This is a literature review I did for the music perception and cognition class taught by Dr. Grace Leslie. This was written in a hypothesis journal format structured by four parts – Question, Conjecture, Theory, and Hypothesis. The subject I chose was the relationship between music and empathy.

Question about Emotional Attachment to Music

Why do some people tend to be more emotionally attached to music in general than the others?

Conjecture about Music and Empathy

One way to answer the question is by studying the correlation between music and empathy.

Music is a language of emotion and emotion is perceived in virtue of empathy. Empathy entails a mirroring of emotion, and the development of parallel and reactive emotions in response to those perceived in another person (Vreeke & Van der Mark, 2003).

It was suggested that musicians and music lovers may have a specialized set of empathy skills that allow them to encode and decode emotion (Juslin, 2000). When composing music one encodes his/her emotion into the music. The other person decodes the emotion as listening to it With empathy, listener can understand the emotions perceived by the musicians at the moment the music were composed or performed. **The higher empathy listeners have, the more emotionally attached they are to the music.** Specifically, empathy facilitates music perception, and in the other way around music cultivates empathy. This mutual reinforcement enhances the phenomenon as raised in the question.

Theory A: Empathy facilitates music perception.

**Mirror Neurons**

Many neurologists have claimed that mirror neurons  (“mirror mechanism”) creates a biological basis for empathy (Rizzolatti, 2005). In 2006 a review of neuroimaging evidence of musical experience indicates that affective response to music may be mediated by the human mirror neuron system (MolnarSazakacs, Overy). Mirror neuron can be seen as a link between empathy and music perception.

**Timbre-related brain activity**

Music is rich in changes. Timbre, dynamic, tempo, harmony, register, any of them can make a huge difference in the emotional expression of music. A violinist can exhibit various timbres on one instrument with artistical expression. Hailstone (2009) has reported empirical evidences that show timbre affects perception of emotion in music.

Scientists have found **insula and superior temporal cortex**being accountable for both timbre-related brain activation and neural mechanisms for empathy. Significant timbre-related brain activation was found in well-defined regions of posterior Heschl's gyrus and**superior temporal sulcus**, extending into the circular **insular** sulcus (Menon, 2002).

Meanwhile, Carr (2003) found a mechanism of action representation that allows empathy and modulates our emotional content. The **insula** plays a fundamental role in this mechanism. Carr with her collegues used functional MRI while subjects were either imitating or simply observing emotional facial expressions. Imitation and observation of emotions activated a largely similar network of brain areas. Within this network, there was greater activity during imitation, compared with observation of emotions, in premotor areas including the inferior frontal cortex, as well as in the **superior temporal cortex**, insula, and amygdala.

**Empathy via Action Representation**

Why would imitation activate the neural network that's said to be related to empathy? How does imitation and empathy relate? When Theodore Lipps introduced the concept of empathy (Einfühlung), he theorized a critical role for the mechanism of inner imitation of the actions of others in generating empathy (Gallese, 2001). In support of Lipps' idea, empathic individuals exhibit nonconscious mimicry of the postures, mannerisms, and facial expressions of others (the chameleon effect) to a greater extent than non-empathic individuals (Chartrand and Bargh, 1999). Thus, empathy may occur via a mechanism of action representation that modulates and shapes our understanding of the emotional contents of other individuals (Lacoboni, 2005).

**Action Representation in Mirror Neurons**

Kohler (2002) has found action representation in mirror neurons of monkeys when they performs a specific action and hear the related sound. Most of the neurons also discharge when the monkey observes the same action. Audiovisual mirror neurons code actions independently of whether these actions are performed, heard, or seen. It explains why even by observing emotional facial expressions the action representation mechanism of empathy gets activated. More importantly, for our particular interest to music perception, these audiovisual mirror neurons code abstract contents—the meaning of actions—and have the auditory access typical of human language to these contents.

To date, parallels between the activity of mirror neurons recorded in the monkey and human neuroimaging findings are established primarily in the domain of action observation/execution. However, functions of this neural system have recently been linked to several high-level human cognitive functions such as empathy (Carr *et al.* , 2003 ; Gallese, 2003b ; Dapretto *et al.* , 2006 )

**Conclusion**

The discovery of individual "mirror neurons" in the macaque brain that fire both when an action is executed and when that same action is observed or *heard*, and of a homologous system in humans, is leading to an extraordinary conceptual shift in our understanding of perception-action mechanisms, human communication, and empathy. In a recent model of emotional responses to music (Molnar-Szakacs & Overy, 2006), it was proposed that music is perceived not only as an auditory signal, but also as intentional, hierarchically organized sequences of expressive motor acts behind the signal; and that the human mirror neuron system allows for co-representation and sharing of a musical experience between agent and listener (Overy, 2009).

Theory B: Music cultivates empathy

As it was hypothesized by Cooke (1963) that grief experienced when listening to music is real in that it stimulates us to partake in the artist's experience vicariously in much the same way that we feel our friend's emotions when they tell us of their experiences.

Previous research has shown that music-related, participatory activities may promote empathy and affiliation (Rabinowitch, 2013; Valdesolo, 2011).

Garrido and Schubert (2011) found individuals who are high in music empathy tend to find it more rewarding to listen to sad music. Huron (2011) has proposed that sad music provides the opportunity to feel more positive afterwards due to it engendering crying, which leads to the secretion of prolactin. This “feel-good” hormone leaves a listener who was not in a negative emotional state prior to listening in a more positive mood afterwards. In mammals, prolactin is among the neuropeptides regulating attachment that are relevant for regulating empathic responsiveness (Decety, 2011).

Hypothesis:

As supposed, the higher empathy listeners have, the more emotionally attached to music they are. People who are empathic are susceptible to affective expression of music. Affective expression of music is through various musical elements including harmony, dynamic, beat, and tempo and so on that are bonded with mood and strong emotions. People understand the emotional expression of the music by detecting the corresponding musical elements that create this emotional sensation. Thereby, ones who are susceptible to emotions of music are better at perceiving music by following melody in pitch, discerning nuances in timbre, detecting harmony and rhythm.

Participants with the same amount of music knowledge go to do a music listening test. They will be assessed on their music perception that's evaluated with following metrics: identifying the type of a chord(major, minor, dim, aug), key(major, minor), meter(duple, triple), dynamic changes (range, frequency), form of the piece (recognizing repetition, variation).

Empathy can be measured by how good a person can detect the nuance of a human's emotion embodied with one's behavior. Have participants rate a number of paired-pictures of facial expression. Pictures of each pair are from the same person with a little difference in facial expression that makes one picture looks more positive relative to the other. Participants with higher music perception (as assessed by the music listening test) will most likely identify which picture is happier than the other in that pair.

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