	0.233	0.811	-0.402	0.513
Westerner	Male	Angry Music	Musician	Non-Musician	0.167	0.236	0.480	-0.297	0.630
			Non-Musician	Musician	-0.167	0.236	0.480	-0.630	0.297
		Fearful Music	Musician	Non-Musician	0.556*	0.231	0.017	0.101	1.011

			Non-Musician	Musician	-0.556*	0.231	0.017	-1.011	-0.101		
	Female	Happy Music	Musician	Non-Musician	0.073	0.135	0.588	-0.192	0.338		
			Non-Musician	Musician	-0.073	0.135	0.588	-0.338	0.192		
		Sad Music	Musician	Non-Musician	0.183	0.187	0.327	-0.184	0.550		
			Non-Musician	Musician	-0.183	0.187	0.327	-0.550	0.184		
		Peaceful Music	Musician	Non-Musician	0.341	0.189	0.071	-0.030	0.713		
			Non-Musician	Musician	-0.341	0.189	0.071	-0.713	0.030		
		Angry Music	Musician	Non-Musician	0.463*	0.191	0.016	0.087	0.839		
			Non-Musician	Musician	-0.463*	0.191	0.016	-0.839	-0.087		
		Fearful Music	Musician	Non-Musician	0.402*	0.188	0.033	0.033	0.772		
			Non-Musician	Musician	-0.402*	0.188	0.033	-0.772	-0.033		
		Based on estimated marginal means									
		*. The mean difference is significant at the .05 level.									
		b. Adjustment for multiple comparisons: LSD.									

Peacefulness Rating for Western Music

Emotion of Music * Cultural Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerner	-0.385*	0.094	<.001	-0.571	-0.200
	Westerner	Chinese	0.385*	0.094	<.001	0.200	0.571
Sad Music	Chinese	Westerner	0.054	0.106	0.610	-0.154	0.263
	Westerner	Chinese	-0.054	0.106	0.610	-0.263	0.154
Peaceful Music	Chinese	Westerner	0.166	0.102	0.107	-0.036	0.367
	Westerner	Chinese	-0.166	0.102	0.107	-0.367	0.036
Angry Music	Chinese	Westerner	-0.187*	0.069	0.007	-0.322	-0.052
	Westerner	Chinese	0.187*	0.069	0.007	0.052	0.322

Fearful Music	Chinese	Westerner	-0.190*	0.076	0.012	-0.339	-0.041
	Westerner	Chinese	0.190*	0.076	0.012	0.041	0.339
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: LSD.							

Anger Rating for Western Music

Emotion of Music * Cultural Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Chinese	Westerner	-0.237*	0.079	0.003	-0.393	-0.081

	Westerner	Chinese	0.237*	0.079	0.003	0.081	0.393
Sad Music	Chinese	Westerner	0.081	0.087	0.347	-0.089	0.252
	Westerner	Chinese	-0.081	0.087	0.347	-0.252	0.089
Peaceful Music	Chinese	Westerner	-0.158*	0.065	0.016	-0.286	-0.029
	Westerner	Chinese	0.158*	0.065	0.016	0.029	0.286
Angry Music	Chinese	Westerner	-0.010	0.113	0.928	-0.232	0.211
	Westerner	Chinese	0.010	0.113	0.928	-0.211	0.232
Fearful Music	Chinese	Westerner	0.062	0.112	0.583	-0.159	0.282
	Westerner	Chinese	-0.062	0.112	0.583	-0.282	0.159
Based on estimated marginal means *. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Gender

Pairwise Comparisons							
Measure:							
Emotion of Music	Gender	Gender	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Male	Female	0.254*	0.079	0.001	0.098	0.410
	Female	Male	-0.254*	0.079	0.001	-0.410	-0.098
Sad Music	Male	Female	0.303*	0.087	<.001	0.132	0.473
	Female	Male	-0.303*	0.087	<.001	-0.473	-0.132
Peaceful Music	Male	Female	0.159*	0.065	0.015	0.031	0.288
	Female	Male	-0.159*	0.065	0.015	-0.288	-0.031
Angry Music	Male	Female	-0.084	0.113	0.457	-0.305	0.137
	Female	Male	0.084	0.113	0.457	-0.137	0.305
Fearful Music	Male	Female	0.011	0.112	0.925	-0.210	0.231

	Female	Male	-0.011	0.112	0.925	-0.231	0.210
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Gender * Musical Background

Pairwise Comparisons								
Measure:								
Musical Background	Emotion of Music	Gender	Gender	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Musician	Happy Music	Male	Female	0.492*	0.120	<.001	0.256	0.727
		Female	Male	-0.492*	0.120	<.001	-0.727	-0.256
	Sad Music	Male	Female	0.369*	0.131	0.005	0.112	0.626

		Female	Male	-0.369*	0.131	0.005	-0.626	-0.112
	Peaceful Music	Male	Female	0.326*	0.099	0.001	0.131	0.520
		Female	Male	-0.326*	0.099	0.001	-0.520	-0.131
	Angry Music	Male	Female	-0.222	0.170	0.193	-0.556	0.113
		Female	Male	0.222	0.170	0.193	-0.113	0.556
	Fearful Music	Male	Female	0.031	0.169	0.857	-0.302	0.364
		Female	Male	-0.031	0.169	0.857	-0.364	0.302
	Non-Musician	Happy Music	Male	Female	0.016	0.104	0.876	-0.188
Female			Male	-0.016	0.104	0.876	-0.221	0.188
Sad Music		Male	Female	0.236*	0.113	0.038	0.013	0.459
		Female	Male	-0.236*	0.113	0.038	-0.459	-0.013
Peaceful Music		Male	Female	-0.007	0.086	0.931	-0.176	0.161
		Female	Male	0.007	0.086	0.931	-0.161	0.176
Angry Music		Male	Female	0.054	0.148	0.715	-0.236	0.344

		Female	Male	-0.054	0.148	0.715	-0.344	0.236
	Fearful Music	Male	Female	-0.009	0.147	0.950	-0.298	0.279
		Female	Male	0.009	0.147	0.950	-0.279	0.298
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Pairwise Comparisons								
Measure:								
Gender	Emotion of Music	Musical Background	Musical Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Male	Happy Music	Musician	Non-Musician	0.493*	0.130	<.001	0.238	0.748
		Non-Musician	Musician	-0.493*	0.130	<.001	-0.748	-0.238
	Sad Music	Musician	Non-Musician	0.235	0.142	0.098	-0.043	0.514

		Non-Musician	Musician	-0.235	0.142	0.098	-0.514	0.043
	Peaceful Music	Musician	Non-Musician	0.492*	0.107	<.001	0.282	0.703
		Non-Musician	Musician	-0.492*	0.107	<.001	-0.703	-0.282
	Angry Music	Musician	Non-Musician	0.104	0.184	0.571	-0.258	0.467
		Non-Musician	Musician	-0.104	0.184	0.571	-0.467	0.258
	Fearful Music	Musician	Non-Musician	0.334	0.183	0.070	-0.027	0.694
		Non-Musician	Musician	-0.334	0.183	0.070	-0.694	0.027
	Female	Happy Music	Musician	Non-Musician	0.018	0.091	0.846	-0.162
Non-Musician			Musician	-0.018	0.091	0.846	-0.197	0.162
Sad Music		Musician	Non-Musician	0.102	0.100	0.305	-0.093	0.298
		Non-Musician	Musician	-0.102	0.100	0.305	-0.298	0.093
Peaceful Music		Musician	Non-Musician	0.159*	0.075	0.035	0.011	0.307
		Non-Musician	Musician	-0.159*	0.075	0.035	-0.307	-0.011
Angry Music		Musician	Non-Musician	0.380*	0.129	0.004	0.126	0.635

		Non-Musician	Musician	-0.380*	0.129	0.004	-0.635	-0.126
	Fearful Music	Musician	Non-Musician	0.294*	0.129	0.023	0.040	0.547
		Non-Musician	Musician	-0.294*	0.129	0.023	-0.547	-0.040
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Fear Rating for Western Music

Emotion of Music * Gender

Pairwise Comparisons							
Measure:							
Emotion of Music	Gender	Gender	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound

Happy Music	Male	Female	0.205*	0.071	0.004	0.065	0.345
	Female	Male	-0.205*	0.071	0.004	-0.345	-0.065
Sad Music	Male	Female	0.285*	0.100	0.005	0.088	0.481
	Female	Male	-0.285*	0.100	0.005	-0.481	-0.088
Peaceful Music	Male	Female	0.169*	0.068	0.013	0.035	0.304
	Female	Male	-0.169*	0.068	0.013	-0.304	-0.035
Angry Music	Male	Female	-0.169	0.123	0.170	-0.411	0.073
	Female	Male	0.169	0.123	0.170	-0.073	0.411
Fearful Music	Male	Female	0.025	0.116	0.831	-0.203	0.252
	Female	Male	-0.025	0.116	0.831	-0.252	0.203
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Musical Background

Pairwise Comparisons							
Measure:							
Emotion of Music	Musical Background	Musical Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Happy Music	Musician	Non-Musician	0.210*	0.071	0.003	0.070	0.350
	Non-Musician	Musician	-0.210*	0.071	0.003	-0.350	-0.070
Sad Music	Musician	Non-Musician	0.186	0.100	0.063	-0.010	0.382
	Non-Musician	Musician	-0.186	0.100	0.063	-0.382	0.010
Peaceful Music	Musician	Non-Musician	0.290*	0.068	<.001	0.156	0.424
	Non-Musician	Musician	-0.290*	0.068	<.001	-0.424	-0.156
Angry Music	Musician	Non-Musician	-0.085	0.123	0.490	-0.327	0.157
	Non-Musician	Musician	0.085	0.123	0.490	-0.157	0.327
Fearful Music	Musician	Non-Musician	-0.100	0.116	0.389	-0.327	0.128

	Non-Musician	Musician	0.100	0.116	0.389	-0.128	0.327
Based on estimated marginal means							
*. The mean difference is significant at the .05 level.							
b. Adjustment for multiple comparisons: LSD.							

Emotion of Music * Cultural Background * Musical Background

Pairwise Comparisons								
Measure:								
Musical Background	Emotion of Music	Cultural Background	Cultural Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Musician	Happy Music	Chinese	Westerner	-0.181	0.108	0.093	-0.392	0.031
		Westerner	Chinese	0.181	0.108	0.093	-0.031	0.392
	Sad Music	Chinese	Westerner	-0.452*	0.151	0.003	-0.748	-0.155

		Westerner	Chinese	0.452*	0.151	0.003	0.155	0.748
	Peaceful Music	Chinese	Westerner	-0.389*	0.103	<.001	-0.592	-0.187
		Westerner	Chinese	0.389*	0.103	<.001	0.187	0.592
	Angry Music	Chinese	Westerner	-0.367*	0.186	0.049	-0.732	-0.001
		Westerner	Chinese	0.367*	0.186	0.049	0.001	0.732
	Fearful Music	Chinese	Westerner	-0.319	0.175	0.069	-0.663	0.025
		Westerner	Chinese	0.319	0.175	0.069	-0.025	0.663
Non-Musician	Happy Music	Chinese	Westerner	-0.206*	0.093	0.028	-0.389	-0.023
		Westerner	Chinese	0.206*	0.093	0.028	0.023	0.389
	Sad Music	Chinese	Westerner	-0.192	0.131	0.142	-0.450	0.065
		Westerner	Chinese	0.192	0.131	0.142	-0.065	0.450
	Peaceful Music	Chinese	Westerner	-0.034	0.089	0.707	-0.209	0.142
		Westerner	Chinese	0.034	0.089	0.707	-0.142	0.209
	Angry Music	Chinese	Westerner	-0.234	0.161	0.148	-0.550	0.083

		Westerner	Chinese	0.234	0.161	0.148	-0.083	0.550
	Fearful Music	Chinese	Westerner	-0.466*	0.152	0.002	-0.764	-0.168
		Westerner	Chinese	0.466*	0.152	0.002	0.168	0.764

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: LSD.

Pairwise Comparisons								
Measure:								
Cultural Background	Emotion of Music	Musical Background	Musical Background	Mean Difference	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
							Lower Bound	Upper Bound
Chinese	Happy Music	Musician	Non-Musician	0.222*	0.092	0.016	0.042	0.403
		Non-Musician	Musician	-0.222*	0.092	0.016	-0.403	-0.042
	Sad Music	Musician	Non-Musician	0.056	0.129	0.661	-0.197	0.310

		Non-Musician	Musician	-0.056	0.129	0.661	-0.310	0.197
	Peaceful Music	Musician	Non-Musician	0.112	0.088	0.205	-0.061	0.285
		Non-Musician	Musician	-0.112	0.088	0.205	-0.285	0.061
	Angry Music	Musician	Non-Musician	-0.151	0.159	0.340	-0.463	0.160
		Non-Musician	Musician	0.151	0.159	0.340	-0.160	0.463
	Fearful Music	Musician	Non-Musician	-0.026	0.149	0.860	-0.320	0.267
		Non-Musician	Musician	0.026	0.149	0.860	-0.267	0.320
	Westerner	Happy Music	Musician	Non-Musician	0.197	0.109	0.070	-0.016
Non-Musician			Musician	-0.197	0.109	0.070	-0.411	0.016
Sad Music		Musician	Non-Musician	0.316*	0.153	0.039	0.016	0.616
		Non-Musician	Musician	-0.316*	0.153	0.039	-0.616	-0.016
Peaceful Music		Musician	Non-Musician	0.467*	0.104	<.001	0.263	0.672
		Non-Musician	Musician	-0.467*	0.104	<.001	-0.672	-0.263
Angry Music		Musician	Non-Musician	-0.019	0.188	0.922	-0.388	0.351

		Non-Musician	Musician	0.019	0.188	0.922	-0.351	0.388
	Fearful Music	Musician	Non-Musician	-0.173	0.177	0.328	-0.521	0.175
		Non-Musician	Musician	0.173	0.177	0.328	-0.175	0.521
Based on estimated marginal means								
*. The mean difference is significant at the .05 level.								
b. Adjustment for multiple comparisons: LSD.								

Appendix 4.

Hierarchical Linear Regression: Chinese Group vs Western Group

Happiness Ratings

Estimates of Fixed Effects									
Culture of Music	Cultural Background	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
								Lower Bound	Upper Bound
Chinese Music	Chinese	Intercept	-1.052784	0.043424	1002.109	-24.244	<.001	-1.137997	-0.967572
		PC1	1.391879	0.045294	1114.556	30.730	<.001	1.303009	1.480750
		PC2	4.969705	0.282236	919.949	17.608	<.001	4.415803	5.523606
		PC3	2.556238	0.133201	898.356	19.191	<.001	2.294816	2.817660
		PC4	0.575225	0.018269	1707.017	31.487	<.001	0.539394	0.611056
		PC5	0.112317	0.019679	942.248	5.707	<.001	0.073697	0.150938
		PC6	-0.153869	0.019137	660.461	-8.040	<.001	-0.191446	-0.116292
	Westerners	Intercept	-0.479785	0.070515	1048.696	-6.804	<.001	-0.618151	-0.341419
		PC1	0.726615	0.068736	946.000	10.571	<.001	0.591722	0.861507
		PC2	2.520492	0.405713	946.000	6.212	<.001	1.724290	3.316694
		PC3	1.396187	0.187593	946.000	7.443	<.001	1.028041	1.764333
		PC4	0.444452	0.032087	946.000	13.851	<.001	0.381481	0.507423

Western Music	Chinese	PC5	0.138841	0.031337	946.000	4.431	<.001	0.077342	0.200340
		PC6	-0.169034	0.025473	946.000	-6.636	<.001	-0.219023	-0.119044
		Intercept	-0.140859	0.019336	833.564	-7.285	<.001	-0.178812	-0.102905
		PC1	0.047972	0.020167	345.572	2.379	0.018	0.008306	0.087637
		PC2	0.339361	0.013277	789.227	25.559	<.001	0.313298	0.365425
		PC3	0.143577	0.020250	1170.008	7.090	<.001	0.103846	0.183308
		PC4	0.373132	0.015807	1339.162	23.605	<.001	0.342123	0.404141
		PC5	0.264683	0.017134	927.688	15.447	<.001	0.231056	0.298309
		PC6	-0.083104	0.020709	776.270	-4.013	<.001	-0.123755	-0.042452
	Westerners	Intercept	-0.038833	0.028325	526.998	-1.371	0.171	-0.094476	0.016810
		PC1	-0.085581	0.027240	199.604	-3.142	0.002	-0.139295	-0.031867
		PC2	0.283274	0.020962	451.762	13.513	<.001	0.242078	0.324470
		PC3	0.078348	0.035260	676.985	2.222	0.027	0.009116	0.147581
		PC4	0.325588	0.026383	738.026	12.341	<.001	0.273794	0.377382
		PC5	0.189215	0.026473	407.764	7.147	<.001	0.137174	0.241256
		PC6	-0.034549	0.034781	419.928	-0.993	0.321	-0.102915	0.033817

Sadness Ratings

Estimates of Fixed Effects									
Culture of Music	Cultural Background	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
								Lower Bound	Upper Bound
	Chinese	Intercept	1.281121	0.059305	1027.072	21.602	<.001	1.164748	1.397494

Chinese Music		PC1	-1.484306	0.058916	1206.998	-25.194	<.001	-1.599894	-1.368717
		PC2	-7.406560	0.373747	1089.557	-19.817	<.001	-8.139905	-6.673215
		PC3	-3.405583	0.174607	1033.312	-19.504	<.001	-3.748207	-3.062959
		PC4	-0.719008	0.025729	1132.705	-27.945	<.001	-0.769490	-0.668526
		PC5	0.138761	0.028208	692.099	4.919	<.001	0.083378	0.194144
		PC6	0.009607	0.023345	748.961	0.412	0.681	-0.036222	0.055436
	Westerners	Intercept	0.739336	0.075450	965.818	9.799	<.001	0.591271	0.887402
		PC1	-0.884153	0.070975	946.000	-12.457	<.001	-1.023440	-0.744866
		PC2	-4.203649	0.418931	946.000	-10.034	<.001	-5.025790	-3.381507
		PC3	-1.930754	0.193704	946.000	-9.968	<.001	-2.310894	-1.550614
		PC4	-0.476544	0.033133	946.000	-14.383	<.001	-0.541566	-0.411522
		PC5	0.071411	0.032358	946.000	2.207	0.028	0.007909	0.134913
		PC6	-0.052563	0.026303	946.000	-1.998	0.046	-0.104181	-0.000945
Western Music	Chinese	Intercept	-0.348788	0.018237	903.450	-19.125	<.001	-0.384581	-0.312996
		PC1	-0.442126	0.018856	420.877	-23.448	<.001	-0.479189	-0.405062
		PC2	-0.198739	0.012915	1140.173	-15.388	<.001	-0.224079	-0.173398
		PC3	-0.044847	0.026191	1407.987	-1.712	0.087	-0.096224	0.006531
		PC4	-0.390428	0.019791	1485.349	-19.728	<.001	-0.429249	-0.351607
		PC5	-0.366922	0.017742	871.400	-20.681	<.001	-0.401744	-0.332099
		PC6	-0.625199	0.021982	1165.763	-28.442	<.001	-0.668327	-0.582070
	Westerners	Intercept	-0.083197	0.038099	291.324	-2.184	0.030	-0.158181	-0.008213
		PC1	-0.398691	0.029220	1218.000	-13.645	<.001	-0.456017	-0.341364
		PC2	-0.226472	0.021244	1218.000	-10.661	<.001	-0.268151	-0.184794

		PC3	0.024733	0.036634	1218.000	0.675	0.500	-0.047140	0.096606
		PC4	-0.157660	0.025442	1218.000	-6.197	<.001	-0.207575	-0.107746
		PC5	-0.226986	0.025651	1218.000	-8.849	<.001	-0.277311	-0.176662
		PC6	-0.465401	0.031152	1218.000	-14.939	<.001	-0.526519	-0.404283

Peacefulness Ratings

Estimates of Fixed Effects									
Culture of Music	Cultural Background	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
								Lower Bound	Upper Bound
Chinese Music	Chinese	Intercept	-0.515106	0.059163	965.813	-8.707	<.001	-0.631208	-0.399003
		PC1	0.171546	0.059379	1037.476	2.889	0.004	0.055030	0.288062
		PC2	2.715236	0.373934	896.928	7.261	<.001	1.981348	3.449124
		PC3	1.264799	0.175166	888.418	7.221	<.001	0.921012	1.608586
		PC4	0.262252	0.025404	1115.770	10.323	<.001	0.212407	0.312097
		PC5	0.058986	0.020508	1007.093	2.876	0.004	0.018744	0.099229
		PC6	-0.531047	0.023207	530.027	-22.883	<.001	-0.576636	-0.485458
	Westerners	Intercept	0.088857	0.076829	1061.426	1.157	0.248	-0.061898	0.239612
		PC1	-0.161546	0.075491	946.000	-2.140	0.033	-0.309694	-0.013397
		PC2	0.199375	0.445582	946.000	0.447	0.655	-0.675069	1.073819
		PC3	0.146670	0.206027	946.000	0.712	0.477	-0.257654	0.550994
		PC4	0.204039	0.035241	946.000	5.790	<.001	0.134881	0.273198
		PC5	0.150976	0.034417	946.000	4.387	<.001	0.083434	0.218519

Western Music	Chinese	PC6	-0.378799	0.027976	946.000	-13.540	<.001	-0.433701	-0.323897
		Intercept	-0.041584	0.020434	1063.795	-2.035	0.042	-0.081681	-0.001488
		PC1	-0.363200	0.017173	557.197	-21.149	<.001	-0.396932	-0.329469
		PC2	-0.238944	0.012389	1190.626	-19.287	<.001	-0.263251	-0.214638
		PC3	0.108739	0.023668	1385.115	4.594	<.001	0.062310	0.155167
		PC4	0.576261	0.019130	1125.614	30.123	<.001	0.538725	0.613796
		PC5	0.136325	0.021393	736.193	6.372	<.001	0.094327	0.178323
		PC6	-0.301306	0.021586	1020.641	-13.958	<.001	-0.343664	-0.258948
	Westerners	Intercept	0.083966	0.038968	285.415	2.155	0.032	0.007265	0.160667
		PC1	-0.378360	0.029543	1218.000	-12.807	<.001	-0.436320	-0.320399
		PC2	-0.136518	0.021479	1218.000	-6.356	<.001	-0.178658	-0.094379
		PC3	-0.026823	0.037039	1218.000	-0.724	0.469	-0.099490	0.045845
		PC4	0.424887	0.025723	1218.000	16.518	<.001	0.374421	0.475354
		PC5	0.137919	0.025934	1218.000	5.318	<.001	0.087038	0.188800
		PC6	-0.384971	0.031497	1218.000	-12.223	<.001	-0.446765	-0.323177

Anger Ratings

Estimates of Fixed Effects									
Culture of Music	Cultural Background	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
								Lower Bound	Upper Bound
Chinese Music	Chinese	Intercept	0.449981	0.050563	800.887	8.899	<.001	0.350730	0.549231
		PC1	-0.588351	0.049993	983.542	-11.769	<.001	-0.686457	-0.490246

		PC2	-2.674234	0.298427	851.672	-8.961	<.001	-3.259974	-2.088495	
		PC3	-1.443264	0.132847	879.528	-10.864	<.001	-1.703999	-1.182530	
		PC4	-0.305487	0.027196	749.349	-11.233	<.001	-0.358876	-0.252099	
		PC5	-0.172811	0.028414	583.099	-6.082	<.001	-0.228617	-0.117005	
		PC6	0.461477	0.018994	731.643	24.296	<.001	0.424188	0.498767	
		Westerners	Intercept	0.255343	0.075516	998.562	3.381	<.001	0.107153	0.403532
			PC1	-0.130039	0.071927	946.000	-1.808	0.071	-0.271194	0.011116
			PC2	-0.447848	0.424549	946.000	-1.055	0.292	-1.281015	0.385319
			PC3	-0.431805	0.196302	946.000	-2.200	0.028	-0.817043	-0.046566
			PC4	-0.193764	0.033577	946.000	-5.771	<.001	-0.259658	-0.127870
			PC5	-0.208533	0.032792	946.000	-6.359	<.001	-0.272887	-0.144179
			PC6	0.358036	0.026655	946.000	13.432	<.001	0.305726	0.410346
Western Music	Chinese	Intercept	-0.144843	0.021292	599.261	-6.803	<.001	-0.186659	-0.103028	
		PC1	0.255057	0.026534	368.543	9.612	<.001	0.202879	0.307235	
		PC2	0.068352	0.016256	890.670	4.205	<.001	0.036448	0.100255	
		PC3	-0.528573	0.031372	1270.138	-16.849	<.001	-0.590119	-0.467027	
		PC4	-0.599727	0.020540	1032.047	-29.198	<.001	-0.640032	-0.559421	
		PC5	-0.270152	0.014817	1007.131	-18.233	<.001	-0.299228	-0.241076	
		PC6	0.029899	0.025402	617.422	1.177	0.240	-0.019985	0.079783	
	Westerners	Intercept	0.099052	0.043167	292.186	2.295	0.022	0.014094	0.184011	
		PC1	0.402316	0.033161	1218.000	12.132	<.001	0.337257	0.467375	
		PC2	0.052407	0.024109	1218.000	2.174	0.030	0.005107	0.099708	
		PC3	-0.289252	0.041575	1218.000	-6.957	<.001	-0.370820	-0.207685	

		PC4	-0.361649	0.028874	1218.000	-12.525	<.001	-0.418297	-0.305002
		PC5	-0.064236	0.029111	1218.000	-2.207	0.028	-0.121348	-0.007123
		PC6	0.328211	0.035354	1218.000	9.283	<.001	0.258849	0.397573

Fear Ratings

Estimates of Fixed Effects									
Culture of Music	Cultural Background	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
								Lower Bound	Upper Bound
Chinese Music	Chinese	Intercept	0.227550	0.045343	895.956	5.018	<.001	0.138559	0.316541
		PC1	-0.223620	0.044985	1080.621	-4.971	<.001	-0.311888	-0.135352
		PC2	-0.601092	0.267784	947.123	-2.245	0.025	-1.126612	-0.075573
		PC3	-0.587323	0.119308	967.815	-4.923	<.001	-0.821455	-0.353191
		PC4	-0.047099	0.024548	893.096	-1.919	0.055	-0.095278	0.001079
		PC5	-0.503690	0.027778	612.479	-18.133	<.001	-0.558241	-0.449139
		PC6	0.358355	0.018350	707.428	19.529	<.001	0.322329	0.394382
	Westerners	Intercept	0.254999	0.075867	919.875	3.361	<.001	0.106107	0.403891
		PC1	-0.057052	0.070223	946.000	-0.812	0.417	-0.194864	0.080759
		PC2	0.310109	0.414493	946.000	0.748	0.455	-0.503322	1.123541
		PC3	-0.138936	0.191652	946.000	-0.725	0.469	-0.515049	0.237177
		PC4	-0.086390	0.032782	946.000	-2.635	0.009	-0.150723	-0.022057
		PC5	-0.365015	0.032016	946.000	-11.401	<.001	-0.427845	-0.302186
		PC6	0.324724	0.026024	946.000	12.478	<.001	0.273653	0.375795

Western Music	Chinese	Intercept	-0.098140	0.020384	516.859	-4.815	<.001	-0.138186	-0.058095
		PC1	0.492125	0.026041	373.943	18.898	<.001	0.440920	0.543330
		PC2	-0.084463	0.016002	853.756	-5.278	<.001	-0.115870	-0.053056
		PC3	-0.254831	0.032199	1200.897	-7.914	<.001	-0.318004	-0.191657
		PC4	-0.385811	0.020094	977.267	-19.201	<.001	-0.425242	-0.346379
		PC5	-0.168830	0.013456	1129.770	-12.547	<.001	-0.195232	-0.142429
		PC6	-0.200409	0.020860	699.939	-9.607	<.001	-0.241365	-0.159453
	Westerners	Intercept	0.133560	0.031907	395.739	4.186	<.001	0.070832	0.196289
		PC1	0.448049	0.036083	204.389	12.417	<.001	0.376906	0.519191
		PC2	-0.042584	0.024522	512.698	-1.737	0.083	-0.090760	0.005592
		PC3	-0.361765	0.048018	701.367	-7.534	<.001	-0.456040	-0.267489
		PC4	-0.507148	0.031822	652.588	-15.937	<.001	-0.569633	-0.444662
		PC5	-0.216975	0.027206	433.907	-7.975	<.001	-0.270446	-0.163503
		PC6	-0.076311	0.040132	491.106	-1.901	0.058	-0.155163	0.002541

Hierarchical Linear Regression: Western Group as Reference Group

Happiness Ratings

Estimates of Fixed Effects ^a								
MusicCulture	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Chinese Music	Intercept	- 1.030224	0.044515	3217.026	-23.143	<.001	- 1.117505	- 0.942944
	[Cultural Background_dum_1=.00]	0.550439	0.077667	3217.026	7.087	<.001	0.398158	0.702721
	[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.
	PC1	1.365794	0.043538	2886.000	31.370	<.001	1.280424	1.451163
	PC2	4.852437	0.256985	2886.000	18.882	<.001	4.348545	5.356329
	PC3	2.509168	0.118824	2886.000	21.117	<.001	2.276179	2.742157
	PC4	0.577373	0.020325	2886.000	28.408	<.001	0.537521	0.617226
	PC5	0.108619	0.019850	2886.000	5.472	<.001	0.069698	0.147540
	PC6	- 0.146767	0.016135	2886.000	-9.096	<.001	- 0.178404	- 0.115130
	[CulturalBackground_dum_1=.00] * PC1	- 0.639179	0.075963	2886.000	-8.414	<.001	- 0.788126	- 0.490231

	[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC2	- 2.331945	0.448372	2886.000	-5.201	<.001	- 3.211106	- 1.452784
	[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC3	- 1.112981	0.207317	2886.000	-5.368	<.001	- 1.519486	- 0.706476
	[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC4	- 0.132921	0.035461	2886.000	-3.748	<.001	- 0.202453	- 0.063390
	[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC5	0.030222	0.034632	2886.000	0.873	0.383	- 0.037685	0.098129
	[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC6	- 0.022266	0.028151	2886.000	-0.791	0.429	- 0.077464	0.032932
	[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.
Western Music	Intercept	- 0.119610	0.019534	1378.580	-6.123	<.001	- 0.157929	- 0.081291
	[Cultural Background_dum_1=.00]	0.045987	0.034081	1378.580	1.349	0.177	- 0.020870	0.112843
	[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.
	PC1	0.035395	0.019867	538.772	1.782	0.075	- 0.003632	0.074422
	PC2	0.333292	0.013765	1266.031	24.214	<.001	0.306288	0.360296

PC3	0.152853	0.021864	1958.511	6.991	<.001	0.109974	0.195731
PC4	0.376714	0.016717	2198.127	22.535	<.001	0.343932	0.409497
PC5	0.277783	0.017705	1303.392	15.690	<.001	0.243050	0.312516
PC6	- 0.053112	0.022070	1188.823	-2.407	0.016	- 0.096413	- 0.009812
[CulturalBackground_dum_1=.00] * PC1	- 0.105045	0.034664	538.772	-3.030	0.003	- 0.173138	- 0.036953
[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC2	- 0.033178	0.024016	1266.031	-1.382	0.167	- 0.080293	0.013937
[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC3	- 0.104108	0.038147	1958.511	-2.729	0.006	- 0.178920	- 0.029296
[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC4	- 0.063980	0.029167	2198.127	-2.194	0.028	- 0.121178	- 0.006783
[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC5	- 0.092674	0.030890	1303.392	-3.000	0.003	- 0.153274	- 0.032074
[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC6	- 0.044273	0.038507	1188.823	-1.150	0.250	- 0.119821	0.031276
[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.

a. Dependent Variable: Zscore(trans2).

b. This parameter is set to zero because it is redundant.

Sadness Ratings

Estimates of Fixed Effects ^a								
MusicCulture	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Chinese Music	Intercept	1.265181	0.059474	1508.440	21.273	<.001	1.148521	1.381841
	[Cultural Background_dum_1=.00]	- 0.512844	0.103766	1508.440	-4.942	<.001	- 0.716386	- 0.309303
	[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.
	PC1	- 1.466233	0.059096	1780.915	-24.811	<.001	- 1.582137	- 1.350329
	PC2	- 7.311094	0.370183	1596.684	-19.750	<.001	- 8.037191	- 6.584998
	PC3	- 3.364433	0.172463	1521.711	-19.508	<.001	- 3.702723	- 3.026143
	PC4	- 0.719306	0.026219	1615.470	-27.434	<.001	- 0.770733	- 0.667879
	PC5	0.140841	0.027888	1033.180	5.050	<.001	0.086118	0.195564
	PC6	0.003070	0.022769	1090.770	0.135	0.893	- 0.041607	0.047746

	[CulturalBackground_dum_1=.00] * PC1	0.566763	0.103106	1780.915	5.497	<.001	0.364541	0.768985
	[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC2	3.036830	0.645874	1596.684	4.702	<.001	1.769981	4.303680
	[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC3	1.403712	0.300903	1521.711	4.665	<.001	0.813484	1.993940
	[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC4	0.246519	0.045746	1615.470	5.389	<.001	0.156792	0.336246
	[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC5	- 0.072421	0.048657	1033.180	-1.488	0.137	- 0.167899	0.023056
	[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC6	- 0.050022	0.039726	1090.770	-1.259	0.208	- 0.127971	0.027927
	[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.
Western Music	Intercept	- 0.305688	0.025852	876.841	-11.825	<.001	- 0.356427	- 0.254949
	[Cultural Background_dum_1=.00]	0.222491	0.045105	876.841	4.933	<.001	0.133965	0.311017
	[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.
	PC1	- 0.458302	0.019673	3714.000	-23.295	<.001	- 0.496873	- 0.419730

PC2	- 0.197248	0.014303	3714.000	-13.790	<.001	- 0.225291	- 0.169205
PC3	- 0.049397	0.024665	3714.000	-2.003	0.045	- 0.097756	- 0.001038
PC4	- 0.380519	0.017130	3714.000	-22.214	<.001	- 0.414104	- 0.346934
PC5	- 0.390799	0.017271	3714.000	-22.628	<.001	- 0.424660	- 0.356939
PC6	- 0.521579	0.020975	3714.000	-24.867	<.001	- 0.562702	- 0.480455
[CulturalBackground_dum_1=.00] * PC1	0.059611	0.034325	3714.000	1.737	0.083	- 0.007687	0.126909
[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC2	- 0.029225	0.024956	3714.000	-1.171	0.242	- 0.078153	0.019704
[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC3	0.074130	0.043035	3714.000	1.723	0.085	- 0.010244	0.158504
[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC4	0.222859	0.029887	3714.000	7.457	<.001	0.164262	0.281455
[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC5	0.163813	0.030133	3714.000	5.436	<.001	0.104735	0.222891
[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC6	0.056177	0.036595	3714.000	1.535	0.125	- 0.015572	0.127927

	[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.
a. Dependent Variable: Zscore(trans2).								
b. This parameter is set to zero because it is redundant.								

Peacefulness Ratings

Estimates of Fixed Effects ^a								
MusicCulture	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Chinese Music	Intercept	- 0.490015	0.058572	1454.294	-8.366	<.001	- 0.604910	- 0.375120
	[Cultural Background_dum_1=.00]	0.516917	0.102193	1454.294	5.058	<.001	0.316456	0.717379
	[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.
	PC1	0.136890	0.059501	1567.312	2.301	0.022	0.020181	0.253599
	PC2	2.575224	0.367072	1346.134	7.016	<.001	1.855128	3.295320
	PC3	1.205559	0.171414	1336.107	7.033	<.001	0.869289	1.541830
	PC4	0.264554	0.025688	1609.847	10.299	<.001	0.214168	0.314939
	PC5	0.055469	0.021268	1505.128	2.608	0.009	0.013752	0.097187
	PC6	- 0.521835	0.022800	812.451	-22.887	<.001	- 0.566590	- 0.477081

	[CulturalBackground_dum_1=.00] * PC1	- 0.216303	0.103813	1567.312	-2.084	0.037	- 0.419931	- 0.012676
	[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC2	- 1.979538	0.640446	1346.134	-3.091	0.002	- 3.235918	- 0.723157
	[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC3	- 0.886625	0.299073	1336.107	-2.965	0.003	- 1.473330	- 0.299921
	[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC4	- 0.053471	0.044819	1609.847	-1.193	0.233	- 0.141381	0.034439
	[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC5	0.091702	0.037107	1505.128	2.471	0.014	0.018915	0.164488
	[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC6	0.115536	0.039781	812.451	2.904	0.004	0.037452	0.193621
	[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.
Western Music	Intercept	- 0.035338	0.020667	1566.686	-1.710	0.087	- 0.075875	0.005200
	[Cultural Background_dum_1=.00]	0.128743	0.036058	1566.686	3.570	<.001	0.058016	0.199470
	[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.
	PC1	- 0.387612	0.018042	765.747	-21.484	<.001	- 0.423030	- 0.352194

PC2	- 0.229817	0.013471	1693.199	-17.060	<.001	- 0.256239	- 0.203396
PC3	0.052926	0.025216	2158.293	2.099	0.036	0.003476	0.102377
PC4	0.532903	0.019443	2375.651	27.409	<.001	0.494776	0.571030
PC5	0.141069	0.020776	1050.240	6.790	<.001	0.100301	0.181836
PC6	- 0.380864	0.022618	1498.814	-16.839	<.001	- 0.425230	- 0.336499
[CulturalBackground_dum_1=.00] * PC1	0.017312	0.031479	765.747	0.550	0.583	- 0.044483	0.079107
[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC2	0.080890	0.023503	1693.199	3.442	<.001	0.034792	0.126989
[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC3	- 0.014106	0.043996	2158.293	-0.321	0.749	- 0.100385	0.072172
[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC4	- 0.073131	0.033923	2375.651	-2.156	0.031	- 0.139653	- 0.006610
[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC5	0.019756	0.036249	1050.240	0.545	0.586	- 0.051373	0.090885
[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC6	0.094194	0.039462	1498.814	2.387	0.017	0.016787	0.171601

	[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.
a. Dependent Variable: Zscore(trans2).								
b. This parameter is set to zero because it is redundant.								

Anger Ratings

Estimates of Fixed Effects ^a								
MusicCulture	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Chinese Music	Intercept	0.462476	0.051601	1327.379	8.963	<.001	0.361248	0.563704
	[Cultural Background_dum_1=.00]	- 0.218474	0.090030	1327.379	-2.427	0.015	- 0.395090	- 0.041858
	[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.
	PC1	- 0.596365	0.051936	1615.959	-11.483	<.001	- 0.698233	- 0.494496
	PC2	- 2.741845	0.307488	1377.439	-8.917	<.001	- 3.345041	- 2.138650
	PC3	- 1.469702	0.137920	1411.990	-10.656	<.001	- 1.740252	- 1.199152
	PC4	- 0.332933	0.027443	1173.329	-12.132	<.001	- 0.386776	- 0.279090
	PC5	- 0.155058	0.028563	894.254	-5.429	<.001	- 0.211116	- 0.098999

	PC6	0.460158	0.019626	1116.654	23.446	<.001	0.421649	0.498667
	[CulturalBackground_dum_1=.00] * PC1	0.480212	0.090614	1615.959	5.300	<.001	0.302478	0.657946
	[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC2	2.327523	0.536487	1377.439	4.338	<.001	1.275104	3.379943
	[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC3	1.045321	0.240634	1411.990	4.344	<.001	0.573281	1.517360
	[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC4	0.157849	0.047881	1173.329	3.297	0.001	0.063906	0.251791
	[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC5	- 0.065790	0.049835	894.254	-1.320	0.187	- 0.163597	0.032018
	[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC6	- 0.097261	0.034243	1116.654	-2.840	0.005	- 0.164449	- 0.030073
	[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.
Western Music	Intercept	- 0.114901	0.022208	986.770	-5.174	<.001	- 0.158481	- 0.071322
	[Cultural Background_dum_1=.00]	0.166340	0.038747	986.770	4.293	<.001	0.090305	0.242375
	[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.

PC1	0.269826	0.026917	545.653	10.024	<.001	0.216952	0.322700
PC2	0.059236	0.016963	1351.088	3.492	<.001	0.025960	0.092512
PC3	- 0.456802	0.031751	1909.652	-14.387	<.001	- 0.519072	- 0.394533
PC4	- 0.547931	0.020595	1579.178	-26.605	<.001	- 0.588328	- 0.507534
PC5	- 0.224408	0.015870	1177.785	-14.140	<.001	- 0.255544	- 0.193271
PC6	0.168606	0.026922	1281.562	6.263	<.001	0.115790	0.221422
[CulturalBackground_dum_1=.00] * PC1	0.094463	0.046964	545.653	2.011	0.045	0.002211	0.186715
[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC2	- 0.027102	0.029595	1351.088	-0.916	0.360	- 0.085159	0.030956
[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC3	0.123617	0.055397	1909.652	2.231	0.026	0.014973	0.232262
[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC4	0.148646	0.035934	1579.178	4.137	<.001	0.078164	0.219129
[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC5	0.051081	0.027689	1177.785	1.845	0.065	- 0.003244	0.105407
[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.

	[CulturalBackground_dum_1=.00] * PC6	0.016378	0.046972	1281.562	0.349	0.727	- 0.075771	0.108528
	[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.

a. Dependent Variable: Zscore(trans2).

b. This parameter is set to zero because it is redundant.

Fear Ratings

Estimates of Fixed Effects ^a								
MusicCulture	Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Chinese Music	Intercept	0.237986	0.048434	1430.195	4.914	<.001	0.142977	0.332994
	[Cultural Background_dum_1=.00]	0.010434	0.084504	1430.195	0.123	0.902	- 0.155331	0.176199
	[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.
	PC1	- 0.231870	0.049028	1712.904	-4.729	<.001	- 0.328031	- 0.135709
	PC2	- 0.658680	0.290501	1459.962	-2.267	0.024	- 1.228524	- 0.088837
	PC3	- 0.609248	0.130564	1480.487	-4.666	<.001	- 0.865357	- 0.353138
	PC4	- 0.065299	0.025840	1338.276	-2.527	0.012	- 0.115991	- 0.014607

	PC5	- 0.488298	0.028358	933.252	-17.219	<.001	- 0.543950	- 0.432646
	PC6	0.360433	0.019608	1104.550	18.382	<.001	0.321960	0.398905
	[CulturalBackground_dum_1=.00] * PC1	0.182696	0.085541	1712.904	2.136	0.033	0.014920	0.350473
	[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC2	0.994725	0.506848	1459.962	1.963	0.050	0.000496	1.988953
	[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC3	0.478201	0.227800	1480.487	2.099	0.036	0.031357	0.925045
	[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC4	- 0.002402	0.045085	1338.276	-0.053	0.958	- 0.090847	0.086043
	[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC5	0.107759	0.049477	933.252	2.178	0.030	0.010660	0.204858
	[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC6	- 0.033634	0.034210	1104.550	-0.983	0.326	- 0.100759	0.033491
	[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.
Western Music	Intercept	- 0.074531	0.021110	920.346	-3.531	<.001	- 0.115960	- 0.033103
	[Cultural Background_dum_1=.00]	0.179344	0.036831	920.346	4.869	<.001	0.107062	0.251627

[CulturalBackground_dum_1=1.00]	0 ^b	.	.	.	.	.	.
PC1	0.484970	0.025786	576.251	18.808	<.001	0.434324	0.535615
PC2	- 0.073332	0.016408	1391.896	-4.469	<.001	- 0.105518	- 0.041146
PC3	- 0.267964	0.032649	1916.456	-8.207	<.001	- 0.331995	- 0.203932
PC4	- 0.410458	0.020804	1653.821	-19.730	<.001	- 0.451263	- 0.369653
PC5	- 0.168923	0.015559	1482.998	-10.857	<.001	- 0.199444	- 0.138403
PC6	- 0.125705	0.024038	1125.409	-5.229	<.001	- 0.172869	- 0.078540
[CulturalBackground_dum_1=.00] * PC1	- 0.023956	0.044989	576.251	-0.532	0.595	- 0.112319	0.064407
[CulturalBackground_dum_1=1.00] * PC1	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC2	0.016002	0.028627	1391.896	0.559	0.576	- 0.040155	0.072158
[CulturalBackground_dum_1=1.00] * PC2	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC3	- 0.073860	0.056965	1916.456	-1.297	0.195	- 0.185579	0.037859
[CulturalBackground_dum_1=1.00] * PC3	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC4	- 0.058002	0.036298	1653.821	-1.598	0.110	- 0.129196	0.013193
[CulturalBackground_dum_1=1.00] * PC4	0 ^b	.	.	.	.	.	.
[CulturalBackground_dum_1=.00] * PC5	- 0.047074	0.027147	1482.998	-1.734	0.083	- 0.100324	0.006176

	[CulturalBackground_dum_1=1.00] * PC5	0 ^b	.	.	.	.	.	.
	[CulturalBackground_dum_1=.00] * PC6	- 0.029116	0.041940	1125.409	-0.694	0.488	- 0.111406	0.053173
	[CulturalBackground_dum_1=1.00] * PC6	0 ^b	.	.	.	.	.	.
a. Dependent Variable: Zscore(trans2).								
b. This parameter is set to zero because it is redundant.								

Appendix 5.

Study 1: English Version of Participant Information Sheet

Thank you for agreeing to take part in this study. Before proceeding further, please read through the following information carefully and let us know if anything is unclear or you would like further information (ml1570@york.ac.uk).

Background

This study is a part of the PhD project *Emotion Recognition in Instrumental Music: A Cross-cultural Study between Western and Chinese Contexts*. The purpose of the study is to examine how Western and Chinese listeners perceive the emotions in the music from their own culture and from the other culture.

This research is being carried out by PhD Music student: Menglan Lyu (ml1570@york.ac.uk), based at the University of York, and part of the York Music Psychology Group (YMPG). This work is being carried out under the supervision of Dr Hauke Egermann (hauke.egermann@york.ac.uk).

Ethics approval has been granted by the University of York ethics committee, with Dr Tom Collins (tom.collins@york.ac.uk) as the most appropriate port of call on the ethics committee, should you have any questions or concerns.

Dates and Venue: Mar 2021 to Apr 2021; Online

How long will the questionnaire take to complete?

15-25 mins

Why have I been invited to participate?

We are looking for volunteers who are born and raised in Western cultural backgrounds or a Chinese cultural background.

To avoid ambiguity, we refer to the definition from Wikipedia:

Western culture is commonly said to include: Australia and New Zealand, Canada, all European member countries of the EFTA and EU, the European microstates, the NATO military alliance, the United Kingdom, and the United States.

Do I have to take part?

No, participation is optional. You are allowed to withdraw from the study at any point without having to provide a reason.

What happens after the study?

The collected data will be recorded and later reported in an academic paper.

On what basis will you process my data?

Under the General Data Protection Regulation (GDPR), the University has to identify a legal basis for processing personal data and, where appropriate, an additional condition for processing special category data.

In line with our charter which states that we advance learning and knowledge by teaching and research, the University processes personal data for research purposes under Article 6 (1) (e) of the GDPR:

Processing is necessary for the performance of a task carried out in the public interest

Special category data is processed under Article 9 (2) (j):

In line with ethical expectations and in order to comply with common law duty of confidentiality, we will seek your consent to participate where appropriate. This consent will not, however, be our legal basis for processing your data under the GDPR.

How will you use my data?

Data will be processed for the purposes outlined in this notice. Analysed data will be included in articles that will be submitted to academic journals or conference presentations.

Will you share my data with 3rd parties?

No. Data will be accessible to the project team at York only.

Anonymised data may be reused by the research team or other third parties for secondary research and/or teaching purposes.

How will you keep my data secure?

The University will put in place appropriate technical and organisational measures to protect your personal data and/or special category data. For the purposes of this project we will store obtained data on electronic response forms within the password protected laptop and Google Drive.

Information will be treated confidentiality and shared on a need-to-know basis only. The University is committed to the principle of data protection by design and default and will collect the minimum amount of data necessary for the project. In addition, we will anonymise data wherever possible.

Will you transfer my data internationally?

No. Data will be held within the United Kingdom in full compliance with data protection legislation.

Only anonymised dataset which contains the essential variables and analyses may be published in an article in a journal outside the United Kingdom or may be reused by other international third parties for secondary research and/or teaching purposes.

Will I be identified in any research outputs?

No, as all data is anonymous.

How long will you keep my data?

Data will be retained in line with legal requirements or where there is a business need.

Retention timeframes will be determined in line with the University's Records Retention Schedule.

What rights do I have in relation to my data?

Under the GDPR, you have a general right of access to your data, a right to rectification, erasure, restriction, objection or portability. You also have a right to withdraw. Please note, not all rights apply where data is processed purely for research purposes. For further information see:

<https://www.york.ac.uk/recordsmanagement/generaldataprotectionregulation/individualsrights/>.

Questions or concerns

If you have any questions about this participant information sheet or concerns about how your data is being processed, please contact Dr Hauke Egermann (hauke.egermann@york.ac.uk) in the first instance. If you are still dissatisfied, please contact the University's Acting Data Protection Officer at dataprotection@york.ac.uk.

Right to complain

If you are unhappy with the way in which the University has handled your personal data, you have a right to complain to the Information Commissioner's Office. For information on reporting a concern to the Information Commissioner's Office, see www.ico.org.uk/concerns.

Study 1: English Version of Consent Form

I have read the above information

I understand that my participation is voluntary and that I am free to withdraw at any time during the survey without giving any reason

I understand that once I complete the survey, my data cannot be withdrawn as it is anonymous

I agree to take part in this study

I consent to any data I submit being stored and used for academic research

I am aged 18 or over

☐ I confirm all of the above

Study 1: Chinese Version of Participant Information Sheet

感谢您同意参加本研究。在进行下一步操作之前，请仔细通读以下信息，如有疑问或您需要

进一步的信息，请联系我们(ml1570@york.ac.uk)。

背景

该研究是器乐中的情绪感知:西方与中国背景下的跨文化研究(*Emotion Recognition in Instrumental Music: A Cross-cultural Study between Western and Chinese Contexts*)这一博士课题中的一部分。该研究旨在考察中西方听众如何感知判别来自他们自身文化与对方文化的音乐中的情绪。

该项研究由约克大学音乐心理学研究组(YMPG)的音乐博士生 Menglan Lyu (ml1570@york.ac.uk)开展，在 Dr Hauke Egermann(hauke.egermann@york.ac.uk)的指导下进行。

伦理认证已由约克大学伦理委员会批准，如果您有任何疑问或疑虑，请联系伦理委员会的 Dr Tom Collins(tom.collins@york.ac.uk)。

时间与地点: 2021.3-2021.4; 线上

完成该问卷需要多久?

15-25 分钟

为何我受邀参与?

我们需要的是在西方文化背景或中国文化背景下出生和成长的志愿者。

为了避免歧义，我们参考维基百科(Wikipedia)的定义: 西方文化通常被认为包括:澳大利亚和新西兰，加拿大，欧洲自由贸易区和欧盟的所有欧洲成员国，欧洲微观国家，北约军事同盟，英国和美国。

我必须参加吗?

不，参加均为自愿。您可以随时退出研究，而无需提供理由。

研究之后会发生什么?

收集到的数据将被记录，并随后被报告于学术论文中。

你们将以什么原则处理我的数据？

根据《通用数据保护条例》(GDPR)，大学必须确定处理个人数据的法律依据，并在适当时确定处理特殊类别数据的附加条件。

根据我们的章程规定，我们通过教学和研究促进学习和知识的发展，大学根据 GDPR 第 6 条第 1 款(e)项的规定，出于研究目的处理个人数据：

处理是执行出于公共利益而执行的任务所必需的

特殊类别数据根据第 9 条第 2 款(j)项处理：

为了公共利益，出于存档目的，出于科学研究和历史研究目的或出于统计目的，必须进行处理

仅在获得伦理批准，有明确的公共利益并且已采取适当的保护措施来保护数据的情况下，才能进行研究。

为了符合伦理规范并为了遵守普通法的保密义务，我们将在适当情况下征求您的同意参加。但是，此同意将不是我们根据 GDPR 处理您的数据的法律依据。

你们将如何使用我的数据？

将出于本通知中概述的目的处理数据。分析数据将包含在将提交给学术期刊或会议演示的文章中。

你们会与第三方共享我的数据吗？

不会。只有约克大学的项目团队才能访问数据。

研究小组或其他第三方可以将匿名数据再用于二次研究和/或教学目的。

你们将如何确保我的数据安全？

大学将采取适当的技术和组织措施来保护您的个人数据和/或特殊类别数据。就本项目而言，我们将把在电子回复表格中获得的数据存储在受密码保护的笔记本电脑和 Google 云端硬盘中。

信息将被视为机密信息，且仅在需要了解的基础上共享。大学致力于设计和默认数据保护的原则，并将收集该项目所必需的最少数据量。此外，我们将尽可能对数据进行匿名处理。

你们会在国际范围内转移我的数据吗？

不会。数据将完全符合数据保护法规的要求而保存在英国境内。只有包含基本变量和分析的匿名数据集才能在英国以外的期刊上的文章中发表，或可以由其他国际第三方重新用于二次研究和/或教学目的。

我会在任何研究成果中被识别出吗？

不会，因为所有数据都是匿名的。

你们将保留我的数据多长时间？

数据将根据法律要求或有业务需求的地方进行保留。保留期限将根据大学的记录保留时间表确定。

我对我的数据有什么权利？

根据 GDPR，您拥有访问数据的一般权利，纠正，删除，限制，异议或可移植性的权利。您也有权退出。请注意，并非所有权利都适用于仅出于研究目的而处理数据的地方。有关更多信息，请参

见：<https://www.york.ac.uk/recordsmanagement/generaldataprotectionregulation/individualsrights/>。

问题或疑虑

如果您对此参与者信息表有任何疑问，或者对如何处理您的数据有任何疑问，请首先联系 Dr Hauke Egermann(hauke.egermann@york.ac.uk)。如果您仍然不满意，请联系大学代理数据保护官 dataprotection@york.ac.uk。

投诉权

如果您对大学处理您的个人数据的方式不满意，则有权向信息专员办公室投诉。有关向信息专员 办公室报告问题的信息，请访问 www.ico.org.uk/concerns。

Study 1: Chinese Version of Consent Form

我已阅读以上信息

我了解我的参与是自愿的，并且我可以随时退出调查，而无需给出任何理由

我了解完成调查后，由于匿名，我的数据无法撤回

我同意参加这项研究

我同意将我提交的任何数据存储并用于学术研究

我已满 18 岁

☐ 我确认以上所有内容

Study 2 & 3: English Version of Participant Information

Project background

The University of York would like to invite you to take part in the following project: *A Cross-cultural Study between Chinese and Western Contexts: Music Emotion Recognition, Personality Traits and Cognitive Styles*.

Before agreeing to take part, please read this information sheet carefully and let us know if anything is unclear or you would like further information.

What is the purpose of the project?

This project is being undertaken by Menglan Lyu (ml1570@york.ac.uk), who is a doctoral student at the University of York.

The work is being conducted according to restrictions that have been subject to approval by the ACT Ethics committee. The Chair of the ACT Ethics committee can be contacted on ACT-ethics@york.ac.uk.

For this research project, we are interested in investigating whether the cultural differences in musical emotion recognition are associated with the differences in the personality traits and cognitive styles of different cultures. You are expected to find a quiet place out of noise or disturbance to participate in this project, which will involve - Part 1 (about 20 minutes): After completing the demographic questionnaire, listening to both Western classical and Chinese traditional music excerpts with different emotions expressed, and answering relevant questions; Part 2 (about 10 minutes): completing questionnaires (all choice questions) related to personality traits and cognitive styles. For online participants, after you complete Part 1, you are free to choose whether to continue to complete Part 2 so as to finish the whole questionnaire in one sitting, or end the questionnaire there and complete Part 2 on another day (a reminder email with the link of Part 2 will be sent to you after you complete and submit Part 1). For offline participants, you are expected to complete the whole questionnaire in one sitting.

Please note that to comply with the approved Ethics requirements of this work, we do not intend to discuss sensitive topics with you that could be potentially upsetting or distressing. If you have any concerns about the topics that may be covered in the research study, please raise these concerns with the researcher.

Your participation in this project is voluntary. If you wish, we will provide you with access to the research report after the project is completed. If you would like to receive access to these, you can indicate as such on a separate questionnaire, the link of which will be available when you complete the whole questionnaire and submit it.

Why have I been invited to take part?

You have been invited to take part because you were born and raised either in Western or Chinese culture, aged 18 years or above.

Why should I take part?

Your participation will contribute to filling the gap of research on the roles of personality traits and cognitive styles in music emotion recognition from a cross-cultural perspective. You will have the opportunity to be informed about the outcomes of the study and enter a prize draw to win a £20 Amazon Voucher or equivalent cash prize.

Do I have to take part?

No, participation is optional. If you do decide to take part, you will be given a copy of this information sheet for your records and will be asked to complete a participant consent form. If you change your mind at any point during the research activity, you will be able to withdraw your participation without having to provide a reason. To withdraw your participation you only need to close the webpage and all your data will be deleted.

Will I be identified in any outputs?

No. Your participation in this research activity will be treated anonymously and you will not be identified in any outputs.

Privacy Notice

This section explains how personal data will be used by the project *A Cross-cultural Study between Chinese and Western Contexts: Music Emotion Recognition, Personality Traits and Cognitive Styles* at the University of York.

For this project, the University of York is the [Data Controller](#). We are registered with the Information Commissioner's Office. [Our registration number](#) is Z4855807.

What is our legal basis for processing your data?

Privacy law (the UK General Data Protection Regulation (GDPR) and Data Protection Act 2018) requires us to have a legal reason to process your personal data. Our reason is we need it to perform a public task.³

This is because the University has a [public function](#), which includes carrying out research projects.⁴ We need to use personal data in order to carry out this research project.

Information about your health, ethnicity, sexual identity and other sensitive information is called [“special category” data](#). We have to have an additional legal reason to use this data, because it is sensitive. Our reason is that it is needed for research purposes.⁵ All research projects at the University follow our [research ethics policies](#).

How do we use your data?

Data will be processed for the purposes outlined in this notice.

Who do we share your data with?

Your data will be treated confidentiality and shared on a need-to-know basis and accessible to the project team at York only. As well as this, we use computer software or systems to hold and manage data. Other companies only provide the software, system or storage. They are not allowed to use your data for their own reasons.

We have agreements in place when we share data. These agreements meet legal requirements to ensure your data is protected.

How do we keep your data secure?

The University is serious about keeping your data secure and protecting your rights to privacy. We don't ask you for data we don't need, and only give access to people who need to know. We think about security when planning projects, to make sure they work well. Our IT security team checks regularly to make sure we're taking the right steps. For more details see [our security webpages](#).

³This refers to [UK GDPR Article 6 \(1\) \(e\)](#): processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller

⁴ [Our charter and statutes](#) states: 4.f. To provide instruction in such branches of learning as the University may think fit and to make provision for research and for the advancement and dissemination of knowledge in such manner as the University may determine.

⁵This refers to [UK GDPR Article 9 \(2\) \(j\)](#): processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes in accordance with Article 89(1) based on Union or Member State law which shall be proportionate to the aim pursued, respect the essence of the right to data protection and provide for suitable and specific measures to safeguard the fundamental rights and the interests of the data subject.

How do we transfer your data safely internationally?

If your data is stored or processed outside the UK, we follow legal requirements to make sure that the same level of privacy rules still apply.

How long will we keep your data?

The University has rules in place for [how long research data can be kept](#) when the research project is finished. Your information will be kept for at least 10 years in accordance with university guidelines and after this time an anonymised version will be kept. As this will be fully anonymous, it will not be possible to identify you in any way from this data.

What rights do you have in relation to your data?

[You have rights over your data](#). This sheet explains how you can stop participating in the study, and what will happen to your data if you do. This information is in the section ‘Do I have to take part?’.

If you want to get a copy of your data, or talk to us about any other rights, please contact us using the details below.

Questions or concerns

If you have any questions or concerns about how your data is being processed, please contact Menglan Lyu (ml1570@york.ac.uk) or Hauke Egermann (hauke.eggermann@york.ac.uk).

If you have further questions, the University’s Data Protection Officer can be contacted at dataprotection@york.ac.uk or by writing to: **Data Protection Officer, University of York, Heslington, York, YO10 5DD.**

Right to complain

If you are unhappy with how the University has handled your personal data, please contact our Data Protection Officer using the details above, so that we can try to put things right.

If you are unhappy with our response, you have a right to [complain to the Information Commissioner’s Office](#). You can also contact the Information Commissioner’s Office by post to **Information Commissioner’s Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF** or by phone on **0303 123 1113**.

Study 2 & 3: English Version of Consent Form

I have read the information sheet about this project.

I agree to take part in this project.

I understand my right to withdraw and/or have my data destroyed from this project at any time.

I understand that my participation in this project will be treated anonymously.

I am over the age of 18.

(I agree to not in any way copy, screenshot, download, save, or share any content of the questionnaire in order to protect the copyright; shown in the copyrighted version)

☐ I confirm all of the above

Study 2 & 3: Chinese Version of Participant Information Sheet

研究项目背景

约克大学希望邀请您参加以下研究项目：*中国和西方背景下的跨文化研究：音乐情绪识别、人格特征和认知风格*。

在同意参加之前，请仔细阅读本信息表，如果有任何不清楚的地方或您需要进一步的信息，请告诉我们。

这个研究项目的目的是什么？

本研究项目由约克大学的博士生 Menglan Lyu (ml1570@york.ac.uk)负责，其是约克大学的博士生。

这项工作是根据 ACT 伦理委员会批准的限制条件来进行的。ACT 伦理委员会的主席可以通过 ACT-ethics@york.ac.uk 联系。

对于这个研究项目，我们旨在探索音乐情绪识别的文化差异是否与不同文化的人格特征和认知风格的差异有关。希望您能找到一个没有噪音或干扰的安静地方来参与这个研究项目，这将包括——第 1 部分（约 20 分钟）：在完成人口统计问卷后，听西方古典音乐和中国传统音乐中表达不同情绪的节选，并回答相关问题；第 2 部分（约 10 分钟）：完成与人格特征和认知风格有关的问卷（全部为选择题）。对于在线参与者，在您完成第 1 部分后，您可以自由选择是否继续完成第 2 部分，以便一次性完成整个问卷，或者立即结束问卷，然后在另一天完成第 2 部分（在您完成并提交第 1 部分后，我们将向您发送一封带有第 2 部分链接的提醒邮件）。

请注意，为了遵守这项工作经批准的道德要求，我们不打算与您讨论可能会引起不安或痛苦的敏感话题。如果您对研究调查中可能涉及的话题有任何顾虑，请向研究人员提出这些顾虑。

您对这个研究项目的参与是自愿的。如果您愿意，我们将在研究项目完成后向您提供研究报告的访问权。如果您想获得这些资料，您可以在另一份问卷上注明，其链接将在您完成整个问卷并提交时提供。

为什么我被邀请参加？

您被邀请参加，是因为您在西方或中国文化中出生和长大，年龄在 18 岁或以上。

我为什么要参加？

您的参与将有助于填补从跨文化角度研究人格特征和认知风格在音乐情绪识别中的作用的空白。您将有机会了解研究结果，并参加抽奖活动，赢取 20 英镑的亚马逊代金券或同等的现金奖励。

我一定要参加吗？

不，参与是非强制性的。如果您决定参加，您会得到一份本信息表的副本作为记录，并会被要求填写一份参与者同意书。如果您在研究活动中的任何时候改变主意，您将能够撤回您的参与，而不需要提供理由。要撤回您的参与，您只需要关闭网页，您的所有数据将被删除。

我是否会在任何产出中被识别？

不会。您对这项研究活动的参与将被匿名处理，您不会在任何产出中被识别。

隐私声明

本节解释了个人数据将如何被约克大学的“中西方背景下的跨文化研究：音乐情绪识别、人格特征和认知风格”研究项目使用。

对于这个研究项目，约克大学是数据控制者(the [Data Controller](#))。我们已在信息专员办公室注册。我们的注册号([Our registration number](#))是 Z4855807。

我们处理您的数据的法律依据是什么？

隐私法（英国《通用数据保护条例》（GDPR）和《2018 年数据保护法》）要求我们有合法的理由来处理您的个人数据。我们的理由是我们需要它来执行一项公共任务。⁶

⁶ 这是指英国 GDPR 第 6(1)(e)条([UK GDPR Article 6 \(1\) \(e\)](#))：为执行公共利益的任务或行使赋予控制者的官方权力，处理是必要的。

这是因为大学有一个公共职能([public function](#))，其中包括开展研究项目。⁷ 我们需要使用个人数据，以开展该研究项目。

关于您的健康、种族、性身份和其他敏感信息被称为 "特殊类别" 数据([“special category” data](#))。我们必须有一个额外的法律理由来使用这些数据，因为它是敏感的。我们的理由是，它需要用于研究目的。⁸ 大学的所有研究项目都遵循我们的研究伦理政策([research ethics policies](#))。

我们如何使用您的数据？

数据的处理将用于本声明中所述的目的。

我们与谁分享您的数据？

您的数据将被保密，并在需要了解的基础上共享，只有约克大学的研究项目团队可以访问。除此以外，我们还使用计算机软件或系统来持有和管理数据。其他公司只提供软件、系统或存储。他们不允许出于自己的原因使用您的数据。

当我们分享数据时，我们有相应的协议。这些协议符合法律要求，以确保您的数据得到保护。

我们如何保证您的数据安全？

大学对保护您的数据安全和保护您的隐私权非常重视。我们不要求您提供我们不需要的数据，并且只让需要知道的人访问。我们在规划研究项目时考虑到安全问题，以确保它们运作良好。我们的 IT 安全团队定期检查，以确保我们采取了正确的措施。更多细节请见我们的安全网页([our security webpages](#))。

我们如何在国际上安全传输您的数据？

如果您的数据在英国以外的地方存储或处理，我们会遵循法律要求，确保同样水平的隐私规则仍然适用。

⁷ 我们的章程和规程([Our charter and statutes](#))规定：4.f. 在大学认为合适的学习领域提供教学，并以大学决定的方式为研究以及知识的进步和传播提供条件。

⁸ 这指的是英国 GDPR 第 9(2)(j)条([UK GDPR Article 9 \(2\) \(j\)](#))：根据第 89(1)条，为公共利益的存档目的、科学或历史研究目的或基于欧盟或成员国法律的统计目的，处理是必要的，这应与所追求的目标相称，尊重数据保护权利的本质，并提供适当和具体的措施来保障数据主体的基本权利和利益。

我们会将您的数据保存多久？

大学对研究项目结束后研究数据的保存时间有规定([how long research data can be kept](#))。您的信息将根据大学的指导方针至少保存 10 年，在此之后将保存匿名版本。由于这将是完全匿名的，因此不可能从这些数据中以任何方式识别您。

您对您的数据有什么权利？

您对您的数据有权利([You have rights over your data](#))。本表解释了您可以如何停止参与研究，以及如果您这样做，您的数据会发生什么。这些信息在 "我必须参加吗？" 一节中。

如果您想获得一份您的数据的副本，或与我们讨论任何其他权利，请通过以下的细节与我们联系。

问题或疑虑

如果您对您的数据如何被处理有任何问题或担忧，请联系 Menglan Lyu (ml1570@york.ac.uk) 或 Hauke Egermann (hauke.egermann@york.ac.uk)。

如果您有进一步的问题，可以通过 dataprotection@york.ac.uk，或写信到以下地址：

Data Protection Officer, University of York, Heslington, York, YO10 5DD，联系大学的数据保护官。

投诉权

如果您对大学处理您的个人数据的方式不满意，请使用上述详细信息联系我们的数据保护官，以便我们可以尝试纠正问题。

如果您对我们的回应不满意，您有权向信息专员办公室投诉([complain to the Information Commissioner's Office](#))。您也可以通过邮寄到 **Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF** 或通过电话 **0303 123 1113** 联系信息专员办公室。

Study 2 & 3: Chinese Version of Consent Form

我已经阅读了有关本项目的信息表。

我同意参加这个项目。

我明白我有权在任何时候退出和/或将我的数据从本项目中销毁。

我明白我对本项目的参与将被匿名处理。

我已年满 18 周岁。

(我同意不以任何方式复制、截图、下载、保存或分享调查问卷的任何内容，以保护版权； shown in the copyrighted version)

☐ 我确认以上所有内容

Appendix 6.

Study 1: English Instructions and Questions for the Listening Experiment

Instructions

Please click on the following file and try out your sound system. We would ask you to use headphones and set the volume to a comfortable level and do not change the volume during the experiment.

(AUDIO FILE)

Which instrument is playing the main melody? Please fill in one word.

Formal listening experiment

Please click first on the play button and listen to this music excerpt only once. When it is finished, please answer the following questions.

(AUDIO FILE)

Are you familiar with the music excerpt presented?

- ☐ Not at all 1
- ☐ A little 2
- ☐ Medium 3
- ☐ Quite 4
- ☐ Extreme 5

On this scale, please rate the extent to which you think this music excerpt expresses the listed emotions. (1=Not at all, 2=A little, 3=Medium, 4=Quite, 5=Extreme) (Please Note: This is not asking how the music makes you feel but rather to what extent you recognise and perceive the following emotions in the music)

	1	2	3	4	5
Happiness	☐	☐	☐	☐	☐
Sadness	☐	☐	☐	☐	☐
Peacefulness	☐	☐	☐	☐	☐
Anger	☐	☐	☐	☐	☐
Fear	☐	☐	☐	☐	☐

Study 1: Chinese Instructions and Questions for the Listening Experiment

Instructions

请播放以下音频，然后测试您的声音系统。我们请您使用耳机然后调整到舒适的音量，在实验过程中请勿更改音量。

(AUDIO FILE)

演奏主旋律的乐器是什么乐器？请用一个词回答。

Formal listening experiment

请先单击“播放”按钮，然后仔细聆听一次该音乐片段。待音乐播放结束后，回答以下问题。

(AUDIO FILE)

您是否熟悉所播放的音乐片段？

- ☐ 完全不熟悉 1
- ☐ 有一点熟悉 2
- ☐ 中等熟悉 3
- ☐ 较多熟悉 4
- ☐ 非常熟悉 5

请在此量表中，对您认为该音乐片段所表达的下列各情绪类型的程度进行评分。（1=完全没有，2=有一点，3=中等，4=较多，5=非常多）（**请注意：**这里并非问该音乐使您感受如何，而是在问您对该音乐中所表达的情绪类型的判定程度）

	1	2	3	4	5
快乐	☐	☐	☐	☐	☐
悲伤	☐	☐	☐	☐	☐
平静	☐	☐	☐	☐	☐
愤怒	☐	☐	☐	☐	☐
恐惧	☐	☐	☐	☐	☐

Study 2 & 3: English Instructions and Questions for the Listening Experiment

Instructions

In order to successfully complete the online study, please read the following instructions:

- Make sure you are in a silent environment where no one can disturb you, as you will listen to music excerpts and answer questions.
- Try not to leave your seats during the entire questionnaire, though feel free to take a break between Part 1 and Part 2 if you choose to complete the whole questionnaire in one sitting.
- **There are no absolute right or wrong answers in this study.**
- **Sound Test:** Click on the following audio file and try out your sound system. Please use headphones if possible, set the volume to a comfortable level, and do not change the volume during the following listening experiment.

(AUDIO FILE)

Which instrument is playing the main melody in the above music excerpt? Please fill in one word.

Formal listening experiment

Please click first on the play button and listen to this music excerpt only once. When it is finished, please answer the following questions.

(AUDIO FILE)

Are you familiar with the music excerpt presented?

- ☐ Not at all Familiar 1
- ☐ Somewhat Familiar 2
- ☐ Moderately Familiar 3
- ☐ Quite Familiar 4
- ☐ Extremely Familiar 5

How much do you like the music excerpt presented?

- ☐ Dislike Strongly 1
- ☐ Dislike a Little 2
- ☐ Neither Like nor Dislike 3
- ☐ Like a Little 4
- ☐ Like Strongly 5

On this scale, please rate the extent to which you think this music excerpt expresses the listed emotions. (*Please Note: This is not asking how the music makes you feel but rather to what extent you recognise and perceive the following emotions in the music*)

	Not at all 1	Somewhat 2	Moderately 3	Mostly 4	Completely 5
Happiness	☐	☐	☐	☐	☐
Sadness	☐	☐	☐	☐	☐
Peacefulness	☐	☐	☐	☐	☐
Anger	☐	☐	☐	☐	☐
Fear	☐	☐	☐	☐	☐

Study 2 & 3: Chinese Instructions and Questions for the Listening Experiment

Instructions

为确保成功完成该网络测试研究，请阅读以下说明：

- 确保您在一个安静的环境中，没有人可以打扰您，因为接下来您需要听音乐片段并回答问题。
- 在整个问卷作答过程中尽量不要离开座位。但如果您选择了一次性完成整个问卷，您可以在第 1 部分和第 2 部分之间休息一下。
- 在这项研究中，没有绝对的正确或错误的答案。
- **声音测试：** 点击下面的音频文件，测试您的声音系统。如果可能的话，请使用耳机。请将音量调到一个令您舒适的水平，并且在接下来的听音测试中不要改变音量。

(AUDIO FILE)

请问在以上音乐片段中演奏主旋律的乐器是什么乐器？请用一个词作答。

Formal listening experiment

请先单击“播放”按钮，然后仔细聆听一次该音乐片段。待音乐播放结束后，回答以下问题。

(AUDIO FILE)

您是否熟悉所播放的音乐片段？

- ☐ 完全不熟悉 1
- ☐ 有点熟悉 2
- ☐ 中度熟悉 3
- ☐ 相当熟悉 4
- ☐ 极为熟悉 5

您对所播放的音乐片段的喜欢程度是？

- ☐ 非常不喜欢 1
- ☐ 有点不喜欢 2
- ☐ 既不喜欢也不讨厌 3
- ☐ 有点喜欢 4
- ☐ 非常喜欢 5

在此量表中，请选择您认为该音乐片段表达出下方所列出的各情绪类型的程度。（**请注意：**这里并非问该音乐使您感受如何，而是在问您对该音乐中所表达的情绪类型的判定程度）

	一点也不 1	有点 2	中等程度 3	大部分 4	完全都 5
快乐	☐	☐	☐	☐	☐
悲伤	☐	☐	☐	☐	☐
平静	☐	☐	☐	☐	☐
愤怒	☐	☐	☐	☐	☐
恐惧	☐	☐	☐	☐	☐