vocalised call to prayer and has a profound meaning for Muslims. Music is deeply embedded in our understanding of the world and hence in the understanding of patients as persons.

Relevance for psychiatry

Music is also embedded in the history and practice of psychiatry (Rollin, 1998). Many asylums had concert halls with orchestra and choir; Elgar conducted the Powick Asylum band and composed music for their concerts. Psychiatrists are consulted by musicians with mental disorders that impair their work and performance, as reported by Matei & Ginsborg in this issue. Severe stress adversely affects the singer's voice and the violinist's intonation and can impair their livelihood. Temporal lobe epilepsy may present with musical hallucinations, and a stroke may be followed by amusia.

For some psychiatrists, however, music making is primarily a regenerating leisure activity that provides self-agency within an interpersonal space. For others (such as Anthony Storr, Felix Post, Michael Trimble and John Cordingly) their musical interest is expressed through their books. The Royal College of Psychiatrists celebrated the millennium with a Festival of Psychiatry and the Arts, with commissioned vocal music, dance, theatre and an exhibition by the psychoanalyst Ismond Rosen. The art and science of psychiatry were in juxtaposition: a blend of intuition, connectivity and natural science which is at the heart of musical appreciation – and very close to the heartland of psychiatry.

The triad of papers in this issue encourage readers to understand the universal and personal aspects of the musical brain and the musical mind and will, it is hoped, also enhance clinical practice.

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THEMATIC PAPER

Music and the brain: the neuroscience of music and musical appreciation

Michael Trimble[1] and Dale Hesdorffer[2]

[1]Institute of Neurology, University College London, UK, email mtrimble@ion.ucl.ac.uk

[2]Gertrude H. Sergievsky Center and Department of Epidemiology, Columbia University, New York City, USA

Through music we can learn much about our human origins and the human brain. Music is a potential method of therapy and a means of accessing and stimulating specific cerebral circuits. There is also an association between musical creativity and psychopathology. This paper provides a brief review.

Art history is the unfolding of subjectivity…. (T. Adorno)

An evolutionary perspective

There have been many attempts to identify behaviours which reliably distinguish our species, *Homo sapiens*, from our closest living cousins. Ascribed activities, from tool-making to having a theory of mind and empathy, have been rejected, as observations of anthropologists and ethnologists continue to emphasise similarities rather than differences placing us within the great chain of beings. There can be no doubt about the greater development of our cognitive attributes, linked closely with the evolutionary developments of our brain, in terms of both size and structure. Bipedalism, the use of fire, the development of effective working memory and our vocal language efficient communication have all emerged from these genetic–environmental adaptations over several million years (Pasternak, 2007).

Two features of our world which are universal and arguably have been a feature of an earlier

evolutionary development are our ability to create and respond to music, and to dance to the beat of time.

Somewhere along the evolutionary way, our ancestors, with very limited language but with considerable emotional expression, began to articulate and gesticulate feelings: denotation before connotation. But, as the philosopher Susanne Langer noted, 'The most highly developed type of such purely connotational semantic is music' (Langer, 1951, p. 93). In other words, meaning in music came to us before meaning given by words.

The mammalian middle ear developed from the jaw bones of earlier reptiles and carries sound at only specific frequencies. It is naturally attuned to the sound of the human voice, although has a range greater than that required for speech. Further, the frequency band which mothers use to sing to their babies, and so-called motherese or child-directed speech, with exaggerated intonation and rhythm, corresponds to that which composers have traditionally used in their melodies. In the same way that there is a limited sensitive period in which the infant can learn language and learn to respond to spoken language, there must be a similar phase of brain development for the incorporation of music.

One of the differences between the developed brains of *Homo sapiens* and those of the great apes is the increase in area allocated to processing auditory information. Thus, in other primates the size of the visual cortex correlates well with brain size, but in *Homo sapiens* it is smaller. In contrast, increases in size elsewhere in the human brain have occurred, notably in the temporal lobes, especially the dorsal area that relates to the auditory reception of speech. The expansion of primary and association auditory cortices and their connections, associated with the increased size of the cerebellum and areas of prefrontal and premotor cortex linked through basal ganglia structures, heralded a shift to an aesthetics based on sound, and to abilities to entrain to external rhythmic inputs. The first musical instrument used by our ancestors was the voice. The ear is always open and, unlike vision and the eyes or the gaze, sound cannot readily be averted. From the rhythmic beating within and with the mother's body for the fetus and young infant, to the primitive drum-like beating of sticks on wood and hand clapping of our adolescent and adult proto-speaking ancestors, the growing infant is surrounded by and responds to rhythm. But, as Langer (1951, p. 93) put it, 'being more variable than the drum, voices soon made patterns and the long endearing melodies of primitive song became a part of communal celebration'. Some support for these ideas comes from the work of Mithen, who has argued that spoken language and music evolved from a proto-language, a musi-language which stemmed from primate calls and was used by the Neanderthals; it was emotional but without words as we know them (Mithen, 2005).

The suggestion is that our language of today emerged via a proto-language, driven by gesture, framed by musicality and performed by the flexibility which accrued with expanded anatomical developments, not only of the brain, but also of the coordination of our facial, pharyngeal and laryngeal muscles. Around the same time (with a precision of many thousands of years), the bicameral brain, although remaining bipartite, with the two cooperating cerebral hemispheres coordinating life for the individual in cohesion with the surrounding environment, became differently balanced with regard to the functions of the two sides: pointing and proposition (left) as opposed to urging and yearning (right) (Trimble, 2012).

The experience of music

A highly significant finding to emerge from the studies of the effects in the brain of listening to music is the emphasis on the importance of the right (non-dominant) hemisphere. Thus, lesions following cerebral damage lead to impairments of appreciation of pitch, timbre and rhythm (Stewart *et al*, 2006) and studies using brain imaging have shown that the right hemisphere is preferentially activated when listening to music in relation to the emotional experience, and that even imagining music activates areas on this side of the brain (Blood *et al*, 1999). This should not be taken to imply that there is a simple left–right dichotomy of functions in the human brain. However, it is the case that traditional neurology has to a large extent ignored the talents of the non-dominant hemisphere, much in favour of the dominant (normally left) hemisphere. In part this stems from an overemphasis on the role of the latter in propositional language and a lack of interest in the emotional intonations of speech (prosody) that give so much meaning to expression.

The link between music and emotion seems to have been accepted for all time. Plato considered that music played in different modes would arouse different emotions, and as a generality most of us would agree on the emotional significance of any particular piece of music, whether it be happy or sad; for example, major chords are perceived to be cheerful, minor ones sad. The tempo or movement in time is another component of this, slower music seeming less joyful than faster rhythms. This reminds us that even the word *motion* is a significant part of e*motion*, and that in the dance we are *moving* – as we are moved emotionally by music.

Until recently, musical theorists had largely concerned themselves with the grammar and syntax of music rather than with the affective experiences that arise in response to music. Music, if it does anything, arouses feelings and associated physiological responses, and these can now be measured. For the ordinary listener, however, there may be no necessary relationship of the emotion to the form and content of the musical work, since 'the real stimulus is not the progressive unfolding of the musical structure but the subjective content of the listener's mind' (Langer, 1951, p. 258). Such a phenomenological approach directly contradicts the empirical techniques of so much current neuroscience in this area, yet is of direct

concern to psychiatry, and topics such as compositional creativity.

If it is a language, music is a language of feeling. Musical rhythms are life rhythms, and music with tensions, resolutions, crescendos and diminuendos, major and minor keys, delays and silent interludes, with a temporal unfolding of events, does not present us with a logical language, but, to quote Langer again, it '*reveals* the nature of feelings with a detail and truth that language cannot approach' (Langer, 1951, p. 199, original emphasis).

This idea seems difficult for a philosophical mind to follow, namely that there can be knowledge without words. Indeed, the problem of describing a 'language' of feeling permeates the whole area of philosophy and neuroscience research, and highlights the relative futility of trying to classify our emotions – 'Music is revealing, where words are obscuring' (Langer, 1951, p. 206).

Musical ability and psychiatric disorder

There is an extensive literature attesting to some associations between creativity and psychopathology (Trimble, 2007). The links seem to vary with different kinds of high achievement, and mood disorders are over-represented. Although samples of creative people have a significant excess of cyclothymia and bipolarity, florid manic–depressive illness is relatively uncommon. Biographies of famous musicians are of considerable interest in exploring brain–behaviour associations. Attempts to transform descriptions of people from biographies into specific DSM diagnoses cannot achieve high levels of validity and reliability, since lack of autobiographical materials and reliable contemporary medical accounts makes any diagnostic formulation necessarily tentative. However, with regard to classical composers within the Western canon, it must be of considerable significance that there are so many who seem to have suffered from affective disorders, the incidence of mood disorders ranging between 35% and 40% (Mula & Trimble, 2009). It is possible that similar associations occur in non-Western composers, although studies have not been published. In contrast, none seems to have had schizophrenia. These results have importance in understanding the structure and function of the human brain, and suggest avenues for therapeutic investigation which will vary with diagnosis.

Music therapy

Music provides and provokes a response, which is universal, ingrained into our evolutionary development, and leads to marked changes in emotions and movement. The anatomical associations noted above suggest that music must be viewed as one way to stimulate the brain. Music provides a non-invasive technique, which has attracted much interest but little empirical exploration to date. The therapeutic value of music can be in part explained by its cultural role in facilitating social learning and emotional well-being. However, a number of studies have shown that rhythmic entrainment of motor function can actively facilitate the recovery of movement in patients with stroke, Parkinson's disease, cerebral palsy and traumatic brain injury (Thaut, 2005). Studies of people with memory disorders, such as Alzheimer's disease, suggest that neuronal memory traces built through music are deeply ingrained and more resilient to neurodegenerative influences. Findings from individual randomised trials suggest that music therapy is accepted by people with depression and is associated with improvements in mood disorders (Maratos *et al*, 2008). Further, the potential applications of music therapy in patients with neuropsychiatric disorders, including autism spectrum disorders, albeit intuitive, have led to psychotherapeutic uses aimed at directly evoking emotions.

Evidence suggests that music can decrease seizure frequency, stop refractory status epilepticus and decrease electroencephalographic spike frequency in children with epilepsy in awake and sleep states. We know that many people with epilepsy have electroencephalographic abnormalities and, in some people, these can be 'normalised' by music. In addition to the need for trials of musical interventions in epilepsy, we should also consider whether the results of sonification of an electroencephalogram, which directly reflects the time course of cerebral rhythms, may be used to entrain 'normal' brain rhythms in people with seizure disorders. Alteration of the electroencephalogram via biofeedback of different components of sonified electroencephalography, or modulation of the musical input to a stimulus that affects the emotional state of the patient and hence cerebral and limbic activity and cerebral rhythms, are therapeutic possibilities which are currently being investigated (Bodner *et al*, 2012).

These data suggest that the effects and cost-effectiveness of music therapy in patients with neuropsychiatric disorders should be further explored. To date, most work has been done with Western-style compositions, and the well structured music of Mozart and Bach has been a popular basis for interventions. The following paper by Shantala Hegde notes the potential of other musical styles as therapy. Through music we learn much about our human origins and the human brain, and have a potential method of therapy by accessing and stimulating specific cerebral circuits.

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THEMATIC PAPER

Music therapy for mental disorder and mental health: the untapped potential of Indian classical music

Shantala Hegde

Neuropsychology Unit and Cognitive Psychology and Cognitive Neurosciences Laboratory, Department of Clinical Psychology, National Institute of Mental Health and Neurosciences, Bangalore, India, email shantala.hegde@gmail.com

Music is a universal human trait. The healing power of music has been acknowledged in almost all traditions of music. Music therapy is moving from a social-science model focusing on overall health and well-being towards a neuroscience model focusing on specific elements of music and its effect on sensorimotor, language and cognitive functions. The handful of evidence-based music therapy studies on psychiatric conditions have shown promising results. Traditional music, such as Indian classical music, has only recently been evaluated in evidence-based research into music therapy. The need for systematic research in this area is underscored.

An overview of Indian classical music

Music, like language, is a ubiquitous human trait. Like any other art form, music has always been viewed from an aesthetic perspective and its healing power has been documented in various traditions of music across the world. Indian classical music (ICM) is perhaps one of the oldest forms of music. It dates back to the ancient scriptures of India, the Vedas (dated around 5000–2000 BC), and is said to have originated from one of the four Vedas, the Samaveda. The Vedas consist of verses in Sanskrit for chanting. The two present forms of ICM, known as north Indian classical music (or Hindustani classical music) (NICM) and south Indian classical music (or Carnatic classical music) branched out from the same tradition around the 13th century AD. *Ragas* (from the Sanskrit phrase *ranjayiti iti ragaha*), meaning 'one which induces emotion in the mind', and *taal* (a rhythmic structure and cycle) form the core of ICM. The *ragas* provide the framework for melodic elaboration and are defined as a melodic basis for compositions and improvisations (Jairazbhoy, 1995). There are hundreds of *ragas* in these two traditions. Each *raga* has specific notes (*swar*) for ascending and descending, and a specific manner in which the notes are combined. Certain notes in the *ragas* are considered crucial. The most important note is called the *vadi-swar* and the second most important note is called the *samvadi-swar*. Each *raga* has a unique melodic line, like a signature tune or motif, which is called the *pakkad*. Each *raga* is associated with a specific affective theme (*rasa* or *ras*, a Sanskrit word meaning 'the essence'). *Ragas* are said to evoke one or more of these emotions (sadness, romance, peace, strength/courage, anger, devotion, longing, passion).

Expression of the *raga-rasa* aspect is considered the primary goal in ICM, and this expression is intended to vary dynamically during performance. The presentation of the *raga* in ICM therefore evolves over time, in various stages (*alap*, *jhor-jala*, *gat*, *vilambit*, *dhrut*) and dimensions. Variations are introduced not only in the melodic improvisation, but also in the composition, tempo and complex rhythmic cycle.

A study investigating the variations in emotional experience during the different phases of *raga* elaboration found that emotional variations within certain *ragas* were often larger than between *ragas*. Indian classical musicians have the ability to strongly vary the expressivity associated with a specific *raga* in their performances, but within the constraints of the *raga* framework (Hegde *et al*, 2012).

In an electroencephalography (EEG) study, 20 musically untrained individuals listened to NICM *ragas*; they showed increased overall alpha, delta and theta power in comparison with an eyes-closed rest condition. The observed changes during music listening had previously been linked with highly relaxed states, such as meditative states (Hegde *et al*, 2012). Listening to certain *ragas*, for example 'Desi-todi', for 30 minutes every day for 20 days has been shown to produce a significant decrease in systolic and diastolic blood pressure, to reduce stress, anxiety and depression, and to enhance feelings of life satisfaction, experience of hope and optimism. Changes in heart rate were much more evident in females than males (Gupta & Gupta,