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Abstract

This article explores the relationship between ideas about the role and purpose of music introduced in the major publications of Charles Darwin, and the fields of child development, music education and pedagogy. It also considers the significant influence on Darwin's work of his own biography and family life. In the global village of 21st-century cyber-culture, music is in danger of increasing commodification, whereby powerful commercial forces shape the assumption that music is a product to be consumed, rather than a process in which to participate. Speculation about the role of music in the evolution of culture (Bannan, 2003; Merker, 2000; Mithen, 2005; Morley, 2002; Wallin, 1991) supports the view that the capacity for music was expressed early in the genetic inheritance that gave rise to the species *Homo*; and that its universality within each individual in every culture is a consequence of its usefulness in behavior and inter-generational transmission that exploit its potential. Given the manner in which modern human societies conduct themselves, a robust evolutionary account of the role of music has significant implications for the way we educate our young, both informally in the home and in the more formal setting of school. This relationship between Darwin's published theories and the role of musical play in the upbringing of children was evident in his and his wife Emma's approach to parenting in the family home at Down House where he wrote his major works.

Keywords

creativity, curriculum, Darwin, Evolution, musical ability

Introduction: Darwin's *The Origin of Species* and its significance

The significance of Darwin's achievement comes down to us both in the form of his published works themselves and in the interpretations of them, as well as of his life, that have formed

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contributions to biology and zoology and fields as disparate as psychology, ethics, education, anthropology and the study of music and its role. *The Origin of Species* (C. R. Darwin, 1859/1968) is central to Darwin's legacy because it represents the single greatest breakthrough since the age of Galileo and Newton in defining mankind's place in the cosmos; and because Darwin's other writings represent, by comparison, either a systematic rehearsal for its arguments (e.g. the 1851 and 1854 monographs on barnacles) or a series of extensive footnotes to them. The 1859 book presented a radical new synthesis based on his studies of geology and zoology around the world, comparing the development of living species both wild and domesticated with evidence in the fossil record that life has a long history, and that its course can be traced through describing the force that shaped it: natural selection. This defines that, where the genetically-determined nature of an organism is nurtured in an environment that allows it to survive and reproduce, it will replicate itself: not to do so spells extinction. Where the environment changes, replication favors such random modifications as permit the organism to cope. This is what Darwinian theory means by "fitness."

The influence of Darwin's ideas has been extended in the work of Richard Dawkins (1976, 1986), Daniel Dennett (1995) and Susan Blackmore (1999) to encompass their application to all systems, whether material or abstract, which are open to undergoing adaptive change. In exploring the role of human musicality through the lens of Darwinian thought, we bring to bear one of the most powerful intellectual tools for explaining it; but we may also reflect on Darwin's own valuation of the importance of music as revealed in both his life and work. Two publications have during the last decade shed new light on this biographical relationship: respectively, Edna Healey's (2001) life of Emma Darwin; and Randall Keynes's book *Annie's Box* (2002), which investigates the effect on Darwin and his beliefs of the early death of a much-loved daughter. In these studies of Darwin's relations with his closest kin, both Healey and Keynes provide insight and commentary on the way that his work emerged from a close, supportive family environment that complemented the influence of ideas associated with extremes of speculative remoteness: his documentation of data from the distant lands he visited on the *Beagle* voyage, and that of the correspondents from all over the globe who provided evidence for his theories; and the controversial re-thinking of historical chronology involved in expressing the symbiosis between evolution and geology (see Winchester, 2001). This contrast of scale remains traceable in Darwin's legacy: while as a theory of biology, evolution is widely accepted and applied, there would seem to be certain fields in which its influence has yet to be fully embraced. One such is music education.

The influence of Darwin's ideas on educational thinking has been contentious and often misguided, though this was hardly the fault of their author. The misrepresentation of his theory in what became referred to as Social Darwinism, portraying "the survival of the fittest" as justifying competitive policies from selective education to eugenics, takes only part of what he defined, the struggle of the individual to amass resources and reproduce, and applies it to political ends.

Stephen Jay Gould (1977) explored these applications of quasi-Darwinian philosophy in his extensive investigation of the biological model proposed by Ernst Haeckel in 1874, that the ontogenetic development of the individual retraces the phylogenetic history of the species. Gould's account (1977, pp. 115–166) illustrates how this idea was transplanted into fields as diverse as anthropology (including recapitulatory arguments supporting racism, the superiority of the male gender, and the diagnosis and treatment of criminals), educational psychology and psychoanalysis. One application of Haeckel's "law" was to the individual's rehearsal of the behavior and experiences undergone by successive societies in cultural history, so-called *racial recapitulation theory*. Of particular interest is the adoption of this theory in the design of primary school curricula, commencing in Germany in the mid-19th century and obtaining widespread influence in the USA

around the turn of the 20th century. John Dewey was himself for a time seduced by the neat formula this presented:

It must first be heartily acknowledged that it makes practically the first attempt to treat the curriculum, especially in its sequence, upon other than formal and logical grounds. Educational theory is indebted to the doctrine for the first systematic attempts to base a course of study upon the actual unfolding of the psychology of child nature. (Dewey, 1911, p. 241)

Dewey's initial enthusiasm in developing his own experimental schools did not embrace the more extreme practices that set out early, biblical and modern history as a sequence of experiences that should be undergone in all subjects taught: reading, science, art and music. Nevertheless, he saw considerable merit in child-centred teaching that appealed to the imagination in constructing a capacity to understand contemporary challenges:

The child is not, educationally speaking, to be led *through* the epochs of the past, but is to be led *by* them to resolve complex culture into simple factors, and to understand the *forces* which have produced the present. (op. cit., p. 241)

Dewey's arguments resonate in the progressivist assumptions that can be traced in approaches to instruction in music history and theory within school and examining board curricula. While the laying-out of musical achievements in chronological order has a certain logic, paralleling Dewey's intention that children experience cultural epochs in a manner consistent with their "unfolding psychology," it can lead to Western-centered exclusivity as well as a form of teaching that places knowledge and assessment *about* music above *experience of* the medium.

Needless to say, there is nothing about historical recapitulation on these lines in any of Darwin's writings, nor in what we know of his and Emma's modern and tolerant approach to raising their own children (Healey, 2001, pp. 197–198; R. Keynes, 2002, pp. 86–92), which was viewed by his more socially-conscious relatives as overly liberal and undisciplined (Healey, 2001, pp. 165 & 175–176). The emphasis in the distortion of Darwin's ideas analysed by Gould in social and educational policy, that developed in the wake of *The Origin of Species* towards arguments for eugenics that found their ultimate goal in Hitler's Final Solution, is predominantly on the competitive and aggressive features associated with natural selection – with "nature red in tooth and claw." But Darwin also wrote of altruism and cooperation, of beauty and fulfillment. In keeping with his Wedgwood family traditions, Darwin was firmly opposed to slavery when it was still legal in Britain and its colonies (Healey, 2001, pp. 30 & 136–137; R. Keynes, 2002, pp. 26–27;), referring to it in *The Descent of Man* as a "great crime" (C. R. Darwin, 1871/2004, p. 142). His research into human anatomy and behavior influenced a leaning towards belief in human equality untypical for his period (R. Keynes, 2002, p. 28), evident in the concluding argument he contributed to devising for a petition submitted on behalf of a proposed constitution for South Africa:

We think it is of the utmost importance that when a new Constitution is in course of being framed for a country in the position of South Africa, the organic law of the State should embody the principle of an equality of rights, without regard to colour or race, leaving the principle itself to be applied only to those natives who have qualified themselves for the satisfactory performance of the duties of citizenship. (C. R. Darwin et al., 1877)

Even if the language he employed to distinguish peoples and their activities occasionally relies on expressions we would now term politically incorrect, in the use of terms such as *primitive* and

savage, his beliefs were the antithesis of racist. In hindsight, we can identify that many who jumped on the Darwinist bandwagon to serve political ends, whether willfully or through having only a partial understanding of the processes of adaptation, misrepresented both the intentions and methods of Darwin's arguments. However, writers in a variety of disciplines have, since the final decades of the 20th century, begun to piece together a coherent and convincing account of how Darwin's ideas explain the human condition, including music and the processes involved in education. This article responds to the agenda of evolutionary musicology that has emerged, and seeks to outline the mean by which it can fruitfully influence practice and advocacy in music education.

Darwin's musical life, and Darwin on life and music

Darwin's preparedness to publish his ideas emerged with great reluctance (R. Keynes, 2002, p. 80). The principle themes of *On the Origin of Species* were well formed in his mind decades earlier than 1859 (R. Keynes, 2002, p. 17). But Darwin was all too aware of the necessity of arming himself and his work against the hostile reception that he knew would be accorded to such a heretical view of man's place in nature. He was also sensitive to the impact of his work on his wife, Emma, who was torn between devotion to him and to her firmly-held religious beliefs (Healey, 2001, p. 215–216).

Darwin lived in a musical household, and attached great significance to the capacity of sound to communicate emotion and information. His wife was an excellent pianist, who had taken lessons from the Bohemian virtuoso Ignaz Moscheles (R. Keynes, 2002, p. 14) and travelled overseas to play for Chopin (Healey, 2001, p. 339). His children were brought up to play instruments: his son Francis, who participated in musical experiments with his father, remained an influential amateur performer (Godman, 1959, p. 14) while following an illustrious career at Cambridge in botany (Healey, 2001, p. 346). Francis was a friend and supporter of the musical antiquarian Francis Galpin and the folklorist Cecil Sharpe, and wrote an erudite paper on the history of the pipe and tabor, including analysis of the botanical origins of the materials from which such a wind instrument could be made (F. Darwin, 1914/1969). Another son, George, who went on to be Plumian Professor of Astronomy at Cambridge, had also been involved in family support for his father's work, providing notes on Helmholtz's theories of musical perception intended for inclusion in the second edition of his father's *The Descent of Man* (G. Darwin, 1872).

Darwin's scientific work employs significant allusions to music, as in the following elaboration of the important concept of instinct:

If we suppose any habitual action to become inherited – and I think it can be shown that this does sometimes happen – then the resemblance between what originally was a habit and an instinct becomes so close as not to be distinguished. If Mozart, instead of playing the piano at three years old with wonderfully little practice, had played a tune with no practice at all, he might truly be said to have done so instinctively. (C. R. Darwin, 1859/1968, p. 235)

He employed musical instruments in several of his experiments:

He asked himself whether animals had likes and dislikes like humans. Jenny the orang [in Regent's Park Zoo] came to mind, and he wrote in the back of his notebook: "Do the Orang Outang like smells, peppermint and music?" He went to the Zoological Gardens in early September with a mouth organ, some peppermints and a sprig of verbena. He played the mouth organ to Jenny and she listened with great attention. He gave it to her and she "readily put it when guided to her mouth". (Keynes, 2002, p. 45)

His son Francis's bassoon, and the grand piano he installed for his wife at Down House, were also exploited in experiments to detect the response to sound of various organisms:

Worms do not possess any sense of hearing. They took not the least notice of the shrill notes from a metal whistle, which was repeatedly sounded near them; nor did they of the deepest and loudest tones of a bassoon. They were indifferent to shouts, if care was taken that the breath did not strike them. When placed on a table close to the keys of a piano, which was played as loudly as possible, they remained perfectly quiet. (C. R. Darwin, 1881, p. 5)

Darwin carried out meticulous observations of his children's behavior, contributing to a project he termed "The natural history of babies:"

Following his experiments with [the orang-utan] Jenny and the mouth organ, Charles watched carefully for Willy's first signs of musical taste. At four months he believed he had "shown decided pleasure in music – his whole expression appearing pleased". But Charles was not sure. Six months later he was still watching. Willy "cried when Emma left off playing the pianoforte." He cried so often and showed "such decided pleasure as soon as she turned round to go back" to the piano, that Charles was "certain there was no mistake".

(Keynes, 2002, p. 56)

Earlier, Darwin's documentation of events encountered on the *Beagle* voyage includes a rudimentary attempt at ethnomusicology, placed in context here by his descendant Randall Keynes:

Charles loved good tunes, but had difficulty remembering them. Francis only ever heard him hum one, the beautiful slow Welsh hymn "All through the night", which he had probably first heard at the Unitarian chapel in Shrewsbury. He remembered another little tune from another world, a song that a Tahitian girl had sung to him when he landed there on HMS *Beagle* in 1835. He wrote in his diary at the time that "Numbers of children were playing on the beach, and had lighted bonfires which illuminated the placid sea and surrounding trees; others in circles were singing Tahitian verses. We seated ourselves on the sand and joined the circle. The songs were impromptu and I believe related to our arrival. One little girl sang a line which the rest took up in parts, forming a very pretty chorus. The air was singular and their voices melodious. The whole scene made us unequivocally aware that we were seated on the shores of an island in the South Sea." (R. Keynes, 2002, pp. 84–85, quoting Darwin in R. D. Keynes, 1988, p. 367)

However, according to his own systematic observations of his waning responses, Darwin found it difficult to engage with or account for music himself, at least in later life:

I have said that in one respect my mind has changed during the last twenty or thirty years. Up to the age of thirty, or beyond it, poetry of many kinds, such as the works of Milton, Gray, Byron, Wordsworth, Coleridge, and Shelley, gave me great pleasure, and even as a schoolboy I took intense delight in Shakespeare, especially in the historical plays. I have also said that formerly pictures gave me considerable, and music very great, delight. But now for many years I cannot endure to read a line of poetry: I have tried lately to read Shakespeare, and found it so intolerably dull that it nauseated me. I have also almost lost my taste for pictures or music. Music generally sets me thinking too energetically on what I have been at work on, instead of giving me pleasure. (F. Darwin, 1887, p. 42)

Whether Darwin's admission of such insensitivity to the arts in old age may have resulted from the almost intolerable nervous and gastric illnesses he suffered continuously from the time of the

Beagle voyage onwards is a matter of conjecture. But there is clear evidence in his earlier life of having enjoyed and participated in music-making (Bannan, 2013).

Whatever the development of his personal tastes, Darwin was increasingly certain that music required explanation, though he doubted his capacity to apply his theories to so “mysterious” a characteristic (C. R. Darwin, 1871/2004, p. 636). Nevertheless, he proposed that musical communication must have been the bridge between animal song and human language:

Whether or not the half-human progenitors of man possessed, like the singing gibbons, the capacity of producing, and therefore no doubt of appreciating, musical notes, we know that man possessed these faculties at a very remote period . . . The arts of singing and dancing are also very ancient, and are now practised by all or nearly all the lowest races of man. Poetry, which may be considered the offspring of song, is likewise so ancient, that many persons have felt astonished that it should have arisen during the earliest stages of which we have any record. (C. R. Darwin, 1871/2004, p. 636)

Drawing on the work of Helmholtz (1885/1954), whom he much admired and deferred to (unpublished letter, 1878) as a superior authority on matters musical, Darwin attempted to outline the relationship between anatomy, emotion and signal that might have linked the origins of song and speech:

When the next full expiration follows, the mouth is slightly closed, and the lips, from causes hereafter to be discussed, are somewhat protruded; and this form of the mouth, if the voice be at all exerted, produces, according to Helmholtz, the sound of the vowel *_O_*. Certainly a deep sound of a prolonged *_Oh!_* may be heard from a whole crowd of people immediately after witnessing any astonishing spectacle. If, together with surprise, pain be felt, there is a tendency to contract all the muscles of the body, including those of the face, and the lips will then be drawn back; and this will perhaps account for the sound becoming higher and assuming the character of *_Ah!_* or *_Ach!_* As fear causes all the muscles of the body to tremble, the voice naturally becomes tremulous, and at the same time husky from the dryness of the mouth, owing to the salivary glands failing to act. Why the laughter of man and the tittering of monkeys should be a rapidly reiterated sound, cannot be explained. During the utterance of these sounds, the mouth is transversely elongated by the corners being drawn backwards and upwards; and of this fact an explanation will be attempted in a future chapter. But the whole subject of the differences of the sounds produced under different states of the mind is so obscure, that I have succeeded in throwing hardly any light on it; and the remarks which I have made, have but little significance. (C. R. Darwin, 1872/1999, p. 38)

Building on this speculative model, Darwin suggested a developmental process by which vocal communication became central to human culture, but with music very much the missing link between animal calls and language:

All these facts with respect to music and impassioned speech become intelligible to a certain extent, if we may assume that musical tones and rhythm were used by our half-human ancestors, during the season of courtship, when animals of all kinds are excited not only by love, but by the strong passions of jealousy, rivalry, and triumph. From the deeply-laid principle of inherited associations, musical notes in this case would be likely to call up vaguely and indefinitely the strong emotions of a long-past age. As we have every reason to suppose that articulate speech is one of the latest, as it certainly is the highest, of the arts acquired by man, and as the instinctive power of producing musical notes and rhythms is developed low down in the animal series, it would be altogether opposed to the principle of evolution, if we were to admit that man’s musical capacity has been developed from the tones used in impassioned speech. We must suppose that the rhythms and cadences or oratory are derived from previously developed musical powers. We can thus understand how it is that music, dancing, song, and poetry are such very ancient arts. We must

go even further than this, and, as remarked in a former chapter, believe that musical sounds afforded one of the bases for the development of language. (C. R. Darwin, 1871/2004, p. 638)

Central to *The Descent of Man* (1871) is Darwin's essential variant of his original theory of natural selection, sexual selection, whereby dimorphic traits in males and females shape anatomy and behaviour so as to determine patterns of reproduction. The whole lengthy book, in establishing this new principle in a wide variety of avian, insect and mammal species, including wherever appropriate copious reference to the "musical" nature of sonic communication (Bannan, 2013), prepares the reader for the moment when the theory of sexual selection is applied, by way of conclusion, to the origins of language:

I cannot doubt that language owes its origin to the imitation and modification of various natural sounds, the voices of other animals, and man's own instinctive cries, aided by signs and gestures. When we treat of sexual selection we shall see that primeval man, or rather some early progenitor of man, probably first used his voice in producing true musical cadences, that is in singing, as do some of the gibbon-apes of the present day; and we may conclude from a widely-spread analogy, that this power would have been especially exerted during the courtship of the sexes, – would have expressed various emotions, such as love, jealousy, triumph, – and would have served as a challenge to rivals. It is, therefore, probable that the imitation of musical cries by articulate sounds may have given rise to words expressive of various complex emotions. (C. R. Darwin, 1871/2004, p. 109)

Darwin's establishment of the theory of natural selection in *The Origin of Species*, his elaboration of sexual selection in *The Descent of Man*, and his provision of evidence and method for the study of communication in both of these books and *The Expression of the Emotions in Man and Animals*, provided a robust foundation for speculation on the origins of music that met with relatively limited support or effective amplification in the century after his death. Nevertheless, from around the time of Frank Livingstone's provocative article of 1973, *Did the Australopithecenes Sing?*, research in a variety of disciplines has begun to illuminate the issues raised but not pursued in Darwin's major works. Finally, a coherent interpretation derived from Darwin's arguments for the role of music in human evolution has begun to be presented, with significant implications for music education.

Darwin in the 21st century: Adaptationist approaches to music, culture and education

The ideas represented in Darwin's great legacy resonate in recent work on the origins of human culture. Psychologists such as Antonio Damasio (1994), Merlin Donald (1991), Bjorn Merker (2000), Colwyn Trevarthen (1994), Tecumseh Fitch (2000), Terrence Deacon (1997), and Oliver Sacks (2007) have contributed to a growing acceptance of the distinct nature of musical and affective cognition revealed in case histories, music therapy, child development and comparative data. The laboratories of acousticians such as Johan Sundberg (2000) and Ingo Titze (2003), and of neurologists such as Donald Hodges (2000) and Lawrence Parsons (2001) have provided new insights into what happens when human beings make music, especially when employing the voice to do so. Scientifically-informed musicologists such as Ian Cross (1999), Arnie Cox (2001) and Tran Quang Hai (with Hugo Zemp, 1989/1997) have contributed accounts of musical perception and production consistent with a Darwinian viewpoint. Linguists such as Michael Halliday (1979), Guy Cook (2000), Alison Wray (2002) and John Locke (1996) examined the alternatives to Chomsky arising from an approach that takes into account the evolved anatomy and psychology of

the child vocal learner. Archaeologists such as Steven Mithen (2005) and Iain Morley (2003) have attempted to set this agenda against the known chronology available in the fossil and geological record; and researchers comparing animal and human behavior such as Robin Dunbar (1997) and Robert Provine (1989, 1996) have explored the social features of human communication and its animal origins. In philosophy, Daniel Dennett (1995) has developed a Darwinian overview aware of the implications of work across several disciplines. Research in these and related fields has converged to outline a fledgling consensus regarding the significance that should be attached to the origins of music and their perceived role in the evolution of language and culture.

The parallels between how human infants engage with vocal sound prior to and in the first months after birth and how our species may have built language on musical foundations are being carefully explored in work by, amongst others, Sandra Trehub (2001), Sheila Woodward (1992), Dean Falk (2004) and Ellen Dissanayake (2008). The elements of music with which we engage in both the perception and production of musical structures – pitch, amplitude, duration and timbre – commence their laying-down of memories and responses before birth. They continue to form the basis of both musical and linguistic competences that must be acquired for communication to develop. In the case of music, these initially vocal abilities become associated with movement and bodily sounds: with clapping and dancing; and thence with the employment of tools that we know as musical instruments. What is now being traced, by Sheila Woodward (1992; Bannan & Woodward, 2009), Susan Young (2002), Eckerdal & Merker (2008) and others, is how early the instinct to make music in these varied ways expresses itself within the life-cycle of members of our species. Central to such behavior is the element of play. Indeed, an interpretation could be proposed on lines suggested by the work of Dmitri Belyaev (Belyaev, Plyusnina, & Trut, 1985) that the lifelong extension of child musical response into adulthood represents an aspect of the “self-domestication” that made possible the development of distinctly human culture (see also Chisholm, 1999).

In Darwinian terms, this represents a significant response to the question of *what music is for*: at a time in which the answer to this question is largely examined within the social sciences in terms of economic data concerning record sales and the consequences of passive consumption of the products of music (Dolfsma, 2004; Martin, 1995; Rentfrow & Gosling, 2003), it is essential that we consider the biologically-determined musicality in all humans. If the capacity for music once played a role in the survival of our ancestors that shaped the development of our species, we surely need to identify and preserve this function of our potential. Views of the purpose of music thus need to replace such commodification, which is all too rife even in within educational practice, with a move towards participation: lifelong, active music-making. Instead, music’s roles as a mediator, as a powerful form of non-verbal communication, as a healer, as a force for collective action, as a distinct intelligence (Gardner, 1983), need to be recognized both for their place in holistic education, and for the continuing part they may play in a healthily-functioning society. A robust argument for music in education able to explain these universal human attributes brings a new urgency to debate regarding the provision of music in the school curriculum, the nature of what is taught, and how this is achieved.

Research and development: Adaptationism in the classroom and studio

Both in practical terms and from the point of view of public understanding, political support and advocacy, the agenda for music education stands to benefit from real-life present-day research able to illuminate a Darwinian view of the origin of human communication and culture. The fields in

which theory and practice could be developed include: pedagogy, curriculum design, and therapy. While music therapy has stimulated research on adaptationist lines (Bannan & Montgomery-Smith, 2008; Schneck & Berger, 2006), practice in the classroom and studio, and its provision in written curricula, seem to have been little influenced by the music evolution debate.

A framework for establishing theoretical models in music education that permit exploration of assumptions and behavior on adaptationist lines could proceed from re-visiting the relationship between ontogeny and phylogeny (Gould, 1977) in the light of recent learning theory that has extended and re-interpreted Darwin's guiding principles. For music practitioners to re-examine their beliefs regarding the nature of musical behavior and its cultural transmission, the principal themes to be examined are thus: where has music come from in our species?; how does musicality arise in each individual?; and what is the relationship between the two – the symbiosis of nature and nurture? These issues represent a bridge between the consideration of animal communication and human activity, and addressing them draws upon a synthesis of research in zoology, anthropology and psychology. Not least, the implications for a pedagogy of human communication that embraces animal imitation (which is, after all, a significant influence on musical practice in all musical cultures) is of great interest to children themselves.

The bedrock of any theory of learning is to consider the capacity of an organism that lacks the capacity for it: that is incapable of adaptation. From such a standpoint, Nico Tinbergen's (1951) model of *Four aspects of instinct* provides an accessible foundation:

- i) how has the capability evolved in the species?
- ii) how do individuals within the species develop the capability?
- iii) what happens in the nervous system when the capability is exercised?
- iv) why is the capability exercised in a particular circumstance?

Tinbergen's definitions are those of an experimental field biologist, and provide for a strong model of behavioral development precisely because they permit investigation of human characteristics in terms of criteria consistent with data assembled from animal studies. They enable us to consider behavior primarily in biological terms unaffected by culture. In seeking to understand musical learning from this viewpoint, it is useful to focus on the means by which the human voice arises and develops from instinct to intentional employment: instruments, for instance, depend by contrast on technology and, as Darwin himself advised (1971/2004, p. 636), play a later part in the story.

The principal agency in Tinbergen's analysis of instinctive behavior is the Innate Releasing Mechanism. Jürgens (1992, p. 31) provides the example 'The shrieking reaction to a painful stimulus', which is exhibited vocally in a great variety of species (Scherer, 1992), and cites experimental evidence of the variable dependence of neural pathways responsible for eliciting vocalizations in the brain of the squirrel monkey (c.f. Jürgens, 1999).

Henry Plotkin has devised a complementary model that illustrates how cognitive and cultural levels of response build on instinctive foundations, defining the need to think of learning and behavior in terms of social and aesthetic interaction as much as cognitive: "Normal human life is lived within a sea of experienced and expressed emotions; emotional knowledge may be different from, but it is every bit as important as, other forms of knowledge" (Plotkin, 1994, p. 211). Indeed, his working definition of knowledge itself is Darwinian: "Knowledge as commonly understood is a special kind of adaptation. And all adaptations are knowledge" (1994, p. 228).

Dennett (1995) illustrates the unique nature of human social interaction brought about by the adaptations of culture:

We are the only species that has an *extra* medium of design preservation and design communication: culture. That is an overstatement: other species have rudiments of culture as well, and their capacity to transmit information “behaviourally” in addition to genetically is itself an important biological phenomenon, but these other species have not developed culture to the takeoff point the way our species has. (p. 338)

Plotkin (1994) extrapolated a system of heuristics which define the capacity of an organism to make choices governing its behavior in response to a stimulus. The process he models follows the sequence *generate – test – regenerate*. At the primary level, there is no choice except that endowed retrospectively by evolution: random mutations may confer survival advantages sufficient to escape extinction:

... the successful variants are fed back into the gene pool where they will be available for sampling by future organisms. This is the conservative, pragmatic part of the heuristic. The other is the generation of novel variants by chance processes. (Plotkin, 1994, p. 139)

The secondary level embraces the possibility that one result of such random mutation is that it permits the organism to learn from experience:

The process of discovery and invention making up the adaptations that compensate for the shortcomings of those formed by the *primary heuristic* I called the *secondary heuristic*. (Plotkin, 1994, p. 153)

The *tertiary heuristic* represents a stage at which individuals within a species acquire the ability to learn from one another. The full *G – T – R heuristic* analyses the means by which learning arises at three nested levels:

Primary heuristic: evolution (instinctive choice)

Secondary heuristic: intelligence (choice informed by prior experience)

Tertiary heuristic: culture (choice informed by experience learned from others)

Plotkin’s heuristics complement the model of communication put forward by Jürgens (1992) and the model of cultural evolution proposed by Merlin Donald (1991). For Jürgens, vocalization proceeds from (i) a completely genetically-determined vocal reaction; to (ii) voluntary control with respect to the initiation and inhibition of innate vocal reactions; to (iii) voluntary control over the acoustic structure of vocal utterances (Jürgens, 1992, p. 32). This three-step ontogenetic model is present in humans, but also in other species such as birds and humpback whales. However, it illuminates Donald’s historical view of human development, in which culture emerges first as *Episodic*; then as *Mimetic*; and finally as *Mythic Culture*, culminating with the development of technology in culture that employs *External Symbolic Storage – a Theoretic Culture* (Donald, 1991).

The parallels between these interpretations of phylogenetic and ontogenetic development help us to see how learning both makes culture possible and arises from it. Plotkin (1994, p. 213) offers a simple definition: “Culture is learning about what others have learned, created or invented.” The Primary heuristic parallels Donald’s *episodic* culture: vocalization is stereotypical and involuntary. At the level of the Secondary heuristic, a variety of behaviors emerge from the properties of learning. Behavior is still dependent on instinctive responses, but these can be modified by experience: in Tinbergian terms, they can be inhibited and released through social engagement and mimicry.

The heuristic conditions Plotkin proposes for the development of behavior can be applied to devise the following sequence for the evolution of vocalization (and therefore of all music-making and language) in both phylogenetic and ontogenetic terms:

1. sound-making reflexes of the organism (cry of pain or hunger);
2. learned behavior of the adaptive individual (song producing reaction from respondent);
3. culturally-transmitted group variants of intentional singing (e.g. chanting; Balinese *kecak*; polyphony; Barbershop).

A framework that synthesizes the models of Tinbergen, Jürgens, Plotkin, and Donald, alongside analyses provided by Deacon (1997), Trevarthen (1994) and Scherer (1992), was devised by Bannan (2000) to investigate the instinctive nature of singing and its role in infant acquisition of vocality (see also Bannan & Woodward, 2009). The implications of this for education were both challenging and varied. One conclusion was that the development of the singing voice should be seen as a form of creativity pragmatically responsive to the prevailing social environment. This helps us to understand the clear differences in individuals whose approach to music-making is polarized into two conditions, the solitary and gregarious: those who prefer to experience music alone, singing in the shower, practicing the piano, or listening to their iPod; as opposed to those who associate music with something they do in company, through singing in a choir, playing in a band, or attending a dance club. From this perspective, the wide and varied spectrum of applications of music, from religious practice to social engagement, from conditions that arouse to those that calm, and from those that are intrinsically musical to those that extrinsically link to other aspects of behavior and lifestyle, illustrate the complex agenda that music education encounters.

An adaptationist analysis of the means by which musicality is acquired supports the view that creativity, as represented in the individual in Plotkin's second heuristic, is apt to be either released or inhibited at the level of the third heuristic according to whether the unique "voice" of the individual is valued. Far from being a special attribute of the few, creativity in its broadest sense (Pope, 2005) is the means by which cognition and personality adapt to permit learning to take place. Teachers, though, possess the key both to unlocking this process, and to shutting it down.

At Donald's final level for the emergence of culture, the *Theoretic*, which relies on external symbolic storage, one can see the growing dependence of cultural transmission on technology. Commentary on how this has been achieved, and is viewed as accelerating in the post-Macluhan world of electronic culture, have not helped us to understand when music presents, universally, as an instinct, and when it becomes a culturally-transmitted artifact:

As far as the listener is concerned, the growth of the mass media, the availability of inexpensive tapes, CDs and videos, advances in miniaturization and portability (e.g. the "Walkman"), and the huge potential of the internet mean that the range of music that can be heard by most people, the uses they make of it and the situations in which they hear it are far more extensive than hitherto . . . These changes mean that creating, performing and listening to music are part of the everyday lives of more ordinary people than ever before . . . Music might be used in therapeutic settings; to promote non-musical aspects of children's learning; to increase work performance in industry. . . . (Hargreaves, Kemp, & North, 2001)

One wonders whether these assertions have taken any account of the possible evolutionary origins of music: the progressivist revelations as to what music "might be" used for betray indifference to the view that therapeutic, mnemonic and psychodynamic outcomes of musical response have been around for a very long time, and may even have defined the growth of human culture which made technology possible.

A Darwinian basis for creative and life-long music teaching

What, then, are the implications of this developing theoretical synthesis for how we justify, deliver and advocate music education? One could identify the following principle themes:

- Broadening the base of the pyramid: access to music for all students, not just those selected as “musical;”
- A historically-informed and dynamic approach to the realities and advantages of multiculturalism in music;
- Notation as an entitlement: as a means to an end rather than as an end in itself;
- Education for musical self-sufficiency and lifelong participation.

Before exploring a possible curriculum addressing these aims, it may pay to consider for whom curricula are normally written. Do they necessarily express the needs and potential of the students whose opportunities they define? Are they written so as to make sense to the principal stakeholders to whom they apply: the students themselves, their teachers, and their parents? Are curriculum-writers fully informed of the cultural, physical and neurological background to the matters over which they adjudicate?

On adaptationist grounds, the curriculum should define the entitlement of students to those peak experiences that form the basis for independent and lifelong musicality. It should therefore spell out clearly that music education centers on performing – singing, playing, and dancing – but also on creating: discovery, invention, composing, and improvising. It is not the business of music education merely to preserve the past, whether remote or recent, as if in a museum (Goehr, 1994): but students are entitled to exposure to the best music of all kinds so as to fertilize their own ideas as composers and performers. This therefore embraces the values of past musics, including the notation by which they may have come down to us and which offers a potent means of today’s students leaving their own legacy. Given the universal nature of musicality, a modern curriculum should not be limited to the “gifted,” though the special needs of those with special abilities need to be met. Above all, a curriculum should not revolve around or be defined by the procedures of its own assessment:

... a centrally-planned curriculum, written as it is in legalistic terms expressed in language, does not itself represent what children learn. It offers an entitlement to experiences it can only describe metaphorically – whether in language or a form of mathematics. In describing, for instance, tasks aimed at eliciting students’ engagement with creativity, it cannot provide meaningful impressions of the consequences – and should not attempt to. If we wish students genuinely to express themselves, we have to provide the means for them to surprise us. It is beyond the capacity of a planned curriculum to capture this level of unpredictability. (Bannan, 2005, p. 401)

Yet the curriculum documents, textbooks, and commercially available revision notes for music exams published internationally amount to little more than lists of theoretical abstractions that need to be learned outside the medium of music itself, whether or not they are understood; of second-hand, potted descriptions of works, periods, cultures, and styles, whether or not their products have been performed or even listened to. Young musicians can all too easily become the force-fed clones of a system that employs them as laborers to perform repertoire selected by adults to amuse other adults – their parents – rather than representing the peak experiences that nurture creativity. Indeed, one conclusion might be that the purpose of music teaching on these lines is to demand compliance: it is effectively something done *by* adults *to* children. The panoply of classroom material that

supports studio and rehearsal activity thus represents a kind of subjunctive experience in which students learn about what music would be like if they participated in it expressively, or were permitted to learn through creating it.

Is such a process an efficient means of replicating culture? Not if we remind ourselves of what Darwin's ideas tell us: where the genetically-determined nature of an organism is nurtured in an environment that allows it to survive and reproduce, it will replicate itself; where the environment changes, replication favors such random modifications as permit it to cope. Applied to music education, this model demands that the new generation discovers for itself a creative ownership of the material it encounters. The industries that tend to undermine this – the media that seeks to enslave young consumers to commercial advantage on the one hand, the publishers, exam boards, and academic taskmasters who require that all is played by their rules on the other – define a musical culture in which all too many are made to feel unmusical and removed from participation (Mithen, 2008; Welch, 2001); or, perhaps worse, are trained to accept that the second-hand, artificially constrained experience of school music (Walker, 2008) is, somehow, the real thing.

The mediator that allows an adaptationist model to be applied to music education is creativity. One could contrast an approach that develops students' curiosity about how music works with one in which the "answers" have to be learnt by rote:

- The trend towards "painting by numbers:" teacher-led, curriculum-defined tasks;
- The Marxist paradigm: "returning to the workers ownership of the means of production."

Music education has failed to parallel other forms of self-expression available in school – dance, drama, creative writing, art – through placing an exclusive emphasis on performers as vehicles for the reproduction (Ross, 1995), at the level of which they are capable, of music that already exists, whether it be "classical," "rock" or a concert band arrangement of the latest film score.

A historically-informed and dynamic approach to the realities and advantages of multi-culturalism in music

A puzzling correlation in Western countries seems to link theoretically-defined musical curricula to a kind of embattled protection of Western Art Music against contamination by other forms of musical expression. The subject, <Music>, is associated in some cases around the colonially-defined global culture exclusively with performance on Western instruments. Advocates of this position defend it with self-righteous passion. But if music is universal, we would expect its sounds and products to transcend boundaries of race, culture and time: as, of course, they do and have always done.

It may be instructive to look at what European music would be like if it had not embraced outside influences. A brief, informal survey must suffice: a more detailed historical argument would be beyond the scope of this article.

Up to the period of the Crusades, the foundations of Western Art Music consisted mostly of chant and monody, usually unaccompanied, though there is some evidence of the use of drones in secular music as well as their introduction as an enrichment and support of chant. Contact with Arabic cultures through trade and conflict not only provided access to a superior numerical system that made calculation easier (including that involved in the construction of instruments and in music theory), but also conveyed the re-discovered Pythagorean system of tunings and harmonic knowledge that had been lost with the end of the Roman Empire. The lute was introduced, the most popular instrument of its day, based on the Arabic *ud*. Then there are the instruments of what was

to become the modern orchestra: the *zorna*, a Turkish instrument that became first the shawm and then the oboe, and in its larger form, the bassoon. I met a young bassoonist in Cyprus in 1974 whose grandmother would not allow the instrument in the house because, as a member of the double-reed family, it was associated with the devil of its supposed Muslim origins. The clarinet had that more “Christian” of constructions based on a single reed, even if it was a Greek shepherd’s instrument, the chalumeau: and this includes its descendants such as the saxophone, which has, though, appeared tainted in the eyes of Westernist purists by its involvement in that musical voodoo known as jazz. The saxophone was only admitted as an instrument fit for examination by the Associated Board of the Royal Schools of Music in the late 1980s. Curricula around the world have tended to place Jazz in a form of academic quarantine.

The central achievement and stylistic catalyst of Western Art Music, the string family, is descended from the *rebab* of North Africa. Then there is the critical influence on Monteverdi’s style of solo vocal writing of his encounter with Arabic music, as an employee of the Duke of Mantua in support of the forces sent to fight the Turks in Hungary in the 1580s (Stevens, 1993). Throughout his later works, even in the religious pieces such as the *Vespers*, one hears the Moorish rhythms he borrowed, and which he marked *moresca*. In the following century, J. S. Bach took a Mexican Indian street dance, the *passacaglia*, banned by the Catholic church for its lasciviousness when first introduced into Europe, and made it the basis of some of his finest organ music as well as the critical declaration of his faith at the heart of the Mass in B Minor, the *Crucifixus*. And Bach’s instrument, the organ, would appear to have its origins in Alexandria, Egypt.

Then there is Mozart, writing a *Rondo alla Turca* and the deliberately foreign-sounding music in *Il Seraglio* and *Così fan Tutti*. When Beethoven introduced cymbals for the first time into the 9th Symphony, it is a specific reference to Turkish music: the point being that if all men are to be brothers, then that includes those of other faiths. When one hears a cymbal clash in 19th-century music, this orientalism is intentional: Berlioz tells us this in his book on orchestration (1856/2003). It is the same with gongs, and xylophones, and castanets, etc.: each new instrument is introduced because of reference to a non-Western sound world. This accords with the influence of *gamelan* on Debussy, Ravel and Britten.

A culture that isolates itself from the enriching effect of contact with external influences is fit only for the museum: in educational terms, it leaves nothing for the new generation to say while relying on systematic repression of opportunity that has no place in the practice of an art-form founded on self-expression. Without the lifeblood of Arabic, Gypsy, Jewish, and North-African practice, European music would, literally, have remained in the Dark Ages. Beyond the features of style and instrumentation sketched above are wider issues: paper was a Chinese invention; and so was printing. We would have no notation, no score and parts from which to perform, without them: and the Chinese arrived at a mixed orchestra of multiple strings, winds and percussion several centuries before its equivalent in the West (Davison & Apel, 1946). In short, apologists for an exclusive approach to music need to understand better the complex cultural and evolutionary processes that gave rise to the traditions they value.

There is, however, a darker side to thinking about cultural history on progressivist lines. While one may view the development of music as an evolutionary process that can account for the structure of works as well as for stylistic change (Jan, 2007), it is clear that inhibition and suppression have played a part in this every bit the equal of release and innovation. J. Street (2007) analysed the relationship between political thought and music from Plato to Adorno and beyond. In educational terms, who, or what, defines the music we can teach or make together is a serious matter. The following will have defined the music education of a generation, many of whom are still living:

The task of the German guardians of music is to be the intermediaries between art and the *Volk*. Our experience with German musical culture allows us to understand uniquely; we are the defenders of our highest musical inheritance, of its fullness and fulfilling purity. To further this defense, we must win over the *Volk* through orderly plans of Education [*Erziehung*]. Our foundational work strives for unity, and we must strive to complete the desired and worthy goal: to create the musical unity of Germans and to further struggle for the world recognition of German music. (Cathcart, 2006, p. 8)

While music confers identity, how is this achieved responsibly? What, in musical terms, is the place of the musical learner in society? It is, one hopes, certain that this would no longer be defined in terms that were intentionally repressive of groups or individuals. The following instructions were issued as “binding for all dance orchestras” in the Germany of the 1930s:

. . . as to tempo, preference is also to be given to brisk compositions over slow ones (so called blues); however, the pace must not exceed a certain degree of allegro, commensurate with the Aryan sense of discipline and moderation. On no account will Negroid excesses in tempo (so-called hot jazz) or in solo performances (so-called breaks) be tolerated; so-called jazz compositions may contain at most 10 percent syncopation; the remainder must consist of a natural legato movement devoid of the hysterical rhythmic reverses characteristic of the music of the barbarian races and conducive to dark instincts alien to the German people (so-called riffs) . . . (Skvorecky, 1979, quoted in Golston, 1996, pp. 12–13)

Such were the regulations that accompanied the deportation of the other “unfavoured races,” the Jews and the Roma, to the death camps of the Nazi regime (Cathcart, 2006; Kenrick, 1998): condemn a people’s music, and you condemn their existence. The more recent suppression of music by Pol Pot in Cambodia (Sam, 2001) and by the Taliban in Afghanistan (Baily, 2004) reminds us of the vulnerability of individuals to such powers of enforcement.

While these relationships between music and politics in totalitarian régimes focus our attention on the crimes against humanity they define, it is part of J. Street’s message (2007) to imply that the price of freedoms of the kinds we might aspire to is eternal vigilance. Teachers need to reflect on whether their own assumptions permit, in the reality of their practice, the kinds of creativity they might espouse in theory. A reading of Street’s persuasive analysis, taken in the light of the evolutionary agenda we have outlined, suggests the conclusion that states and their educational representatives need to have a robust and well-informed view of the role of music in human culture if they are to meet the needs of their present and future citizens. In particular, the following need to be assured:

- Entitlement to participate as a function of (musical) citizenship;
- Entitlement to (musical) creativity as a function of democracy;
- Entitlement to plurality as evidence of sensitivity to multi-culturalism, and as evidence that, where judgements are made, they are informed but not prejudicially imposed.

Re-examining the relationship between theory and practice, and the role of notation

Perhaps, in terms of what, following Darwin’s predictions, psychologists and anthropologists are now beginning to discover about how human communication evolved, we should re-conceptualise the *theory-practice* dichotomy that figures in educational theory as the more integrated model of *perception-production*. Simply, this defines the relationship between the auditory system and its effect on memory on the one hand, and the vocal or instrumental means by which we control

musical utterance on the other. It embraces a wide spectrum of additional features: learning styles, personal experience, motivation, emotion, and so on; and permits acceptance of the key issue in an adaptationist approach to education, that of *music as instinctive*. Curricular practice arising from the application of a *perception–production* model is likely to embrace the adaptive nature of musical learning, including its therapeutic potential, and retain a view of music as integrating the physical and emotional in addition to the cognitive.

To address this issue requires us fully to recognize the role of creativity in effective music education from the earliest unprimed response of the foetus through the musically socializing processes of early infancy to a fluent, expressive and participatory pattern of musical exploration and re-presentation not only as a function of primary education but also through the precious years of early adolescence. For what best represents the relationship between perception and production is that it should retain an element of the instinctive, as in infancy? This is the quality that needs to be recaptured and maintained through the experiences of the classroom and studio. But there is a paradox here. The aspect of Western music education so often held up as a barrier to understanding, as too difficult for the average student to attempt, is notation. After all, musical creativity does not depend on the employment of notation: and a great deal of the world's music is not, and never has been, written down.

This is certainly true, but it is not a reason to abandon notation as a contributing aspect of the music curriculum. The problem is again historical, and continues as a polarization in the pedagogical stance of teachers between those practices that are notation-based and those that are not. A culturally-open music education can pick and choose in terms of styles and influences, but should retain the entitlement of students to develop the use of notation for the reason that it can prove useful to them: not, in the short term as a mere imposition of authority, requiring the supplying of right answers to examination questions based on testing its understanding; but lifelong, as a means of retaining self-sufficiency, independence, and the heightened capacity to transmit to the next generation of the informed culture-bearer.

Sir Michael Tippett, who began his career as an enlightened teacher of non-specialists, used to refuse to teach any theory until a student illustrated the need to know it. Tippett felt that you were far more likely to learn the viola clef if you wanted to write for viola than because it was arbitrarily considered important. The motivation is “bottom-up” rather than “top-down:” the place of notation in students' experience is that of an entitlement, available to them to allow them to become more independent and flexible musicians able to express themselves in sound.

Education for musical self-sufficiency and lifelong participation

Jim Chisholm (1999), in a compelling application of Darwinian ideas to the environmental challenges that face us today, illustrates that the most significant outcome of successful adaptation, both at the biological and the cultural level, is provision for accomplished reproduction by the next generation. The logic of this accords with Plotkin's levels, in that culture consolidates parental learning that can be applied to the “weaning” of the newborn as they take the first steps from instinct towards intentionality. It therefore seems puzzling that we do not commonly include in justifications or advocacy for music education that it may produce better parents. Yet in the research of Alison Street (2003), we encounter the recognition that mothers-to-be who do not normally sing and who consider themselves unmusical begin to employ song uninhibitedly as a means of bonding with their new babies. In Darwinian terms, Street's analysis suggests that child-rearing is culturally adaptive: modes of communication that may have lain dormant emerge as valuable to the new role of parent. Where a model of education for child-rearing might lead (Chisholm, 1999; A. Street,

2003; Bannan & Woodward, 2009), we should also consider music education for the ageing process (Bannan & Montgomery-Smith, 2008; Burack, Jefferson, & Libow, 2003). Musical competences and memories seem amongst the most resilient that we acquire (Sacks, 2007), able to comfort us and permit us to remain social beings even after language and locomotion desert us. Darwin's unfortunate loss of pleasure in music in later life would appear to be unusual compared to the many people for whom it remains a source of stimulus and comfort.

Conclusions: Research questions we can continue to address within a Darwinian framework

This paper set out to illustrate that Darwin's major works set the agenda for all the questions that remain to be fully explored in accounting for the phenomenon of music: What are the acoustic, physiologic and neural differences between speech and song? What role may musical engagement have over the extended human life-cycle? "How musical (indeed) is Man?" (Blacking, 1973). The progress that is currently being made in addressing these issues has significant implications that all educators, whether engaged with music education as specialists or more generally employed in teaching young people, need to consider.

Darwin's work, emerging from his family background as an independent radical, concerned father and humanitarian as much as from his scientific experimentation and observation, reminds us to consider the universality of music and its function in cementing social relationships. Application of his ideas to the means by which children engage with music suggests that theory and practice within the discipline of music education have become separated: we seem to overlook the fact that, in most languages, the word *play* or its equivalent is employed to denote musical engagement. In answer to this, music education needs to address more fully the creative and participatory responses that maintain musical engagement as a strongly socialising, non-verbal medium for thinking and feeling. Above all, our universal capacity for music-making should be reflected in approaches that remove artificial barriers between styles and genres in developing a context in which the original productions of young people are heard.

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