Please Don't Stop the Music: Commentary on "Musical Sounds, Motor Resonance, and Detectable Agency"

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ABSTRACT: Music allows the expression of emotion, evokes pleasure, and creates the sense of social belonging. Since the advent of recorded music, asocial music listening has become increasingly possible, with a majority of people reporting that emotional reactions to music are easiest to achieve while listening alone (Juslin & Laukka, 2004). Launay (2015) presents the argument that music is imbued with qualities that allow the listener to attribute it with agency, thus, making music listening a fundamentally social experience, even in the absence of a human agent. I agree that music listening is an inherently social experience for humans, and propose that the biological correlates of music's inherent sociality lie in the study of the interaction of neural systems of empathy, motor resonance, and pleasure and reward. However, where Launay dismisses emotional empathy as peripheral to the music perception question, I propose that it is indeed central to the mystery of the universal power of music.

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MUSIC listening is an unparalleled experience that allows our imagination to travel, to feel, regulate and express emotion, to experience a feeling of belonging and identification. Music is the most abstract of arts, and yet music is a ubiquitous element in all human cultures (Wallin, Merker, & Brown, 2000). A variety of reasons for the existence and evolution of music have been proposed, including that it may be part of our hominid mating strategy (Darwin, 1871), it evolved from animal territorial signals (Hagen & Hammerstein, 2009), or simply because of the pleasure it produced (Wallin et al., 2000).Music production involving the use of the human body (singing, drumming, stomping, etc.) has been a part of human history and evolution for millennia as part of ritual dances, hunting songs, religious hymns, nursery rhymes, and concerts. In fact, recent findings show that the earliest bone flutes date to approximately 40,000 years ago (Conard, Malina, & Munzel, 2009), meaning that forms of music-making possibly existed even before this period. However, in modern-day western culture, music is frequently experienced as an accompaniment to mundane everyday activities, as a "background" to doing housework for example, or during personal travel (Juslin & Laukka, 2004).

Launay (2015) has methodically argued that music has properties that allow us to attribute it with agency, thus turning an asocial experience into a social one. This can occur through i) learned associations between sound and movement that lead to internal simulation of the action and learned agency; ii) motor resonance with features of musical sound and implied agency; iii) pattern detection in the musical sound and anticipated agency. Thus, even asocial musical experiences can be perceived and experienced in a social way.

I would like to propose that Launay has left out a major factor in his argument, perhaps the most essential component of musical enjoyment—emotion. I propose that studying emotion in music perception is essential to understanding how asocial music listening may be perceived as a social experience. Leo Tolstoy has supposedly said "…music is the shorthand of emotion." In his own autobiography, Darwin lamented:

> ...if I had to live my life again, I would have made a rule to read some poetry and listen to some music at least once every week; for perhaps the parts of my brain now atrophied

> would thus have been kept active through use. The loss of these tastes is a loss of happiness, and may possibly be injurious to the intellect, and more probably to the moral character, by enfeebling the emotional part of our nature. (Darwin, 1887, p. 139).

The study of emotion and agency in music perception has experienced a recent boom, being facilitated by advances in neuroimaging technologies (Baumgartner, Esslen, & Jancke, 2006; Koelsch, 2014; Koelsch, Fritz, Cramon, Muller, & Friederici, 2006; Menon & Levitin, 2005; Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011).

Launay considers that "While there has been speculation for many years about a relationship between motor resonance and other forms of empathy, there is little empirical evidence to suggest a direct relationship" (2015, p. 34). I would like to argue that while emotional empathy takes a backseat in Launay's argument, it should be in the driver's seat, moving theory and research forward in music perception. The notion that we possess a kind of immediate understanding of what others are doing or feeling is rooted in philosophy. Adam Smith, in 1759, proposed the concept of sympathy, defining it as "our fellow-feeling with any passion whatever" (p. 5), and according to him we are capable of feeling something similar to what others feel, by simply observing others' behavior (Smith, 1976). Smith continues by arguing that people feel pleasure from the presence of others with the same emotion as oneself, proposing that such mutual sympathy heightens the original emotion and "disburdens" the person of sorrow, "because the sweetness of his sympathy more than compensates the bitterness of that sorrow" (Smith, 1976, p. 14). I would argue that it is through its ability to evoke emotion that we can begin to understand the power of music in human experience.

Emotion understanding is at the core of empathy, and at the heart of most social bonds. Processing of emotion-laden information recruits the limbic system, including both cortical regions like the orbitofrontal cortex, the anterior cingulate cortex, and subcortical structures including the amygdala, the nucleus accumbens and the hypothalamus (Pessoa, 2008). Dopamine release in these regions can lead to reinforcement of behaviors (Schultz, 2007). In a recent review, Zatorre and Salimpoor (2013) describe in beautiful detail how the dopaminergic mesolimbic striatal system is involved in reward, motivation, and pleasure and thus mediates the experience of pleasure associated with music. More specifically, they have shown that the ventral striatum and other brain regions associated with emotion were recruited as a function of increasing intensity of the chills response to music (Blood & Zatorre, 2001). This study was important in showing that the mesolimbic reward system could be recruited by an abstract aesthetic stimulus. They then used ligand-based positron emission tomography (PET) to confirm that strong emotional responses to pleasurable versus neutral music lead to dopamine release in the mesolimbic striatum. Thus, music, an abstract stimulus, can have the same rewarding effects as some of our most fundamental survival behaviors such as eating, sex, and caring for offspring.

The reward value for music can be coded by activity levels in the nucleus accumbens, whose functional connectivity with auditory and frontal areas increases as a function of increasing musical reward (Zatorre & Salimpoor; 2013). These neural pathways thus allow us to feel musical emotion—but how does the "social" component of the musical experience arise? There are at least two main theories describing the mechanisms of understanding the feelings of others (Adolphs, 2009; Decety & Jackson, 2004; Preston & de Waal, 2002). One possibility, cognitive perspective-taking, implicates a top-down cognitive process, which supposes that emotion understanding occurs through inferential elaboration based on emotion-related sensory information. For example, recognizing a facial emotion requires matching the seen face to the known representation of the categories of human emotions into which expressions can be assigned—happiness, sadness, and so on. Launay (2015) argues that motor resonance, important to music perception, is most related to this form of "cognitive empathy." In contrast, the process of simulation which supports emotional empathy, allows us to understand emotions because emotion-related sensory information is directly mapped onto neural and bodily structures that, when active, create a similar emotional reaction in us, the observer. This type of emotion understanding relies on first person motor knowledge in the same way that has been proposed for the neural mechanism of action understanding, subserved by the human mirror neuron system (MNS) (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003). I would argue that it is this simulation-based, emotional empathy that gives us the feelings of "sociality" in asocial music listening.

Based on recent findings in music neuroscience, Molnar-Szakacs and Overy developed the Shared Affective Motion Experience (SAME) model of music perception, emphasizing the importance of shared emotion in music perception (Molnar-Szakacs, Green Assuied, & Overy, 2012; Molnar-Szakacs & Overy, 2006; Overy & Molnar-Szakacs, 2009). The SAME model suggests that musical sound is perceived not

only in terms of the auditory signal, but also in terms of the intentional, hierarchically organized sequences of expressive motor acts behind the signal. At the neural level, SAME posits that interactions between cortical and subcortical neural networks allow the human brain to understand complex patterns of musical signals and provide a neural substrate for the subsequent emotional response. Recent evidence for this has been detailed by Zatorre and Salimpoor (2013) and described above. The framework of the SAME model fits Launay's argument exceedingly well, as the model could be applied to all three main mechanisms detailed in the paper. However, the main advantage of using SAME as a framework for understanding music perception is, that in addition to presenting an embodied view of music perception as Launay does, it also incorporates an affective component, missing in Launay's argument.

Music has the incredible power to move, to heal, and to soothe the human spirit in a way no other stimulus can. It unites us across places, cultures, and time. Music has the ability to be our companion when we are alone. I propose that the biological correlates of music's inherent sociality lie in its ability to act as a rewarding stimulus. Although abstract, music is able to produce neurobiological effects of reward similar to our most fundamental survival behaviors. While Launay (2015) presents a methodical study of motor resonance, pattern detection, and agency, a more holistic picture is needed if we are to understand music's incredible ability to engage in a social way. The further study of the interaction of neural systems of empathy, motor resonance, and pleasure and reward will surely help reveal some answers.

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REFERENCES

Adolphs, R. (2009). The social brain: Neural basis of social knowledge. *Annual Review of Psychology, 60*, 693-716.

Baumgartner, T., Esslen, M., & Jancke, L. (2006). From emotion perception to emotion experience: Emotions evoked by pictures and classical music. *International Journal of Psychophysiology, 60*(1), 34-43.

Blood, A. J., & Zatorre, R. J. (2001). Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. *Proceedings of the National Academy of Sciences of the United States of America, 98*(20), 11818-11823.

Carr, L., Iacoboni, M., Dubeau, M. C., Mazziotta, J. C., & Lenzi, G. L. (2003). Neural mechanisms of empathy in humans: A relay from neural systems for imitation to limbic areas. *Proceedings of the National Academy of Sciences of the United States of America, 100*(9), 5497-5502.

Conard, N. J., Malina, M., & Munzel, S. C. (2009). New flutes document the earliest musical tradition in southwestern Germany. *Nature, 460*(7256), 737-740.

Darwin, C. (1871). *The descent of man, and selection in relation to sex*. London: J Murray.

Darwin, C. (1887). *The life and letters of Charles Darwin.* London: J Murray.

Decety, J., & Jackson, P. L. (2004). The functional architecture of human empathy. *Behavioral and Cognitive Neuroscience Reviews, 3*(2), 71-100.

Hagen, E., & Hammerstein, P. (2009). Did Neanderthals and other early humans sing? Seeking the biological roots of music in the territorial advertisements of primates, lions, hyenas, and wolves. *Musicae Scientiae, 13*, 291-320.

Juslin, P. N. & Laukka, P. (2004) Expression, perception, and induction of musical emotions: A review and a questionnaire study of everyday listening, *Journal of New Music Research*, *33*(3), 217-238.

Koelsch, S. (2014). Brain correlates of music-evoked emotions. *Nature Reviews Neuroscience, 15*, 170-180.

Koelsch, S., Fritz, T., Cramon, D. Y, V., Muller, K., & Friederici, A. D. (2006). Investigating emotion with music: an fMRI study. *Human Brain Mapping, 27*(3), 239-250.

Launay, J. (2015). Musical sounds, motor resonance, and detectable agency. *Empirical Musicology Review, 10*(1), 30-40.

Menon, V., & Levitin, D. J. (2005). The rewards of music listening: response and physiological connectivity of the mesolimbic system. *Neuroimage, 28*(1), 175-184.

Molnar-Szakacs, I., Green Assuied, V., & Overy, K. (2012). Shared Affective Motion Experience (SAME) and creative, interactive music therapy. In D. J. Hargreaves, D. E. Miell, & R. A. R. MacDonald (Eds.), *Musical Imaginations: Multidisciplinary perspectives on creativity, performance and perception* (pp. 313–331). Oxford: Oxford University Press.

Molnar-Szakacs, I., & Overy, K. (2006). Music and mirror neurons: From motion to 'e'motion. *Social Cognitive and Affective Neuroscience, 1*(3), 235-241.

Overy, K., & Molnar-Szakacs, I. (2009). Being together in time: Musical experience and the mirror neuron system. *Music Perception, 26*, 489-504.

Pessoa, L. (2008). On the relationship between emotion and cognition. *Nature Reviews Neuroscience, 9*(2), 148-158.

Preston, S. D., & de Waal, F. B. (2002). Empathy: Its ultimate and proximate bases. *Behavioral and Brain Sciences, 25(*1), 1-20; discussion 20-71.

Salimpoor, V. N., Benovoy, M., Larcher, K., Dagher, A., & Zatorre, R. J. (2011). Anatomically distinct dopamine release during anticipation and experience of peak emotion to music. *Nature Neuroscience, 14*(2), 257-262.

Schultz, W. (2007). Behavioral dopamine signals. *Trends in Neuroscience, 30*(5), 203-210.

Smith, A. (1976). *The theory of moral sentiments*. Oxford: Oxford University Press.

Wallin, N., Merker, B., & Brown, S. (2000). *The origins of music.* Cambridge, MA: MIT Press.

Zatorre, R. J., & Salimpoor, V. N. (2013). From perception to pleasure: Music and its neural substrates. *Proceedings of the National Academy of Sciences of the United States of America, 110*(Suppl 2), 10430-10437.