Music and meaning, ambiguity and evolution

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Humans as animals

From a biological perspective humans are unusual animals. Not only are we the single truly bipedal mammal, we have brains that are much larger than would be warranted by our body size. It seems reasonable to assume that this large brain comes together with the immense cognitive flexibility that humans possess, a flexibility that enables us to manipulate our environments in extraordinarily complex ways. This cognitive flexibility is not the only attribute that appears to mark us out from all other species. Humans are also capable of an immense social flexibility; the ways in which we can interact with others are extremely diverse and can be immensely sophisticated. Some of this capacity for diversity of social interaction we share with our nearest evolutionary neighbours, the apes; indeed a close correlation between degree of social flexibility and the size of the neocortex in the brain has been found across the primate and hominid lineages (see Dunbar, 1992)).

But perhaps the most salient and unique feature of humans that seems to underlie our cognitive and social flexibility is the capacity to communicate in language, whether spoken, signed or written. While other species are self-evidently able to communicate with other members of the same species by sound, sight, touch or smell, only humans have the capacity to communicate to each other information about complex states of affairs in the material and social worlds. Despite the best efforts of researchers over the last thirty-odd years, neither chimpanzees nor bonobos, our closest evolutionary relatives, seem capable of employing communicative media to express their perceptions, desires, intentions or attitudes with the level of syntactic and semantic sophistication that seems to be naturally acquired by an average five year old human child (see Conway & Christiansen, 2001).

The human capacity to communicate through language is perhaps the one unique marker that differentiates us from all other species, and it is natural to think of this capacity as intrinsic to our cognitive and social flexibilities. Communication through language, enabling complex and useful information to be represented and exchanged, seems to be the principal guarantor of our intellectual powers and of our cultural complexities, features that are likely to have had considerable potency in enabling humans to have emerged as a highly successful species over the 200,000 years or so in which modern humans have been in existence. In other words, it is highly probable that language, in enabling and sustaining our cognitive and social proficiency, was an adaptive factor in human evolution (see Pinker, 1994)); it enabled humans, individually and in groups, to communicate useful and accurate information to each other and hence to survive and reproduce in situations where other species could not.

Like language, music can also be conceived of as a communicative medium; indeed, both seem to fit equally well within a widely used theoretical model of communication, the 'information theory' model of Shannon and Weaver (1949). In this model a sender makes use of a channel to send information to a receiver; the sender and receiver can be any type of entity, the channel can be constituted of any medium, and the information that is sent may take any form. In a musical context, one can think of the sender as the performer, the receiver as the listener, the channel as the air and the information transmitted is the sonic patterns that constitute the music. Analogously, in language, the sender is the speaker, the receiver is the

listener, the channel is the air, and the information sent is the patterned fluctuations of air pressure that constitute the sound of speech. The model seems to provide a basis for considering music and language to be analogous systems of communication, setting aside for the moment the nature of the information that is communicated.

But while this model seems to fit most instances of language use quite well (and perhaps fits all instances of animal communication, see Seyfarth and Cheney, 2003), it is not clear that it is so generally applicable to music. Although in perhaps most musical situations in contemporary western global culture, it is easy to categorise participants as sender or receiver, performer or listener, there are many musical situations which may not yield such clear distinctions. The members, say, of a recreational choir, or of an amateur rock band, may rarely if ever fulfil the role of performer; for them, music may be more a medium for participatory interaction where all are equally and simultaneously performers and listeners than a medium for display, for communication of musical information to 'passive' listeners. Moreover, the interaction is likely to take the form of synchronous and synchronised sound patterns and behaviours rather than the asynchronous and alternating sonic sequences that are typical of speech. Similarly, if we look to non-western musical practices, many seem to have as their raison d'être not the transmission of musical information from active performer to passive listener but collective engagement in the synchronous production and perception of complex patterns of sounds and movement (see Arom, 1991; Blacking, 1976). Music in these guises does not seem as easily assimilable as is language into the model of communication provided by information theory.

Music

So where does this leave music? Is it, to quote Steven Pinker (Pinker, 1997), simply 'auditory cheesecake', a human faculty that pretends to communicate but that is more or less parasitic on many of the abilities that underlie language and that has no real function other than to tickle the senses? Is music merely an opportunistic and non-adaptive exploitation for solely pleasurable purposes of capacities to communicate that have arisen in humans through evolutionary processes for the serious business of survival? It has been argued by Miller (2000) that music was in fact an adaptive factor in human evolution, playing a role in processes of sexual selection through the opportunities it afforded for the communicative display by performers of the 'protean' or unpredictable intellectual and social attributes that rendered them and their offspring more likely to survive in an uncertain world. However, this view, and that of Pinker, both rely on the 'conventional' idea of music as requiring participants to fulfil roles of performer and listener, and as we have seen this does not appear to be generally applicable to all manifestations of music. If we are to understand music as a communicative medium it seems that we must look beyond the notion that music exists as sonic information communicated from performer to listener, and it may be that we must also look beyond the model of communication provided by information theory.

For most musicologists and for almost all ethnomusicologists, music is not just sonic pattern. Music involves action and interaction. Indeed the structure of its sonic patterns may be as much determined by the actions that produce them as by any abstract considerations of sonic design, as both Baily (1985) and Nelson (2002) have shown is the case for, respectively, the music of the Afghan dutar and the

improvisation of blues guitar solos. In music, sound and action may be intrinsically interlinked, and action in music is, more often than not, a form of interaction that is typically expressed in terms of entrainment to some common temporal framework or pulse. In the western concert hall this fact is only overtly evident in the actions and interactions of the performers, but it is very likely that many audience members will covertly engage in surreptitious finger or foot tapping, conducting, or regular and expressive head and upper body movement that is entrained with the musical sound. Indeed, neurobiological evidence suggests that entrainment to a regular beat can equally be a conscious or a non-conscious process and the capacity to entrain to a pulse appears to be deeply embedded in our neural organisation (see Thaut, this volume). It should be noted that even were a member of the audience at a western concert to show no overt signs of movement, the *acquisition* of the capacity to listen and respond appropriately to concert music is likely to have involved movement, as we shall see. Moreover, Petr Janata and others (see Janata and Grafton, 2003) have shown that even 'passive' listening to music can involve activation of brain regions concerned with movement.

Outside the confines of the concert hall, the 'action' and 'interaction' dimensions of musical participation can be less covert and may be extremely ostentatious. Indeed, in many non-western contexts active and collective entrainment with the sonic structure of the musical sound seems to be as much a part of the music as is the structure of the sound itself, perhaps evidenced in the lack of distinction made in certain societies between what in the west might be separately categorised as music and as dance (Gourlay, 1984). The intelligibility of the sonic structure of music may even depend on its contextualisation in collective movement, as is evident in, for example, many of the musical practices of the *campesino* culture of Northern Potosí in Bolivia (see Stobart and Cross, 2000).

And finally, the issue of what - if anything - music is communicating must be addressed. Whereas in language it is usually possible to specify the subject of an utterance with some precision, this is almost never the case for music. Music appears to be a strangely malleable and flexible phenomenon. The meaning or significance of a musical behaviour or of a piece of music can rarely be pinned down unambiguously; music appears to be inherently ambiguous (see Kramer, 2003). As Langer (1942, p195) puts it '…music at its highest, though clearly a symbolic form, is an unconsummated symbol. Articulation is its life, but not assertion; expressiveness, not expression. The actual function of meaning, which calls for permanent contents, is not fulfilled; for the *assignment* of one rather than another possible meaning to each form is never explicitly made.' This ambiguity has been conceived of as valuable within social and political contexts. Lydia Goehr (1993, p187) suggests that 'music has no meaning to speak of, and hence can be used to envision an alternative culture and political order while escaping the scrutiny of the censor'; Devereux and LaBarre (1961, p369) propose that 'In addition to viewing art as a harmless safety valve, society and the artist alike consider the artistic utterance as *unrepudiable* in form but *repudiable* as to content...'. In effect, one and the same piece of music can bear quite different meanings for performer and listener, or for two different listeners; it might even bear multiple disparate meanings for a single listener or participant at a particular time. Music has a sort of 'floating intentionality' (the word 'intentionality' here simply means 'aboutness'); it can be thought of as gathering meaning from the contexts within which it happens and in turn contributing meaning to those contexts.

Music seems to be inherently ambiguous, yet it is intuitively plausible that music is a communicative medium. How, and what, then, is it communicating? In order to explore this it is necessary to consider whether or not the model of communication provided by information theory is in fact adequate to account for all aspects of human communication. This model postulates that information is sent to a receiver who decodes the information encoded in the message received. When applied to human linguistic communication, this requires a very close match between the capacities of the sender and of the receiver. The capacities of the sender and receiver must be similar enough for the receiver to be capable of all the processes that are necessary to decode the message accurately. In effect, this model presupposes that sender and receiver both possess a body of shared knowledge that will render the information that is communicated unambiguously intelligible. This seems to be a reasonable proposition in respect of language; one might expect that a speaker and a hearer belonging to the same language community might be bound by the same set of rules and conventions that they can both bring to bear so that the speaker's message is intelligibly decoded by the hearer.

Music and meaning

However, this model can be questioned, at the very least on the grounds that while a pool of mutual knowledge seems plausible, it can never be guaranteed, hence neither can the intelligibility of a linguistic message. Without the certainty of mutual knowledge there will always be a degree of ambiguity in linguistic communication. The exchange of a verbal message requires that inferences are made by the hearer as to the speaker's intended referent, and that inferences are made by the speaker in respect of the hearer's capacity to identify the speaker's intended referent. So, for example, the sentence 'This land belongs to the Duke of Sutherland' would have quite different import when spoken by the Duke's bailiff to a tenant farmer during the Highland Clearances in the nineteenth century and when spoken by a guide to a group of tourists visiting the north of Scotland in the present day. Sperber and Wilson (1986) have analysed the implications of this requirement for inference at length in developing a theory of *ostensive-inferential communication* in which a speaker is characterised as not simply broadcasting a message to a listener but as producing a stimulus that is intended to change the cognitive environment of a listener by seeking to achieve some degree of resemblance between a speaker's and hearer's thoughts (Sperber, 1996). This theory claims that human cognition is geared to the maximisation of *relevance*, defined by Sperber (ibid.) as a human 'tendency to optimize the effect-effort ratio' in any particular situation and hence minimise the cognitive load involved in processing the information that an individual encounters. For Sperber & Wilson, a presumption of relevance by both speaker and hearer is what frames and guides processes of inference in human linguistic communication and reduces the ambiguity inherent in a communicative act.

Accepting that a degree of ambiguity seems to be inherent in all (even linguistic) acts of human communication, then music's apparent ambiguity does not debar it from being considered to be a communicative medium. However, language has referents - it is *about* something - and hence language can be said to communicate information about states of affairs. Indeed, aboutness or *intentionality* can be considered intrinsic to any act of communication. But what is it, if anything, that music can be said to be *about*? What information is music communicating? A view that was put forward by Hanslick in the late nineteenth century and that still has considerable currency is that music is about nothing other than itself. As music unfolds in time, it articulates

complex structures that relate to, and perhaps refer to, each other. And it is certainly the case that music embodies what Leonard Meyer has called 'evident' meaning. For Meyer (1956), p37), music's evident meanings are 'those that are attributed to the antecedent gesture when the consequent becomes a physico-psychic fact and when the relationship between the antecedent and the consequent is perceived'; this relationship will depend on the expectations that the antecedent aroused and on whether or not the consequent fulfils or abrogates those expectations. The ongoing abstraction of evident meaning in a piece of music by a listener or performer will depend on the continual making of inferences - 'generation of expectations' in Meyer's terms - which may or may not be fulfilled as the music unfolds.

The types of information that underlie and that may constitute music's evident meaning have been the focus of a great deal of cognitive-psychological research over the last half century. This has explored in depth the nature of the human capacity to abstract a range of types of musical information, such as which notes or musical events are more important, stable or 'closural (final) than which other notes or events, which sets of events belong together and which belong to separate groups, which groups of events appear to be dependent for their identity on other sets of events, etc (see Deutsch, 1999). Here it is important to note that, just as with language, the making of appropriate inferences appears to depend on the degree to which a listener or performer is embedded in a given musical culture, although some types of inferences might be more universally and cross-culturally available than others. For example, Castellano, Bharucha and Krumhansl (1984) showed that the frequency distribution or total sounding duration of different pitches in passages of North Indian music were powerful determinants of listeners' attributions of different degrees of stability to different pitches: the more frequent or the longer total sounding duration, the more stable the pitch was perceived to be. This applied equally to western listeners with little previous experience of North Indian music and to Indian listeners with considerable experience. However, Indian listeners were also capable of finer degrees of distinction between the perceived stability of pitches, a capacity that appeared to be related to their previous experience of or exposure to music of that particular kind. The seeming universality of the strategies that could be employed by both sets of listeners probably reflects generic learning processes that are common to all humans, irrespective of cultural background, whereas the different discriminatory skills of the Indian and western listeners can be thought of as arising from particularisations of those learning processes operating over the long term in specific and different cultural contexts. The inferences that are made in the abstraction of evident meaning from music appear to be dependent on individual and cultural histories, and on both generic and specific attributes of the cognitive systems that make them.

However, the idea that music is solely about itself was under attack from the outset. As already noted, many if not most cultures' musics appear to be embedded in broader suites of cultural practices. The ethnomusicologist Philip Bohlman (2000) claims that 'all human beings produce music and that expressive practices do not divide into those that produce music and those that produce something else, say ritual or dance. Music accumulates its identities… from the ways in which it participates in other activities…'. And music's self-reflexive aboutness can scarcely account for what John Booth Davies (1978) has called its 'darling-they're-playing-our-tune' dimension. For most members of contemporary western culture, music bears meanings that extend beyond the 'music itself'. One obvious candidate for what music might be about - for what it might *intend* - is emotion.

Emotions can be defined as complex, dynamic and integrated states of brain, body and mind which arise in response to environmental stimuli (and here the environment might be thought of as being as much cognitive as physical), and both prepare the body for appropriate action and impact on the functioning of perceptual and cognitive processes (see LeDoux, 1998; Damasio, 1995). It seems entirely uncontentious to characterise music as portraying or eliciting emotions. How, and indeed, whether, music does this has been the focus of a great deal of recent research (see Juslin and Sloboda, 2001; see also Juslin, this volume), much of which appears to confirm Meyer's (1956) proposal that the unfolding of music's evident structure modulates the affective states of both listeners and performers, probably in part by mirroring the temporal forms of emotional brain-mind-body processes (ibid, p79) and those of correlates of these such as gesture or linguistic utterance (see Lavy, 2001). In addition, as Lavy points out, music may be involved in the elicitation of emotion as much by virtue of its 'raw' sonic attributes as by its structure, and, as Scherer and Zentner (2001) note, by its capacity to embody and to connote specific cultural referents.

Music seems to have the capacity to communicate, hinting, alluding, connoting and referring not only beyond itself but to itself. It does appear to be 'about' itself in the evident meanings which are bound to its structure and become apparent as the music unfolds, allowing for the elicitation of emotion in the listener and performer. And music also means by virtue of the connotations that it embodies, perhaps best expressed, to quote Meyer (1956), as 'connotative complexes'. As Meyer (ibid., p265) states, 'Music does not [for example] present the concept or image of death itself. Rather it connotes that rich realm of experience in which death and darkness, night and cold, winter and sleep and silence are all combined and consolidated into a single connotative complex.' … 'What music presents is not any one of these metaphorical events but rather that which is common to all of them, that which enables them to become metaphors for one another. Music presents a generic event, a 'connotative complex', which then becomes particularised in the experience of the individual listener.'

Moreover, music's meanings can be less or more explicit according to the contexts in which it is encountered and according to the degree to which the constituents of the musical 'sign' may bear specific significances. For instance, it is likely that the experience of western art-music would allow for a greater latitude in apparent meaning than would that of a piece of music employed in the context of a Hollywood film. Two different solitary listeners to a CD of Beethoven's *Grosse fuge* might well abstract quite different highly personal and intricate emotional significances from the music's complex evident structure. If the listener has considerable previous experience of Beethoven's oeuvre, the ongoing flow of the piece might be registered as a continual struggle between the apparent implications of the fugue's subjects and their constant metamorphoses in their traversal of harmonic space. For a listener with little experience of Beethoven's late style, the abruptly pitching subjects might evoke images of a sea-storm, or it might impel a sense of emotional disequilibrium; their diffuse harmonic treatment could be experienced as destabilising and threatening, or it could be felt as somehow grave, objective and detached. For both types of listener it is even possible that the piece could evoke particular sets of words such as 'struggle', 'defiance', 'hero' etc. that have been conventionally related to Beethoven's music (particularly the later works) within the traditions of western culture or that may be associated with particular

temporal forms of emotional brain-mind-body processes that the music mirrors in its sonic and structural dimensions, and that may thus be thought of as reflecting the existence of underlying connotative complexes (after Meyer). A recent study by Koelsch et al. (2004) suggests that listeners' brain responses to words which other listeners have judged to be mismatched in respect of a preceding piece of music yield similar EEG patterns to the responses to words that are semantically incongruent in respect of a preceding sentence, whereas such responses are not evident when congruent words are presented (though in both cases the musical context yields rather less consistent results than does the linguistic). In other words, it seems that the experience of music, just as the experience of language, can afford access to a semantic or referential dimension, though the meanings that music elicits are very unlikely to be so explicit as are those borne by language (see also Clayton, this volume).

The situation might be quite different and much less ambiguous in respect of music experienced in the context of film (see also Lipscomb and Tolchinsky, this volume). For example, the very low-pitched semitonal ostinato overlaid by a non-tonally related horn call at the outset of the film *Jaws*, overlaid on an otherwise fairly innocuous underwater scene, signifies to the listener/viewer that something big and unseen is out there in the water (only big things can produce low-frequency sounds) and that it may well be hunting (horn calls, in western culture, are conventionally interpreted in terms of hunting topics - see Agawu, 1991) - hence fear and perhaps terror may be wholly appropriate, and fairly universal, responses.

In many respects the ways in which music means, and the information that it may convey, are similar to those of language. Language also hints and alludes, it may even refer to itself and connote through its sounds as well as its structure, as in poetry (see, e.g., Vendler, 1997). It can certainly be employed to elicit emotion! Even a very recent attempt to delineate the human faculty for language (Hauser, Chomsky, and Fitch, 2002) puts forward a narrow and exclusive definition of language that could equally well define music; Hauser et al. suggest that language is a unique human faculty because of its recursive capacities (roughly speaking, recursion is the capacity of a system such as a linguistic grammar to embed entities in themselves (such as clauses within clauses) so as to enable the generation of an infinite (in theory) range of expressions from a finite set of elements). However, the property of recursion seems to be as much a feature of music and of the experience of music as of language (see Lerdahl and Jackendoff, 1983; Horton, 2002). These similarities appear to validate the notion that music may be just an offshoot of language. Viewed in evolutionary terms, it seems that Pinker may have been right; the human faculty for music may indeed be parasitic on the human faculty for language, simply exploiting capacities that have arisen for evolutionarily adaptive ends.

However, music does appear to have an efficacy that is different from that of language by virtue of the specific features that differentiate it from language. Whereas perhaps the most prominent feature of language is its capacity to be deployed so as to narrow down the range of its possible referents (see Sperber and Wilson, 1986; Deacon, 1996), music *by itself* does not appear to be capable of doing so. In the limit, language can express semantically decomposable propositions; it can refer unambiguously to complex states of affairs in the world. Music, however, seems to embody an essential ambiguity, and in this respect it can be suggested that language and music are at the opposite poles of a communicative continuum, almost

meeting in the middle somewhere near poetry (Cross, 2003c). This inherent ambiguity, together with the quality of the actions and interactions that were noted earlier as being integral to music, suffices to differentiate music from language. Music's attributes of *embodying*, *entraining*, and *transposably intentionalising* time in sound and action (see Cross, 2003a) enable it to be efficacious in contexts where language may be unproductive or impotent precisely because of its capacity to be interpreted unambiguously, and it can be suggested that the emergence of musicality is likely to have been crucially adaptive in processes of human evolution.

Music can be efficacious for groups, for individuals within groups and for individuals. If one imagines a group of people involved in a collective musical behaviour, their individual behaviours are likely to be co-ordinated within a temporal framework and thus stand in more-or-less predictable relationships in respect of each other. This endows the collective activity with a high degree of coherence which is more than likely to help establish a strong sense of group identity in this directed and synchronised modulation of action, attention and affect (see McNeill, 1995). It is even feasible to propose that such collective musical behaviour engenders sufficiently similar affective and cognitive dynamics in the participants that one could conceive of the music as eliciting or instantiating forms of intersubjective experience (see Benzon, 2001). The reinforcement of group identify or the instantiation of a form of intersubjectivity can function in collective musical behaviours not only because of the music's capacity to entrain but also because music allows each participant to interpret its significances individually and independently without the integrity of the collective musical behaviour being undermined. Music's inexplicitness, its ambiguity or floating intentionality may thus be regarded as a highly advantageous characteristic of its function for groups; music, then, might serve as a medium for the maintenance of human social flexibility.

In addition to this efficacy at the level of the group, music may be efficacious for individuals within groups which are engaged in collective musical behaviours (see also Ansdell and Pavlicevic, this volume). This is perhaps most evident if we consider a group of children interacting musically. Here it may be that social flexibility is not just being maintained but formed. Music's powers of entrainment, together with its ambiguity, may allow each participating child to explore forms of interaction with others while minimising the risk that such exploration might give rise to conflict, effectively underlying the gestation of a social flexibility (see Cross, 2003a). One only has to envisage a group of children interacting verbally and unambiguously rather than musically to see (and hear) how quickly conflict is likely to emerge in linguistic rather than musical interaction!

For individuals, any efficacy for music beyond the purely hedonic seems harder to articulate, but a clue might be found in Meyer's notion of 'connotative complexes', where he implies that music does not so much embody metaphors as constitute a metaphorising medium, one through which seemingly disparate concepts may be experienced as interlinked. While it is more than feasible that music fulfils this role for mature members of a culture, it seems more viable to suggest that music's efficacy at the level of the individual may be greatest in infancy and in childhood.

Over the last twenty years it has become evident that infants and children, though hugely flexible in that their neural systems are immensely plastic, are not general-purpose learning machines (see, e.g., Spelke, 1999). Rather they seem to be

predisposed to pick up certain types of information and to deal with it in particular and distinct ways. So, for example, even a very young infant will show that it has expectations about the likely behaviours of animate objects that are quite different from those which it exhibits in respect of inanimate objects. Similarly, even extremely young infants can respond appropriately to facial expressions. These capacities emerge too rapidly to be explained on the basis of the operation of a general-purpose learning mechanism. Moreover, they seem to be specific to the particular domains within which they are displayed. An ability to deal with information in one domain, for example, the physical world, is unlikely to be transferable to another domain, say, the social. Infants seem to be predisposed to pick up and deal with information in these distinct domains rapidly and effectively.

Yet the hallmark of the human species is a generalised ability to deal with information that is not specific to any particular domain. It is in the emergence of this domain-general intellectual flexibility that music is likely to play a role. Music's floating intentionality, its potential for its meaning or aboutness to be transposed from one situation to another, allows that one and the same musical act might be co-opted by an infant or child in dealing with information in two quite different domains. This could help in the emergence of the capacity to relate or to integrate information across domains, and assist in the emergence of a domain-general competence. In effect, early musical, or rather, proto-musical, behaviours may be functional in individual development in giving rise to a *metaphorising* capacity. The attributes of music that may facilitate this transposition of its significances and hence allow the *redescription* of information across domains (see Karmiloff-Smith, 1992) may lie in its capacity to mirror forms of emotional and cognitive dynamics (see Cross, 1999). Alternatively, it may be that positive emotions evoked in an infant's or child's engagement with music are directly beneficial in cognitive processing, particularly in affording the conditions for rich integration of representations and enhanced exploratory behaviour (see Damasio, 1995).

Indeed, individual musical behaviours in childhood have been characterised as fundamentally exploratory and children seem to be predisposed to engage in music-like activities from birth. Over the last ten years a considerable amount of research has demonstrated that caregiver-infant interactions in many cultures have musical or proto-musical attributes, incorporating exaggerated pitch contours and periodic rhythmic timings in their structure, involving turn-taking and a close linkage between sound and movement, with similar or the same 'musical' interactions occurring in a wide variety of contexts. Even very young infants can engage in music-like or *proto-musical* behaviours - which involve not only sound perception and production but also movement (see Papousek, 1996) - and they are highly motivated to do so.

It is notable that in the earliest years proto-musical and proto-linguistic behaviours appear to be indissociable; the infant's early manifestations of linguistic capacity and of musicality are more likely to co-occur than to be displayed separately. In the course of the infant's development, linguistic and proto-musical behaviours can be thought of as gradually differentiating out from this common suite of complex and communicative behaviours; linguistic behaviours become increasingly bound by considerations of relevance (after Sperber and Wilson, 1986) so as to constrain the extent to which they can substitute one for another in the linguistic contexts in which they are deployed. However, proto-musical and musical behaviours are likely to retain a degree of 'floating intentionality'; for the child, they are likely to continue to

be appropriate in a wide range of dissimilar situations and types of information, their individual and social functionality being closely tied to their effective ambiguity.

Music in evolution

Overall, it appears that music plays crucial roles for humans in individual and social development, and that a predisposition to engage in music-like activities seems to be part of our biological heritage. That biological heritage is, by and large, a consequence of the operation of evolutionary processes, and it can be suggested that music may have played a significant role in human evolution.

The intellectual and social flexibilities that marks out modern humans seem to have emerged in the hominid lineage sometime within the last seven million years, the likely date of the last common ancestor of humans and of our nearest relatives, the chimpanzees and bonobos (see Foley, 1995). For about the first five million years of that separation, the main feature distinguishing our ancestors from the contemporaneous chimps was likely to have been posture; our early ancestors, the australopithecines, were bipedal. In terms of cognitive capacities, it's likely that the australopithecines were much closer to chimps than to ourselves. Around two and a half million years ago, *Homo habilis* emerges, with a brain capacity about 66% greater than the australopithecines and the first evidence of the consistent manufacture and use of (albeit primitive) stone tools. Around two million years ago *Homo ergaster* appears, with at least double the brain capacity of the australopithecines and a considerably more robust physique, marked particularly by a barrel-shaped - as opposed to pyramidal, or ape-like - rib-cage; with *Homo ergaster* there is a leap in the sophistication of the stone tools produced and employed. While the australopithecines, *habilis*, and *ergaster* all originated in Africa, *ergaster* was the first to disperse beyond Africa into Eurasia. Between seven and five hundred thousand years ago, *Homo heidelbergensis* appears in the archaeological record, the predecessor of both the *Neanderthals*, who arise some three hundred and fifty to two hundred and fifty thousand years ago, and ourselves, modern *Homo sapiens*, who seem to have emerged as an African species some two hundred thousand years ago (see White et al., 2003).

Successive hominid species had ever larger brains, and left traces of progressively increased sophistication in dealing with tool manufacture and use, and exploitation of habitat. However, within each species, from *habilis* to *heidelbergensis*, the archaeological record suggests a kind of cognitive conservatism. As Mithen (1996) and others have suggested, whilst each successive species developed increasingly complex skills in dealing with the problems of survival, within the behaviour of each species these skills appear to have been restricted to relatively narrow domains. This suggests that while the cognitive capacities of each of our predecessor species were increasingly highly developed, in certain respects they were also somewhat inflexible. Only with the advent of *Homo sapiens sapiens*, modern humans, do we find unambiguous evidence for a capacity to transfer skills flexibly from one domain to another - a generalised cross-domain intellectual capacity - together with the ability to make use of symbols, the earliest evidence for symbolic behaviour consisting of engraved pieces of ochre found in South Africa and dated to 77,000 BP (Henshilwood et al., 2002).

It would appear that none our predecessor species possessed anything like the degree of flexibility of modern humans in producing complex technologies, exploiting natural resources, and perhaps in managing social relations with each other; it is this intellectual and social flexibility (or, as Henshilwood and Marean (2003) put it, a capacity for 'fully symbolic *sapiens* behaviour') that marks us off from our hominid predecessors. As this chapter has suggested, music (and I include dance in this) appears to play a significant role in the achievement or enhancement of cognitive flexibility as well as being efficacious in the rehearsal (and hence the acquisition) of competences in managing social relationships. It is only with modern humans that we find evidence for musicality, in the flexibility of our cognitive and social capacities, and it seems feasible to propose that music emerged with modern humans and helped to stabilise our cognitive and socio-cultural capacities; it may even have been critical in the emergence of these crucial capacities (see Cross, 1999). And of course it is only with modern humans that we find unambiguous evidence for musical behaviours in the form of musical instruments in the ancient archaeological record.

The earliest musical instrument yet found is a bone pipe from Geissenklösterle in southern Germany, dated to about 36,000 BP, and a large assemblage of musical bone pipes has been found in Isturitz in southern France covering a time-span of some 15 to 20 thousand years and first appearing at around 30,000 BP (see D'Errico et al., 2003). These are, for the time, extraordinarily sophisticated objects, and it's notable that the dates to which the earliest is attributed is around the time of the earliest appearance of modern humans in Europe. In other words, almost as soon as modern humans reach Europe they are leaving traces of sophisticated musical behaviours, which strongly suggests that humans brought music with them out of Africa and to me, and to many others, strongly suggests that musicality constitutes a specific and unique attribute of modern humans. It should be noted here that there is no sound evidence for Neanderthal musical instruments; claims that a 'Neanderthal flute' was found in Divje Babe in Slovenia (see Kunej and Turk, 2000) have been countered on what appear to be incontestable archaeological grounds (see D'Errico and Villa, 1997).

This is not to suggest that music arose *ab initio*, full-blown, with the emergence of modern humans. It is more likely that components of musicality were possessed to some degree by our predecessor species, but that only with modern humans did an integrated capacity for music appear. It is likely that human musicality is built from a number of disparate capacities that arose in response to a variety of evolutionarily selective pressures at different times and over different time-scales in the hominid lineage, some of which may be tentatively identified. The evolutionarily adaptive value of social flexibility might have underpinned the probable use by *Homo ergaster* of complex vocal signals (control of which would have been enabled by the barrel-shaped chest) to communicate affect or emotional state in order to regulate social interactions; the same factor may well have led, with *Homo heidelbergensis* to the modern human vocal tract, which would allow the articulation of the full range of vocal sounds (including musical sounds) of which modern humans are capable (see Morley, 2002). The selection pressures of sociality may also have impacted on rate of individual maturation within the hominids; each successive species appears to be progressively more *altricial* than its predecessors (consecutive species spending a progressively longer proportion of their total life-span in a juvenile state). The need to accommodate to population structures with an increasing proportion of members with access to juvenile modes of cognition and behaviour may have favoured the

emergence of something like musicality as a means of assimilating the exploratory value of such modes of cognition and (inter)action into the adult behavioural repertoire (see Cross, 2003b).

To return to the point made at the outset of this chapter: humans are unusual animals. We are intellectually and socially flexible to a degree that seems to differentiate us from all other animal species. Yet our capacities have arisen largely in the same way in which the capacities of other species have arisen, through processes of evolution; we are different from them, but the mechanisms through which *we* became *us* are of the same kind as those through which *they* became *them*. If we got rhythm and we got music (and it does appear that we are unique amongst primates in both of these capacities, see Merker, 2000), then we probably got them the way we got everything else - through evolution. But it is very likely that without the emergence of musicality our species would have seemed far less different from our evolutionary neighbours; without music, we might not have become fully us.

Finally, the claim that musicality has its roots in processes of human evolution does not mean that musicality is explicable in terms of those processes. The meaning of music is not reducible to its significance in human evolution. Music in present day societies takes a multiplicity of forms and fulfils a wide array of functions, from the underpinning of ritual to the articulation of filmic narrative, from the shaping of interaction in dance to the socialisation of infants in song, from the evocation of connotative complexes in the concert hall to the framing of adolescent rites of passage. In all these situations music takes identities and plays roles that cannot be explained solely in terms of the features that may have made it efficacious in evolution. Yet at the same time music's powers in the present are likely to be underwritten by the features that appear to have rendered music functional in evolution: its potential to keep people together in time, and to clear a social and mental space for the unhindered exploration of the capacity to mean.

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