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Music, Emotions and the Influence of the Cognitive Sciences

Tom Cochrane*
University of Geneva

Abstract

This article reviews some of the ways in which philosophical problems concerning music can be informed by approaches from the cognitive sciences (principally psychology and neuroscience). Focusing on the issues of musical expressiveness and the arousal of emotions by music, the key philosophical problems and their alternative solutions are outlined. There is room for optimism that while current experimental data does not always unambiguously satisfy philosophical scrutiny, it can potentially support one theory over another, and in some cases allow us to synthesize or reject traditional philosophical differences.

The potential for the cognitive sciences to inform long-standing philosophical debates has not gone unnoticed by many philosophers working on the aesthetics of music. This is symptomatic of a growing tendency for aestheticians to pay attention to experimental data; partly motivated by a desire to justify armchair theorizing and partly because the sheer amount of relevant research being conducted by psychologists and neuroscientists demands our attention.[1] Moreover, some philosophers may regard our aesthetic activities as particularly illuminating examples of the way our minds work. Appealing to cognitive data is a natural way to connect aesthetic cases to more general theories of cognition.

Yet there may be some concern that the interests of philosophers and cognitive scientists in music do not properly coincide. The cognitive science of music is typically focused on the causal origins of our musical tendencies. There is for instance an ongoing debate as to the evolutionary provenance of music—whether our musical tendencies were specifically selected by evolutionary pressures, or are a by-product of other evolved functions (e.g. Patel 2007). Similarly, much research has focused on musical learning and expertise (such as the possession by some individuals of absolute pitch—the ability to identify the pitch of a sound without relating it to some pre-established pitch). Such concerns are only tangentially related to the exploration of musical experience, which may be of interest to philosophers regardless of how we came to be capable of it.

Yet both philosophers and scientists are interested in the extent to which our musical experiences are universal or the product of individual or cultural differences. It is hard to see how this issue could be broached without referring to underlying causal and developmental mechanisms. Causal accounts are also relevant to the aesthetic variety of the realism debate that is perennial to the philosophical discipline as a whole, viz. does the music *really* possess its aesthetic properties and/or any values that result from such possession, or is it a purely subjective matter? Philosophers who appeal to general psychological mechanisms for the perception of aesthetic qualities, as opposed to say, subjective associations, will tend to side with some variety of realism (dispositional accounts being a popular route, e.g. Davies 1994; Matravers 2003; Levinson 2005).

Another possible point of divergence may be the way that the cognitive science of music tends to focus on rather low-level musical features, such as detailed musical structure or syntax. This is exemplified by experiments in which listeners are asked to predict how a given sequence of tones will continue, whether a note 'sounds right' within a context or whether a melody sounds finished or not (musicologist David Huron 2006 reviews a number of experiments). The focus on single tones or cadences, or at best short musical samples, may not satisfy philosophers interested in the aesthetic significance of complete works. However, we may suppose that at least a significant degree of musical experience relies on our experience of such details, whether or not we are fully aware of the effect that they have on us. Moreover, although philosophers may be motivated to solve fundamental conceptual problems and leave the details to empirical investigation, it is often in the details that philosophical theories become unstuck, or where rich new possibilities can open up.

Keeping in mind these potential conflicts or cross-fertilizations between philosophical and scientific approaches then, I will focus in this article on an area in which the interests of cognitive scientists and philosophers quite definitely coincide, which concerns the relationship between music and emotions. Our interest in this relationship boils down to two fundamental questions: 1) how music manages to be *expressive* of emotional states and, 2) how music can *arouse* emotional states in listeners.

The expression and arousal of emotion are issues common to other art forms, as well as our aesthetic appreciation of nature. However, they are considered particularly problematic in the case of pure instrumental music because of a common observation that emotions are always about something—I am afraid of the bull or happy about my promotion—yet instrumental music provides no situations or appraised content for emotions to be about. How then, could music express an emotion without conveying the content that is apparently essential to specifying what emotion it is? The phenomenon is especially fascinating when we also recognize that music is widely regarded as one of the most intensely expressive art forms there is. We are not merely vaguely reminded of emotions when listening to music, but often have an immediate and vivid impression of an occurrent emotional state.

Meanwhile with regards to being aroused by emotion when listening to music, we must again wonder what forms the intentional object of our emotion. Could we really say that the music itself is the object of our sadness, fear or joy? It is hard to see how an abstract sequence of tones can provide sufficient reason to motivate such emotions. And if the music itself is not the object of one's emotional response, can the emotion really be relevant to the proper aesthetic appreciation of the music?

I will address these two issues in turn.

1. Musical Expressiveness[2]

To begin, it is worth noting that it was not until cognitive scientists actually surveyed listener's musical judgements that we could be sure that listeners do reliably agree on the emotional content of musical works (at least when simple emotion labels are used). A good example is Patrick Juslin's (1997) study, in which professional guitarists were instructed to play a familiar melody (*When The Saints*) according to different emotional interpretations; either happy, sad, angry, fearful or without expression. Changes to the pitches of the tune were not permitted, but the performers could use significant variations in dynamics, articulation and tempo. Despite the melodic restriction, listeners were able to accurately judge (using scales of intensity) which emotion the performer had intended

to express with a success rate comparable to decoding ordinary vocal expressions of emotion. Cross-cultural comparisons of musical judgement similarly show reasonable agreement on expressive qualities (Balkwill et al. 2004 is a good example) and the judgements of young children have also been investigated, though with less conclusive results (see Dowling 1999 for a review). Overall the degree of reliability observed in listeners' judgements encourages us to look beyond a purely subjective story of association (appealed to by Descartes for example), according to which we associate pieces of music with previous experiences in which we felt a certain emotion. Though such subjective associations may certainly occur, they will not explain such wide agreement between listeners.

There are three main theoretical alternatives when accounting for our judgements of musical expressivity, each of which find a way to bypass the apparent lack of intentional content[3]: 1) *Resemblance theory*, which states that we perceive a resemblance between the music and the way emotions *appear*—usually the behavioural and vocal expressions of emotions but also sometimes bodily feelings; 2) *Arousal theory*, which states that we attribute emotional content to music on the basis of our own emotional reactions and; 3) *Expression theory*, which states that we hear the music as the expressive product of someone's emotion, usually an imagined persona in contemporary formulations rather than the composer or performer.

With regards to role of the cognitive sciences in supporting one or more of these accounts, the crucial distinction is between the causal basis of musical expressiveness and the nature of the experience supported by that causal basis. Typically theories of musical expressiveness have something to say about both issues, and it is easy to become confused as to what is being claimed as a result (Noordhof 2008 is particularly sharp on this point). A causal account will talk about the properties of the music that make it suitable for the expression of emotions and/or the psychological mechanisms employed in the appreciation of those properties. An experiential account meanwhile is concerned to characterize the phenomenology of hearing music as somehow related to emotion as accurately as possible. Matravers (2007) claims that an impasse has been reached with respect to the experiential question, in that a correct phenomenological account should command the assent of all suitably qualified listeners—all we should need to do is introspect when hearing music and there it is—and yet philosophers shockingly still manage to disagree about the main candidate accounts (e.g. Davies 2005; Levinson 2005). There does appear to be a consensus that the emotion is experientially attributed to the music rather than the listener or the performer (at least Kivy 1999 declares one). But given this constraint, the phenomenology of hearing music on the one hand and experiencing the sense of an emotion on the other, seems hard to combine in a way that satisfies everyone.

Is it possible that a better understanding of the causal mechanics behind musical expression will point us towards the correct account of its experience? There is some scepticism on this front. For instance, as a proponent of resemblance theory Stephen Davies (e.g. 1994) claims that genuine resemblances between music and emotionally expressive vocal and bodily gestures are responsible for the appearance of emotions in music. As a causal view, this theory is supported by the work of psychologists such as Juslin and Laukka (2003) who locate features in common between expressive music and emotional vocalizations. But as an experiential account, can we simply say that we experience a resemblance between the music and various emotion features? Aaron Ridley criticises Davies' account thus;

> [It] would be like offering an account of pictorial space wholly in terms of the perspectival devices contained by a picture: It might be true that we experience pictorial space in virtue of the perspectival devices that a picture contains; but the experience itself is not merely the

> experience of perceiving perspectival devices (which could be done without ever experiencing pictorial space). (Ridley 1995: 121)

In this way, it may be argued that whatever causal account is accepted, it will remain an open question as to how the experience should be characterized. However, one line of response to this is that the causal process involved will still constrain what experiences are coherent with that process, just as assumptions about the experience involved will constrain one's causal account. So for instance, if it is sensitivity (perhaps at a sub-personal level) to resembling features of the music that enable perceptions of expressivity, then at least it makes sense that one's experience of expressivity involve close attention to the music.

Consider in contrast the arousal theory. This says that we perceive the music as expressive because it arouses certain emotions in us (Matravers 1998 provides the most sophisticated account in recent years). Critics of this theory state that they are quite capable of hearing the expressive qualities of music without feeling emotionally aroused at all. However, if we suppose that the experience of musical expressivity involves the sense of an occurrent emotion, it seems plausible that the listener's own emotions play some role in generating the sense of feeling, even if, as Matravers claims, these feelings may be highly attenuated. Yet it has been a particular problem for arousal theorists to then explain why feeling personally aroused should lead to experiences of emotion *in the music*. The mere fact that the music is causally responsible for one's emotional arousal is insufficient. By comparison, we do not attribute emotional qualities to drugs just because they arouse feelings in us (see Matravers 2003 for discussion).

Expression theory may come to the aid of the arousal theorist here. Recent formulations (Nussbaum 2007; Noordhof 2008; Molnar-Szakacs and Overy 2009; Cochrane 2010) have appealed to mental simulation, a general cognitive mechanism that allows us to judge the mental states of others. According to simulation theory, we empathize with others by imaginatively taking on their mental or behavioural attributes, allowing our cognitive faculties to process these attributes as if they were our own, generating an output state that is then attributed to the other. Simulation theories are currently in vogue due to various strands of evidence suggesting that when we observe the behaviours of others, we tend to activate similar systems as when undergoing the same behaviours ourselves (see especially Goldman 2006 for a review). The theory has been further boosted by the discovery of 'mirror neurons' which fire both when observing an action and engaging in it oneself. These neurons were initially observed in the brains of macaque monkeys and were long expected to exist in human brains as well until they were finally directly observed (Mukamel et al. 2010). They seem to provide a direct means by which one's own mental states can be used to track the similar mental states of others.

In the simulation version of expression theory then, the listener is supposed to mirror certain features of the music as if those features are attributes of a person undergoing an emotional state. This compares to the arousal theorist's claim that one utilize one's own feeling in the recognition of emotions in music. The crucial difference is that the simulation process is initiated by replicating certain attributes of the target and is geared throughout towards the goal of attributing properties to that target by a (probably automatic) process of projection. It is the empathic goal of the process which requires that the simulated mental state be held 'offline', that is, inhibited from triggering overt behaviours or altering one's beliefs about one's self. Given that the simulated feeling is still *felt* however, it may be compatible with Matravers' appeal to attenuated feelings.

So what are the attributes of the music that the listener mirrors? Here, the expression theorist can appeal also to resemblance theory by claiming that the listener mirrors the

expressive gestures that the music resembles, generating neural models of those gestures and/or subtle bodily movements. This allows the feelings correlated with those gestures (either the feelings of the behaviours themselves or associated inner feelings) to be triggered which are then projectively attributed to the music.[4]

Now the account of musical *experience* most associated with expression theory is one that seems appropriate for a mechanism that has evolved to empathize with other people. This is the persona theory, a sub-variety of expression theory which states that we imagine (perhaps quite automatically) a person as responsible in some way for the emotion perceived in the music (e.g. Levinson 2005; Robinson 2005). However persona theory is accused of placing overly complex demands on the listening experience, while some philosophers claim that they can hear musical works as expressive without any sense of a person. For instance, Noordhof (2008) employs simulation theory while also denying that we imagine a persona, appealing instead to the imagination of 'an emotion-guided creative process'. That is, we imagine how an act of emotional expression *could* have resulted in the music that we hear without imagining a person actually expressing their emotion.

In general it seems that even if we agree upon the causal process supporting judgements of musical expressivity, there are still various ways to construe the experience. Yet one way to respond to this disagreement may be to deny that there is just one essential way in which emotions are experienced in connection to music. For if we suppose that a complex causal process like that implicated in simulation theory is true—involving resemblance, simulated arousal and projective perception—why not allow that the subject may shift their attention to different aspects of this causal process? They may experience the resemblance, or a sense of personal arousal, or a sense that a person has produced the music. One way or another, a listener has been caused to get a sense of emotion while listening to music. How exactly the two combine in experience may at least partially depend on how aware they are of the causal process responsible.

Alternatively, if as is demanded by simulation theory, the listener is required to imaginatively engage with the music, then that imaginative act might be elaborated in a number of ways. Even limiting oneself to persona theory, how the persona is identified may vary widely. The listener can attribute the emotion heard in the music to themselves, the composer, the performer or some purely imaginary person. They can imagine that the music somehow embodies the person (as in Trivedi's 2001 account) or that it emanates from them in some *sui generis* way (as in Levinson 2005). They can centrally imagine introspecting upon this musical emotion (as in Walton 1997), or imagine a person interacting with an environment that impacts upon them (as in Nussbaum 2007). If we embrace such variations, it may also be possible to establish contextual factors that encourage listeners to have one particular sort of experience rather than another. For instance, an experienced performer of the work in question might be more likely to imagine themselves as responsible for the emotion in the music. The cognitive sciences are in a position to confirm or deny whether such variations obtain and what, if any, conditions influence our experience one way or the other.

2. Musical Arousal

Let us turn now to the issue of musical arousal. In a recent target article in *Brain and Behavioural Sciences*, Juslin and Vastfjäll (2008) outline seven distinct mechanisms by which music may arouse emotion, providing empirical evidence and investigative hypotheses for each. The mechanisms they identify are, briefly; 1) cognitive appraisal, in which one evaluates how the music impacts upon one's goals (i.e. whether it is a pleasing perfor-

mance or not); 2) brain stem reflexes, whereby the sheer nature of the sound triggers an immediate instinctual reaction in the manner of an animal alarm call; 3) evaluative conditioning, whereby repeated (perhaps unconsciously perceived) pairings between the music and certain events trigger emotions according to the nature of the paired event; 4) emotional contagion, in which the listener automatically mirrors the emotion expressed by the music; 5) visual imagery, whereby the music causes the listener to imagine a scene which triggers an emotion; 6) episodic memory, in which the music reminds the listener of a particular past occasion (known as the 'darling they're playing our tune' effect) and; 7) musical expectancy, in which by violating or satisfying expectations the listener has about the way the music progresses, emotions are aroused.

Commentators on Juslin and Vastfjäll's paper also suggest additional options of; 8) rhythmic entrainment, in which one is automatically lead to move along to the music, affecting one's emotional state (576); 9) a sense of synchronization or bonding with the composer or other listeners leading to emotion (579); 10) semantic meaning, whereby the music is conventionally associated with certain emotionally moving meanings, e.g. a national anthem (580) and; 11) the mere exposure effect, whereby, all else being equal, we tend to prefer stimuli with which we are more familiar (589, 595).[5]

Whether or not we endorse the exact way our responses are categorized above, there seems to be a myriad of means by which music can arouse emotions. The issue of concern to philosophers however is whether any of these means are in fact relevant to the aesthetic appreciation of music. As Jenefer Robinson notes (2008: 593), most of the mechanisms to which Juslin and Vastfjäll refer merely involve music as part of the causal stimulus for an emotion rather than its intentional object. In these cases the intentional object of the listener's emotion is really the associated stimuli (the visual scene, the primitive danger linked to the animal call, the past romantic experience and so on). In the same way, Peter Kivy (1990, 1999) has repeatedly claimed that without the listener making such subjectively variable associations, the music itself is unable to arouse the emotions of which it is expressive (he refers in particular to the 'garden variety' emotions such as fear, anger, happiness, sadness and the like). Similarly, Nick Zangwill (2004) takes the line that it is entirely extrinsic to musical appreciation that it arouse emotions (though one can certainly take *pleasure* in the music). The reason for their scepticism is again the abstract nature of the musical stimuli. Since no situation is presented in instrumental music that impacts, even fictionally, upon one's well-being, any emotion aroused within a music listening context could not take the music itself as its object.

This kind of sceptical argument potentially undermines any experimental evidence purporting to show that listeners are emotionally aroused by the expressive qualities of music. For instance, in a study by Carol Krumhansl (1997) listeners reported the arousal of everyday emotions in response to those same emotions expressed in the music, and moreover showed various signs of physiological arousal.[6] However, as noted by both Kivy (2006) and psychologist Vladimir Konečni (2008) listeners were only given the opportunity to report on a fixed list of possible emotional responses, so their responses may have been biassed towards reporting emotions rather than other states. Moreover, it is possible that listeners confused their aroused response with the emotions expressed.

What a sceptic like Kivy demands for refutation is that listeners freely report the arousal of emotions, or show physiological changes that are sufficient for, and consistent *only with* the arousal of emotions matching the garden variety emotions expressed in the music (Kivy 2006: 314). In addition, it must be established that listeners are paying proper attention to the music itself and are not distracted by personal associations. Ensuring suffi-

cient focus on the part of the listener presents a significant challenge because while one might give listeners various tasks during an experiment that force them to attend closely to the music, such tasks may at the same time inhibit or overly influence the desired musical arousal of emotions. Given also that we currently lack unambiguous ways to detect specific emotions with physiological and neural measures, experimenters must generally trust listener self reports.

Perhaps the kind of rigorous evidence required by the philosophers will eventually be supplied by cognitive scientists. In the meantime however, we can more closely investigate two means to arousal by music that might potentially satisfy the sceptic's demand that our emotional responses are focused on the music itself.

MUSICAL EXPECTATIONS

The mechanism of musical expectations was first systematically outlined in Leonard B. Meyer's pioneering study *Emotion and Meaning in Music* (1956), though his goal was to use listener arousal to explain musical expressiveness.[7] Meyer claims that our stylistic expectations about the music are skillfully manipulated by the composer, arousing feelings of tension as our expectations are raised or frustrated, and relief as they are finally satisfied. Increases in tension (measured by electrodermal activity) due to unexpected harmonies have been confirmed in Steinbeis et al. (2006). Meyer's theory has also been notably elaborated by David Huron (2006) who appeals to the statistical frequencies with which we are acquainted with various musical features, as well as a more detailed model of the ways that expectation may influence the arousal of emotions.

Expectations have also been implicated in one of the most striking cases of musical arousal, which is the sense of chills (also known as 'frisson' or 'shivers down the spine'). The subjective feeling of chills has been correlated with a piloerection response (hairs standing on end) elicited by 'unexpected' changes in the music (Sloboda and Juslin 2001: 91; Huron 2006: 33–35; Grewe 2009). A well-known fMRI study by Blood and Zatorre (2001) also shows reliable activations in neural centres associated with reward. Given this connection to reward however, it is unclear whether chills are stimulated by musical events that 'shock' the listener at some level, or whether the anticipation of certain dramatic changes triggers a sense of reward when they occur. In most experimental studies, listeners respond with chills to their own preferred piece of music, and not those selected by others.[8] This suggests that familiarity with a piece of music (as well as preference) plays a significant role.

In general, the claim that expectations can generate arousal is noteworthy because it seems only to require close attention to the structural properties of the music. One feels patterns of tension and release, or surprise and satisfaction simply in virtue of attending to the music itself. Two concerns remain however: first it is not clear whether a phenomenon such as chills really counts as an emotion so much as a sensational pleasure. The same may apply to tension and release more generally; they may lack the intentional meaning demanded of emotions. Second, this kind of arousal will not refute Kivy's denial that the music arouse emotions of which it is expressive. Being surprised by a piece of music does not entail that the music expresses surprise, and in general the subjective variability of our expectations concerning the music indicate that emotions relying on these expectations would not track the intersubjectively stable expressive features of the music.

Nevertheless if it could be shown that patterns of tension and release, or even the sense of chills are at least sometimes reliably evoked in listeners, *and* that these feelings serve the capacity to detect expressive features of the music, then we would have a case of musical arousal that is essential to the aesthetic appreciation of the music itself.

EMOTIONAL CONTAGION

As noted above with regards to simulation theories of musical expressivity, it has been suggested that we employ our emotion arousal mechanisms to perform offline simulations of the emotional features of the music. It is possible that such simulations may on occasion go 'online', arousing the listener with the full blooded emotional state. Stephen Davies (forthcoming) makes a comparable appeal to 'attentional contagion'. As he notes, emotional contagion typically involves the unconscious mirroring of another's emotion, but it seems quite possible that the listener be aware that his or her emotional arousal tracks the expressive qualities of the music and is simply not inclined to inhibit its flourishing as a full emotion. Of course, this does not settle the problem that the music has not represented any situation for one to have an emotion about. So in what sense would the uninhibited mirrored feeling count as an emotion?

One possible response here would be to question whether it is indeed the case that an intentional object is always necessary for an emotion. If a simulated feeling is sufficient to identify some specific emotion in the music (or in another person) despite being unaware of an intentional object, perhaps the full-blooded arousal of the same feeling in the listener could be sufficient for a specific emotion. Alternatively, we may appeal to the arousal of moods. Both Jenefer Robinson (2005) and Noël Carroll (2003) have suggested that by means of such contagious entrainment, music may arouse moods, which they claim, differ from emotions with regards to lacking an intentional object. Robinson also suggests that listeners may cognitively monitor their feelings and supply a more specific interpretation of the feeling for themselves. This however would not satisfy the Kivy type demand to avoid subjective associations. In addition, Zangwill (2004) has rejected the appeal to moods by arguing that such directionless states would still not be about the music, and thereby not aesthetically relevant to appreciating the music itself (though he grants that some music may be deliberately tailored to arouse such moods).

Another possibility would be to reject the idea that moods lack intentional objects, particularly since such a feature would reject the widely held view that 'intentionality is the mark of the mental', but retain the assertion that no specific intentional object is required because moods are about *everything* rather than nothing; they are about how one's life is going in general (cf. Prinz 2004). In this case, moods should be understood as a sub-class of emotions that have a distinctively broad intentional content, rather than as a separate class of affective state. Thus if a listener is emotionally aroused by a general sense of say, sadness, that matches that expressed by the music, this could be understood as the listener feeling in sympathetic resonance with an attitude expressed by the music towards life, or the world in general. Moreover, if one adopts the persona theory of musical experience, one's emotional experience could be construed as a sense of sympathy with the musical persona. One has a sense that the musical persona has expressed a vivid sense of what sadness is like, and one *endorses* that emotion with one's own matching state. That is, one affirms that sadness is a legitimate attitude to take towards life in general (this seems comparable to the 'sense of synchronization' route to musical arousal mentioned above). This seems to have sufficient intentional content for an emotion, and does not seem to distract from one's appreciation of the music itself, which one feels has captured some profound aspect of life.

Finally, it is worth noting that we might simply reject the demand that the proper aesthetic appreciation of the music requires that we only pay attention to the music itself, and scorn all associative thinking as mere distraction. Musical works do not exist in a vacuum but are produced within a historical and social context; an awareness of which may

legitimately contribute to the intentional content of an emotional experience concerning the music in a broader sense. While Kivy's 'enhanced' formalism enjoins us to concentrate on the purely musical properties of works while also recognizing their special expressive powers, I am less inclined to exclude the everyday imaginative activities of ordinary listeners, so long as they are ultimately centred on the music. This seems comparable to the way other forms of art can inspire ideas and associations. By making connections to associated experiences, we appreciate the relevance of the music across time and circumstance. Moreover, Kivy agrees that our concentration is liable to flag when attending only to the formal features of the music (2006: 308). It is somewhat amusing to imagine the formalist constantly fighting off those troublesome images appearing unbidden in his head. But if we want to account for the aesthetic meaning of musical experiences, and particularly when utilizing data from the cognitive sciences, it may be as well to seek some kind of reflective equilibrium between how listeners do in fact respond to music, and what seems to be conceptually essential.

Short Biography

Tom Cochrane holds a BA in philosophy from University College London, an MA in music composition from Birmingham Conservatoire and a PhD in philosophy from the University of Nottingham. His thesis, supervised by Gregory Currie, was entitled 'Shared Emotions in Music' and argued for the possibility that several musicians literally share a single mental state when performing music together. He is currently a postdoctoral research fellow at the Swiss Center for Affective Sciences, University of Geneva, where until May 2010 he worked for the focus on 'Aesthetic Emotions' and is now working for an international project researching emotional entrainment between musicians called 'Social Interaction and Entrainment using Music Performance Experimentation (SIEMPRE). In September 2010, he will begin a individual project at the Sonic Arts Research Centre, Queen's University Belfast called 'The Mood Organ: putting theories of musical expression into practice'. His research interests generally concern the link between art and mind with a particular focus on music, emotion and extended/embodied cognition. He has published articles on these subjects in the *British Journal of Aesthetics*, *The Journal of Aesthetics and Art Criticism* and the *Australasian Journal of Philosophy*.

Notes

⋆ Correspondence: Tom Cochrane, Swiss Center for Affective Sciences, University of Geneva, 7 Rue des Battoirs, CH-1205 Genève, Switzerland. Email: thomas.cochrane@gmail.com.

[1] As large edited collections such as Juslin and Sloboda's, *Music and Emotion. Theory and Research* (recently revised and expanded) will attest. There have also been two recent UK projects on the relation between aesthetics and cognitive science; 'Aesthetic Perception and Cognition: Towards an Aesthetic Psychology' led by Peter Goldie and Elizabeth Schellekens and 'Method in philosophical aesthetics: the challenge from the sciences' led by Gregory Currie, Aaron Meskin and Mathew Kieran. See references for internet links.

2 The terminology of 'expressiveness' or 'expressivity' is typically used for the case of music, where it is preferable to retain 'expression' for cases in which an agent reveals an emotional state, deliberately or not. See Robinson (2007) for discussion.

[3] For a more detailed account of these alternatives see the *Philosophy Compass* article 'Musical Expressiveness' by Derek Matravers (2007).

[4] This would require an account of how sound events can be translated by the listener into behavioural gestures that are then directly mirrored. See Cochrane 2010; as well as Davies 1994 for detailed accounts, which again appeal to supporting empirical data.

[5] Juslin and Vastfjäll resist recognizing these additional options as distinctive mechanisms however.

[6] Robinson (2005) in particular draws on this experiment in support of her claim that music can arouse emotions.
[7] It is worth noting that Meyer later updated his theory to allow that expectations may be founded upon a sense of 'ethos' (1976/2000), a more immediately conveyed emotional atmosphere reminiscent of the resemblance theory.
[8] Konečni (2008) reports an experiment in which multiple listeners felt chills in response to the end of Rachmaninoff's 2nd piano concerto, though he did not detect significant changes in mood as a consequence of experiencing chills and so casts doubt on their psychological significance.

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