THE EFFECT OF MUSIC LISTENING ON EMOTIONAL RESPONSES TO COMPASSIONATE SCENES: THE ROLE OF STIMULUS TYPE AND TRAIT EMPATHY

Adriana Zamudio Gurrola

Master's Thesis

Music, Mind and Technology

Department of Music

16 September 2018

University of Jyväskylä

JYVÄSKYLÄN YLIOPISTO

Tiedekunta – Faculty Humanities	Laitos – Department Music, Art and Culture Studies
Tekijä – Author ADRIANA ZAMUDIO GURROLA	
Työn nimi – Title THE EFFECT OF MUSIC LISTENING ON EMOTIONAL RESPONSES TO COMPASSIONATE SCENES: THE ROLE OF STIMULUS TYPE AND TRAIT EMPATHY	
Oppiaine – Subject Music, Mind & Technology	Työn laji – Level Master's Thesis
Aika – Month and year September, 2018	Sivumäärä – Number of pages PAGES 52

Tiivistelmä – Abstract

The perception of emotion is not something we experience using isolated sensory modalities. Research has shown that auditory and visual domains influence each other in the processing of affective stimuli. Nevertheless previous studies have looked at the effects of these influences while dealing with only a few basic emotions, such as happiness, sadness, fear or anger. It is yet to be observed whether similar interactions can be observed for more complex emotions.

The present study tested whether listening to music could influence people's emotional response to a visual cue for a higher-level emotion such as compassion by evaluating the effects that different types of music had on compassionate scenes as opposed to non-compassionate ones. It also set out to explore the role that trait empathy and musical preference played in accounting for individual differences.

To achieve this, ratings on Valence, Arousal and Compassion for compassion-inducing (CI) and non-compassion-inducing (NCI) pictures during four different music and silence conditions were collected. As a measure for empathy the Empathic Concern subscale of the Interpersonal Reactivity Index was obtained as well as a liking score for each of the music pieces.

Results showed that High-Valence+Low-Arousal music significantly increased the compassionate response to both types of pictures, whereas Low-Valence+Low-Arousal and Low-Valence+High-Arousal music showed virtually no effect. High-Valence+High-Arousal music, although preferred by most participants, decreased the compassionate response to affective pictures and increased it for neutral stimuli. More empathic participants displayed stronger overall feelings of Compassion and also showed more variability in those ratings between the music conditions, particularly when rating NCI pictures.

Asiasanat – Keywords Music, emotion, compassion, empathy	
Säilytyspaikka – Depository	
Muita tietoja – Additional information	

Acknowledgments

I would like to thank the National Counsel for Science and Technology (CONACyT) in conjunction with the National Institute for the Beaux Arts Foundation (FINBA) for granting me a scholarship to study abroad. I would like to extend this thanks to the people of Mexico, all of whom directly or indirectly have contributed daily to this end.

I want to also express my sincere gratitude to my supervisor Suvi Saarikallio for her contribution to this work, all the good feedback, and for always meeting me with a smile. To Marc Thompson and Geoff Luck, for all the time and effort they put into the MMT program. To all the professors and staff at the MUTKU department for making out of the M building a friendly learning hub.

To all the wonderful people of the MMT and MT, thank you because I learned as much from each of you as I learned from the program itself.

Thanks as well to my friends back home who cheered me on from afar. Of course thanks to my parents, the two main responsible ones for making me who I am today. To Ale and Andrea, for their unconditional support, and to Oswaldo, for motivating me move on in the hard times and for being always there to share the good times with.

Last but not least, thanks to God, for placing me in the correct places at the correct times.

CONTENTS

1 INTRODUCTION

The world is full of phenomena that stimulate our senses and awaken different emotions. While walking outside on a cool morning, the smell of wet earth and the sight of tiny buds in the branches of trees, embellished by the distant song of unseen birds have the capacity of filling one with an indescribable feeling of happiness (specially after a long Finnish winter). We are generally used to perceiving the world in a multidimensional way, collecting and combining information from different sensory modalities and integrating it into one coherent experience. Nevertheless, the exact way in which the integration of information happens is not yet fully understood, particularly when it comes to how we experience emotions. Thankfully for us, many researchers from many different areas are addressing this phenomenon; the influence that different sensory modalities have over each other, and how they influence our emotions and cognitions. How, although sometimes unnoticed, multisensory information combines to make sure that we make sense of the world. Our emotions, our judgment and even our morals all have their basis on how we manage and organize all the incoming multisensory information. This study will focus on a tiny aspect of this intricate world; how music, as an incredibly rich auditory phenomenon, can influence the emotional content of complex visual scenes and our emotional reactions to them. In this intricate relationship of complex stimuli however, there is a third, even more complex actor: people. We all come in all shapes and sizes, and when it comes to emotions, there is no one set of rules that can fit all. Therefore, in an attempt to account for the individuality of each person, this study will also take into consideration a single personality trait: empathy, which based on literature, might actually play a role not only in the way in which we relate to others, but also to music.

2 LITERATURE REVIEW

2.1 Music and emotion

Emotion can be perceived and experienced through the different human senses. Particular attention has been placed on the importance of visual information for the processing of emotion, and most emotion-related studies use visual stimuli as a cue for eliciting different emotions in their participants (Gerdes, Wieser, & Alpers, 2014).

In the field of music psychology, and more recently cognitive neuroscience, quite a few studies have used music to elicit emotion in participants, and the popularity of music as an emotional stimulus in research is increasing, as its ability to evoke different emotions in people becomes better understood.

2.1.1 Cognitive models in the processing of musical emotions

In the field of emotion research, two main tendencies have dominated the area: the dimensional and the discrete models for representing emotions (Eerola, & Vuoskoski, 2011). An important expositor of the dimensional model is James Russell (1980), who proposes a circumplex model for representing emotions. He supports the idea of a two bipolar dimensional space (valence and arousal), where emotions are mapped in a circular way in this space. According to Juslin and Västfjäll (2008) Rusell's circumplex model is inappropriate for the study of musical emotions, since it has the limitation of not accounting for mixed emotions –i.e. feeling two opposing or contrasting emotions at the same time and as a result of the same stimulus. This is consistent with Eerola and Vuoskoski's (2011) position, in which dimensional models cannot account for all musical emotions.

Paul Ekman (1992), on the other hand, posits the discrete, basic emotions model. In this model there is a concrete number of basic emotions, from which all other emotions derive. These emotions have an evolutionary importance and a biological foundation. According to Ekman's theory, there should be an individual neural basis for each of the basic emotions, although he clearly stated that more research was still required to support this. The work by Eerola and Vuoskoski (2011) compares both the discrete and dimensional models only to find

that in the rating of perceived emotions in music, they highly correlate. Their findings support hybrid models for representing emotion, where core affect is mapped in a dimensional way, and the conscious interpretation of the emotion is presented with discrete emotion terminology.

There are many discrepancies in research results regarding emotions in general and music-induced emotions in particular. One of them is whether music is capable of inducing basic emotions, or if music induces a different type of emotion. Ekman's (1992) basic emotions model does not take into account emotions induced by music, and as has been pointed out by Eerola and Vuoskoski (2011), in music research, the model has been modified to fit the most commonly elicited emotions in music, because some emotions like disgust are hardly ever experienced in musical settings.

The idea of there being music-specific emotions is supported by some researchers, such as Zentner, Grandjean, and Scherer (2008), and is further supported by the music-specific emotion model (Geneva Emotion Music Scale or GEMS) proposed by Zentner et al. (2008). This model proposes nine emotions that may be elicited by music, namely wonder, transcendence, tenderness, nostalgia, peacefulness, power, joyful activation, tension and sadness. Eerola and Vuoskoski (2011) acknowledge that the GEMS model provides domain-specificity and reflects the nature of emotions elicited by music. Nevertheless, they question the reported results of a better performance of this model over the discrete and dimensional emotion models. Juslin and Västfjäll (2008) categorically reject the view of music-specific emotions as well as the idea that these are induced through different processes than everyday emotions. Instead, they propose that emotions elicited by music share the same underlying mechanisms with other stimuli and that music is capable of inducing real everyday emotions in listeners. They consider that the many discrepancies among researchers that lead to many times opposing views are mostly due to the fact that different underlying mechanisms behind musical emotions have been disregarded. Section 2.4 discusses further which are these mechanisms. It will cover mainly the mechanism of "emotional contagion", which is considered the most relevant to the present study.

2.2 Auditory and visual interaction

This section will review previous research that has explored the crossmodal interactions of the visual and auditory modalities in the processing of affective stimuli, with an obvious emphasis on those studies that have used music as an auditory stimulus while addressing this topic.

2.2.1 Audio-visual interaction on emotion processing

One of the most recurrent ways in which audiovisual interaction has been addressed is by using face-voice pairing stimuli. The various studies using this paradigm are consistent in showing that paired stimuli as opposed to unimodal facilitate the recognition of emotion, as well as produce more extreme affective ratings (De Gelder, & Vroomen, 2000). This face-voice pairing approach has also shown that even when participants have been instructed to ignore one of the modalities, stimuli from this modality still exerts influence over the perception of stimuli from the attended modality (De Gelder, & Vroomen, 2000; Föcker, Gondan, & Röder, 2011). Results from these studies suggest a mandatory integration of information form both domains, which occurs very early in the processing of information and without the need of conscious awareness. While using face-voice pairing stimuli has yielded important and consistent results, these are constrained to human communication and thus findings may not transfer to other occasions in which the integration of information from the auditory and visual domains may be just as relevant. Another important thing to take into consideration about the use of face-voice pairings as stimuli in emotion research is the effectiveness of such stimuli in eliciting emotions as opposed to only representing them. Based in these limitations, Gerdes and colleagues (Gerdes et al., 2014) have pointed out the necessity of using a broader variety of stimuli in studying auditory-visual interactions in emotion processing.

Consistent with this idea, there is a growing number of studies that use music as an affective auditory stimulus when addressing crossmodal interactions, and findings have been quite consistent as for now. Using happy and sad music as an affective prime (i.e. presented before as opposed to simultaneously) to either congruent or incongruent facial expressions, Logeswaran and Bhattacharya (2009) found that rating of facial expressions was shifted

toward the valence of the music presented prior to the visualization, thus demonstrating an influence of the music over the pictures, which had a more significant effect for neutral or ambiguous faces. Similar results were obtained by Van den Stock, Peretz, Grèzes, and De Gelder (2009) for ratings of emotions conveyed by whole-body language. In another study, also utilizing an affective priming paradigm, but in this case either consonant or dissonant chords, Sollberger and Reber (2003) recorded latencies for valence ratings of affective words presented in visual form. They found that congruent pairs (consonant chord-positive word or dissonant chord-negative word) were processed faster than incongruent ones (dissonant-positive, consonant-negative). In a study by Baumgartner, Lutz, Schmidt, and Jäncke (2006), the intensity of the emotional experience was measured both behaviorally and using fMRI for an affective picture-only condition and an affective picture-affective music condition. They found that the combined condition was rated as being more intense by the participants as well as an enhanced activation of the brain areas associated with processing of emotions, memory and audio-visual integration. Another interesting study looking at the interaction between audio-visual affective information used eye-tracking methods to explore the effects of background music on the selective attention to either positive or negative affective pictures (Arriaga, Esteves, & Feddes, 2014). This study found that music did not influence the initial attentive choice, but maintenance of attention on a particular visual stimulus was significantly influenced by the valence of the music in the background. In general, research looking at multisensory integration in emotion processing using music as an auditory cue provides evidence that music influences the perception of emotion from the visual domain, as well as enhances the affective experience without the need for explicit attention to the stimulus.

In a study by Vuoskoski, Thompson, Clarke and Spence (2014) that assessed the crossmodal effects of audio-visual information in the perception of expressivity within a musical performance, they found that these were stronger for pairs of stimuli that were less contrasting than for the more contrasting ones. This is to say that visual cues had a stronger influence on auditory ratings (and vice versa) when the paired stimuli could be perceived as likely occurring in real life, than when the two stimuli were exceedingly mismatching. They also found that visual kinematic cues had a slightly stronger effect than auditory cues in the overall perceived expressivity. However, a later study (Vuoskoski, Thompson, Spence, & Clarke, 2016) revealed that regarding the emotional reaction to a musical performance, both auditory

and visual kinematic cues had a similar weight in the overall ratings of emotional reaction from the participants.

2.2.2 Influence of music on cognitive appraisal of visual scenes

Other studies provide evidence for the influence of music over the cognitive appraisal of visual scenes (e.g. the semantic content of a scene, or the perception of the characteristics or intentions of the characters). Studies such as Marshall and Cohen's (1988), and Hoeckner, Wyatt, Decety, and Nusbaum's (2011) demonstrate that music influences the way people relate to or interpret the attitudes of characters in movies. For example, in Marshall and Cohen's (1988) study, different background music while watching an animated film modified the perception of the characters' levels of activity. This same study concluded that "associations generated by the music provide a context for the interpretation of the action in the film." A study conducted by Bolivar, Cohen and Fentress in 1994 used video clips of friendly-aggressive social interactions between wolves paired with music without lyrics previously selected to match both types of interactions. They found that the interpretation of the scene (i.e. whether it was friendly or aggressive) was predicted by the music that it was paired with. A similar result was found in a study by Ziv and Goshen (2006), where a non-emotional, simple story was read to kindergarten children aged five or six with either happy background music, sad background music or no background music. The children's interpretation of the story (i.e. whether it was happy or sad) was clearly influenced by the music condition in which they engaged.

2.3 Moral emotions

Emotions play a fundamental role in human life, and have clear evolutionary advantages, as for example the emotion of fear would elicit a flight response at the sight of danger, or experiencing disgust would prevent the ingestion of potentially harmful foods. Perhaps less obvious is the role that emotions play in shaping human morality. There is an ongoing controversy ever since the times of Plato, of whether human behavior is governed by reason or by emotion. Particularly in the field of human morality, the question has been raised as whether moral emotion precedes or obeys moral reasoning.

In the present day, there is reason to believe that emotion plays a significant role in the shaping of human morality, and social scientists and philosophers have claimed that moral emotions precede moral reasoning, and moral reasoning is engaged post-facto only to persuade others, while the actual moral judgment is formulated based almost entirely on emotion (Haidt, 2002).

According to Prinz (2010), there are two ways in which emotions help build human morality: First, by motivating moral behavior (feeling good after doing something good, or bad as a consequence of a bad action) and second, through the emotional basis of moral evaluation i.e. the perception of something as good or bad based on the elicited emotional response. Emotions that are involved in the shaping of human morality are then considered as moral emotions.

Moral emotions may be defined as "those emotions that are linked to the interests or welfare either of society as a whole or at least of persons other than the judge or agent" (Haidt, 2002). There are two identifying components of moral emotions, namely disinterested elicitors and pro-social behavior action tendencies. What this basically means, is that for an emotion to be considered a moral emotion, it must be elicited by a stimulus that does not affect the self directly (disinterested elicitor) and its corresponding action tendency must favor or promote behavior that will in someway contribute positively to society. Based on these two criteria, Haidt (2002) pinpoints ten moral emotions that he then groups into four families: Other-condemning emotions (anger, disgust and contempt), self-conscious emotions (shame, embarrassment and guilt), other-suffering emotions (compassion) and other-praising emotions (gratitude, awe and elevation). In Haidt's view, moral emotions precede moral judgment, playing a very important role in shaping human morality.

2.3.1 Compassion, empathy, sympathy and concern

Based on what was previously stated, the definition of compassion is that of a moral emotion, belonging to the "other-suffering" family, elicited by the perception of suffering in another, and whose action tendency is that of prompting helpful behavior directed toward the alleviation of the perceived suffering. That being said, it is then important to distinguish between the closely related or sometimes overlapping concepts of empathy, sympathy and concern. Although in this section I present definitions for each of these terms, it is important

to keep in mind that the boundaries between them are not always clear, and they have sometimes been used interchangeably.

Prinz (2010) defines empathy as experiencing an emotion that someone else is experiencing or thought to be experiencing, and Davis (1980) as "reactions of one individual to the observed experiences of another". As pointed out both by Haidt (2002) and Prinz (2010), empathy is not actually considered an emotion, but an ability to match that which another person is feeling. Such ability may lead to pro-social behavior, but not necessarily. For example, someone might feel an empathic response of fear when perceiving someone else's fear. This might cause the individual to flee to alleviate the feeling of fear, without necessarily helping the other in the fearful situation. On the other hand, a different person might choose to help the person in the fearful situation in response to the same empathic process. Empathy is thus believed to be a multidimensional complex concept, and as such may be measured utilizing a set of subscales, where both the cognitive capacity of the individual as well as the emotional reaction to affective stimuli contribute to the overall measure of empathy (Davis, 1980). The Interpersonal Reactivity Index, developed by Mark Davis in 1980, is constituted by four subscales. Each subscale is designed to measure a separate aspect of what he considers the "global" concept of empathy.

Sympathy closely relates to empathy in the sense that it is also vicarious in nature, but differs from it since emotions experienced empathetically may be positive or negative in valence, whereas sympathetically experienced emotions can only be negative. Another difference is that sympathetic emotions may not necessarily be the same ones as the perceived emotion e.g. one may feel sad that the other is angry (Prinz, 2010).

A third concept that relates closely to the concept of compassion is that of concern. It refers to another kind of fellow-feeling (i.e. feeling for other) that can be defined as a negative emotion elicited by perceiving the misfortune of another (Prinz, 2010). Concern in this sense may be considered a moral emotion since it has a disinterested elicitor and promotes pro-social behavior. The sort of unease or worry (concern) about a third party's well being is more likely to lead to action in favor of the misfortunate.

It is interesting to note that both the concepts of compassion and concern are assessed in the subscale of 'Empathic Concern', included in the Interpersonal Reactivity Index (Davis, 1980), which is designed to assess "a tendency for the respondent to experience feelings of warmth, compassion and concern for others undergoing negative experiences." (p. 6)

2.4 Previously-found effects of music on morality

Also, closely related to the concept of compassion and moving on to how music might influence it, previous research has looked at the effects that music has on helping behavior and moral judgment (e.g. Fried & Berkowitz, 1979; North, Tarrant & Hargreaves, 2004). Overall, it has found that mood modulates helping behavior. From receiving cookies, finding spare change on a public phone when using it, emotional narratives and bogus aptitude tests to listening to music, researchers have been very creative with the strategies they employ for mood-induction. Overall, a pleasant mood has been related to enhanced helping behavior, whereas a negative mood tends to inhibit helping behavior when the costs for helping are high, and enhance helping when the costs are low (Weyant, 1978). Research on this area has not been focused on the effects of music as of itself, but rather at the effects of music as an effective mood-inducer, and through inducing a given mood, its effectiveness in modulating helping behavior and moral judgment (e.g. Siedel & Prinz, 2012). The mentioned studies have used mainly pleasant and unpleasant music as a way to induce positive or negative mood.

2.5 Trait empathy in the processing of music-induced emotions

Music has the capacity of inducing emotions in listeners. In fact, one of the main reasons why people engage in music listening is to take advantage of this property of music (Lonsdale & North, 2011). Music listening is widely used to induce a certain affect or to modify an already existing one. To understand the way by which music can achieve this, Juslin and Västfjäll (2008) proposed the existence of several underlying mechanisms, namely brain stem reflexes, evaluative conditioning, emotional contagion, visual imagery, episodic memory, and musical expectancy. For the purpose of this study, emotional contagion is particularly relevant. In their words about emotional contagion, the authors state the following:

> This refers to a process whereby an emotion is induced by a piece of music because the listener perceives the emotional expression of the music, and then "mimics" this expression internally, which by means of either peripheral feedback from muscles, or a more direct activation of the relevant emotional representations in the brain, leads to an induction of the same emotion. (p.565)

In this sense, the emotional contagion mechanism is some sort of music-specific empathic response. In fact, it has been shown that listeners scoring higher in trait empathy (measured with the IRI) are more likely to experience sadness in response to unfamiliar sad music (Vuoskoski, & Eerola, 2012). In a different study, stronger experiences of moving sadness were recorded in response to sad music for listeners scoring higher in trait empathy (measured with the IRI) and emotional contagion, which was measured using the Emotional Contagion Scale (ECS) (Eerola, Vuoskoski, & Kautiainen, 2016).

A particularly interesting study found that listening to music from a specific culture implicitly facilitates feelings of affiliation toward members of that same culture (Vuoskoski, Clarke, & DeNora, 2016). Furthermore, they found that participants scoring higher in trait empathy were more susceptible to these implicit effects of music listening.

2.6 Concluding remarks to literature review

To summarize, research from the fields of psychology, cognitive sciences and neuroscience suggests that information from the visual and auditory domains integrates effectively to produce a unified cognitive and emotional response, regardless of whether more or less attention is paid to one or the other domain. Although results in this area have been quite consistent, to the best of my knowledge no study has yet explored the effects of music over the processing of visual stimuli representing or evoking any other than the basic emotions of happiness, sadness, fear or anger. Needless to say, no study was found that looked at the effect of music listening on the processing of visual stimuli representing or eliciting compassion (or any other moral emotion).

Studies looking at music and motion picture support this by showing that music can also influence our cognitive appraisal of a given scene. Studies such as Bolivar et al. (1994) have explored how different music influences the perceived semantic content of a scene. Research by Marshal and Cohen (1988) and Hoeckner et al. (2011) show that music can also modulate the perceived intentions and personality of a character.

Finally, evidence from music and emotion research suggest that emotional contagion is an important underlying mechanism through which music evokes emotions in listeners (Juslin and Västfjäll, 2008). Research following that vein provides evidence that in fact emotional contagion and trait empathy play a relevant role in modeling listeners' emotional responses to music (Eerola et al., 2016).

2.7 Aims of the current study

The purpose of this study is manifold. First, as a main objective, the present study sets out to explore whether listening to music has an effect on the emotional response to compassionate scenes. Second, it seeks to evaluate the different effects that different types of music might have on the reported response. Third, it investigates whether the effect of music is similar in the context of highly affectionate pictures and neutral pictures. Finally, it explores the role that trait empathy, and musical preference play in conveying affective information from music across sensory modalities.

In short, this study tested whether music influences the emotional response to compassion-inducing (CI) and non-compassion-inducing (NCI) scenes, the effect of different music on this response and the role of trait empathy, and musical preference in this setting.

Based on previous findings, we expected that the different music conditions would have an influence on the emotional response to the visual stimuli. However, this study is exploratory in nature for this particular aspect, since due to the limited amount of prior research linking music to feelings of compassion, we did not have a directional hypothesis as to how feelings of compassion would vary in response to each of the different types of music.

Moreover, since previous research has shown that passive music listening is able to evoke feelings of affiliation, and more empathic people have been seen to be more prone to these effects (Vuoskoski, Clarke, & DeNora, 2016), as well as to experience stronger emotional reactions to music (Vuoskoski & Eerola, 2012; Eerola, Vuoskoski, & Kautiainen, 2016), then it was reasonable to expect that trait empathy would be related to the extent to which listeners were influenced by the affective content of the music.

Finally, regarding music preference, we expected that the preference ratings for music would correlate positively to ratings of Valence during that same listening condition. In other words, we expected that ratings of Valence would be higher during the preferred music condition. However, we did not have a particular expectation as to how ratings of Compassion and Arousal could be affected by musical preference.

3 METHOD

An experimental design was developed to answer the aforementioned research questions, and a validation study was conducted previously to select the visual stimuli that would be used in the main experiment. Both of these studies are explained in detail in the following subsections.

3.1 Validation study for choosing the visual stimuli

To choose the visual stimuli, we selected 42 pictures from the International Affective Picture System (IAPS) based on their IAPS ratings and on our subjective appreciation of whether they effectively induced compassion or not. More details on this are provided in section 3.1.2. The validation study presented in this section was performed to test the effectiveness of the chosen pictures in inducing compassion in viewers. In this study, participants rated the amount of felt compassion independently for each of the 42 pictures. Based on the results of this study, 30 pictures were chosen, half of which effectively elicited compassion (mean compassion rating > 7.48) while the other half did not (mean compassion rating < 5.94).

3.1.1 Participants

Participants were 33 (19 female, 14 male) people aged 18 to 64 (M= 31). They were contacted through personal communication and were not offered any compensation for their participation.

3.1.2 Stimuli

The first approach for choosing the visual stimuli was to base the selection on a study by Mercadillo, Barrios and Díaz (2007) in which they validated 28 pictures from the IAPS picture bank for effectively eliciting compassion. However, the previously mentioned set of pictures showed very intense suffering situations, which produced highly unpleasant feelings. Since the design of this study requires participants to look at the pictures five times (one for

each music condition), the use of these perturbing images for this study was not deemed appropriate.

The next approach was to choose new pictures, and to subsequently run a validation study to select those pictures that would effectively elicit compassion. The 40 pictures used in the validation study were selected from the IAPS picture bank based on their valence, arousal and dominance ratings and on the subjective appreciation of the experimenter. Compassion-inducing pictures (n = 21) had lower valence ratings (M= 2.72), higher arousal, (M= 5.13) and lower dominance (M= 3.96) compared to non-compassion-inducing pictures (n =19, $M_{Valence}$ = 6.12, $M_{Arousal}$ = 3.52, $M_{Dominance}$ = 5.94).

A list of the pictures used and their ratings in the IAPS bank can be found on Appendix A.

3.1.3 Design

A standalone Max application was developed on Max 7 version 7.3.2 and was distributed through the Internet.

When participants opened the application, they were first presented with a welcome screen where they would insert their participant ID. Then, a *Done* button would take them to the main experiment window where they were asked to read the instructions and when ready, to click on the *Start* button to begin the trials (Figure 1).

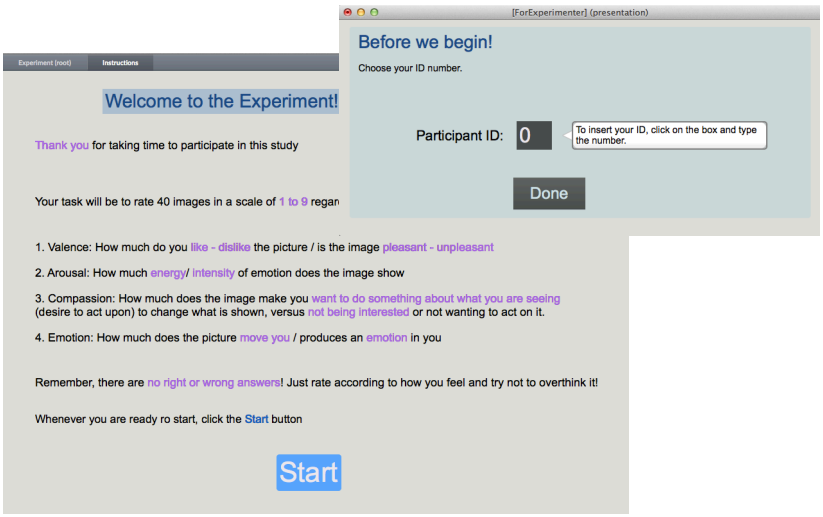

FIGURE 1. Screenshot of the welcome screen and instructions screen on the Validation study interface.

Pictures were shown one by one, and participants were required to rate each picture on Valence, Arousal and Compassion before moving to the next one. As shown in Figure 2, Valence was measured from *highly unpleasant* to *highly pleasant*, and Compassion was measured from *no compassion at all* to *very compassionate*. The Arousal measurement was divided in two separate scales: energy (low-high) and emotional impact (low-high). This gave a total of four nine-point Likert scales for rating each picture.

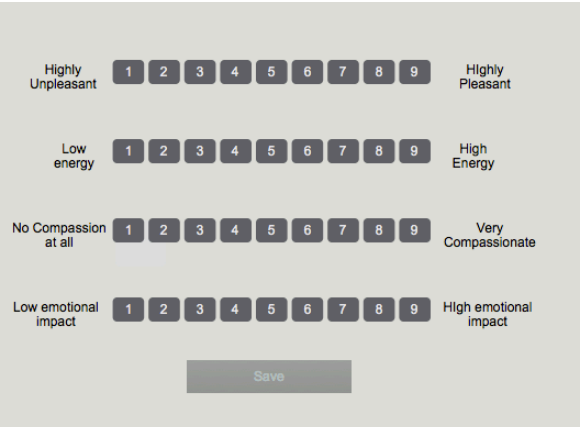

FIGURE 2. Screenshot of the rating scales used in the validation study.

3.1.4 Analysis

All 40 pictures were ordered according to their mean Compassion rating. The lowest-scoring CI pictures and the highest-scoring NCI pictures were removed from the sample.

A paired samples t-test was then carried out on the selected 30 pictures to compare the mean ratings of Compassion for the two types of picture stimuli (compassion-inducing or non-compassion-inducing). The dependent variable (DV) was Compassion rating, and the independent variable (IV) was Picture Type.

Results

The results of the paired samples t-test indicated that there was a significant difference in Compassion ratings between CI (M= 7.46, SD =1.09) and NCI (M= 3.82, SD = 1.83) pictures; $t(32) = 13.92$, $p < .001$.

3.2 Main study

3.2.1 Participants

The main study was administered to 41 participants (32 female). They were recruited through postings on social media, email, paper advertisings, and word of mouth. Participants were between the ages of 18 to 45 (M= 28.4). Most participants were students at the University of Jyväskylä. All of them reported having no hearing impairment at the time of the study. Participants were provided with cookies, tea, and participation in the raffle of a 50€ gift card as a compensation for their time.

3.2.2 Stimuli

Visual stimuli

The visual stimuli were 15 CI and 15 NCI pictures taken from the IAPS picture bank and tested for their effectiveness in eliciting compassion in viewers in a previously-conducted validation study (see section 3.1). For a listing of the 30 pictures used in this study, along with their IAPS ratings of Valence, Dominance, and Arousal, see Appendix A.

Music stimuli

The auditory stimuli used for this study was selected from a set of music stimuli developed by Eerola and Vuoskoski (2011). The music used in the mentioned study consists of short (~17s) unfamiliar excerpts of film music that have been validated to be representative of different target emotions. All excerpts were rated in terms of both the discrete and dimensional models of emotion. The set contains both extreme and moderate examples for each category of emotion and for each extreme of the dimensional dipole scales.

Since the interest of this study was to test the effects of different types of music on emotion processing, and because there was no previous directional hypothesis as to what type of music would exert what effect, there was not a predefined criterion for selecting the music stimuli except that each piece could be clearly differentiated from each other. An option to do this was to choose those excerpts that were highly representative of each combination of the

Valence and Arousal dipole scales (high valence-high arousal, high valence-low arousal, low valence-high arousal and low valence-low arousal). The rationale behind this decision was that the selected pieces would differ substantially from each other in their emotional content, while belonging to the same genre (film music) and being equally unfamiliar to participants.

As previously noted, the set developed by Eerola and Vuoskoski (2011) consists of short excerpts of about 15-20s each. Due to the way the present experiment was designed (see section 3.2.3), it was required that the pieces of music lasted longer than that. For this reason, another guideline for choosing the final stimuli was that the complete music track was homogeneous enough so as to assume the same emotional content for the whole piece as for the rated short excerpt.

Four stimuli were finally chosen that were adequate to fit these guidelines (i.e. being highly representative of each combination of the valence and arousal dipole scales, and that the whole track varied as little as possible from the rated excerpt). The final stimuli were the following: from the film "Pride and Prejudice", track number four was representative of high valence-high arousal (HV+HA). From the film "Dances with Wolves" track number four was representative of high valence-low arousal (HV+LA). From the film "Hellraiser" track number five was representative of low valence-high arousal (LV+HA), and finally, from the film "The English Patient" track eighteen was representative of low valence-low arousal (LV+LA) (see Eerola &Vuoskoski, 2011 for more information about the ratings).

Due to the experimental design, the tracks were modified to fade in at the beginning and to fade out at the end so that the piece could loop continuously without creating a disruption and to avoid startling the participants at every loop. This was done using Audacity 2.0.4 software. The final stimuli lasted between 1-3 min. Because the audio would be looping uninterruptedly and the pieces were chosen to be homogeneous across the whole track, it was not considered important to match them in duration and they were used as such. The use of the whole track with smooth looping gave it a sense of continuity throughout the rating session.

3.2.3 Measures

This section will describe the outcome variables or measures of the present study. There were several measures being collected. The first three, namely the ratings of Valence, Arousal and

Compassion, were later treated as Dependent Variables (DVs) in the main statistical analysis. Each of these variables was measured for every picture as the rating on independent dipole nine-point Likert scales.

The next two measures were Empathy, measured as the score obtained on the Empathic Concern subscale of the IRI, and Music Preference, measured for each of the four music pieces in a nine-point Likert scale.

Ratings of Valence

To provide a rating of Valence for each picture, participants were prompted with a legend that read: *This picture makes me feel…* followed by a nine-point Likert scale labeled on each end as *Unpleasant* (1) and *Pleasant* (9). A previous version of the interface used the scale labeled as *Absolutely Like* (1), and *Absolutely Dislike* (9). However, this preliminary version was not useful for the purpose of rating emotional pictures, as participants reported to be confused and unsure about whether to rate the content of the picture or the aesthetic value of it. For this reason, and to avoid inconsistency on how the pictures were rated in relation to Valence, the Pleasant-Unpleasant version was used (see Figure 3). After its implementation, participants no longer reported confusion or uncertainty about their ratings.

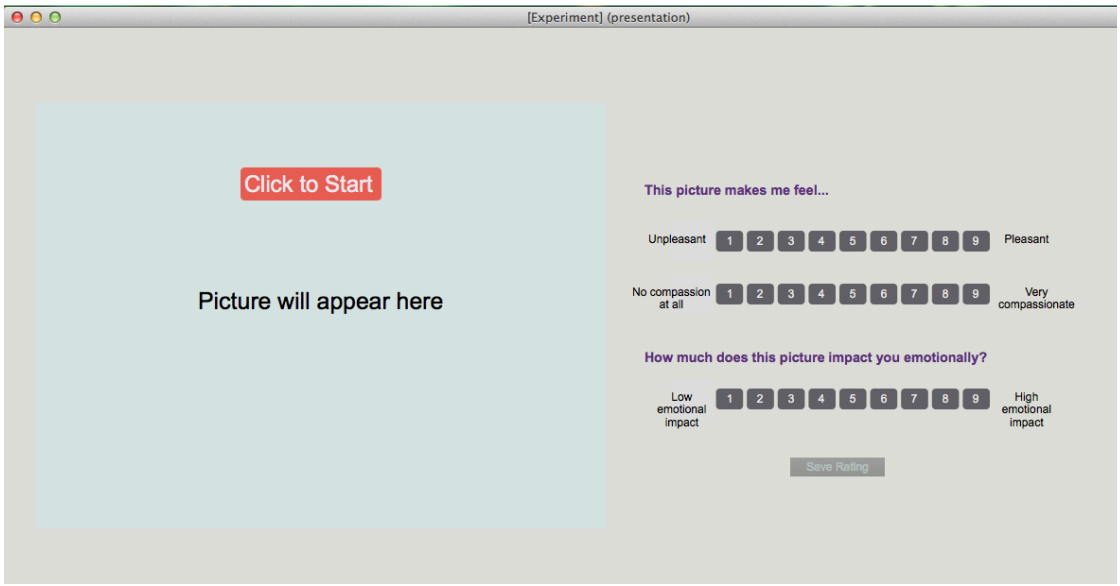

FIGURE 3. Screenshot of the main experiment window. At the right-hand side, the three scales used to collect the measures of Valence, Arousal, and Compassion.

Ratings of Arousal

Arousal was measured for every picture using a nine-point Likert scale, (see Figure 3) where the low end was labeled as *Low emotional impact* (1) and the high end was labeled as *High emotional impact* (9). The scale was preceded by a legend that read: *How much does this image impact you emotionally?*

Ratings of Compassion

As shown in Figure 3, the nine-point Likert scale used to measure Compassion for each picture was preceded by the same legend that preceded the Valence scale (*This picture makes me feel…)*. The low end of the scale was labeled as *No compassion at all* (1), and the high end was labeled as *Very compassionate* (9).

Empathy: The Interpersonal Reactivity Index (IRI)

The IRI was used to measure trait empathy in participants. This measure was developed by Mark Davis in the eighties (Davis, 1980). It is divided in four different subscales, namely Perspective Taking, Fantasy, Empathic Concern, and Personal Distress. Although we aimed at looking only at the Empathic Concern subscale of the IRI due to its relationship with Compassion (see section 2.3.1), participants were required to fill in the whole questionnaire as it is not very long, and it could potentially hold interesting data for future research. The whole IRI consists of 28 statements such as: *"Other people's misfortunes do not usually disturb me a great deal."* Participants are required to respond to each item in a five-point Likert scale ranging from *"Does not describe me well"* to *"Describes me very well"*. Each of the subscales is made up of seven different items.

Music Preference

To measure music preference participants were asked to rate on a nine-point Likert scale how much they liked each of the four music pieces they heard during the study (Figure 4). The scale was labeled on one end as *Absolutely Dislike* (1) and on the other as *Absolutely Like* (9).

FIGURE 4. Screenshot of the scale used to collect the ratings for Music Preference.

3.2.4 Design

This study followed a repeated-measures mixed design. The two independent, within-subjects variables were: 1) Listening condition, with five levels (HV+HA music, HV+LA music, LV+HA music, LV+LA music, and Silence), and 2) Picture Type with two levels: compassion-inducing (CI) and non-compassion-inducing (NCI) pictures. There was one between-subjects factor: Empathy, measured as the Empathic Concern subscale score. There were also three dependent variables (DVs), which were the ratings of Valence, Arousal and Compassion.

To test our hypothesis concerning music preference, a separate analysis was used, which will be discussed in the analyses section. Also, with the purpose of facilitating our interpretations of the results, we collected participants' open-ended responses to questions regarding how they felt the music had affected their feelings and perception of the pictures.

Materials

The experiment interface was programed and administered using Max 7 version 7.3.2 software. The pictures were presented through the developed interface on a MacBook Pro laptop computer, and the music was played through Sony MDR-XB450 headphones. Participants were asked not to change the volume of the music throughout the experiment, and a volume test was carried out before each session to place the volume at a confortable level for each participant.

Procedure

For this study, participants (n =41) were asked to look at CI (n =15) and NCI (n =15) pictures in five different music/silence conditions, and to rate how each one made them feel for Valence (pleasant-unpleasant), Arousal (emotional impact), and Compassion. They were then asked to rate how much they liked-disliked each of the music excerpts they had just heard. Afterwards, they would answer a couple of open-ended questions regarding how they thought the music had affected their feelings and perception, and finally, they were asked to complete the IRI questionnaire as a measurement for trait empathy.

Every participant was administered the test individually and each session lasted approximately one hour. Participants gave their written consent to participate in the test. There, they were also informed that they could quit the experiment at any moment, as well as take a break whenever they felt the need. Cookies and tea were provided before the last section of the experiment, and participants were explicitly told that they could take a break if they so wished to, at this point. Each session consisted of three main parts plus a short practice section.

Before the beginning of the experiment, participants went through two practice-trials (i.e. rating of two pictures) together with the experimenter to familiarize them with the interface, as well as to clarify any questions regarding the rating scales. After this, they were left alone to complete the first two sections. After these two sections, a *Thank you* pop-up popped up and the experimenter came in (with cookies) to move participants on to the last section.

The first section was divided into five blocks or conditions, one for every piece of music (n = 4) and one silent block or condition as a control. In each condition, participants had to rate all 30 pictures while listening to the same music, or in silence for the control condition. In total, participants rated each picture five times (one time for each music/silence condition). Within each block, the same music track was programed to loop continuously until all 30 pictures had been rated. Once all pictures were rated, the program would move automatically to the next music (or silence). The order in which the pictures appeared was randomized within conditions, and the order of the conditions was randomized for each participant to account for possible order effects.

The second section was the shortest, where participants listened one last time to each of the four music pieces they had heard during the previous section. They were then asked to rate how much they liked each piece on a nine-point Likert scale. The ends of the scale were labeled with *Absolutely dislike* (1) and *Absolutely like* (9).

For the third and last section of the experiment, participants were first asked to rate from one to nine how much they felt the music impacted their perception of the pictures. Then there was the open question: *If at all, how did you feel the music affected your feelings of compassion?* To finalize the session, they were asked to fill in the IRI questionnaire as a measure of trait empathy.

3.2.5 Analyses

Main analysis

To test whether the ratings of Valence, Arousal, and Compassion differed in all five listening conditions and for each type of picture, a three-way mixed multivariate analysis of variance (MANOVA) was used. There were three dependent variables (DVs) being measured, namely the ratings of Valence, Arousal and Compassion. The two within-subjects factors (i.e. the independent variables for the repeated measure) were Listening Condition with five levels (HV+HA music, HV+LA music, LV+HA music, LV+LA music, and Silence) and Picture Type with two levels: compassion-inducing (CI) and non-compassion-inducing (NCI). Empathy, measured as the score obtained for the Empathic Concern subscale of the IRI, was grouped into five discrete categories and entered as a between-subjects factor (i.e. the independent variable that is different across participants). The 20^{th}, 40^{th}, 60^{th} and 80^{th} percentiles were calculated for the original variable and the cases were grouped taking those values as cut-off points for each group. The five groups were labeled as Low, Mid-low, Medium, Mid-high, and High, representing five different levels of Empathic Concern.

Variation Scores

To account for how participants' ratings of Compassion were influenced by the music, a variation vector was calculated for each participant based on the difference between the rating on each listening condition and the control condition. This was done by considering the

ratings of each picture for every participant, taking the value for each of the four music conditions and subtracting it from the given rating on the silence condition (taken to serve as a baseline). The absolute values of the four difference values were then added into a variation score for that picture. Then, a total variation score was calculated by taking the mean variation across all pictures as well as separately for each type of picture stimuli. This yielded a total of three variation scores per participant: for CI pictures, NCI pictures, and total variation.

These scores were thought to reflect how much the music influenced participants' ratings. A low variation score would reflect a participant who rated the same picture consistently during the music conditions and with no difference from the silence condition (hence, being less influenced by music). On the other hand, a high variation score would reflect a participant whose ratings for the same picture largely varied during the music conditions in contrast to the silence condition (presumably being more influenced by the music). Since it was expected that variation and empathy scores would exhibit a positive relationship (i.e. as empathy score increased, so would the influence of music on Compassion ratings), one-tailed bivariate Pearson's correlations were performed.

Assessing music preference

Music preference was assessed using bivariate correlations. It was expected that music preference would have some influence on a person's ratings. Valence ratings were expected to correlate positively to participants' preference of music, i.e. if a person enjoyed the music they were listening to, it would probably yield higher ratings of Valence towards the picture, whereas if a person disliked the music, this might lead them to show higher dislike for the pictures as well. However, there was no particular expectation as to how ratings of Compassion and Arousal could be affected by musical preference. For this reason, two-tailed (as opposed to one-tailed) bivariate Pearson correlations were performed across music conditions.

4 RESULTS

This section will report the results of the analyses that were previously mentioned. First, it will describe the ones regarding the main effects and interactions of the music (Listening Condition) and Picture Type. Second, it will describe the main effects and interactions regarding the role of Empathy, as well as its relationship to the variation scores. Finally, the results regarding the role of Music Preference will be addressed, followed by our findings regarding the open-ended responses. For the quantitative results, all effects are reported as significant at $p < .05$.

4.1 Results for the effects of Music and Picture Type

4.1.1 Main effects of Listening condition

There was a significant main effect of the listening condition on the ratings of all pictures (i.e. without differentiating between Picture Type) and across measures, $F (12, 25) = 3.48$. Simple contrasts were used to compare the four different music conditions to the Silence or control condition for each DV.

Valence: During the HV+HA music condition overall ratings were higher $F (1, 36) = 15.7$, $\eta^2 = .3$, and the same was true during the HV+LA music condition $F (1, 36) = 7.56$, $\eta^2 = .17$. The LV+HA music condition yielded overall lower ratings $F (1, 36) = 15.07$, $\eta^2 = .3$, and there was no significant difference for the ratings during LV+LA music condition $F (1, 36) < 1$; All these in relation to the Silence condition.

Arousal: Ratings in the HV+HA music condition exhibited no significant difference from the Silence condition $F (1, 36) < 1$. During HV+LA music condition however, ratings were significantly higher than during Silence condition $F (1, 36) = 23.06$, $\eta^2 = .39$, and so were those during LV+HA and LV+LA music conditions, $F (1, 36) = 8.89$, $\eta^2 = .2$ and $F (1, 36) = 7.37$, $\eta^2 = .17$, respectively.

Compassion: For this measure, ratings during the HV+LA music condition were significantly higher than during the Silence condition F (1, 36) = 10.61, η^2 = .23. No other music condition differed significantly from the Silence condition for this measure. For a graphic representation of these contrasts see Figure 5.

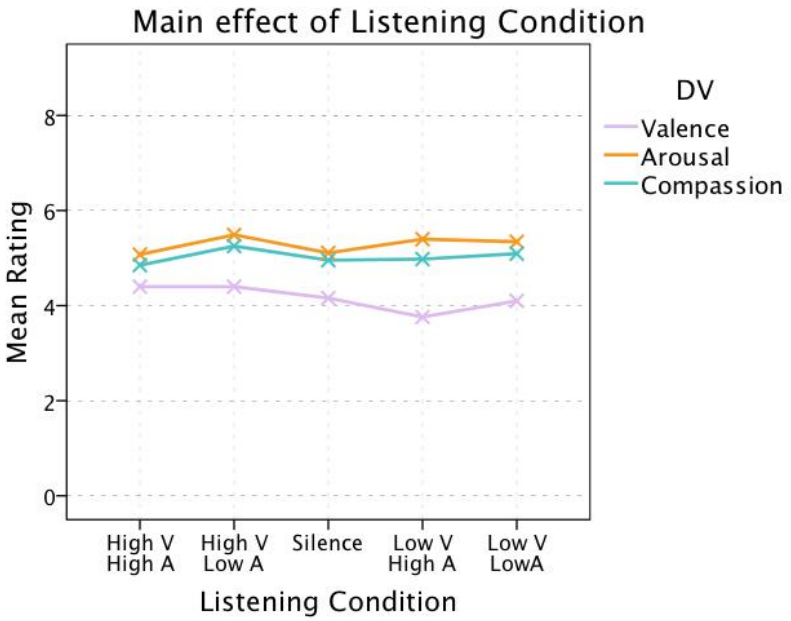

FIGURE 5. Figure illustrating the main effect of Listening Condition on each DV. Ratings of Valence during both High-Valence music conditions were significantly higher than baseline, whereas during the LV+HA music condition ratings were significantly lower and there was no significant difference for LV+LA music condition. For Arousal measure, ratings were significantly higher than baseline for all music conditions, with the exception of HV+HA, which showed no significant difference. Compassion ratings were significantly higher than baseline during the HV+LA music condition, and no other music condition showed further significant differences.

4.1.2 Main effects of Picture Type

There was also a significant main effect of the type of picture on the ratings, F (3, 34) = 90.83, η^2 = .89. Since there were only two levels for this variable, this shows that ratings for CI pictures differed significantly from NCI pictures regardless of the music condition and the l.evel of empathy of the rater (Figure 6). By looking at the mean estimates, we can see that for ratings of Arousal and Compassion, CI pictures were rated overall higher (M_{Aro}= 6.31, M_{Com}=6.52) than NCI (M_{Aro}= 4.26, M_{Com}= 3.53). The opposite is true for ratings of Valence, where CI pictures received an overall lower rating (M_{Val}= 2.66) than NCI pictures (M_{Val}=5.67).

4.1.3 Listening condition – Picture Type interactions

There was a significant interaction effect between the listening condition and the type of picture that was being rated F (12, 25) = 3.57, η^2 = .63. This indicates that the relationship between ratings for CI and NCI pictures was different across listening conditions. To break down this interaction, contrasts were performed comparing each music condition to the silence condition across CI and NCI pictures.

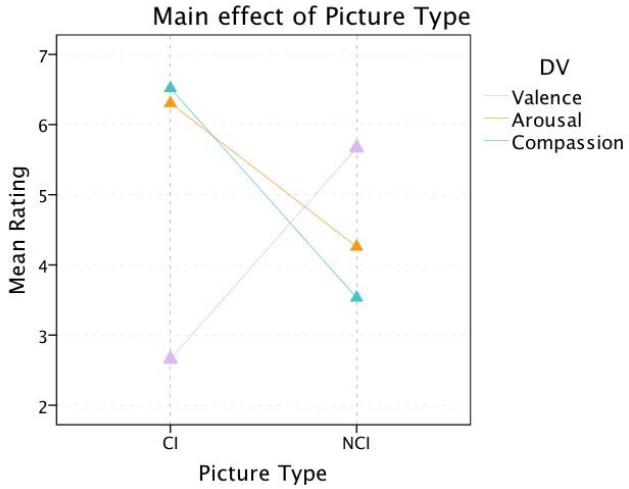

FIGURE 6. Figure illustrating the main effect of Picture type. The three different lines represent the three DVs. For measures of Arousal and Compassion, ratings are significantly higher for CI than for NCI pictures. The opposite is true for measure of Valence, where CI pictures present significantly lower ratings than NCI pictures.

Valence: Simple contrasts revealed that ratings during the LV+HA music condition were significantly lower than during the Silence condition for NCI but not so for CI pictures F (1, 36) = 9.13, η^2 = .2. No other contrasts for this level of interaction were significant for measures of Valence (Figure 7).

Arousal: During the HV+HA music condition, CI pictures were rated significantly lower than during the Silence condition, whereas NCI pictures were rated higher F (1, 36) = 16.91, η^2 = .32. There were no other significant contrasts at this level of interaction (Figure 8).

Compassion: For this measure, a similar pattern was found. During the HV+HA music condition, while CI pictures were rated lower, NCI were rated higher than during Silence condition F (1, 36) = 20.79, η^2 = .37. There were no other significant contrasts for ratings of Compassion at this level of interaction (Figure 9).

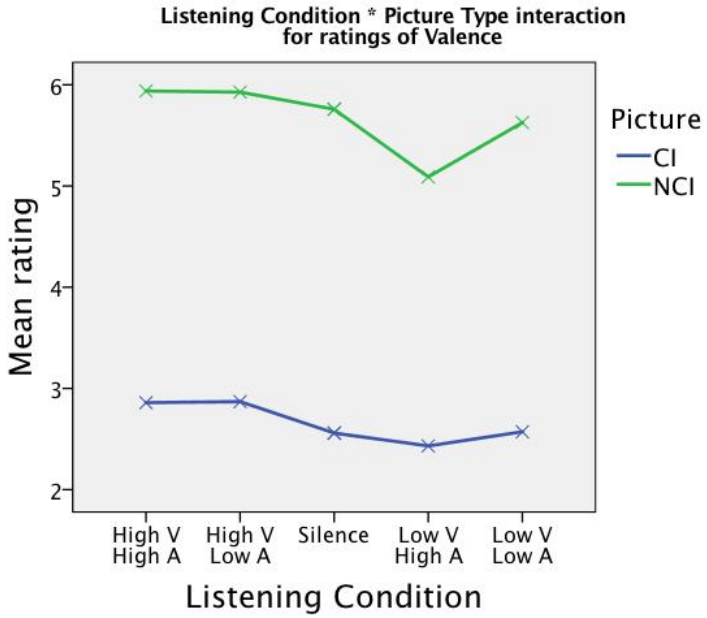

FIGURE 7. Interaction Listening Condition × Picture Type for Valence ratings. During LV+HA music condition, Valence ratings for NCI pictures decreased significantly in contrast with the silence condition, whereas for CI pictures the decrease was not significant. For all other music conditions, increases or decreases in Valence ratings (in contrast with silence condition) were consistent for both types of pictures.

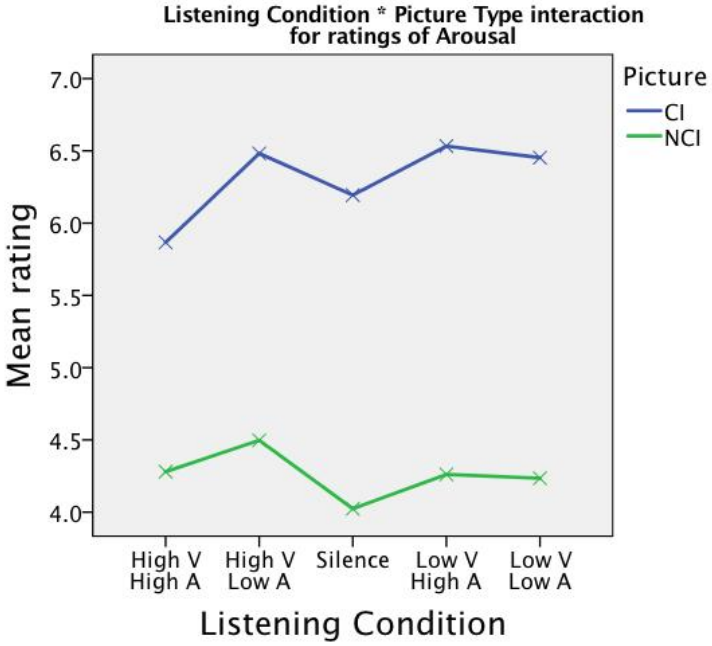

FIGURE 8. Interaction Listening Condition × Picture Type for Arousal ratings. During HV+HA music condition, CI pictures were rated lower than baseline, whereas NCI were rated higher.

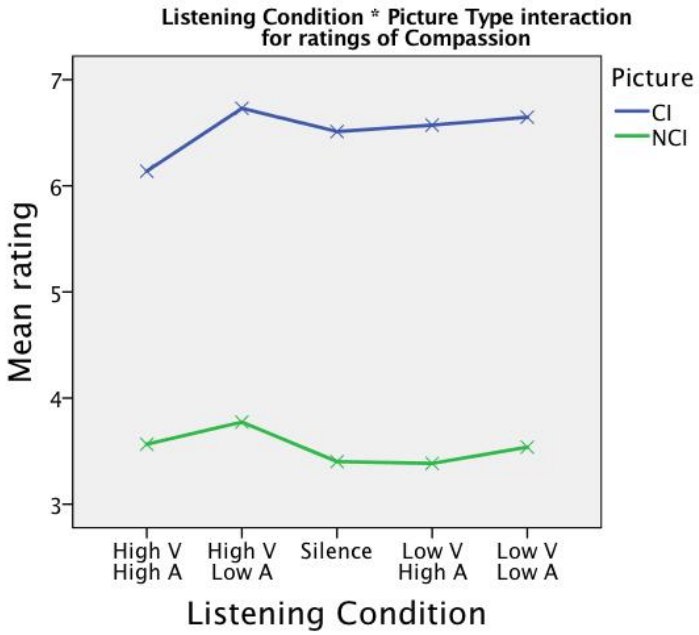

FIGURE 9. Interaction Listening Condition × Picture Type for Compassion ratings. During the HV+HA music condition, ratings for CI pictures were significantly lower than baseline, while ratings for NCI pictures were higher.

4.2 Results regarding the role of Empathy

4.2.1 Main effects and interactions of Empathic Concern

The main effect of Empathic Concern on Valence ratings was non-significant $F(4, 36) < 1$, indicating that participants' empathy level did not affect the way they rated either type of picture for this measure. However, the main effect of Empathic Concern on Arousal and Compassion ratings was significant $F(4, 36) = 6.59$, $\eta^2 = .42$, and $F(4, 36) = 8.11$, $\eta^2 = .47$, respectively. This indicates that participants' Compassion and Arousal ratings were affected by their level of Empathic Concern irrespective of the type of picture. Figure 10 illustrates the relationship between level of empathy and ratings, for all three DVs.

The interaction between Listening condition and Empathic Concern was non-significant, indicating that the ratings of all three DVs across listening conditions were not different for the different levels of empathy $F(48, 112) < 1$.

There was no significant interaction between Picture Type and Empathic Concern, which shows that the difference in ratings for CI and NCI pictures did not vary in relationship to the level of empathy F (12, 108) > 1.

The three way interaction Listening Condition × Picture × Empathic Concern was not significant F (48, 112) < 1, indicating that the significant two-way interactions previously discussed were not affected by levels of empathy.

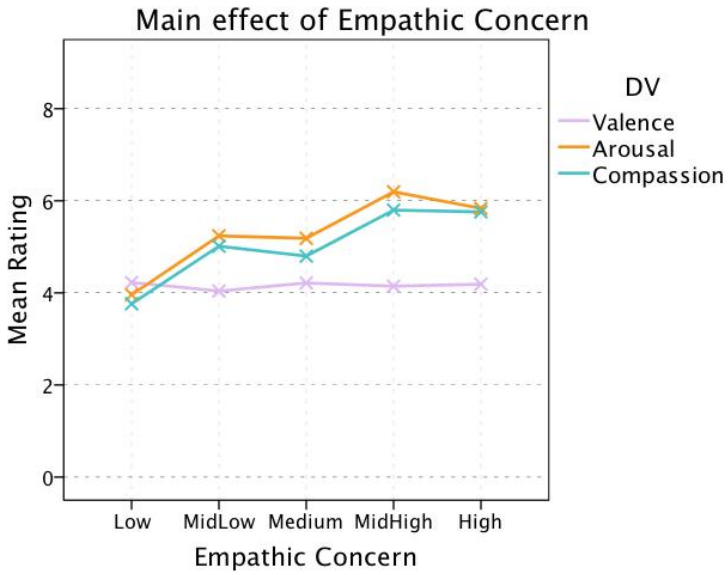

FIGURE 10. Main effect of Empathic concern on each DV. The three different lines represent the three DVs. Overall ratings of Arousal and Compassion tend to increase as empathy score increases. Overall ratings of Valence do not show this interaction.

4.2.2 Relationship between Empathic Concern and Variation scores

The relationship between Empathic Concern and the three Variation scores was examined using Pearson correlations (to see how these were calculated see section 3.2.4). For this analysis, the original measure for Empathic Concern, which was measured at the interval level, was used. The results, which can be observed in Table 1, indicate that Empathic Concern was positively correlated with the Variation score for NCI pictures, r = .33, *p* (one-tailed) < .05 (Figure 11). It was however, not significantly correlated to the Variation score for CI pictures; Empathic Concern was also not significantly correlated to the Variation score for overall ratings of Compassion.

TABLE 1. Pearson correlations for empathic concern, variation scores for CI, NCI and for all pictures.

	Empathic Concern	Total Variation	Variation score for NCI pictures	Variation score for CI pictures
Empathic Concern	1	.11	.33*	-.12
Total Variation	-	1	.86**	.82**
Variation score for NCI pictures	-	-	1	.42**
Variation score for CI pictures	-	-	-	1

*. Correlation is significant at the 0.05 level (1-tailed).
**. Correlation is significant at the 0.01 level (1-tailed).

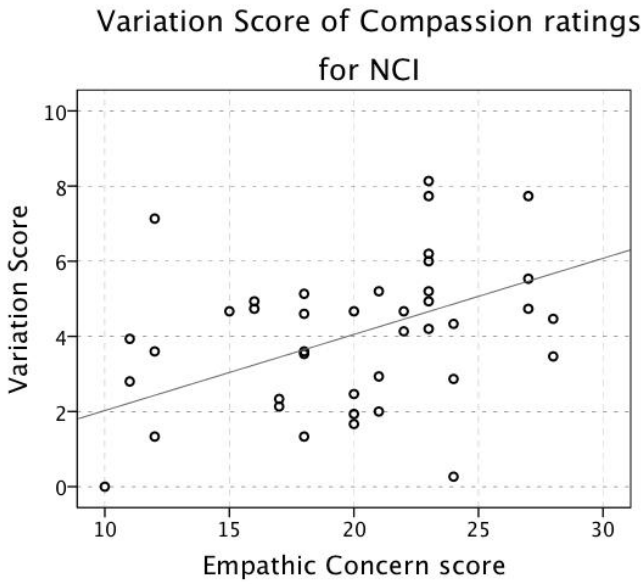

FIGURE 11. Empathic concern was positively correlated with the variation score for non-compassion-inducing pictures, r = .33, *p* (one-tailed) < .05. Note that the variation scores consider ratings during the silence condition as a baseline, from which ratings from the music conditions are subtracted. The absolute values of this difference are then averaged for each picture, then for each picture type and finally for all pictures, rendering three different variation scores per participant.

4.3 Results regarding Music preference

To adjust for family-wise error, alpha levels were adjusted by applying the Bonferroni correction. This was done by dividing alpha ($\alpha = .05$) between the number of correlations being performed ($n = 7$). This yielded a corrected alpha value of .007. Therefore all effects in this section are reported as significant at $p \leq .007$. All conducted correlations were two-tailed.

For the tests comparing preference for HV+ HA music to ratings on all three DV's during the corresponding listening condition, there were no significant correlations. This is to say that participants who liked HV+HA music better, did not present consistently higher or lower ratings of either Valence, Arousal or Compassion, for neither CI or NCI pictures, when rated during this same music condition.

For the HV+ LA music, there was a significant positive correlation between preference for this music piece and ratings of Valence during the corresponding listening condition only for NCI pictures r = .47. This result is illustrated in Figure 12.

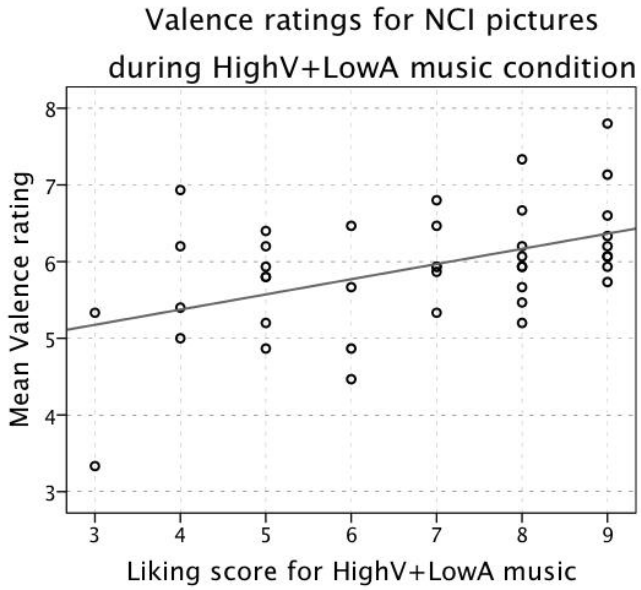

FIGURE 12. Scatterplot showing the correlation between preference for HV+LA music and mean ratings of Valence during the corresponding listening condition for NCI pictures r = .47, p < .007. As Liking score increases, so do the ratings of Valence for NCI pictures.

For the tests comparing preference for LV+HA music to ratings for all three DVs during the corresponding listening condition, there was a significant positive correlation only with ratings of Valence for CI pictures r = .42. This indicates that participants who rated LV+HA music higher on preference also tended to raise their ratings of Valence for CI pictures during the same music condition. A graphic representation of this is provided in Figure 13.

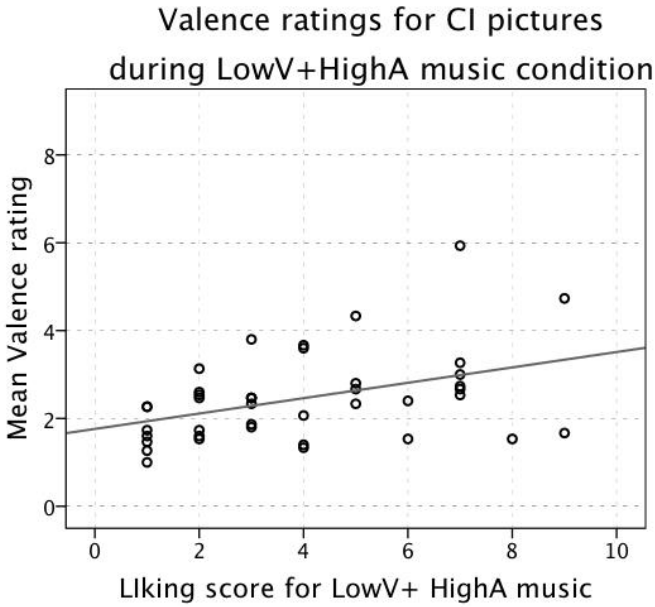

FIGURE 13. Scatterplot showing the correlation between preference for Low-Valence + High-Arousal music and mean ratings of Valence during the corresponding listening condition for CI pictures r = .42, *p* = .007. As liking score increases, so do the ratings of valence for CI pictures.

For the LV+LA music condition, correlations between preference for this music and ratings on all three DVs were not significant. This indicates that participants who liked this music better, did not present consistently higher or lower ratings of either Valence, Arousal or Compassion, for neither CI or NCI pictures, when rated during this same music condition.

4.4 Open-ended responses

From the open-ended responses to the question of: *If at all, how did you feel the music affected your feelings of compassion?* We found that most participants (n=24) agreed that music influenced their feelings considerably, while some participants (n= 7) expressed not being affected by music very much or at all, and others (n=10) did not comment on it directly.

Only two participants explicitly mentioned having experienced enhanced feelings of compassion while listening to tender (HV+LA) music, while seven participants reported enhanced feelings of compassion while listening to sad (LV+LA) music. On the other hand, four participants reported decreased feelings of compassion while listening to the happy (HV+HA) music, and three participants reported feeling less compassion while listening to the anxious (LV+HA) music.

Additionally, four participants reported that the music changed their perception of the picture and/or made them interpret the scene differently, therefore changing the way they felt towards it. Finally, only one participant reported that music affected their mood, and therefore the way the pictures looked with the different music playing.

5 DISCUSSION

The following section will first begin with a discussion of the implications of the results and how they relate to each of the research questions. It will then move into what were some of the limitations of this study, and finally, what are some possible future directions to take.

5.1 Influence of music in modulating feelings of compassion

The first objective of this study was to assess whether listening to music could influence the emotional response to compassionate and non-compassionate scenes. The short answer to this is found in the significant main effect of listening condition in the multivariate test, and it is yes; music was found to influence the emotional response to compassionate and non-compassionate scenes. This is to say that pictures were rated differently depending on the listening condition.

The long answer leads us to the second goal for this study, which was to observe the different effects of the different types of music on the emotional responses of participants. The differences in the overall effects of music can be inferred from the contrasts between each listening condition as opposed to baseline (i.e. the Silence condition). These indicate that the only listening condition that differed significantly across all three DVs and regardless of the type of picture presented was the HV+LA music condition. Although in itself this is an interesting finding, looking only at main effects does not tell enough, since the way music influenced ratings depended to a large extent on the type of picture that was being presented. The following section will elaborate on the Listening Condition × Picture Type interaction for each music piece. The interpretation of the results for each Listening Condition was largely founded on previous research and on participants' open-ended responses.

5.1.1 HV+LA / "tender" music

During the previously mentioned HV+LA music condition, ratings consistently increased for measures of Valence, Arousal and Compassion, and across both types of pictures. This music is usually considered as being "tender-sounding", and it was the second best liked piece of the

four used in this study (M = 6.73). While listening to this piece, participants' ratings tended to be higher for both types of pictures and for all three measures. In other words, participants tended to find both CI and NCI pictures more pleasant (measure of Valence) when tender music was playing. They also showed a tendency towards receiving a stronger emotional impact (measure of Arousal), and experiencing stronger feelings of Compassion for both types of pictures when these were accompanied by the HV+LA music. The tendency for ratings of Valence to increase when paired with congruently-valenced music is in line with results from previous research on multimodal perception of emotions, where valence in one modality tends to modify the perception of valence for the other modality in the same direction (e.g. Logeswaran & Bhattacharya, 2009). The increase in Arousal and Compassion ratings supports previous research on music and helping (North et al., 2004), which has shown that pleasant music can increase helping behavior. Also, Siedel and Prinz (2012) found that music-induced happiness increased people's judgment on how good and obligatory was helping those in need. It is relevant to note that Siedel & Prinz's study used Grieg's "Morning Mood" to induce happiness in their participants, and this piece shares the emotional characteristics of the stimulus employed in the present study (i.e. has positive valence and low arousal characteristics). When observing participants' open-ended responses, many (though not all) agreed that music influenced their ratings considerably. One observation actually reflects these particular results: *"sweet - sorrow/ motivating" music […] made me feel more compassion for the pictures […] in comparison to the absence of music.*

5.1.2 HV+HA / "happy" music

During the HV+HA music condition, ratings of Valence, Arousal and Compassion were higher for NCI pictures, whereas for CI pictures, ratings of Arousal and Compassion were lower, although Valence ratings were still higher than baseline. This music was generally perceived as "happy", and it had an upbeat and cheerful dance-like taste to it. It was the most liked (i.e. the one that received the highest preference scores: M = 7.17) piece of the four. The increase in ratings of Valence for both types of pictures during this music condition, also evident in the HV+LA music condition, supports the idea that music with positive valence tends to enhance our perception of positive valence in things (e.g. happy things seem happier), make ambiguously-valenced things seem positive (e.g. neutral things seem happy) and even make negatively-valenced things seem less negative (e.g. a sad face might seem less

sad). While listening to the upbeat music, participants' mood might also have been impacted positively, especially if we consider that this music was enjoyed the most for most participants. However, during this study, there was no systematic measure for how mood might have been altered in the different music conditions, and with the exception of one participant who explicitly reported the music to have affected her mood, this explanation can only be speculative. In that case, considering that music is effective in modulating mood states, the induced positive mood would then explain why the feelings of Compassion and the emotional impact were also increased for NCI pictures (see research by Weyant, 1978, and Isen & Levin, 1972 to see how positive mood can influence helping behavior). Nevertheless, during this same listening condition, ratings of Arousal and Compassion were significantly lower for CI pictures. In the voice of some of the participants: *...the happy music made me feel a little less compassion*; *...I believe that sad music was much more compassion-provoking than the jolly one*; *...I felt less inclined toward "sad feelings" when the lively fiddle music played.* At a first glance, this finding could seem contradictory with previous research; however, it is consistent with the findings of Pavlović and Marković (2011), who found that joyful music reduced the perception of sadness from a sad film. In the case of this study, the cheerful music could have minimized the negative content of the CI pictures, thus inducing feelings of Compassion that were less strong, together with a weaker emotional impact. A different explanation for this could be that the happy, dance-like music paired with scenes depicting suffering situations produced a highly incongruent scene, thus minimizing the crossmodal effect. This is in line with the findings of Vuoskoski et al. (2014) who found that more contrasting audio-visual pairs, which are also less likely to co-occur in a natural setting, elicited weaker crossmodal responses in participants. It is also supported by participants' responses such as: *Almost started crying when there was sad pictures and sad music, but sad pictures and happy music just made me feel confused* ; *[...] cheerful music on most of the sad / unpleasant pictures confused me* ; *I think I felt more compassionate if I felt the music fit the picture.* However, it is also possible that HV+HA music influenced the cognitive appraisal of what was happening in the CI pictures, making the scene less "compassion-inducing" and thus lowering their emotional impact and participants' ratings of Compassion.

5.1.3 LV+HA / "scary" music

During the LV+HA music condition, which was described as *"passionate and anxious",* "*scary",* or as *"ominous and dramatic",* ratings of Valence presented a significant decrease for NCI pictures, whereas for CI pictures this decrease was not significant if there was in fact any. This finding is also consistent with research showing that our perception of Valence from one modality is shifted towards the direction of the Valence of the stimuli presented in the other modality, especially for ambiguously-valenced stimuli (e.g. Logeswaran & Bhattacharya, 2009). In this particular case, the negative valence of the music made the pictures that were otherwise perceived as positive, seem less positive. Whether this is true for CI pictures as it was for NCI is yet to be seen, since the Valence data for CI pictures in this study presented a floor effect (i.e. it was rated consistently low, making it hard to be rated even lower, so although ratings in this condition were in fact slightly lower, the difference with the control condition was not large enough to be statistically significant). This music was the least favorite piece for most participants. During this same condition, ratings of Compassion showed no significant difference to the silence condition, while ratings of Arousal presented a significant increase for both types of pictures. This is to say that participants' feelings of Compassion were similar to what they felt during silence, but the emotional impact was stronger.

5.1.4 LV+LA / "sad" music

Finally, during the LV+LA condition, ratings for all three measures and for both types of pictures stayed virtually the same as for the control condition. This was a surprising finding, as it would suggest that LV+LA music, generally perceived as "sad", had no significant effect upon viewers' emotions, seeing as it was generally rated in a similar way as in the silence condition. This finding contradicts participants' own perception of how the music influenced their emotions. Comments provided by participants during data collection, such as: *"...I believe that sad music was much more compassion-provoking…", "sad music made me feel more sad of some pictures", "the melancholy music strengthened my feelings of compassion", "sad music made me more compassionate", "Almost started crying when there was sad pictures and sad music",* and *"the sad music made me feel more compassion for the pictures than the other music pieces and in comparison to the absence of music"*, would make one believe that during this condition the highest ratings of Compassion and Arousal would be

found. However, this was not the case. Although a closer look at the data tells us that ratings of Compassion were indeed higher during the LV+LA listening condition than they were during the Silence condition for both CI (M_{Sad} = 6.65, $M_{Control}$ = 6.51) and NCI (M_{Sad} = 3.54, $M_{Control}$ = 3.4) pictures, this slight increase was not enough to be statistically significant (i.e. it might as well have happened due to chance). Especially when assessing participants' own perception on how the music influenced their emotions (see comments above), it is surprising to find that the LV+LA music condition had the least impact of the four music conditions. This, however, tells a lot about the subjectivity of emotion perception, and how it might not always reflect what is actually happening. Intuitively one would expect that sad music would enhance the experience of sadness and this would lead to stronger feelings of Compassion and a greater emotional impact. On the other hand, to the best of our knowledge, negative mood and particularly sadness, has not been related to increased helping behavior or to increased fellow-feelings. Presumably, the LV+LA music might have induced a negative mood in listeners, thus not promoting compassionate feelings, particularly. This study, however, did not assess participants' experience of sadness, and therefore it is impossible to say whether it was in fact enhanced during this music condition. Nevertheless, regardless of whether the experience of sadness was or not enhanced, sad music did not lead to enhanced feelings of Compassion or to a stronger emotional impact.

5.2 Empathy and music's influence on feelings of compassion

The third goal of the present study was to find out whether empathy and musical preference played a role in how affective information is conveyed from music across to the visual modality. The hypothesis was that people who scored higher in the Empathic Concern subscale of the IRI questionnaire would present a higher tendency to be influenced by the affective content of the music when rating their emotional response to pictures. Not much could be deduced through the results yielded by the MANOVA. However, this same issue was assessed by calculating how much variation each participant presented in rating the same picture during the music conditions as opposed to during the silence condition, and correlating it to the Empathic Concern scores. Results showed that higher Empathic Concern scores were related to a larger variation in ratings during music conditions, whereas lower scores were related to more consistent ratings regardless of whether there was music or silence. In other

words, participants scoring higher in Empathic Concern appeared more susceptible to be emotionally affected by the background music than did participants with lower scores.

This implies that empathy levels do play a role in shaping how much a person's feelings of Compassion are influenced by listening to music, but only when the emotional impact of the visual scene is not strong (i.e. for NCI pictures).

This same effect was not seen for CI pictures presumably because these pictures had an emotional impact that was too strong by itself to be modified by the background music. However, NCI pictures, presumably because of their more ambiguous character, allowed for a higher contribution of the affective content of the music to the overall emotional response.

5.3 Role of musical preference

Musical preference was observed to play a role only in modulating how pleasant a picture was felt to be (i.e. only in ratings of Valence). It correlated positively to higher feelings of pleasantness towards NCI pictures during the HV+LA music condition. In other words, the more participants reported to like this piece of music, the higher their feelings of pleasantness for NCI pictures while listening to it. This was similarly true for the LV+HA music condition, where participants who liked this music the most, tended to experience increased feelings of pleasantness, though this time towards CI pictures. The reason as to why this relationship was not evident for the other two music pieces or as to why this effect was only seen for either CI or NCI pictures remains obscure.

Putting it all together, positive-valence music enhanced feelings of Compassion for NCI pictures, which would generally depict everyday situations and emotionally neutral scenes. The reason for this positive boost on feeling of Compassion could reside in the effects of positive-valence music on participants' mood (especially when we take into account that these two pieces were the best liked of the four), and the subsequent effect of positive mood on helping behavior (Isen & Levin, 1972). On the other hand, CI scenes, which depicted suffering and had emotionally-negative content required that the music was perceived as congruent with the scene, and therefore facilitated feelings of Compassion only for the Low-Arousal version of the two. The highly incongruent display of emotions that the happy-music-

negative-picture coupling presented significantly decreased feelings of Compassion and the overall emotional impact. The negative-valence music did not significantly enhance feelings of Compassion for either type of picture, which is in line with previous research demonstrating the effects aversive music on helping behavior (Fried & Berkowitz, 1979). When taking into account that both Low-Valence pieces were rated the lowest in relation to preference (mean preference scores: $M_{HighA} = 3.95$, $M_{LowA} = 5.8$), it can also be inferred that mood could have played a role in shaping this response (Isen & Levin, 1972). It is very important to acknowledge here that as a limitation for this study, changes in mood were not assessed after any of the listening conditions, and therefore any observations related to them are based on the general rationale that listening to preferred music would favor a positive mood as opposed to listening to music that was not so well-liked. Further research is needed in order to validate this hypothesis.

Differences in levels of empathy were not seen to yield different ratings across the various listening conditions, which means that individuals across all empathy levels responded similarly to the different listening conditions. Nevertheless, our findings suggest that empathy is related to the extent to which a person's feelings of Compassion can be influenced by music, although only when the affective content of the stimulus is ambiguous.

5.4 Limitations and future directions

This study, like most research, had its limitations, which are important to acknowledge. One of these has already been pointed out, and is that there was no measure for how mood was affected during the different listening conditions. Asking participants to rate their mood at the beginning of the experiment, and then to monitor it after every Listening Condition could have easily covered this. By doing this it would have been possible to test the aforementioned theories as to why different music conditions had varying effects in listeners.

Another important limitation of this study was the convenience sample. As was mentioned in section 3.2.1, participants were not offered immediate compensation for their participation other than cookies and tea. Although they were also offered participation in the raffle of a 50€ gift card, this did not appear to be appealing enough to reach a broader audience. There were several problems linked to this issue. First, most participants were university students, which

makes the conclusions reached here hard to generalize to other populations. Second, it has been suggested that compassion may be processed differently in men and women (Mercadillo, Días, Pasaye, & Barrios, 2011), however, for this study there were not enough male participants (19.5% male, 78% female) to explore possible gender differences. Lastly, many of the people who volunteered to participate in this study explicitly stated that they did this because they could relate to "how hard it is to collect data", or simply to help a friend. While this was very much appreciated, it could potentially constitute an issue as to the homogeneity of the sample in relation to their natural predisposition towards empathy. In other words, since this study used trait Empathy as a between-subjects variable, it could be a potential problem if most of the people who constituted the sample were highly empathic individuals. All these issues should be taken into consideration for future research.

This study has been a first attempt into looking at audiovisual interactions on emotion processing for a complex emotion, such as compassion. Our findings suggest that music can influence feelings of compassion, and that trait empathy is important when it comes to the extent to which music can influence our emotions. However, the relationship between audiovisual interactions and personality is complex, and more research is needed to fully comprehend how this works.

Some of the aspects that were not covered in this study and that would be very interesting to address in future studies are how the perception of congruence/incongruence between the visual and auditory stimuli influences the emotional outcome. Closely related to this, it would be interesting to learn which music is perceived as congruent to compassion-inducing scenes. Another road left unexplored is the effect of different music genres on audiovisual integration of information for emotional processing, and how perhaps other personality traits such as introversion/extraversion can be part of this complex scene. Also, this study did not exhaustively explore the role of music preference, and other strategies can probably be implemented to address this in the future. Presumably more could be unveiled about the role of music preference if other music genres would be used, perhaps even if participants were to choose their own favorite/least favorite music.

Future research would need to explore the other three subscales from the IRI and their relationship to how music can influence our emotions. It could also be aimed at answering

some of the questions that were raised directly as a result of this study. For example, why did sad music not affect participants' compassionate response? Which are the mechanisms through which music modulates feelings of compassion? Is it by changing a person's mood? Or is it maybe by providing an extra contextual cue that would change the cognitive interpretation of the scene?

The findings derived from the present study have valuable implications to the fields of music and emotion, and audiovisual interactions. They are in line with previous research that shows that affective stimuli from the auditory modality influences the perceived affective content of stimuli presented visually. They showed that tender music was particularly effective in enhancing feelings of compassion to complex visual scenes. They also support the idea that accounting for individual differences is important in understanding the effects of music on emotion processing. Particularly, they suggest that empathy is intimately related to the way in which we experience emotion in music and how music shapes our emotional response, even to complex emotions.

References

Arriaga, P., Esteves, F., & Feddes, A.R. (2014). Looking at the (mis)fortunes of others while listening to music. *Psychology of Music* 42(2):251–268

Baumgartner, T., Lutz, K., Schmidt, C.F., & Jäncke, L. (2006). The emotional power of music: how music enhances the feeling of affective pictures. *Brain Research* 1075:151–164

Bolivar, V.J., Cohen, A.J., & Fentress, J.C. (1994). Semantic and formal congruency in music and motion pictures: effects on the interpretation of visual action. *Psychomusicology* 13:28–59

Davis, M.H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalog of Selected Documents in Psychology* 10:85

De Gelder, B., & Vroomen, J. (2000). The perception of emotions by ear and by eye. *Cognition and Emotion* 14:289–311

Eerola, T., & Vuoskoski, J. (2011). A comparison of the discrete and dimensional models of emotion in music. *Psychology of Music* 39(1):18–49, DOI 10.1177/0305735610362821

Eerola, T., Vuoskoski, J., & Kautiainen, H. (2016). Being moved by unfamiliar sad music is associated with high empathy. *Frontiers in Psychology* DOI 10.3389/fpsyg.2016.01176

Ekman, P. (1992). Are there basic emotions? *Psychological review* 99(3):550–563

Focker, J., Gondan, M., & Roder, B. (2011). Preattentive processing of audio-visual emotional signals. *Acta Psychologica* 137:36-47

Fried, R., & Berkowitz, L. (1979). Music hatch charms. . . and can influence helpfulness. *Journal of Applied Social Psychology* 9:199–208

Gerdes, A.B.M., Wieser, M.J., & Alpers, G.W. (2014). Emotional pictures and sounds: a review of multimodal interactions of emotion cues in multiple domains. *Frontiers in Psychology* DOI 10.3389/fpsyg.2014.01351

Haidt, J. (2002). The moral emotions. In R. Davidson, (ed.) *Handbook of Affective Sciences,* Oxford University Press

Hoeckner, B., Wyatt, E.W., Decety, J., & Nusbaum, H. (2011). Film music influences how viewers relate to movie characters. *Psychology of Aesthetics, Creativity, and the Arts* 5(2):146–153

Isen, A.M., & Levin, P.F. (1972). The effects of feeling good on helping: Cookies and kindness. *Journal of Personality and Social Psychology* 21:384–388

Juslin, P.N., & Vastfjall, D. (2008). Emotional responses to music: The need to consider underlying mechanisms. *Behavioral and brain sciences* 31:559–621

Logeswaran, N., & Bhattacharya, J. (2009). Crossmodal transfer of emotion by music. *Neuroscience Letters* 455:129-133

Lonsdale, A.J., & North, A.C. (2011). Why do we listen to music? a uses and gratifications analysis. *British Journal of Psychology*

Marshall, S., & Cohen, A. (1988). Effects of musical soundtracks on attitudes toward animated geometric figures. *Music Perception* 6:95–112

Mercadillo, R.E., Barrios, F. A., & Diaz, J. L. (2007). Definition of compassion-evoking images in a Mexican sample. *Perceptual and Motor Skills*, 105(2): 661–676.

Mercadillo, R.E., Díaz, J.L., Pasaye, E.H., & Barrios, F.A. (2011). Perception of suffering and compassion experience: Brain gender disparities. *Brain and Cognition* 76:5–11

North, A., Tarrant, M., & Hargreaves, D.J. (2004). The effects of music on helping behavior: A field study. *Environment and Behavior* 36:266–275

Pavlovic, I., & Markovic, S. (2011). The effect of music background on the emotional appraisal of film sequences. *Psihologija* 44(1):71–91

Prinz, J.J. (2010). The moral emotions. In P. Goldie (ed.) *The Oxford Handbook of Philosophy and Emotion*, Oxford University Press

Russell, J.A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology* 39(6):1161–1178

Seidel, A., & Prinz, J. (2013). Mad and glad: Musically induced emotions have divergent impact on morals. *Motivation and Emotion* 37:629–637

Sollberger, B., & Reber, R. (2003). Musical chords as affective priming context in a word-evaluation task. *Music Perception* 20:263–282

Van den Stock, J., Peretz, I., Grèzes, J., De Gelder, B. (2009). Instrumental music influences recognition of emotional body language. *Brain Topography* 21(3-4): 216–220

Vuoskoski, J., & Eerola, T. (2012). Can sad music really make you sad? Indirect measures of affective states induced by music and autobiographical memories. *Psychology of Aesthetics, Creativity, and the Arts* 6(3):204–213

Vuoskoski, J., Clarke, E.F., & DeNora, T. (2016). Music listening evokes implicit affiliation. *Psychology of Music* 1–16, DOI 10.1177/0305735616680289

Vuoskoski, J., Thompson, M., Clarke, E. F., & Spence, C., (2014). Crossmodal interactions in the perception of expressivity in musical performance. *Attention, Perception, & Psychophysics* 76:591-604

Vuoskoski, J., Thompson, M., Spence, C., & Clarke, E. F., (2016). Interaction of sight and sound in the perception and experience of musical performance. *Music Perception* 33(4): 457-471

Weyant, J.M. (1978). Effects of mood states, costs, and benefits on helping. *Journal of Personality and Social Psychology* 36:1169–1176

Zentner, M., Grandjean, D., & Scherer, K.R. (2008). Emotions evoked by the sound of music: Characterization, classification, and measurement. *Emotion* 8(4):494–521

Ziv, N., & Goshen, M. (2006). The effect of 'sad' and 'happy' background music on the interpretation of a story in 5 to 6-year-old children. *British Journal of Music Education* 23(3):303–314

Appendix A.

TABLE 1. Pictures used as non-compassion-inducing stimuli and their IAPS means and standard deviations for Valence, Arousal and Dominance ratings.

Description	IAPS ID	Valence M	Valence SD	Arousal M	Arousal SD	Dom M	Dom SD
Women	1340	7.13	1.57	4.75	2.31	6.13	1.78
Boys	2224	7.24	1.58	4.85	2.11	6.39	1.89
Family	2340	8.03	1.26	4.9	2.2	6.18	1.86
Three Men	2370	7.14	1.46	2.9	2.14	6.12	2.22
Couple	2396	4.91	1.05	3.34	1.83	5.59	1.59
Family	2598	7.19	1.3	3.73	1.84	6.07	1.79
Flower*	5010	7.14	1.5	3	2.25	7.4	2.25
Boat*	5390	5.59	1.54	2.88	1.97	6.33	2.02
Cave	5661	5.96	1.41	4.15	2.3	5.45	2.02
Farmland	5720	6.31	1.6	2.79	2.2	5.58	2.15
Clouds*	5870	6.78	1.76	3.1	2.22	5.2	2.13
Earth	5890	6.67	1.75	4.6	2.3	4.15	2.78
Outlet	6150	5.08	1.17	3.22	2.02	5.54	1.69
Spoon	7004	5.04	0.6	2	1.66	6.74	1.99
Book	7090	5.19	1.46	2.61	2.03	6.65	2.03
File Cabinets	7224	4.45	1.36	2.81	1.94	6.26	2.23
Man*	7493	5.35	1.34	3.39	2.08	5.75	1.92

Street	7496	5.92	1.66	4.84	1.99	5.55	1.72
Bridge	7547	5.21	0.96	3.18	2.01	5.76	2

The pictures marked with an asterisk (*) indicate those pictures that were not used in the main study.

TABLE 2. Pictures used as compassion-inducing (CI) stimuli and their IAPS means and standard deviations for Valence, Arousal and Dominance ratings.

Description	IAPS ID	Valence M	Valence SD	Arousal M	Arousal SD	Dom M	Dom SD
Hospital	2205	1.95	1.58	4.53	2.23	3.22	2.13
Girl	2276	2.67	1.66	4.63	1.93	4.4	1.95
Kids	2278	3.36	1.57	4.55	2.02	4.36	2.08
Kid Cry*	2301	2.78	1.38	4.57	1.96	4.13	1.89
Elderly Man*	2520	4.13	1.9	4.22	1.69	4.44	2.33
Hunters	2688	2.73	2.07	5.98	2.22	3.99	2.42
Sad Children	2703	1.91	1.26	5.78	2.25	3.15	1.95
Drug Addict*	2710	2.52	1.69	5.46	2.29	4.63	2.56
Drug Addict	2718	3.65	1.58	4.46	2.03	5.21	2.21
Jail*	2722	3.47	1.65	3.52	2.05	5.34	2.34
Crying Boy*	2900.1	2.56	1.41	4.61	2.07	4.83	2.26
Soldier	6212	2.19	1.49	6.01	2.44	3.45	2.1
Attack	6520	1.94	1.27	6.59	2.08	2.88	2.16
Suicide	6570.1	2.54	1.76	6.12	2.17	3.46	2.36
Fire	8485	2.73	1.62	6.46	2.1	3.25	2.2
Cemetery*	9220	2.06	1.54	4	2.09	3.13	1.97
Pollution	9341	3.38	1.89	4.5	2.1	4.39	2.06

Handicapped	9415	2.82	2	4.91	2.35	4.22	2.24
Assault	9423	2.61	1.51	5.66	2.15	3.43	2.13
Assault	9429	2.68	1.26	5.63	2.04	3.68	1.96
Car Accident	9900	2.46	1.39	5.58	2.13	3.63	2.05

The pictures marked with an asterisk (*) indicate those pictures that were rated on compassion below 7.03 on the validation study; they were not used in the main study.