

Music and science: three views

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Three views of music

In this paper I want to consider the relevance and utility of science for our understandings of music and the opinions and beliefs that have been held about that relevance and utility. I shall start by outlining three possible definitions of music as it exists in our perceptions, productions and creations. They are self-evidently not the only possible definitions, but I would suggest that they constitute three extreme loci between which can be positioned many of the views that have been held - and are held - about what music is or can be.

(i) Music is *out there*, it is a necessary consequence of the operation of physical laws that we can specify and hence employ to predict what music might be. In this view, our sensitivities to music are sensitivities of the same order as our sensitivities to shape, form, colour or intensity. Hence the materials of music are “given” by nature, and the sounds and structures that we employ and experience in music are wholly determined by the physical facts that underlie them. This we can call the **physicalist** position.

(ii) Music, *per se*, does not exist as any sort of physical reality. The concept “music” has a purely instrumental utility if it can be said to have any at all. It can be held to arise because of the human capacity to endow with meaning the contingent phenomena of the material world and of human discourse and interaction. The only humanly-shared characteristic that can be postulated in this view is a meaning-seeking capacity, which enables complex events to be identified as music and behaviours linked to that identification to be construed as having intentionality in respect of something that can be termed “music”. This can be taken as an extreme account of a deconstructionist position, in which music does not exist out there but is constructed and indeed constituted by social interaction and discourse which is impenetrable by scientific means of enquiry; I shall refer to this view as the **immanentist** position.

(iii) Music is itself a product of cultural convention and of the facts of embodiment, being instantiated in the cognitions of the members of a culture. A culture - a group of humans who share similar needs, environments, concerns and values - identifies and selects regularities of the world of sound and of the human sensitivity to sound, and to the production of sound, in time, or inherits and modifies such a selection. It does this by conferring value on, codifying (not necessarily in any written form) and transmitting sets of principles of organisation, or of organised action, that enable members of the culture to share more-or-less abstract representations of musical events or phenomena (I won't say “works”), or that constitute specifications for actions that are held to be musical. These abstract representations are shared to different degrees by

members of the culture, who have, as with language, *de natura* the capacity to comprehend and to use music; the abstract representations are thus stable, but are also subject to change, by processes of cultural selection operating on the results of differential individual sensitivities to aspects of them. The structure and function of these abstract representations, of their instantiations in cognition and in the material correlates of that instantiation in terms of musical behaviours, musical sound and neural activity, are susceptible to scientific explanation. I shall refer to this view as the **cognitivist** position.

Physicalism

The **physicalist** view would appear to be the paradigmatic scientific view of music. Within it, music is determinately comprehensible in the way that physics is comprehensible (at least, to some people). If the physicalist view were to hold then there would be no question of science's efficacy for understanding music - music would simply be subsumed by physical science.

But in many respects the physicalist view is problematic. It is very difficult to find any instance of its explicit avowal in the current literature, although as an historical phenomenon it is much more evident (as, for instance, in the underpinnings of Rameau's *Traitée* - at least, after D'Alembert had corrected Rameau's misunderstandings of the physics of the time). Its traces do still pervade much current musicological thinking and writing about tonal music, if only peripherally; a typical instance is Rosen's brief homage to the harmonic series as the "premise" of tonal harmony on p23 of the introduction to his "The Classical Style". Similarly, those writers on electroacoustic music who invoke the framework of "Acousmatics" to account for the subjects of their discourse - which draws on Pierre Schaeffer's doctrine of "sound morphology", the idea that sounds have identities and relations that can be accounted for in terms of their intrinsic structure (for an introduction, see Manning, 1993) - appear to be adhering to an implicitly physicalist view.

The possibility of holding an extreme physicalist notion that the materials of music are wholly *given* by nature is undermined not only by its elusiveness in the current literature, but also by the fact that it's largely **wrong**. In the extreme form that I am depicting, physicalism would rely on a sort of Locke-ian "Direct Realism", a direct, one-to-one correspondence between objects and events in the physical world and our sensations and perceptions. This is simply untenable in the light of our current understandings of the operation of our sensory systems. While much of the substantive nature of our perceptions is relatable to physical properties of the objects and events that we encounter in the physical

world, it is not simply predictable from knowledge of those physical properties. Moreover, the idea that the sounds and structures that we employ and experience in music are wholly determined by the physical facts that underlie them is somewhat controverted by the diversity of musics that have succeeded one another through our own history or that co-exist at present; if music were predicated solely on physical fact, one would expect to find little diversity or change.

Immanentism

The unfeasibility of the **physicalist** view would seem to deny science at least some of its efficacy as a means for understanding music - at least, if science is to be construed solely as physics. The **immanentist** view, on the other hand - wherein music has no physical reality or locus but is constituted and inferred from the human capacity to endow with meaning the contingent phenomena of the material world and of human interaction - appears to deny all science any efficacy in respect of music: and, unlike the physicalist view, the immanentist view seems to pervade current musicological thinking and writing.

Explicit rejections of science, or of the premises of science, as having any utility for understanding music are to be found in many musico-philosophical sources. For example, Scruton (1983, p87) straightforwardly rejects the possibility of scientific accounts of music because “science deals with the material, and music, being intentional, is not material”. A recent article by Johnson (1997) is less bald but seems equally dismissive of the utility for understanding music of one of the primary features that is usually claimed for science, the idea that it deals with the actualities of the physical world. In proposing the development of a performance-based analysis that should incorporate “fantasy”, Johnson states that “there is no genuine absolute, no given that is not ideological in origin, hence no understanding [of a piece of music] except in terms of interpretation”.

Perhaps the most explicit, and certainly the most articulately informed, attempt to repel the embrace of science from an apparently immanentist perspective has come from Nicholas Cook. In his book “Music, Imagination and Culture” (Cook, 1990) he situates music scrupulously within culture, rejects the applicability of scientific methods to music in favour of what he terms “mythopoeic explanation” because:

“It is by virtue of being internal to a culture that mythopoeic explanation is the opposite of scientific explanation...[because] one of the defining aims of a scientific explanation is to achieve a generality and a validity that transcends the bounds of any given culture.”

Cook arrives at this conclusion by a variety of routes, which to me appear to derive from one primary consideration: that a scientific approach to music involves a reductionism that is antithetical to the nature of music as experienced. He flatly rejects an atomistic account of the “basic units” of music, and goes on to discount the utility of the study of music cognition, suggesting that what it deals with is simply not the stuff of musical experience. He asserts that:

“when we speak of combinations of pitches or intervals, we are not speaking of any psychoacoustical reality...we are modelling the experience of music in terms of the musicological categories embodied in ear training”

The fact that Cook does acknowledge a role for “intersubjective representations” in underpinning musical cultures appears to hint at a position compatible with cognitivism. However, Cook, in identifying these intersubjective representations as ways of thinking or talking about music, orients himself towards the immanentist view in holding that all such discourse consists of metaphors that cannot be considered as being “explanatory in any scientific sense”, a view also held by Scruton; in other words, Cook holds that culture-bound discourse is of a different order from scientific discourse, that the two are incommensurable, and hence science can never play a role within music theory.

So, of the three views outlined at the outset, the first, the **physicalist**, appears not only unfashionable but unfeasible, while the second, the **immanentist**, is seemingly ubiquitous and unanimous in its proscription of not only physical science but also cognitive science as being legitimate ways of knowing music. They are proscribed because they aspire to a generality that renders them incompatible with the “mythopoeic explanations” that are required of cultural phenomena such as music, or because they rely on the absolute and “there is no genuine absolute, no given that is not ideological in origin”, or because they “deal with the material, and music, being intentional, is not material”. Where does that leave the third view, the **cognitivist** position? Before addressing that point, I wish to reflect a little on the nature of science in an attempt to evaluate whether or not it has justly been condemned as unsuitable by the immanentists.

Conceptions of science

Most of the objections that the immanentists raise to the application of science to music appear to me to derive from an idea of science that is squarely located within the logical positivist tradition. In that tradition, science is concerned with the verifiable, and its methods, structures and theories can be evaluated by the application of the rules of logic. An alternative approach relies not on the idea of verification but of falsification; this derives from the idea that while it is

never possible to verify a scientific proposition (as this would require testing all possible instances of its application), at least it appears feasible to falsify it, thus narrowing down the range of possible scientific propositions (for a brief overview see Brown, 1977). However, theories of science of the last thirty years locate its methods and theories firmly within the social domain; in one interpretation of the work of Kuhn (1970), it is the consensus of workers in the discipline of science that determines at any given time what can constitute science, a consensus that may change and that is shaped by the ideologies and dynamics that predominate within the specific culture to which the scientific workers belong.

Nevertheless, the societal account of science is problematic; how can science be differentiated from other forms of social activity and enquiry, and can the societal account be reconciled with the generality and power that science is held to possess? A compelling answer to these problems is provided by Lakatos (1970) who develops the idea of falsificationism in the construction of a view of scientific enquiry that embraces societal factors while avoiding the relativism that pervades the Kuhnian perspective.

Lakatos proposes an account that seems to reflect the sorts of processes that characterise the actual conduct of science. This account is based on what he calls “sophisticated methodological falsificationism”; in it, a distinction is drawn between the “core components” of a scientific theory - which are resistant to change, and for which experiments may seek confirmation rather than falsification - and “auxiliary hypotheses”, which are more open to question and alteration in the light of empirical data. The focus in his account is on series - and auxiliary elements - of scientific theories, and the ways in which these can be tested. In his view, what constitutes scientific knowledge is a theory or body of theories that is dynamic (in that it can and will change), and that constitutes science so long as its theories and observation statements (facts) remain consonant and so long as any changes in the body of the theories lead to the prediction of novel facts. Science proceeds in the form of research programmes that constitute sustained adherence to and testing of bodies of scientific theory and auxiliary hypotheses, and are subject to progressive change in the light of empirical evidence that is most likely to manifest itself at the level of the auxiliary hypotheses. Sufficient weight of evidence combines with sufficient weight of change in the background of the bodies of scientific theory to enforce a change in what constitutes the core components of the body of theory. Thus the influence of societal factors is integrated into a model of scientific understanding that is rooted in a falsificationism that need be no more than instrumental to account for science’s generality and predictive power; an account of science that acknowledges both the social actuality of what is done in the name of science and the requirements of rationality is achievable.

This account of science seems to dispose of many of the objections of the immanentists; if science is in part determined by societal factors, is “internal to a culture”, then it is no less available for cultural exegesis than any other “mythopoeic” level of explanation. Moreover, the requirement that those phenomena that constitute its empirical evidence are observable is no hindrance to its application to the intentional sphere, while its provisional and dynamic nature is not dissonant with the idea that “there are no genuine absolutes”.

Cognitivism

So where does that leave the **cognitivist** position? It seems that the objections to the application of scientific method to music can largely be discounted, but we have not yet specified any positive gains from applying science to music, nor have we accounted for the choice of a cognitivist (rather than, say, a sociological) position.

As we have seen, the positivistic physicalist approach suffers from severe limitations when applied to music. It seems that if we are to apply science to music, that science must be capable of elucidating the intentional as much as the material. It should be consonant with our intuitions about the cultural matrix within which music is formed, and should enhance our understanding of music as process, object and experience. An explanation of acoustical actuality does not suffice to account for musical experience; even an account at the psychoacoustical level - focusing on the ways in which acoustical information is transformed into sense-data - can at best only describe some of the constraints on that experience. If science is to be applied fruitfully to music it must be in the form of a cognitive-scientific research programme, which would involve the scientific study of all aspects of the musical mind and of musical behaviour at all achievable levels of explanation - in terms of neurophysiology, psychoacoustics, cognitive psychology and cultural psychology - by theoretical and empirical inquiry, and by means of theoretical and formal modelling and by practical experiment.

To reiterate the earlier definition: from the cognitivist perspective music is a product of cultural convention and of the facts of embodiment, being instantiated in the cognitions of the members of a culture. A culture - a group of humans who share similar needs, environments, concerns and values - identifies and selects regularities of the world of sound and of the human sensitivity to sound - and to the production of sound - in time, or inherits and modifies such a selection. It does this by conferring value on, codifying (not necessarily in any written form) and transmitting sets of principles of organisation, or of organised action, that enable members of the culture to share

more-or-less abstract representations of musical events or phenomena, or that constitute specifications for actions that are held to be musical. These abstract representations are shared to different degrees by members of the culture, who have, as with language, *de natura* the capacity to comprehend and to use music; the abstract representations are thus stable, but are also subject to change, by processes of cultural selection operating on the results of differential individual sensitivities to aspects of them. The structure and function of these abstract representations, of their instantiations in cognition and in the material correlates of that instantiation, in terms of musical behaviours, musical sound and neural activity, are susceptible to scientific explanation.

The adoption of a cognitivist view, entailing the application of cognitive science to music, constitutes an attempt to make explicit connections between music-as-experienced and the discourse through which we describe it and teach it, connections that derive their strength from their origins in lawful, generalisable and predictive accounts of how our cognitive plasticities and fixities enable us to be in the world and to interact in the world. The application of cognitive science to music offers the possibility of gaining insight into the dynamics of what Bruner (1990) has called “the forms of logical and narrative explication” that shape minds within cultures. These dynamics are usually not consciously known and may not be consciously-knowable, but may be unravelled and determined by means that are often oblique but which are centred on cognitive-scientific method that is sensitively and imaginatively applied (as I have argued elsewhere, see Cross & Deliège, 1993). Instances of such an insightful application can be found in the work of Simha Arom (1976) in his elucidation of the generative processes underlying the polyphony of the Aka peoples of Central Africa, or of Christopher Longuet-Higgins (1987) in his comprehensive account of the dynamics of tonal-harmonic music. (It should be noted that Longuet-Higgins in fact coined the very term “cognitive sciences”).

Of course, the possibility that cognitive science may afford us such insights does not mean that it has already done so in any comprehensive way; we have barely begun to scratch the surface. And much of what has been done is open to criticism on a number of grounds. But that criticism is beginning to be subsumed into the practice of the cognitive sciences of music, to direct it, shape it and continually to test its findings, theories and relevance. For a certain atmosphere of scepticism, combined with a willingness to accept criticism and to respond constructively to it is a necessary concomitant of the successful conduct of science.

Let me end by using science to make a claim about music, perhaps the most important that can be made about music - that music is a necessary concomitant of being human. For a recent essay in the prehistory of cognition by Steve

Mithen has thrown open this intriguing possibility. In his book “The prehistory of the mind” (1996) he suggests that the nature of the human mind - that of homo sapiens sapiens, our own species - is structurally different from that of its archaic human predecessors, homo erectus and homo sapiens neanderthalensis. That difference inheres, Mithen suggests, in the developmental tendency of human infants to go through processes of what Karmiloff-Smith has defined as “representational redescription” - processes of forming links between - and integrating - domain-specific capacities that result in the emergence of new, domain-independent representations and competences. According to Mithen, it is the emergence of these new “supra-domain” cognitive capacities that distinguishes modern humans from their archaic predecessors.

Now, *if*, as Blacking (1995) suggests, “musical ability [is] a general characteristic of the human species rather than a rare talent”, and *if*, as Graeme Lawson (personal communication) has suggested, music does not appear to have been among the competencies of homo neanderthalensis but is likely to have arisen with homo sapiens sapiens, and *if*, as Hanus Papousek (1996) suggests, the precursors of musical capacities are universally present:

Then it can be postulated that one function of such precursors of musical capacity is to facilitate processes of representational redescription, to provide non-goal-directed means of integrating information and exercising competences across modalities and domains. These precursors of musical capacity are characterisable as undirected play, as the exercise of spatio-temporal movement sequences that are not directed towards overt ends, as the repetition and variation of sets of sounds and movements associable with, but not directly interpretable as, acts and signs of communication and intentionality. The precursors of music become adapted to the structures and functions of the music of the child’s culture in the course of her development (see M. Papousek, 1996), and can come to play a significant role in the child’s interactions with and accommodations to the vicissitudes of “being-in-the-world” as a member of her culture.

In other words, music, I would suggest, can be held to have subserved a direct adaptive function in human evolution. At the very least, it - in the form of its developmental precursors - may have contributed to the emergence of one of our most distinguishing features, our cognitive flexibility. At the most, it may have been the single necessary factor that enabled representational redescription to evolve. In other words, through an application of science to music - through adopting a cognitivist stance - it becomes possible to make the claim that **it is only through music that we have become human.**

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