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Music, Culture and the Evolution of the Human Mind: Looking Beyond Dichotomies

Dylan van der SCHYFF

Simon Fraser University, Vancouver
dva5@sfu.ca

ABSTRACT | The origin of human musicality is often discussed within a dichotomous nature-or-culture framework. While most non-adaptationist views maintain this either/or perspective, recent developments in neuroscience and evolutionary theory are opening up 'dual inheritance' models of music's origins. Many recent theories posit a shared evolutionary origin for music and language; and some have suggested that music played a crucial role in the emergence of the human mind and 'cultural cognition'. Indeed, growing evidence for music's deep roots in the most primordial areas of the brain – and of its effects on the plasticity of the neocortex – support strong connections between the emotional communications of animals, musicality in human ontogenesis, and the wide variety of musical activities we learn and participate in as the cultural creatures we are.

Keywords: music and evolution, music and evolutionary psychology, nature-culture, music and the brain, 'musilanguage'

1. INTRODUCTION

The discussion over the origins of human musicality is surely one of the most complex and polarized in all of contemporary musicology. For some, music is central to the development of human consciousness; it has primordial roots in the communication of emotional states of being, a necessity we share with many other animals. For others, music is a human invention whose relationship to our survival is not well defined, and whose origin is best understood as a result of cultural forces acting on pre-existing cognitive adaptations. In what follows, I review some of the key arguments on both sides of this debate. In the process I suggest that much disagreement arises due to differing conceptions of how the human mind evolved and functions; and because of discrepancies in how the word music is understood. I conclude by considering how advances in evolutionary theory and neuroscience may allow us to move beyond dichotomous 'either/or' (e.g. nature-or-culture) frameworks and embrace more integrated bio-cultural conceptions of music's origins.

2. 'MUSILANGUAGE' AND ARGUMENTS FOR MUSIC-AS-ADAPTATION

The idea of music as a biological adaptation begins with Darwin (1871) when he suggested that the origin of music was tied to sexual selection (see Miller, 2000) with analogous evolutionary roots in other species; and that this early form of affective communication led to the evolution of language. While many subsequent theorists have claimed that the reverse is true – that music emerged from language and culture – others have followed Darwin's lead by developing models of a musical protolanguage or 'musilanguage' (Brown, 2000; Marler, 2000; Merker, 2000; Mithen, 2005; Livingstone, 1973; see also Fitch, 2006).

In connection with this, a number of researchers have done comparative studies of music-like behavior in animals; and it has been observed that many animal communication systems do bear striking similarities to human music making – terms of both innate and learned behaviors (see Wallin, Merker & Brown, 2000). Most of these behaviors are generally understood as analogous to human music making (e.g. bird and whale song), however it has been suggested that potential homologues may exist in activities such as bimanual great ape drumming (see Fitch, 2006).

Despite this, some have suggested that music-like behavior in animals may not have much direct relevance to human music making after all (McDermott & Hauser 2005; Patel, 2008). It is argued that in comparison to the wide range of contexts in which human music occurs, animal song is limited to territory defense and mate attraction. It is also suggested that while human music is "characteristically produced for pure enjoyment," animal song has a solely communicative function (Hauser & McDermott, 2003; Pinker, 1997); and that where human music making is egalitarian the production of animal song is a predominantly male behavior.

But some of these arguments may be problematic as it has been shown that animal song does occur outside of such limited contexts; and that in some species females sing as much as males – with males and females of some bird and primate species engaging in duets (Geissmann, 2000; Langmore, 1998; 2000; Riebel, 2003). Furthermore, human music making is often limited to certain cultural or environmental contexts and is sometimes dominated by either males or females (Titon et al., 1984; see also Lomax, 1977). It is also clear that humans communicate all kinds of meanings through music and engage in music making for more than purely hedonistic reasons (Blacking, 1973); and it is not at all certain that animals do not derive some form of pleasure from their 'musical' activities. It may also be argued that contextual and other types of limitations do not necessarily disqualify certain behaviors from being considered musical; nor is it necessary that a "shared adaptive context should be a pre-requisite of biological analogy" (Fitch, 2006, p. 184; see also Tinbergen, 1963).

This notwithstanding, it seems to be generally agreed that comparative studies may allow us to better understand "general constraints on the evolution of complex signalling systems, and specific aspects of musical form that may result from constraints imposed by the vertebrate nervous system by producing and processing such complex signals" (Fitch, 2006, p. 185; see also Whaling, 2000). Fitch concludes that thanks to comparative studies of music-like behavior in animals, we now have,

> … abundant evidence that music-like communication systems can evolve relatively easily (at least three times among birds and three times in mammals), while a complex

> communication system with the ability to communicate arbitrary meanings has evolved only once, in humans. This makes a hypothesis in which complex signals (''song'') evolved first, and that meanings were added to these signals later quite parsimonious from a comparative viewpoint." (Fitch, 2006; see also Hauser et al., 2002; Marler, 2000; Wray, 2002).

Indeed, this insight offers some support to the 'musilanguage' theory, where music and language evolved as two specializations from a common proto-musical ancestor – an early communicative system that formed the basis of the "dual acoustic nature" of music and language: "sound as emotive meaning and sound as referential meaning" (Brown, 2000). Mithen (2005) develops the theory further, arguing that musilanguage was holistic, multi-modal, manipulative, musical and mimetic ('Hmmmmm'); and he suggests it is precisely the kind of multi-modal systems of signalling (movement, gesture and sound) that we find in non-human primates that points to musilanguage's deep roots in our pre-human ancestors. Mithen discusses a suite of adaptations – Theory of Mind, encephalization, bipedalism, anatomical developments for complex vocalization – that he claims emerged in association with 'Hmmmmm' communication well before the split between the European and African homo lineages (with Homo ergaster c. 2,000,000 BP). However, he suggests the emergence of the "cognitively-fluid mentality" of the Homo sapien mind made possible the kind of abstract, cross modal and metaphorical thinking associated with language, technology, art, music and culture we find in modern humans (i.e. thinking that goes "beyond modularity", see Karmiloff-Smith, 1992; see also Mithen, 1996). Thus Mithen hypothesizes that the early holistic form of musilanguage was "segmented" by the Homo sapien mind (c. 200,000 BP) resulting in a compositional communication system that became increasingly specialized for the communication of semantic and propositional information (language). However, the emotional core of 'Hmmmmm' communication remains in music and dance; it has developed in manifold ways through culture and its long association with language.

It has been argued that the emergence of musilanguage was due to selective pressures for, among other things, enhanced communication associated with foraging (later hunting and gathering), mate competition, increased periods of child rearing, and group activity (cooperation & socialization). And it is often suggested that musical behavior contributed to the development of "shared intentionality" and Theory of Mind (ToM) in modern humans, which in turn permitted the rapid development of cultural evolution and the emergence of modern human cognition (Tomasello, 1999).

Support for musilanguage is drawn from the archaeological record, comparative studies with primates and other animals (Wallin, Merker & Brown, 2000), as well as from studies of socialization and human ontogenesis. These last two areas are perhaps most often cited in connection with the possible adaptive functions of music. Indeed, although ethnomusicology struggles with the idea of universals (Nettl, 2000) it has shown us that music arises in "social situations that are emotionally motivated – situations that are the product of both subjective and inter-subjective processes of meaning formation" (Tolbert, 2001, p. 85; see also Blacking, 1973; DeNora 2000; 2011; Nettl, 1983; 2000). It follows that music should have played an important role in regulating social cohesion in our ancestors, perhaps through the creation of shared mood states that strengthened bonds between individuals. Dunbar (1993; 1996; 2003) suggests that because collective music making causes endorphin release in the brain it may have mimicked the effects of primate grooming thereby permitting "grooming at a distance" – this would have allowed for the communication of social information over larger distances

resulting in the formation of larger groups, increased foraging (children could be soothed at a distance; Balter, 2004; Falk, 2000; 2004), and the development of language.

In connection with this, some have discussed music's adaptive function in terms of the considerable survival challenges associated with the long altricial stage in human ontogenesis (e.g. Cross, 2003; see also Joffe, 1997). Researchers have demonstrated the universal and seemingly intuitive way parents create both stimulating and soothing musical environments for infants through prosodic speech, lullabies and the like (Dissanayake, 2000; Falk, 2004; Fernald, 1992;Trehub, 2000; Papousek H., 1996; Papousek M., 1996; Trehub & Trainor, 1998). Others have considered the adaptive benefits of music's ability to soothe crying infants in the course of our evolutionary history (Falk, 2004; Mithen, 2005). And Trehub (2003) discusses music's role in strengthening the bond between mother and infant with clear adaptive implications.

Additionally, the idea that music is derived from language may be weakened by research where infants have shown a clear preference for maternal song over speech (Trehub & Nakata, 2001; Shenfield et al., 2003). These studies support claims that musical perception and communication emerge very early in human ontogenesis (unlike other cultural universals such as fire making; cf. Patel, 2008; 2010). Cross writes, "music is a cognitive capacity arising from an infant's propensities to search for 'relevance in', and mastery over, itself and its world … particularly [in] the interactions with the primary caregiver" (1999; see also M. Papousek, 1996). Similarly, Trevarthen (1998; 1999; 2002) argues that humans possess an in-born "communicative musicality" that is related to the necessity for embodied intersubjectivity in highly social beings such as ourselves – it is mediated more by imitation and co-ordination of movement with others than solely through faculties associated with language.

This capacity for multi-modal communication of embodied individual and social states has prompted the suggestion that music is a necessary "correlate" to the structure of the human mind (Cross, 1999; Tolbert 2001). This view sees musicality as central in the emergence of human cognitive fluidity – placing a special emphasis on how music facilitates 'representational redescription', which is thought to allow for the development of abstract, amodal thought and with it the increased ability to recognize others as intentional agents (i.e. ToM; see Karmiloff-Smith, 1992; Tomasello, 1999). Cross suggests that because of its "multiple potential meanings" music affords a means by which social activity may be explored in a "risk free" environment; its "transposable aboutness" (2001), or "floating intentionality" (1999), is employed in infancy and childhood to explore, create meaning, and develop competencies between different domains of embodied experience; music is a "play-space" for developing cognitive flexibility and social understanding.

By this view, music facilitates "the development of individual minds and [affords] structures for their interactions in society" (1999). Thus, Cross hypothesizes that musicality was crucial in "precipitating the emergence of the cognitive and social flexibility that marks the appearance of modern Homo sapiens sapiens—it is an "evolutionary engine" he claims, without which "it could be that we would never have become humans" (2001).

3. NONADAPTATIONIST PROPOSALS

Musilanguage and the positions that support it are highly persuasive. Nevertheless, many have suggested that claims for music-specific adaptations are premature (Huron, 2001; Justus & Hutsler,

2005; McDermott & Hauser, 2005). It has been argued that although music can be linked to mental processes that have clear adaptive value for survival – e.g. language, auditory scene analysis, habitat selection, emotion, and motor control – music is merely parasitic on these domains and has no adaptive value of its own. Pinker (1997) has gone so far as to claim that music is a human "invention" designed to "tickle" biologically functional aspects of human experience; that it is a pleasure technology or "auditory cheesecake."

This hedonistic-parasitic view emerges from a trend in evolutionary psychology that attempts to explain the diversity of human thought and culture in terms of the evolution of a large array of late-emerging cognitive modules, each adapted to serve a specific function (e.g. Chomsky, 1975; 1980; Tooby & Cosmides, 1989; 1992; Pinker, 1997; c.f. Fodor, 1983; 2001). For example, Sperber (1996) argues that the "proper domain" of information a given cognitive module is adapted to process may become replaced by other features of the environment that satisfy the given module's "input conditions." This results in what he calls the "actual domain" of the module. By this view "cultural transmission causes, in the actual domain of any cognitive module, a proliferation of parasitic information that mimics the module's proper domain" (Ibid., p. 141). Thus music is said to constitute such parasitic information to a hypothetical module that evolved in the course of early hominid communication in order to process "complex sound patterns discernable by pitch variation and rhythm" (Ibid., p. 142). The proper adaptive domain of this proposed module became empty over time, but because stimulation of the module provides pleasure to humans it was used to process and produce other sounds which lead to the creation of a new cultural domain – namely music – which, according to Sperber, "is parasitic on a cognitive module the proper domain of which pre-existed music and had nothing to do with it" (Ibid, p. 142; c.f. Cross, 1999).

This "massively modular" view of mind contrasts with the more fluid notion of human cognition discussed above; it has also been criticized as overly reductive and deterministic (e.g. Fodor, 2001). Moreover, it has been suggested that there may not have been sufficient evolutionary time for such a diverse range of proposed cognitive domains to have developed via natural selection (Tomasello, 1999). Thus the emergence of Theory of Mind (ToM) in humans – supported by the discovery of mirror neurons and understood as a single cognitive adaptation that permits recognition of the cognitive-emotional states of conspecifics – has been suggested as a more parsimonious solution (Livingstone & Thompson, 2009).

It is argued that as ToM allowed a more compact suite of domain specific and general cognitive abilities to function in consort it permitted the development of complex cultural artifacts and behaviors including forms of affective communication that rely "on a variety of cross-domain, multimodal channels of expression" (Livingstone & Thompson 2009, p. 86; see also Tomasello et al., 2005). This has lead to non-adapationist accounts that consider music and other "affective engagement measures" (such as dance) as cultural products of ToM. And indeed, because music takes on such diverse modes of expression, it is thought that Theory of Mind may offer a promising way of understanding music, as it emerges "at the cultural level, including its use in symbolic rituals, in identity of self and ethnicity, and its continuous growth in complexity and diversity" (Livingstone & Thompson, 2009, p. 100).

Whilst this view reverses the evolutionary relationship between music and ToM considered above in the context of 'musilanguage', it also has a good deal in common with the general music-as-

adaptation position when it asserts music's relevance to human wellbeing – how it affords us a means of affective engagement that promotes empathy and social cohesion.

Although non-adaptationist in his outlook, Patel (2008; 2010) also considers the beneficial effects of music, albeit from a more explicitly biological perspective. Patel examines the principle adaptationist arguments in detail (Patel, 2008); and while he never denies the bio-cultural benefits associated with music, he questions whether they amount to sufficient evidence to accept music as a product of natural selection (i.e. to reject the "null hypothesis" that music has not been "a direct target" of natural selection (Ibid., p. 356). He claims that while music is an undeniably universal human activity, this is no reason to assume that it has been naturally selected – other universal and uniquely human activities, such as fire making, are clearly learned through culture (c.f. above). He also points out that although selective musical deficits due to brain damage (e.g. "acquired selective amusia"; see Peretz, 1993) suggest specialized cortical areas for music, such modules may be explained in terms of development (e.g. "progressive modularization"; Karmiloff-Smith, 1992) and are thus "largely irrelevant to evolutionary arguments" (Patel, 2008, p. 357). Patel (2010) further suggests that musical processes such as the perception of tonality may emerge from mechanisms selected for language processing "… because tonality, like linguistic syntax, deals in abstract categories that are processed in terms of hierarchical structures"; and that "musical beat perception and synchronization" is a "byproduct" of brain structures associated with complex vocal learning—an evolutionary "trait shared by humans and only a few other groups of mammals and birds" (Ibid.; see also Patel et al., 2005; Patel 2006; Patel et al., 2009). These and other arguments lead Patel to conclude that music is best understood as an invention.

However, Patel's notion of music as invention is of a very different order than the hedonistic-parasitic model discussed earlier. He demonstrates how musical activity results in long lasting changes to brain structures and functions – largely, he suggests, through neuroendocrine effects and mechanisms of brain plasticity (Patel, 2010). In brief, Patel argues that although music is not an adaptation, it is not biologically useless either, as Pinker (1997) would have us believe. Rather, music is a biologically powerful "transformative technology of the mind" that physically shapes the brain in ways that afford all manner of physical, cognitive and social benefits to those who participate in it.

Patel responds to claims that language may also be a cultural invention – perhaps the product of naturally selected cognitive learning abilities such as ToM – with "10 lines of evidence" that point to "a direct role for natural selection in the evolution of language" (Patel, 2008, p. 359). Interestingly, he suggests that a number of these attributes – infant babbling, the anatomy of the human vocal tract and the fixation of the FOXP2 gene – "could all reflect adaptations… that originally supported both language and vocal music" (2008, p. 371-372). However, Patel claims that the rate of learning musical structure is slower than it is for language; that humans are "far more uniform in their linguistic abilities than in their musical abilities"; and that there is no visible biological cost associated with the failure to develop musical abilities or as a result of musical deficits, such as tone or rhythmic deafness.

However, it may be argued that some of these observations reflect notions of musical acquisition associated with Western post-industrial society. Indeed, musical structure (e.g. tonal harmony) is largely a product of culture – more research is needed in other cultures where musical activity is a larger part of everyday life, and where the acquisition of musical skills appears to occur much more rapidly. Also, it should be noted that in modern Western society it is thankfully much easier for people with a wide

range of physical and cognitive deficits to flourish. In this environment musical deficits are far less relevant to survival and go almost completely unnoticed. Patel does not speculate on the impact of such deficits for people in prehistoric times or in other cultural contexts.

Patel also argues, as I mentioned above, that many of the core 'musical' perception skills that infants (and some animals) appear to be born with – "discrimination skills for frequency, pitch, timbre, and durational patterning" – are explicable by other adaptive traits such as language or general auditory processing mechanisms. In short, Patel is looking for "dispositions or innate learning preferences that are specific to music" (2008, p. 377; italics original). But this raises the difficult question of what is meant by the word music. In contrast to the categorical, rarified, and often reified notions in the West (DeNora, 2000; 2011; Small, 1999), 'music' may have more far-reaching and cross-modal implications for other peoples of the world (as it may have had for our prehistoric ancestors, see Blacking, 1973; Mithen, 2005; Nettl, 1983; 2000). Again, cultural bias may influence interpretations. And finally, although it may not be possible to demonstrate the existence of brain structures adapted specifically and only for music (cf. Peretz, 2006), if the musilanguage theory is in any way correct, we would expect common cognitive roots for language and music. Indeed, depending on how broadly we are willing understand the word music, something like this appears to be what we find.

4. CONCLUSION: LOOKING BEYOND DICHOTOMIES

The musilanguage approach is attractive because it posits a shared origin for what we refer to as music and language, while also allowing for their differences to develop via subsequent biological and cultural evolution. This view may find support in 'dual inheritance' theories of human cognition (Richerson & Boyd, 2005; Tomasello, 1999) – where the question of whether either biology or culture should account for deeply social and universal human activities that require complex cognitive processing is replaced by a perspective that integrates the two. By this view the notion that music must be either an adaptation or a cultural invention effectively becomes a non-starter.

Furthermore, a growing number of theories are emerging that challenge the current orthodoxies in evolutionary psychology and these will most certainly change the way that we frame questions about the origins of music. Darwin himself did not believe adaptation through natural selection should be the sole mechanism of evolution; and a large number of compelling critiques of the so-called 'adaptationist orthodoxy' have emerged in recent decades (e.g. Fodor & Piattelli-Palmarini, 2010; Gould & Lewontin, 1979; Lewontin, 1983; Varela, Thompson & Rosch, 1993). There is also growing neurobiological evidence that complex human behaviors, such as those involved with social cognition, depend as much on development and environment as on innate dispositions – the plasticity of the human neocortex and the formation of cognitive structures through experience and epigenetic effects are emphasized over a large suite of genetically determined modules (Doidge, 2007; Karmiloff-Smith, 1992; Lickliter & Honeycutt, 2003; Sur & Leamey, 2001; see also Fodor, 2001).

Indeed, as Panskepp (2009) suggests, it is possible that the human neocortex contains no evolutionary determined modules for either music or language; that the origins of musicality are largely sub-cortical; and that the emergence of "emotional proto-musical communications" may have led to the development of both music and propositional language. Thus it may be that the ancient emotional core of the limbic system provides "the actual instinctual energetic engines that still motivate our music-

making, and continue to be the tap-roots that allow the rich foliage of cultural invention that is modern music to assume the impact it does on our minds" (Ibid., p. 237). This notion of musicality as rooted deep in the primordial areas of the brain implies strong connections between the emotional communications of animals, human infant musicality, and the manifold musical activities we engage in as the cultural creatures we are.

As new views of evolution and the human mind continue to emerge the debate over the origins and meaning of human musicality may move beyond orthodox adaptationist and strict modular frameworks, perhaps trading oppositional nature-or-culture, adaptation-or-nonadaptation dichotomies for more nuanced and integrated views. And while it is almost certain that a definitive account of the origin of human musicality will remain elusive, investigating the subject affords us a deeper appreciation of the bio-cultural meanings of music and, in turn, what it is to be human. This project seems all the more relevant in the current global cultural climate where music is increasingly understood as a pleasure product mass produced for financial gain; and where it is regularly consumed apart from the social contexts in which it was created. We can only hope that research in this area continues so that we may better understand this remarkable phenomenon that so seamlessly integrates the most complex aspects of culture with our most primordial being.

5. REFERENCES

Balter, M. (2004). Seeking the key to music. *Science, 306*(5699), 1120–1122.

Blacking, J. (1976). *How Musical is Man?* London: Faber.

Brown, S. (2000). The 'musilanguage' model of human evolution. In N.L. Wallin, B. Merker & S. Brown (Eds.), *The Origins of Music* (pp. 271-300). Cambridge, Mass: MIT Press.

Chomsky, N. (1975). *Reflections on Language.* New York: Pantheon.

Chomsky, N. (1980). Rules and representations. *Behavioral and Brain Sciences, 3*(1), 1-61.

Cross, I. (1999). Is music the most important thing we ever did? Music, development and evolution. In Suk Won Yi (Ed.), *Music, Mind and Science* (pp.10-39). Seoul: Seoul National University Press.

Cross, I (2003). Music and evolution: Consequences and causes. *Contemporary Music Review, 22(*3), 79-89.

Cross, I. (2001). Music, Mind and Evolution. *Psychology of Music 29*(1), 95-102.

Darwin, C. (1871). *The Descent of Man, and Selection in Relation to Sex.* London: John Murray.

DeNora, T. (2000). *Music in Everyday Life*. New York: Cambridge UP.

DeNora, T. (2011). *Music in Action: Selected Essays in Sonic Ecology.* Burlington, VT: Ashgate Publishing Company.

Dissanayake, E. (2000). Antecedents of the temporal arts in early mother-infant interaction. In N. L. Wallin, B. Merker & S. Brown (Eds.), *The Origins of Music* (pp. 389-410). Cambridge, MA: MIT Press.

Doidge, N. (2007). *The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science.* New York: Penguin.

Dunbar, R. (1993). Coevolution of neocortical size, group size and language in humans. *Behavioral and Brain Sciences, 16*(4), 681–735.

Dunbar, R. (1996). *Grooming, Gossip and the Evolution of Language*. Cambridge, MA: Harvard University Press.

Dunbar, R. (2003). The origin and subsequent evolution of language. In M.H. Christiansen & S. Kirby (Eds.), *Language Evolution* (pp. 219-234). Oxford, UK: Oxford UP.

Falk, D. (2000). Hominid Brain Evolution and the Origins of Music. In N. L. Wallin, B. Merker & S. Brown (Eds.), *The Origins of Music* (pp.197-216). Cambridge, MA: MIT Press.

Falk, D. (2004). Prelinguistic evolution in early hominins: Whence motherese? *Behavioral and Brain Sciences, 27*(4), 450–491.

Fernald, A. (1992). Human maternal vocalizations to infants as biologically relevant signals: An evolutionary perspective. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), *The Adapted Mind* (pp. 391–428). New York, NY: Oxford UP.

Fitch, T.W. (2006). The biology and evolution of music: A comparative perspective. *Cognition, 100*(1), 173–215.

Fodor, J. (1983). *The Modularity of Mind*. MIT Press.

Fodor, J. (2001). *The Mind Doesn't Work That Way: The Scope and Limits of Computational Psychology.* Cambridge, Mass: MIT Press.

Fodor, J. & Piattelli-Palmarini, M. (2010). *What Darwin Got Wrong*. New York: Farrar, Straus, and Giroux.

Geissmann, T. (2000). Gibbon songs and human music from an evolutionary perspective. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The Origins of Music* (pp. 103–123). Cambridge, Mass: MIT Press.

Gould, S. J. & Lewontin, R. (1979). The spandrels of San Marco and the Panglossian paradigm: A critique of the adaptationist programme. *Proceedings of the Royal Society*, B 205, 581-598.

Hauser, M., Chomsky, N. & Fitch, W. T. (2002). The language faculty: What is it, who has it, and how did it evolve? *Science, 298*(5598), 1569–1579.

Hauser, M. & McDermott, J. (2003). The evolution of the music faculty: A comparative perspective. *Nature Neuroscience*, *6*(7), 663–668.

Huron, D. (2001). Is Music an Evolutionary Adaptation? *Annals of the New York Academy of Sciences, 930*(1), 43-61.

Joffe, T. H. (1997) Social pressures have selected for an extended juvenile period in primates. *Journal of Human Evolution, 32*(6), 593-605.

Justus, T. & Hutsler, J. J. (2005). Fundamental issues in the evolutionary psychology of music: Assessing innateness and domain-specificity. *Music Perception 23*(3), 1–27.

Karmiloff-Smith, A. (1992). *Beyond Modularity*. London: MIT Press.

Langmore, N. E. (1998). Functions of duet and solo songs of female birds. *Trends in Ecology and Evolution, 13*(4), 136–140.

Langmore, N. E. (2000). Why female birds sing. In Y. Espmark, T. Amundsen, & G. Rosenqvist (Eds.), *Signalling and Signal Design in Animal Communication* (pp. 317–327). Trodheim, Norway: Tapir Academic Press.

Lewontin, R. (1983). The Organism as Subject and Object of Evolution. *Scientia*, *118*(1), 65-82.

Lickliter, R., & Honeycutt, H. (2003). Developmental dynamics: Toward a biologically plausible evolutionary psychology. *Psychological Bulletin, 129*(6), 819-35.

Livingstone, F. B. (1973). Did the Australopithecines sing? *Current Anthropology, 14*(1-2), 25–29.

Livingstone, S. & Thompson, W.F. (2009). The emergence of music from the Theory of Mind. *Musica Scientiae*, Special Issue 2009/10 "Music and Evolution," 83-115.

Lomax, A. (1977). Universals in song. *World of Music, 19*(1/2), 117–129.

Marler, P. (2000). Origins of music and speech: Insights from animals. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The Origins of Music* (pp. 31–48). Cambridge, Mass: MIT Press.

McDermott, J. & Hauser, M. D. (2005). The origins of music: Innateness, development, and evolution. *Music Perception, 23*(3), 29–59.

Merker, B. (2000). Synchronous chorusing and human origins. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The Origins of Music* (pp. 315-327). Cambridge, Mass: MIT Press.

Miller, G. (2000). Evolution of music through sexual selection. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The Origins of Music* (pp. 329–360). Cambridge, Mass: MIT Press.

Mithen, S. (1996). *Prehistory of the Mind.* London: Thames & Hudson.

Mithen, S. (2005). *The Singing Neanderthals: The Origins of Music, Language, Mind and Body.* London: Weidenfeld & Nicholson.

Nettl, B. (1983). *The Study of Ethnomusicology: Twenty-nine Issues and Concepts*. Urbana: University of Illinois Press.

Nettl, B. (2000). An ethnomusicologist contemplates universals in musical sound and musical culture. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The Origins of Music* (pp. 463–472). Cambridge, Mass: MIT Press.

Panksepp, J. (2009). The emotional antecedents to the evolution of music and language. *Musicae Scientiae,* Special Issue 2009/10 "Music and Evolution," 229-259.

Papousek, H. (1996). Musicality in infancy research: biological and cultural origins of early musicality. In I. Deliège & J. Sloboda (Eds.), *Musical Beginnings* (pp. 37-55). Oxford: Oxford UP.

Papousek, M. (1996) Intuitive parenting: a hidden source of musical stimulation in infancy. In I. Deliège and J. Sloboda (Eds.), *Musical Beginnings* (pp. 88-112). Oxford: Oxford UP.

Peretz, I. (1993). Auditory atonalia for melodies. *Cognitive Neurophyschology 10*(1), 21-56.

Peretz, I. (2006). The nature of music from a biological perspective. *Cognition, 100*(1), 1-32.

Patel, A.D. (2006). Musical rhythm, linguistic rhythm, and human evolution. *Music Perception, 24*(1), 99-104.

Patel, A. D. (2008). *Music, Language, and the Brain*. Oxford: Oxford UP.

Patel, A.D. (2010). Music, biological evolution, and the brain. In M. Bailar (Ed.), *Emerging Disciplines* (pp. 91-144). Houston, TX: Rice UP.

Patel, A.D., Iversen, J.R., Chen, Y., & Repp, B.H. (2005). The influence of metricality and modality on synchronization with a beat. *Experimental Brain Research, 163*(2), 226-238.

Patel, A.D., Iversen, J.R. Bregman, M.R. and Schulz, I. (2009). Studying synchronization to a musical beat in nonhuman animals. *Annals of the New York Academy of Sciences*, *1169*(1), 459-469.

Pinker, S. (1997). *How The Mind Works.* London: Allen Lane.

Richerson, P. J. & Boyd, R. (2005). *Not By Genes Alone: How Culture Transformed Human Evolution*. Chicago: University of Chicago Press.

Riebel, K. (2003). The 'mute' sex revisited: Vocal production and perception learning in female songbirds. *Advances in the Study of Behavior, 33*(1), 49–86.

Shenfield, T., Trehub, S. & Nakata, T. (2003). Maternal singing modulates infant arousal. *Psychology of Music, 31*(4), 365–375.

Small, C. (1999). *Musicking: The Meaning of Performing and Listening.* Middletown, CT: Wesleyan UP.

Sperber, D. (1996). *Explaining Culture*. Oxford: Blackwell.

Sur, M. & Leamey, C.A. (2001). Development and plasticity of cortical areas and networks. *Nature Reviews Neuroscience, 2*(4), 251-62.

Tinbergen, N. (1963). On aims and methods of ethology. *Zeitschrift für Tierpsychologie, 20*(4), 410–433.

Titon, J. T., Koetting, J. T., McAllester, D. P., Reck, D. B., & Slobin, M. (Eds.) (1984). *World's of Music: An Introduction to the Music of the World's Peoples*. New York: Schirmer Books.

Tolbert, E. (2001). Music and meaning: An evolutionary story. *Psychology of Music, 29*(1), 84-94.

Tomasello, M. (1999). *The Cultural Origins of Human Cognition.* Cambridge, MA: Harvard UP.

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences, 28*(5), 675-91.

Tooby, J. & Cosmides, L. (1989). Evolutionary psychology and the evolution of culture, part I. *Ethology and Sociobiology, 10*(1), 29-49.

Tooby, J. & Cosmides, L. (1992). The psychological foundation of culture. In Barkow, L. Cosmides, & J. Tooby (Eds.), *The Adapted Mind* (pp.19-136). Oxford: Oxford UP.

Trehub, S. E. (2000). Human processing predispositions and musical universals. In Wallin, Merker and Brown (Eds.), *The Origins of Music* (pp.427-448). Cambridge, MA: MIT Press.

Trehub, S. E. (2003). Musical predispositions in infancy: An update. In I. Peretz & R. Zatorre (Eds), *The Cognitive Neuroscience of Music* (pp. 3-20). New York: Oxford UP.

Trehub, S. E., & Nakata, T. (2001-2002). Emotion and music in infancy. *Musicae Scientiae, 6*(1), 37-61.

Trevarthen, C. (1998). The concept and foundations of infant intersubjectivity. In S. Bråten (Ed.), *Intersubjective Communication and Emotion in Early Ontogeny* (pp. 15-46). Cambridge, UK: Cambridge UP.

Trevarthen, C. (1999). Musicality and the intrinsic motive pulse: Evidence from human psychobiology and infant communication. In I.Deliège (Ed), *Rhythms, musical narrative, and the origins of human communication. Musicæ Scientiæ,* Special issue, 1999-2000,157- 213.

Trevarthen, C. (2002). Origins of musical identity: Evidence from infancy for musical social awareness. In R. A. R. MacDonald, D. J. Hargreaves & D. Miell (Eds), *Musical Identities* (pp. 21-38). Oxford: Oxford UP.

Varela, F., Thompson, E., & Rosch, E. (1993). *The Embodied Mind: Cognitive Science and Human Experience.* Cambridge MA: MIT Press.

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

Whaling, C. (2000). The neural basis of song learning in birds. In N.L. Wallin, B. Merker & S. Brown (Eds.), *The Origins of Music* (pp. 65-76). Cambridge, Mass: MIT Press.

Wray, A. (2002). *Formulaic Language and the Lexicon.* Cambridge: Cambridge UP.

DYLAN VAN DER SCHYFF

Simon Fraser University, Vancouver

Dylan van der Schyff received his MA in Liberal Studies from Simon Fraser University (Vancouver, Canada) and is currently engaged in graduate studies in music psychology at the University of Sheffield (UK). His research focuses on the nature of musical meaning at the intersection of biology, culture and lived experience. As a performer (drums/percussion) and producer, van der Schyff has appeared on close to 100 recordings spanning the genres of jazz, electro-acoustic, improvised, experimental and new music. Van der Schyff teaches music at Capilano University and gives courses in contemporary culture at Vancouver Community College.