The misunderstanding of music

1. Introduction

I was driving through London’s rush hour one morning in March this year, listening to a BBC radio news item of an interview with a member of a joint USA/UK team who were reporting on a study of pitch perception in the journal of Science. The authors’ conclusion, based on experimental data from identical female twins, was that ‘heritability for tune deafness is 0.80’, i.e. that 80 per cent of the observed variability in pitch perception amongst twins was genetic in origin (Holden, 2001). ‘These results demonstrate for the first time the powerful influence of genes on the ability of humans to recognise correct pitches and melodies’ (Holden, 2001). The interviewer asked about the implications of these findings for parents whose children were learning to play musical instruments. The research scientist suggested that many parents were wasting their money, presumably on the assumption that significant proportions of the child population were not capable of making or responding to music.

Such a misunderstanding of the nature of musical behaviour is part of the folklore of music (see quotations on p. vii), namely that people are either ‘musical’ or ‘unmusical’. Indeed, the scientific study of musical behaviours during much of the twentieth century was driven by a conception of music as a special behaviour that was distributed unevenly across the population – a view shared by at least one senior politician with overall responsibility for education in England and Wales during the last decade.

I am also concerned about those pupils – of whom I think there may be many – with real appreciation of music but perhaps a limited aptitude for its practice.

Kenneth Clarke, Secretary of State for Education, Letter to the National Curriculum Music Working Group (DES 1991)
Many influential studies, such as those by Seashore (1938), Drake (1957), Wing (1960), Gordon (1965, 1979) and Bentley (1966), among others, were concerned with the design of formalised tests to provide scored ratings of comparative musicality, based on an assumption of an uneven distribution. An individual’s response to the acoustic features of sound (frequency, amplitude, duration and waveform), whether presented singly or in combination, was assessed by itemised psychometric tests utilising sound’s psychological correlates (pitch, loudness, rhythm and timbre). The resultant data were believed to reveal some underlying musical ‘capacity’, ‘capability’, or ‘talent’ (in Seashore’s terminology), or to be a predictor of musical ‘aptitude’ (Gordon). Such positivistic notions of scientific ‘objectivity’ were then used as arguments to justify why some people achieved limited success in music. The test data were also used to restrict access to scarce (and ‘expensive’) musical instrumental tuition in school (Mawbey, 1973). Even today, debates continue into these forms of measurement and their meaning (Good et al., 1997). Gagné (1999: 40) employed both Seashore’s and Gordon’s conceptualisations to argue that musical ‘talents progressively emerge from the transformation of...high aptitudes’. Gordon’s ‘School of Music Learning’ website states that although each child has an ‘innate level of musical aptitude’, this is ‘normally distributed in the population’ (i.e. evenly distributed around some notional average, with relatively few high flyers at one extreme and a similar proportion of musically incapable at the other). Furthermore, Gordon (1979) believes teaching can only promote development of this musical aptitude (in his terms) to the age of 9 years.

The Science report also has echoes of an early-to mid-twentieth-century obsession with twin studies and the generation of scientific ‘proof’ that drew on a culture of explanatory and predictive conceptualisations from the natural sciences. The notions of context and judgment that are central to theory in the social sciences (Flyvbjerg, 2001) are little in evidence. Arguably, the original attraction of psychometrics for the early music psychologists such as Seashore appeared to be in an academic legitimation of the study of musical behaviour through the application of a ‘scientific’ method that offered (by association) ‘objectivity’ and quantifiable measurement. Yet the effect of such a philosophical perspective, of humankind being divided into musical ‘sheep’
and non-musical ‘goats’, is to underscore a powerfully commonsensical myth that embraces a negative, even pejorative, bias.

One of the unique products of human evolution is the automatic habit of imposing symbolic meaning on experience, especially the tendency to evaluate events and self with a good or bad gloss.

(Kagan, 2001: 188)

Almost irrespective of the evidence base, perhaps the myth persists because we prefer this simple division: for each category, it legitimises our particular sense of being amongst others that share our musical (in)adequacy.

The potential sterility of nurture/nature debates (see Deary, 2001; Meaney, 2001) can be set alongside other lines of evidence that shed light on our species-wide facility for musical behaviour, particularly in relation to the impact of favourable or not-so-favourable contexts for musical development. This other evidence includes new advances in our understanding of the neuropsychobiological realities underpinning human behaviour (see Gazzaniga, 1998; Edelman and Tononi, 2000; Damasio, 2000), educational effectiveness (see Scheerens and Bosker, 1997; Gray et al., 1999; Teddlie and Reynolds, 2000; MacBeath and Mortimer, 2001) and how interpretation, judgement, culture and context shape human behaviour and achievement in music (Hargreaves and North, 1997, 2001; Thurman and Welch, 2000; Juslin and Sloboda, 2001; Zatorre and Peretz, 2001; BERA Music Education Review Group, 2001).

2. A universe of music

As far as we can tell, music in one form or another has been an omnipresent feature of human societies stretching back over 40,000 years (Cross, 2001; Huron, 2001). Carterette and Kendall (1999: 726), in their authoritative study of comparative music perception and cognition, define music as ‘temporally organised sound and silence that is a referentially [non-referentially] communicative within a context’. By this they mean that, although music is ‘intentionally organised sound’, unlike speech, it is not designed to signify something outside itself. Cook (1998: 4) defines music as ‘humanly generated
sounds that are good to listen to, and that are so for themselves and not merely for the message they convey.’ Altenmüller (2001: 274) describes music as ‘a phenomenon of subjective human experience’.

The essence of music, then, is sounds that are subject to some form of human organisation (either in production or reception or both) and communication that is not the same as spoken or written language. Nevertheless, the latest neuropsychobiological research suggests that one reason for music’s universality could be its close association with the human voice and internal affective processing (and see ‘Early musical development’, below). Functional magnetic resonance imaging (fMRI) has revealed that sound from the human voice is processed bilaterally and simultaneously in several different areas of the brain (Belin et al., 2000 – see Figure 1). In particular, the brain has a demonstrable sensitivity to the combination of high and low frequency components that are characteristic of human vocal products (Titze, 1994), particularly in the right hemisphere which has a long tradition of association with certain aspects of pitch processing, including music (Zatorre et al., 1992; Zatorre, Evans and Meyer, 1994). Spoken language can be characterised as having two essential components: prosody (being patterns

Figure 1: Average voice-sensitive activation in a group of eight adults. Regions with significantly (p<.001) higher response to human voices than to energy-matched non-vocal stimuli are shown as black areas on an axial slice (centre) and on sagittal slices of each hemisphere (left and right). [after Belin et al. (2000: 309)]
of stress and intonation – essentially connotative) and vocabulary (including semantic and phonetic elements – essentially denotative). Studies of brain function, both in health (Van Lancker, 1997) and following trauma (Gardner, 1977), indicate that prosody tends to be right-hemisphere dominant, whereas language is principally biased to the left hemisphere (Kuhl et al., 2001). In other words, it would seem that the ‘melody’ of the voice in speech is processed predominantly in areas of the right hemisphere adjacent to those implicated in the processing of musical pitch. This processing includes the spectral information that underlies the perception of vocal and musical timbres (Liégeios-Chauvel et al., 2001). Moreover, several studies of brain trauma indicate that aphasic patients (those with language deficits because of primarily left-hemispheric damage) are often still able to sing. This seems to be further confirmation of vocal pitch contour having a right-hemispheric bias (Brust, 2001). Conversely, clinical studies of right hemisphere damage can be associated with some form of amusia (musical disorder) that is not necessarily coincident with a major or equal deficit in language abilities (Marin and Perry, 1999; Schuppert et al., 2000; Peretz, 2001). Although the cortical network associated with singing is similar to that for speech, there are asymmetries in motor and auditory regions, depending on which behaviour is being primarily exhibited (Perry et al., 1999).

Further evidence of the links vocally between language and music concern syntax (the grammatical rules governing language structure). Recent studies (Patel et al., 1998; Koelsch et al., 2000; Maess et al., 2001) have explored the neurological outcomes of hearing harmonically unrelated and functionally inappropriate chords within a musical (major-minor) context. Typically, participants hear a succession of chords into which a ‘harmonically unexpected’ chord has been inserted. The results suggest that brain areas previously identified as involved in the processing of syntax in language (principally Broca’s area in the left hemisphere and, less so, its right homologue) are also implicated in the processing of musical syntax. Moreover, the processing is evident in participants with no formal musical training or education (other than what they may have experienced in school), perhaps suggesting ‘an implicit musical ability of the human brain’ (Koelsch et al., 2000: 539), or more accurately, an implicit musical capability for
constructing and perceiving patterns that functions in response to particular sonic events.

In summary, neuropsychobiological research reveals that both music and language, although often regarded as discrete subjects within the school curriculum (perhaps with the exception of singing activities), are products of differentiated, but often common, areas of the brain, usually functioning simultaneously (Besson and Schön, 2001). There are similarities between the processing of melody in music and prosodic contour in speech. A further acoustic connection arises from emotion and vocalisation (Ross, 1996). Six primary emotions – fear, anger, joy, sadness, surprise and disgust - are all commonly expressed vocally (Titze, 1994: xx) and are differentiated by strong vocal acoustic variation (Scherer, 1995). The integration of cortical and subcortical areas (such as the cerebellum) in vocal self-expression is just one example of how the nervous, endocrine and immune systems are interconnected in the human ‘bodymind’ (Damasio, 2000; Thurman and Welch, 2000; Welch and Thurman, n.d.).

Furthermore, notwithstanding the evidence for the universality of musical behaviour, there is also evidence that its likely configuration is unique in some way to the individual, a product of personal experiences over time. Altenmüller’s (2001) review of the essential ‘modularity’ (Fodor, 1983) of neurological functioning as applied to music indicates that ‘widespread and individually developed neuronal networks may underlie music processing’ (Altenmüller 2001: 275). He cites experimental evidence to suggest that auditory brain activation patterns are influenced by the nature and amount of musical experience and also by the ways that music has been learned (Gruhn, 1997). Notions of individuality are also supported by case study data on amusia (Schuppert et al., 2000; Peretz, 2001; Peretz et al., 2001). These reveal much complexity in the determination of those brain areas whose damage or malfunction is attributable to a particular musical deficit.

Given the emerging evidence of both commonality and diversity in individual neuropsychobiological functioning in music (Zatorre and Peretz, 2001), Gordon’s (1979) notion of a ‘normal’ distribution of ‘musical aptitude’ in children becomes somewhat problematic. Moreover, the research data on musical development and music education suggest that there is considerable work to be done before we can be confident that each child is receiving a
music education that is matched to current abilities, as well as maximising the realisation of potential within individual capability.

3. Musical development

**Human design and socio-cultural contexts**

There is a symbiotic relationship between our neuropsychobiological design for musical behaviour and our socio-cultural (and socio-musical) environment. Societal influences are able to shape cortical structure, function and development (Schlaug *et al.*, 1995a; Schlaug *et al.*, 1995b; Merzenich and deCharms, 1996; Brothers, 1997; Recanzone, 2000; Altenmüller, 2001). For example:

- Practised string players (violin, cello, guitar) have greater cortical activation from stimulation on their fingertips of their left hands than people who do not play an instrument (Elbert *et al.*, 1995)
- Skilled adult musicians have (on average) 25 per cent more of the auditory cortex given over to musical processing than adults within the non-performing population (Pantev *et al.*, 1998)
- The learned ability to read a musical score is associated with asymmetrically larger left hemispheric activity in areas associated with spatial processing (Sergent *et al.*, 1992)
- Compared to controls, musicians with absolute pitch (AP) ability recruit a specialised neural network in the retrieval and manipulation of verbal-tonal associations, particularly with single pitches (Zatorre *et al.*, 1998).

Such examples of musical behaviour are products of particular socio-cultural environments. In the last two of the above examples, the behaviours are likely to be typically exhibited within a musical culture that embraces musical literacy. This particular musical culture values the abilities to ‘read’ music for rehearsal and performance (as opposed to ‘playing by ear’) and to make use of a specialised discourse for its musical notation (using terms such as ‘scales’, ‘augmented fourths’, ‘perfect fifths’, ‘Neapolitan chords’ and ‘C sharp’). In contrast, irrespective of any differences in how their particular musics are constructed and sound, the first two examples are likely to be more generic to any musical culture that has relatively skilled musicians, including
those who play instruments with strings (including the Indian *sitar*, Tuvan *igil* (two-string upright fiddle) or Vietnamese *dan tranh* (zither)).

Thus, observed musical behaviour may be conceived as a product of the interaction of three generative elements: individual neuropsychobiological development, a particular socio-cultural context and a specific musical genre. Changing one of these three elements is likely to effect concomitant change in the observed or expected behaviour. A skilled singer of German *lieder*, whose principal music experience is within a Western classical genre and who performs regularly in concert venues, would expect to find her musical behaviours and vocal skill levels somewhat challenged if she were suddenly required to perform Mongolian ‘throat music’ (*Xöömi*), whether in the music studio or on a mountainside.

![Figure 2: A multi-dimensional generative interface for the manifestation of musical behaviours (Welch, 2000b: 2)](image)

The socio-cultural context interfaces with the developing neuropsychobiological history of the individual and with how ‘music’ is defined and constructed within the (sub)culture (Welch, 1998, 2000a, 2000b – Figure 2). It is suggested that the mind makes sense of the surrounding sonic world through the utilisation of a hierarchical signal-processing capability that appears to progress from the perception of *psycho-acoustic features* (such as pitch, loudness, duration, timbre), to *structures* (detecting/constructing...
patterns and regularities in the sounds), and (subsequently) to music’s syntactic and communicative elements (being the potential for musical sounds to be characterised by a grammatical function within the musical context: music as a form of language) (Spender, 1987; Welch, 1998). However, neuropsychobiological development presents constraints to this progression, with certain musical behaviours surfacing earlier than others. For example, melodic-processing skills progress from the recognition of ‘gross, obvious features to the use of more and more subtle features’ (Dowling, 1999: 616). This is the case in young children’s singing development in which reproduction of melodic contour precedes individual phrase stability and, subsequently, overall key stability (Welch, 1994).

Additionally, the functioning of this basic cognitive architecture is shaped temporally by socio-cultural factors (see above). These include social and pedagogical structures and processes within the home, school and community, as well as clusters of associated values, norms, roles, and identities that facilitate socio-cultural reproduction and transformation. Such socialisation determines which particular groupings of perceived sounds are classified and valued as ‘music’ within the culture, being something learned and not absolute (Finnegan, 1989; Burns, 1999; Carterette and Kendall, 1999). Sounds that are processed by one acculturated mind as belonging to a particular musical genre (with that genre’s concomitant set of rules) could equally be perceived by a culturally ‘naive’ listener either at a basic psycho-acoustical level where musical form appears to be lacking, or misperceived (in relation to the authenticity of the original genre) using a culturally inappropriate framework – such as when a Western ‘ear’ perceives African drumming as purely rhythmic and misses its tonal, melodic components (Nzewi, 1997).

The effects of cultural context are implicated, for example, in the ability of 6-month old infants who are better at detecting patterns in the music of their ‘home’ culture compared to music of other cultures (Lynch and Eilers, 1992; Dowling, 1999). This is not surprising if one considers the enormous amount of music that is interwoven with many different aspects of our waking lives, particularly in Western society.³ This broad and extended exposure to musical sounds is exampled in a recent survey of music provision in special schools for children with severe or profound and multiple learning difficulties.
Children were likely to experience music at home (morning and evening), travelling to and from school (car/taxi) and at any given moment during the day (as a background, for greeting, session transition, therapy, rest, curricular support and structured movement) (Welch, Ockelford and Zimmermann, 2001).

Other contemporary research continues to illuminate the interface between our genetic capabilities for musical behaviours and how these are adapted in response to different socio-cultural contexts (Pantev et al., 2001). ‘Absolute pitch’ (AP, sometimes labelled as ‘perfect pitch’) ability allows an individual to identify, or produce, a specific pitch by musical name without any objective reference tone (Ward, 1999). This ability is customarily regarded as highly specialised and relatively rare, being found in less than 1 per cent of the general adult population. However, the incidence of AP is much higher in those who learned to play a musical instrument at an early age, particularly if it was an instrument that required tuning, such as a violin (Sergeant, 1969). Furthermore, where there is an ongoing reliance on auditory cues for systematic and predictable interaction with the environment, such as is the case for the congenitally blind, the incidence of AP behaviours is much higher, being over 50 per cent in at least one study (Welch, 1988). One explanation for AP is that it begins as a universal ability, but that its continuance is negated for the majority through interaction with an environment in which relative, rather than absolute, judgements are more important (Ward, 1970; Sergeant and Roche, 1973). Such a position has received support recently from evidence of AP behaviours in 8-month old infants. These very young children were able to detect small differences in sequential patterns of notes, whereas the adults in the study were not (Saffran and Griepentrog, 2001). As mentioned in the examples at the opening of this section on human design, the neurological evidence concerning AP, when compared to relative pitch (RP) abilities, suggests that the former involves a specialised network for the retrieval and manipulation of verbal-tonal associations (Zatorre et al., 1998). However, musicians without AP use this network whenever associations need to be made to the relations between pitches (interval naming) rather than a single pitch.

The interaction between the model’s three generative elements produces similarities and differences at the level of the individual in the development of
musical behaviour. In terms of socio-cultural context, there exists a wide range of musical ‘pathways’ (Finnegan, 1989) that groups and societies utilise to induct, foster, perpetuate, and transform musical traditions across successive generations. Pathways include the musical genres to be found in the home, school and community (such as neighbourhood, church, club and media). Individual differences arise, in part, because of the somewhat more idiosyncratic developmental ‘routes’ (Welch, 1998) actually taken by people as they negotiate such pathways, including the extent to which they believe such pathways may be ‘open’ to them. ‘Openness’ will reflect perceptions of self-identity (‘the subjective sense of meaning the person gives to his or her personal situation’, Lindesmith et al., 1999: 218) with respect to particular musical pathways. These include pathways that are perceived as having a particular gender orientation (O’Neill, 1997; Green, 1997; Cohen, 2001) and/or that relate to a particular racial group (Chinn, 1997; Kwami, 1998; Shank, 2001), musical genre (Harland et al., 1995; Zillman and Gan, 1997) and/or disability (MacDonald and Miell, in press).

**Early musical development**

Musical development begins pre-birth. Normally, the foetal auditory system is functional throughout the third trimester. The womb is a relatively quiet environment and foetuses from 28–30 weeks have been observed to react reliably to external sounds, including their mothers’ speech and singing, as well as external musics (Lecanuet, 1996; Abrams and Gerhardt, 1997). In particular, although speech is partially muffled and the sound spectrum is reduced for its higher frequencies, the pitch inflection of the mother’s speech (prosody) is clearly audible (Thurman and Grambsch, 2000). Such experiences can affect behaviour post-birth, with neonates demonstrating a particular sensitivity to their own mother’s voice compared to other mothers, as well as sensitivity to the music of the maternal culture – the music that the mother listened to during pregnancy (Woodward et al., 1996). For example:

A young Canadian conductor was rehearsing a small symphony orchestra in a particular composition for the first time. He became very puzzled. He had a deep sense of familiarity with the music’s ‘cello part. Some time later he was startled to learn
that his mother, a ‘cellist, had rehearsed and performed the composition on several occasions during the third trimester of her pregnancy, just before she gave birth to the [subsequent] conductor.

(Thurman and Welch, 2000: 657)

By the third trimester of pregnancy, the foetus will also have key elements of the nervous, endocrine and immune systems developed and functioning for the processing of affective states (feelings and emotions) (Dawson, 1994). Consequently, a mother’s neuroendocrine condition (such as in response to stress, or as a result of something pleasant or relaxing) will produce related reactions in the foetus (Thurman and Grambsch, 2000). Therefore, any concurrent sounds that are generated by the mother and/or the maternal environment and which produce a neuroendocrine change in her condition are likely to produce a similar sound-associated affect in the foetus. This is evident immediately post-birth, for example, in neonate preference for the sound of their own mother’s recorded reading voice compared to voices of other mothers recorded reading the same story (DeCasper and Fifer, 1980). A complex networking of different brain areas is implicated in other research into the neural bases of emotion. Particular types of emotional response are associated with specific areas, including the pre-frontal cortex in the anticipation of future affective outcomes and the amygdala in negative responses, such as fear (Davidson, Jackson and Kalin, 2000). Furthermore, although there are relatively stable commonalities and differences in the central neural circuitry of emotion between individuals (depending on their emotional predisposition), there is also circuitry plasticity in response to environmental influences. One outcome is that a negative life event (such as being labelled as ‘tone deaf’ – see ‘routes and pathways’ below) can result in ongoing negative emotional responses in similar contextual situations (Davidson, Jackson and Kalin, 2000).

The interweaving of language and music, speech and song continues to be evident throughout infancy. Infants are genetically programmed both to produce and respond to sounds (Thurman and Grambsch, 2000). Parents and caregivers interact with infants to facilitate a growing sophistication in vocalisation in which spontaneous singing is relatively indiscriminable from
the precursors of early speech (M. Papousek, 1996). Infants make pre-verbal sounds that progress from crying and non-crying vegetative sounds (birth to 1 month) to prolonged ‘euphonic cooing’ with melodic modulation (2 to 3 months), exploratory vocal play (4 to 6 months), repetitive babbling (7 to 11 months), ‘variegated babbling’ and early words (9 to 13 months) to a ‘one-word’ stage (12 to 18 months). The latter stages are characterised by the use of protowords to name persons, object and events in the infant’s microenvironment (H. Papousek, 1996: 45).

The terms ‘infant-directed speech’, ‘parentese’ or ‘motherese’ have been used to label the vocal activities of parents and caregivers with their infants (see Fernald, 1992). Such vocalisations are inherently prosodic and utilise musical elements to facilitate the acquisition of speech. The adults use strongly accentuated prosodic elements, with marked stresses and rhythmic patterning, sometimes combined with dramatic changes in intensity. The adult vocalisations have expressive prosodic contours, frequent pitch glides and a prevalence of basic harmonic intervals (3rds, 4ths 5ths, octaves). Moreover, studies of motherese in different languages, such as German, Russian, Caucasian American, Swedish and Mandarin Chinese suggest that these musical characteristics are evidenced as cross-cultural universals, irrespective of the adults’ mother tongue (H. Papousek, 1996; M. Papousek, 1996; Kulh et al., 2001). In each case, mothers were observed to exaggerate critical acoustic features in speech when addressing young children (including an exaggeration of the acoustic differences between vowels compared to when they speak to adults – Kuhl et al., 2001).

Alongside infant-directed speech, there is also ‘infant-directed singing’. When mothers and fathers sing to their infants they employ a special repertoire of lullabies and play songs that are characterised by a higher pitch level, slower tempi and more emotive voice quality compared to their usual singing style (Trehub, 2001). These musical characteristics are also demonstrated when pre-schoolers sing to their infant siblings. Although infant-directed speech and singing employ similar acoustic features (higher pitch, slower tempo, exaggerated intonation contours – Kuhl et al., 2001), infant-directed singing is less highly pitched (up a semitone) compared to infant-directed speech (up three to four semitones) (Trehub).
There is now an extensive and growing body of research into early musical development (see Hargreaves, 1986; Deliege and Sloboda, 1996; Trehub et al., 1997; Welch, 1998; Dowling, 1999; Hargreaves and North, 2001). The evidence suggests that all children enter the world with a range of musical experiences and are capable of exhibiting a variety of musical behaviours.

It is clear that infants do not begin life with a blank musical slate. Instead, they are predisposed to attend to the melodic contour and rhythmic patterning of sound sequences, whether music or speech. They are tuned to consonant patterns, melodic as well as harmonic, and to metric rhythms...infants begin life as musical beings, being responsive to the musical primitives or universals that are the foundations of all styles of music.

(Rtrehub, 2001:11–12)

**Routes and pathways**

Yet, despite this species-wide ability, musical potential is not always fully realised. Consider these comments from individual adults about their remembrances of musical experiences in childhood.

I remember playing skipping, and singing on the street. I can’t remember the tunes now. My sister, I remember singing a little bit to her, but I don’t think I ever really couldn’t sing until Grade 7 [age 12] and the teacher and all my friends and I were in Glee Club and it was a major time. She stopped and said, “Somebody is tone deaf here.” She said, “It’s you, Val. You’re tone deaf.” She said, “You don’t have any notes. You just can’t sing along with the music at all.” I said I really want to stay in Glee Club because all my friends are there. She said, “You can stay in Glee Club, but you’re not allowed to sing, you just got to mouth the words. You can’t sing.” From then on I assumed I was tone deaf. I never sang in any other choirs after that. I go to church most of the time and I mouth the words. If we’re out with a bunch of friends at a party, I try to mouth the words.

Knight, S. interview with V, aged 47 (private communication)
We always sang. We’d sit on the fence in the evening, friends and stuff like this, and we’d sing different songs that would be on the go and, of course, you would be playing and there would be songs with that. But it was always something that we did. Then in Grade 6 [age 11], we had a two-room school and we had Grade 1 to 3 in one room and Grade 4 to 6 in the other room and the same teacher, of course, taught the three Grades. Her daughter was in school with us and there was some kind of play or something for Christmas, and so singing – these songs were sung. I practised at home for ages and I stood up to sing it and she [the teacher] told me to sit down, that I couldn’t sing. Well, I was devastated. And I thought I had done such a good job with it...I’m sure I wanted to cry. Of course, you came home; it was no good of telling your parents at the time that something like this had happened to you.

Knight, S. interview with L, aged 42 (private communication)

As a child, I loved to sing. I sang all the time. One day the music teacher at school had us sing for her by ourselves, and she divided us up into two groups – the bluebirds and the crows. I was a crow. Well, I grew up on a farm and I knew what crows sounded like. I haven’t sung since. But I guess that before I die, I want to learn how to sing.

Mack, L. (1979). Interview with applicant aged 86 who wanted to join a new community choir for ‘non-singers’

The common elements in each of these are childhood remembrances, apart from strong emotions, are negative comments from teachers, public humiliations in front of friends and peers and lifelong perceptions of musical disability. A clear association seems to have been made between a child’s apparent inability to sing a particular song ‘in tune’ and a subsequent ongoing acceptance of the teacher’s implied belief that there are two categories of people: musical and non-musical. The act of singing as a catalyst for such a categorisation is not confined to the English-speaking world. In Japan, the term onchi (‘tone idiot’) is applied to those who find difficulty with singing in
tune (Murao, 1994). Other cultures have similar derogatory terms (being equivalent to the labels ‘growler’, ‘gruntler’, ‘droner’, ‘tone deaf’, ‘tone dumb’ and ‘monotones’ that are found in the English language literature – Knight, 1999).

However, there is a body of evidence to suggest that it is erroneous to assume that ‘out-of-tune’ singing implies a lack of musical ability. A recent study, for example, required Israeli children aged 6, 9 and 12 years to listen to and learn an unfamiliar Zulu song that was presented to them on audiotape (Brand, 2000). Children were permitted to devise their own strategies in learning the song and each was provided with materials as learning aids (xylophone bars, drum, colouring pens and paper). The song had been chosen because it was thought to be sufficiently complex to sustain interest, yet not too difficult such that children were deterred from persisting in their learning of it. Although there were vocal inaccuracies and only a minority of the group managed to learn the song completely successfully, the children’s learning strategies revealed a wide range of underlying musical competences. These included the ability of children to find the song’s tonal centre and some children’s construction of erroneous, but musically plausible endings.

Implicit in the musical/non-musical conception is the notion that singing ‘in tune’ is normal and that singing ‘out of tune’ is both abnormal and evidence of a general musical disability. However, this is not born out by the available evidence. The nature and numbers of ‘out-of-tune’ singers depends on the definition. If the definition were purely made against a machine-based standard, then everyone would be classified as ‘out of tune’. This is because musical performances are perceived as being more musically acceptable when they deviate in a meaningful way from the nominal description given in a musical score (Sundberg et al., 1991). To err (in this sense) is human – not least because a central element of music relates to the expression of emotion (Thurman, 2000). In vocal music this is conveyed by variation in pitch, timing and tone colour, as well as phrasing and changes in loudness (Sundberg, 1998). Consequently, high status musical performance actually embraces some form of vocal mis-tuning, but such deviations must be within some socio-culturally defined range. Once deviations exceed such expectations, then a more commonplace, culturally derived, notion of ‘out-of-tuneness’ is likely to be applied.
Within Western-type cultures, significant proportions of the child population experience some difficulties in accurately matching the pitches of particular songs in a school context at some point in their development. The reported incidences in the research literature vary from approximately 30 per cent of 7-year-olds to only 4 per cent of 11-year-olds (Welch, 1979a). However, these percentages relate to the way that singing is conceived and to its classification as a ‘disability’ (a focus on what the child cannot do). All percentages also reflect the particular choice of assessment instrument. Compared to questionnaire surveys, fewer ‘out-of-tune’ singers are reported by researchers in informal settings where efforts are made to interact with the participant and to make them feel at ease on an appropriate singing task. Nevertheless, in general, the larger the number of categories that the researcher employs and the finer the gradations between categories, then the greater the numbers of children who become labelled as ‘out-of-tune’.

Within these percentages, there are considerable age and sex differences. Each successively older age group has fewer children categorised as singing ‘out-of-tune’. However, the reported ratio of boys to girls is approximately 2 or 3:1 for each age group, indicating that girls develop accurate vocal pitch matching earlier than boys (Welch, 1979a; Howard and Angus, 1997).

Another factor in the reported percentages is the expertise of the person making the assessment. In one classic study in New Zealand (Buckton, 1982), a wide variation was discovered between initial teacher assessments of singing competency and subsequent researcher assessment of each individual child, using a teacher-selected song that ‘the children sing best’. For example, one teacher in the survey reported that there were no ‘out-of-tune’ singers in her class, but was discovered to have 50 per cent. In contrast, another teacher reported 33 per cent ‘out-of-tune’ singers, but was discovered to have none.

A further factor relates to the likelihood of some form of relatively short-term conductive hearing disability, such as ‘glue ear’ (otitis media), which is often found in children up to the age of 8 years. Fluid in the middle ear limits the reception of sound, both in frequency range and spectra, and may lead to inappropriate vocal behaviours (Lysons, 1996). Nevertheless, children with hearing loss, including those who are profoundly deaf, are capable of a wide range of musical behaviours (Darrow, 1989; Dalgarno, 1990).
An alternative view of singing development, one focused more on competency than on ‘disability’, has been presented by a series of related studies involving over 1,000 children and young people aged from pre-school to late adolescence (ASME, 1997; Welch, 2000a; 2000b; 2000c). Included in this series was a London-based longitudinal study of how young children’s singing developed over time during their first three years in school. The research data indicated that simple categories of ‘can/cannot’ sing ‘in tune’ were (and are) inappropriate. Instead, a continuum of singing development was evidenced. Young children were found to be much more accurate in their vocal pitch matching in each subsequent year of assessment when the focus was on the musical elements of songs alone (melodic contours, melodic fragments and single pitches), rather than the combination of words and music as in a song (Welch, Sergeant and White, 1996; 1997; 1998).

Furthermore, there was a highly significant school effect. Some schools fostered song-singing development in their pupils; others did not (Welch, 2000a). The longitudinal data indicated that, although schools had similar distributions of vocal pitch matching and song text matching in their 5-year-olds at the beginning of the study, by the time that these same children were assessed at age 7, not all children had made progress (Sergeant, private communication; Welch, 2000a). In some schools, children who were relatively less accurate than their peers at age 5 (in their pitch or word accuracy or both) had become even more inaccurate by age 7. But, in contrast, every child in other research schools (and who, collectively, had demonstrated the same competency profile at age 5) had improved, implying that the nature and quality of teaching were variable between schools.

In addition to these educational context effects on the development of singing ability and ‘in-tuneness’, there are three other significantly related causes of perceived singing ‘disability’. Firstly, for young children, the borders between speaking and singing are often blurred. It would seem that many (Western) children follow a phased-base sequence of singing development in which completely ‘in-tune’ song singing is preceded by simpler, less complex, singing behaviours. These phases appear to be related to the child’s particular perceptual focus, which tends to progress from the song text, to melodic contour, to phrase-based accuracy and finally to increased accuracy overall (Welch, 1986; 1994; 1998). Sung vocal range
tends to develop and become more extensive as children get older, with some evidence that girls’ vocal ranges are greater than boys for successive age groups (Welch, 1979b). Consequently, there can be a mismatch between a developing singer’s current vocal abilities (including pitch range) compared to the pitch range required in the performance of school music (Welch, 1979a; 2000c). There are many examples of this, including recent research evidence from Japan (Kitayama et al., 2001) that analysed the pitch ranges of 1,403 songs in commonly available song textbooks for children. The songs were compared to the individually assessed vocal range of 104 pupils aged 4 to 12 years. The research team found that the textbooks took no account of developing vocal range and that the pitch ranges were inappropriate for children who had little formal music education.

Secondly, there is the issue of the actual type of music that children are expected to sing. Musical tastes are related to personalities and self-concepts (Kemp, 1997), as well as social class, gender and ethnicity (Russell, 1997). Pre-school children have been found to have preferences for certain singing activities (such as action songs), but to dislike others (such as ‘long’ songs, or those considered uninteresting or babyish) (Temmerman, 2000). Children exhibit preferences for certain musical instruments, related both to gender stereotyping and also to musical timbre (O’Neill and Boulton, 1996; Green, 1997). ‘School music’ and school music teaching are a sub-set of larger and more varied groups of musical genre and pedagogies (Wiggins, 1996; Cope and Smith, 1997; Kwami, 1998). Customarily, certain musics (often popular) and musical practices (such as informal learning) have been poorly represented in school music (Green, 2001). The outcome can be a potential mismatch between the interests and musical identities of the pupils and the curriculum that they are offered.

The differences between ‘school music’ and the child’s music were vividly exemplified in the first year of the longitudinal study (reported above). One 5-year-old boy was rather tentative in his singing of the project’s focus song for that year (‘There’s a fox in a box in my little bed’) that had been taught to him during the previous two weeks by his teacher in line with the agreed protocol. However, on completion of the task, he offered to sing another song and launched into a vocally polished rendition of a Michael Jackson ‘hit’ number ‘Heal the World’, complete with body movements and
vocal stylistics. Comparison between his performances of these two culturally diverse songs demonstrates the potential pitfall in assuming that one piece of musical behaviour is somehow characteristic of a general level of musical competence.

The impact of social context on singing behaviour is also demonstrated in a recent three-year longitudinal study in Australia of pre-school children in a community setting. The data reveal that the children used songs for specific purposes, relating to the activities that they were engaged in and with whom they were interacting (Whiteman, 2001). Similar effects of social context have been reported on musical behaviour in pre-school instrumental music making (Young, 2000).

Thirdly, the educational practice of the teacher can promote or hinder musical progress. Music, particularly singing, is commonly experienced in primary school as a class activity (OfSTED, 1999: 133). Each class will probably contain children who vary in their current phase of singing development. Arguably, teaching should be most effective when provision is matched to individual developmental need (as with other school subjects). However, matching can be problematic to achieve (but not impossible – see Mills, 2000) if the class are all expected to learn and sing the same piece of vocal music at the same time – a common prospect in the history of school music (Birge, 1937; Cox, 1993). The difficulty centres on each child being able to make sense of any feedback about individual performance from the teacher as the lesson unfolds. By definition, each child is an individual and makes an individual contribution to the performance of the focus song. There will be a variety of individual vocal pitch matching behaviours exhibited. Yet the teacher is extremely unlikely to hear each contributory voice. The teacher will hear a ‘collective’ (choral) voice, being an amalgam of the constituent elements. Consequently, feedback will be provided on this perceptual basis and bias. It may be that a majority of children in the class (depending on their current linguistic and vocal competencies) are more than capable of making sense of such a ‘collective’ teacher feedback in order to improve and be successful. However, a few will need greater clarification on how to change their current vocal production towards that which is desired. In a conservatory or higher education context such one-to-one teaching is commonplace, allowing instant noticing, comment, interpretation and correction of perceived
errors as part of the ongoing dialogue between tutor and student. But whole-class teaching in school requires different pedagogical behaviours. In particular, given the difficulties in accurate perception, the words and music need to be deconstructed and taught separately because (Western) children are reported as being more accurate when focusing on pitch alone (Welch, Sergeant and White, 1996; 1997; 1998). Children who initially sing ‘out of tune’ become more pitch accurate when allowed to practise a variety of pitches within a limited range (Welch, 1985a; 1985b). Also, breaking the song down into small components (such as in a ‘game’ format, Durrant and Welch, 1995) allows children more opportunity to master each before having to deal with them all in combination.

It is normal, therefore, for children to exhibit a range of singing behaviours and competences as part of their musical development. On entry to school, there could be considerable variation between children with respect to their current musical competences. Yet, this is not necessarily a predictor of future musical behaviours. If the educational environment is appropriately supportive and matched to their needs, children, adolescents and young adults will develop musically, not least because the human brain is designed to undergo repeated cycles of growth in neural connectivity from the first few weeks of life through to age 25 (Fischer and Rose, 1996). These growth spurts are associated with increases in cognitive capability that are experience and environment dependent for optimal functioning. Even those children and adults who appear to be most musically ‘disabled’ in terms of vocal pitch matching will improve if experience is appropriate (Welch, Howard and Rush, 1989; Welch, Rush and Howard, 1991; Mitchell, 1991; Knight, 1999). Similarly, if children and young people find ‘authenticity’ in the musical experiences that they are offered, such as exemplified in collaborative partnerships between education and professional performers, there is more likelihood of musical potential to be realised (Swanwick and Lawson, 1999; Adams, 2001).

Issues concerning developing singing abilities, musical preferences and appropriate pedagogical expertise may also be evidenced as children move into adolescence. The onset of puberty brings a change in the shape and structure of the vocal instrument for females and males. Both sexes undergo voice change and experience a period of up to five years (in extreme cases)
where voice quality is susceptible at times to a comparatively limited range of expressions (Cooksey and Welch, 1998; Gackle, 2000). In the case of males, this period is marked as a transition from boyhood to adulthood, with vocal pitch range descending progressively to approximately an octave lower. Female voices experience less of a dramatic vocal pitch change, but there is a noticeable period of instability in vocal pitch and quality before a wider vocal range is established generally. This period of voice change also coincides with the marked musical preferences that characterise adolescence (Zillmann and Gan, 1997) and the unpopularity of much school music, particularly for boys (Ross and Kamba, 1998). In essence, this is potentially a particularly difficult time for music education unless it is sensitive both to the anatomical and physiological changes of the vocal instrument and also the musical tastes and identities of individuals and groups of pupils. For a section of the population, adolescence represents another significant opportunity for a mismatch to occur between human potential and the provision of music education (Welch, 2001).

4. The misunderstanding of music

There are several ‘misunderstandings’ concerning music. Firstly, the limiting conception of humankind as either musical or non-musical is untenable. The neuropsychobiological research evidence indicates that everyone is musical (assuming normal anatomy and physiology). Moreover, everyone is likely to be uniquely musical (Zatorre and Peretz, 2001; Altenmüller, 2001). Secondly, the term ‘tone deaf’ should be confined to that rare number of people who have some form of neurological disorder in the processing of sound (Griffiths, 2001; Zatorre, 2001). It is inappropriate, even as a conventional shorthand, for use with developing singers because it ignores the reality, namely that ‘out-of-tune’ singing behaviour should be understood commonly as a mismatch between the designated musical task and current singing competency. Singing behaviour is a ‘continuum’ of multi-faceted development that is socially and culturally located. Sometimes (as in the three cases quoted above) individual development is halted and potential is not realised because of inexpert teaching and/or an erroneous view of musical ability. But this is not to imply that there is no singing competency. Adults (and children) who have self-
labelled themselves as ‘non-singers’ and ‘tone-deaf’ have been shown to improve and develop enhanced singing skills in an appropriate educational setting (Welch, Rush and Howard, 1991; Mitchell, 1991; Knight, 1999).

Thursday nights have to be the high point of the week. I love singing class. Never thought that I’d say that. In fact, if anyone had told me last spring, I’d say that I’d seriously considered having them committed.

(Knight, 1999: 153. Interview with Diana, aged 35, a member of a community extension course for adults ‘So You Always Wanted to Sing?’)

In an educational context, every effort should be made to counter the deficit model that has been explicitly nurtured through the use of negative labelling (such as ‘growlers’ and ‘monotone’) for developing singers. The following strategy is not recommended:

If there are ‘growlers’ in the class they should be at the side – about two yards away from the other scholars. These children should be allowed to join in occasionally, very quietly [original italics]. They will often gain more from listening than from ‘singing’. Periodically, they should be tested, and promoted if fit. Very few are quite hopeless.

(Carroll, 1922: 9)

A third misunderstanding is to assume that perceived singing competency is a reflection of a general level of musical competence. Singing is one form of musical behaviour. Others, such as composing (Swanwick, 1991) and playing an instrument (Hallam, 2001) are subject to their own multi-faceted developmental processes related to particular experiences and contexts. There may be an overlap between them, but if particular musical behaviours require discrete areas of the brain networking (such as in the playing of musical scales or Bach, score reading and the processing of harmonic, rhythmic or melodic elements (Parsons, 2001), then each behaviour will develop in its own similar, yet different, way. Even within the form of musical behaviour termed
‘singing’, advanced competency in one genre is no guarantee of similar skill in another, either within or without the dominant culture. Although music has been reified within conventional Western language as a singular entity, its neuropsychobiological reality is plural and multiply faceted, including motoric, visual, spatial, linguistic, numerical and emotional elements. One beneficial outcome of music’s neuropsychobiological networked diversity is a potential for education through music (as opposed to education in music). Whilst this has long been recognised in the field of music education and therapy in special education (Ockelford, 2000), it has surfaced more recently in relation to certain forms of spatial-temporal reasoning (see the ‘Mozart Effect’ – Rauscher et al., 1993; Hetland, 2000).

A fourth ‘misunderstanding’ is often reflected in curriculum design. The dominant model of school knowledge is predicated on the classification of ‘subjects’ within a curriculum that are arranged in a hierarchical manner. This conception would seem to be mismatched with human brain design and function. Although the natural sciences, arts, humanities and social sciences have a long history, to a certain extent their separation as separate disciplines is a cultural artifice that has allowed them to be studied, develop and flourish as ‘distinctive’ ways of knowing. But neurological evidence suggests that the modularity of the mind is not singular in the same way, if at all. There may be biases in the neurological networks for different kinds of processing (such as has been discussed above concerning phonetic and pitch processing, Zatorre et al., 1992), but there is also complexity allied to integration (Edelman and Tononi, 2000). Arguably, recent movements toward a greater bringing together of established disciplines (Damasio et al., 2001) reflect an awareness that curriculum (in its broadest sense) needs to become more sophisticated and more in touch with human design. Such a conception has been argued for many times in the world of education under the banners of ‘child-centred’ and, more recently, ‘learner-centred’ education. Two recent examples of learner-centred education concerned young children’s musical development (Barrett, 2001) and music teacher effectiveness with adolescents (Chung, 2001). Each researcher employed learner-centred approaches in a particular cultural context (Tasmania and Hong Kong, respectively). In both instances, the former concerning the symbolisation of music and the latter the fostering of compositional development, higher order musical behaviours were evidenced
when the learners were presented with opportunities to be fully involved in open-ended, learner-centred situations.

A fifth ‘misconception’ concerns the word music. This suggests a single, perhaps unitary phenomenon. However, although such a generic conceptualisation can be useful, the reality is that there are many and diverse musics (plural) in our world. Within each society and its constituent communities many musics flourish, not least as adjuncts to group and personal identities. Music education has to find a way to celebrate, understand and promote access to this diversity if it is to realise the musical potential of the individuals it is meant to serve.

In 1837, a social and moral ‘experiment’ began of introducing vocal music into the curriculum of the schools of Boston. In May of the following year, the Mayor of Boston requested a report on progress. The school’s response was subsequently published by the *Boston Music Gazette* on Wednesday, July 25, 1838:

One thing has been made evident, that the musical ear is more common than has been generally supposed...Many who at the outset of the experiment believed that they had neither ear nor voice, now sing with confidence and with considerable accuracy; and others who could hardly tell one sound from another, now sing the scale with ease.

(Birge, 1937: 50)

We are all musical; we just need the opportunity.
Notes

1. Although such authorities define music as essentially a human product, this is not to say that we cannot have musical experiences that are non-human in origin. Sounds that we perceive as ‘musical’ from animals, birds or machines, for example, are just that, a production of our perception. The musical structures that we perceive in such sounds arise through the way that the brain seeks patterns and categories in sonic events, drawing on our previous experiences of music and musical elements.

2. The links between speech (spoken language) and singing are strongly evidenced also with respect to pitch-based languages (that is, languages in which denotative meaning is dependent on pitch patterns and prosodic contours). There is a close correlation between the musical melodic elements of native songs and the pitch contours in the language. Studies of children’s singing in Ghana (Addo, 1996), Hong Kong (Chen-Haftek, 1999), Japan (Fujita, 1990) and Chinese Canada (Mang, 2001) indicate a correspondence with the speech melodies of the respective native languages.

3. The latest UK Government statistics (ONS, 2001) indicate that:
   - each week average UK citizens watch 26 hours of television and spend 19 hours listening to the radio, with children averaging 9 hours; women watch more than men, boys watch more than girls; sound is an omnipresent feature of broadcast media;
   - 176 million CDs and 80 million singles were sold in the UK in 1999. The best selling single was Britney Spears ‘One More Time’ and best selling album Shania Twain’s ‘Come on Over’;
   - following their launch in April 1998, 4 million DVDs were sold in 1999 – the fastest growing medium of all time;
   - 95 per cent of children aged 7 to 14 years attended cinema;
   - 12 per cent of adults regularly attended classical music concerts; 6 per cent attended ballet and opera; whereas, 25 per cent of the population aged over 16+ attended a disco or night club (1996 figures).

4. This finding is a further indication of why caution is needed in the interpretation of the twin study ‘inheritability’ data for pitch perception that was reported at the opening of this paper. To examine adults (even twins) on a particular socio-cultural behaviour (perceiving differences in altered tunes) and to predict backwards to genetic predisposition, whilst ignoring the lifespan events that shape cortical structure and function, is too simplistic.

5. The latest research on an application of ‘motherese’ suggests that it could be a powerful model for second language learning. This is because its inherent
parameters – the exaggeration of prosodic and segmental language aspects, frequent repetition of critical information, use by many speakers in informal settings – seem to provide a richer learning experience that traditional feedback and reinforcement models (Kuhl et al., 2001: 162).

6. There is also growing interest in the potential for musical experience to enhance other areas of behaviour, the so-called ‘Mozart Effect’ (Rauscher, Shaw and Ky, 1993). The latest evidence suggests that a limited ‘Mozart Effect’ exists, related to a specific type of spatial task that requires mental rotation in the absence of a physical model (Hetland, 2000). This seems to be further evidence that musical processing at a neurological level can be multi-faceted, with potential linkages with other specialised areas of the brain.

7. In order to answer the question ‘What is the percentage of “out-of-tune” singers in Western-type musical cultures?’ it is necessary to understand the process whereby researchers have generated data. Teacher-derived definitions of out-of-tune singing have been based on their responses to questionnaire data, whereas child singer-derived definitions have been based on some form of empirical observation of actual singing behaviours. These two basic approaches have utilised differing numbers of response categories. For example:

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Date(s)</th>
<th>Type</th>
<th>Location</th>
<th>Number Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentley</td>
<td>1954/1957</td>
<td>questionnaire</td>
<td>UK</td>
<td>2</td>
</tr>
<tr>
<td>Joyner</td>
<td>1969/1971</td>
<td>observation</td>
<td>UK</td>
<td>3</td>
</tr>
<tr>
<td>Roberts</td>
<td>1972</td>
<td>questionnaire</td>
<td>UK</td>
<td>6</td>
</tr>
<tr>
<td>Buckton</td>
<td>1982</td>
<td>observation</td>
<td>New Zealand</td>
<td>7</td>
</tr>
<tr>
<td>Rutkowski</td>
<td>1986/1997</td>
<td>observation</td>
<td>USA</td>
<td>5 then 9</td>
</tr>
<tr>
<td>Ellis</td>
<td>1993</td>
<td>observation</td>
<td>N. Ireland</td>
<td>6</td>
</tr>
</tbody>
</table>

In essence, the greater the number of categories, the higher the percentage of ‘out-of-tune’ singers that was reported. For example, Bentley (1954/1957) reported 11 per cent of his sample, whereas Joyner (1969/1971) reported 26.2 per cent and Roberts (1972) reported 31.06 per cent.


**Phase 1** The words of the song appear to be the initial centre of interest rather than the melody; singing is often described as ‘chant-like’, employing a restricted pitch range and melodic phrases. In infant vocal pitch exploration, descending patterns predominate.

**Phase 2** There is a growing awareness that vocal pitch can be a conscious process and that changes in vocal pitch are controllable. Sung melodic outline begins to follow the general (macro) contours of the target melody or key constituent phrases. Tonality is essentially phrase-based. Self-invented and ‘schematic’ songs ‘borrow’ elements from the child’s musical culture. Vocal pitch range used in ‘song’ singing expands.
Phase 3 Melodic shape and intervals are mostly accurate, but some changes in tonality may occur, perhaps linked to inappropriate singing register usage. Overall, however, the number of different reference pitches is much reduced.

Phase 4 No significant melodic or pitch errors in relation to relatively simple songs from the singer’s musical culture.

Singing development in relation to non-Western musics may be different because differing musical traditions and structures shape auditory perception and, potentially, vocal production. Chen-Haftek (1999), for example, reports that Cantonese-speaking children are more accurate at melody reproduction than text. Although singing is a commonplace human activity, it is also culturally diverse.
References


The misunderstanding of music


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The misunderstanding of music


The misunderstanding of music


**Web pages**
Gordon Institute for Music Learning http://www.unm.edu/~audiate/home.html