

COMMENTARY

The power of music

What an odd thing it is to see an entire species—billions of people—playing with listening to meaningless tonal patterns, occupied and preoccupied for much of their time by what they call ‘music.’ This, at least, was one of the things about human beings that puzzled the highly cerebral alien beings, the Overlords, in Arthur C. Clarke’s novel *Childhood’s End*. Curiosity brings them down to the Earth’s surface to attend a concert; they listen politely and patiently, and at the end, congratulate the composer on his ‘great ingenuity’—while still finding the entire business unintelligible. They cannot think what goes on in human beings when they make or listen to music, because nothing goes on within them. They, themselves, as a species, lack music.

Clarke likes to embody questions in fables, and the Overlords’ bewilderment makes one wonder, indeed, what it is about music that gives it such peculiar power over us, a power delectable and beneficent for the most part, but also capable of uncontrollable and sometimes destructive force.

We may imagine the Overlords ruminating further, back in their spaceships. This so-called ‘music,’ they would have to concede, is in some way efficacious to humans. Yet it has no concepts, and makes no propositions; it lacks images, symbols, the stuff of language. It has no power of representation. It has no relation to the world. These, indeed, are the very issues Schopenhauer raises in *The World as Will and Representation*—and Schopenhauer himself was passionately musical. Music, for him, was an embodiment of pure ‘will’—but this is not a notion that goes down well in a neuroscientific age.

Another passionately musical philosopher, Nietzsche, said, ‘We listen to music with our muscles.’ This, at least, is something we can see. It is evident in all of us—we tap our feet, we ‘keep time’, hum, sing along or ‘conduct’ music, our facial expressions mirroring the rises and falls, the melodic contours and feelings of what we are hearing. Yet all this may occur without our knowledge or volition.

All this is normal, and may be seen as a half-conscious resonance to music, a sort of involuntary personal expression as the music works on us. But these effects, the overflow of music into the motor system, can easily go too far, becoming irresistible and perhaps even coercive.

Anthony Storr, in his excellent book *Music and the Mind*, stresses that in all societies, a primary function of music is collective and communal, to bring and bind people together. People sing together, dance together, in every culture, and one can imagine them doing so, around the first fires, a hundred thousand years ago. This primal role of music is to some extent lost today, when we have a special class of

composers and performers, and the rest of us are often reduced to passive listening. One has to go to a concert, or a church or a musical festival, to recapture the collective excitement and bonding of music. In such a situation, there seems to be an actual binding of nervous systems, the unification of an audience by a veritable ‘neurogamy’ (to use a word favoured by early Mesmerists).

It is easy to be overcome, for better or worse, in a communal setting. One of the most dramatic effects of music’s power is the induction of trance states, which have been described by ethnomusicologists in nearly every culture. Trance—ecstatic singing and dancing, wild movements and cries, perhaps, rhythmic rocking, or catatonia-like rigidity or immobility—involves both motor and gross emotional, psychic and autonomic effects, culminating in profoundly altered states of consciousness; and whilst it can be achieved by a single individual, it often seems to be facilitated in a communal group. I have not encountered music-induced trance in the course of clinical practice, but it has been documented by countless films, and experienced by many thousands of people, whether in concerts, drum circles or meditation—and it has been used by various religions for millennia. Gilbert Rouet, in his monumental book, *Music and Trance*, discusses these phenomena at length.

We see the coercive power of music if it is of excessive volume, or has an overwhelming beat, at rock concerts where thousands of people, as one, may be taken over, engulfed or entrained by the music, just as the beat of war drums can incite extreme martial excitement and solidarity. (There is now, indeed, a whole genre of modern dance music called ‘Trance,’ designed to have such an effect.) Mickey Hart and others have written eloquently of the power of drumming in cultures all over the world, and here it is especially the dynamic power of rhythm that is pre-eminent.

This motor power of rhythm may be especially strong in various forms of motor and impulse disorder—and music can indeed be therapeutic here. Thus, patients with parkinsonism, in whom movements tend to be incontinently fast or slow or sometimes frozen, may overcome these disorders of timing when they are exposed to the regular tempo and rhythm of music. The eminent (and now parkinsonian) composer Lukas Foss, for example, whom I saw recently, may festinate or rocket almost uncontrollably to his piano, but once he is there, can play a Chopin nocturne with exquisite control and timing and grace—only to festinate or freeze once more as soon as the music ends.

Music is profoundly important to those with motor disorders, though the music must be of the ‘right’

kind—suggestive, but not peremptory—or things may go wrong. For one of my deeply parkinsonian post-encephalitic patients, Frances D., music was as powerful as any drug. One minute I would see her compressed, clenched and blocked, or else jerking, ticking and jabbering—like a sort of human time bomb. The next minute, if we played music for her, all of these explosive-obstructive phenomena would disappear, replaced by a blissful ease and flow of movement, as Mrs D., suddenly freed of her automatisms, would smilingly ‘conduct’ the music, or rise and dance to it. But it was necessary—for her—that the music be legato; for staccato, percussive music might have a bizarre counter-effect, causing her to jump and jerk helplessly with the beat, like a mechanical doll or marionette.

People with Tourette’s syndrome—including many I know who are professional musicians—may become composed, tic-free, when they listen to or perform music; but they may also be driven by certain kinds of music into an uncontrollable ticcing that is entrained with the beat.

The stirring or animating power of music entails emotional no less than motor arousal. We turn to music, we need it, because of its ability to move us, to induce feelings and moods, states of mind. Therapeutically, this power can be very striking in people with autism or frontal lobe syndromes, who may otherwise have little access to strong emotional states. And the evocative power of music can also be of immense value in people with Alzheimer’s disease or other dementias, who may have become unable to understand or respond to language, but can still be profoundly moved—and often regain their cognitive focus, at least for a while—when exposed to music, especially familiar music that may evoke for them memories of earlier events, encounters or states of mind that cannot be called up in any other way. Music may bring them back briefly to a time when the world was much richer for them.

But music can also be profoundly evocative, have deep resonances, without being familiar, and without calling up specific memories. All of us have had the experience of being transported by the sheer beauty of music—suddenly finding ourselves in tears, not knowing whether they are of joy or sadness, suddenly feeling a sense of the sublime, or a great stillness within. I do not know how to characterize these transcendent emotions, but they can still be evoked, as far as I can judge, even in deeply demented (and sometimes agitated or tormented) patients. Music can bring them, if only for a little while, a sense of clarity, joy and tranquility.

Although we are now becoming attuned to the many forms of amusia that may result from cortical damage, and might expect that people with extensive cortical damage would lose the ability to recognize or respond to music, one finds instead that even people with advanced Alzheimer’s disease can nonetheless respond to the evocative powers of music. Isabelle Peretz and others have called attention to this, and the need for investigating how such responsiveness is maintained.

There is a wide range of sensitivity to the emotional power of music, ranging from virtual indifference at one extreme (Freud was said to be indifferent to music, and never wrote about it), to a sensitivity that can barely be controlled. Individuals with Williams syndrome, for example, though they have severe visual and cognitive defects, are often musically gifted, and usually extravagantly sensitive to the emotional impact of music. I have seen few sights more extraordinary than a group of 40 young people with Williams syndrome breaking into uncontrollable weeping at tender or sad music, or uncontrollably excited if the music is animated.

That music and especially melody can be profoundly evocative is clear. But what is it that is evoked? Anthony Storr quotes Suzanne Langer and Marcel Proust in this regard. For Proust, ‘Music...helped me to descend into myself, to discover new things; the variety that I had sought in vain in life, in travel, but a longing for which was nonetheless renewed in me by this sonorous tide.’ Jonathan Miller, the opera director, summarizes this in a single word: the real role of music, in his view, is not to take one outside oneself, but to take one inside oneself. Suzanne Langer goes further, writing that music not only has the power to recall past emotions, but to evoke ‘emotions and moods we have not felt, passions we did not know before.’

This wonderful, enlarging power, can, however, be deeply upsetting to those who need to have their emotions and imaginations under tight control—whether this be obsessive or artistic. Thus, Tolstoy was deeply ambivalent about music—it had, he felt, a power to induce in him ‘fictitious’ states of mind, emotions and images that were not his own, and not under his control. He adored Tchaikovsky’s music, but often refused to listen to it, and in *The Kreutzer Sonata*, he described the seduction of the narrator’s wife by a violinist and his music—the two of them play Beethoven’s Kreutzer Sonata together, and this music is so powerful, the narrator comes to think, that it can change a woman’s heart, and cause her to be unfaithful. The story ends with the outraged husband murdering his wife—though the real enemy, he feels, the enemy he cannot kill, is the music.

Indeed, for many of us the emotions induced by music may be overwhelming—Robert Zatorre speaks of ‘chills’ in this connection, and has shown some of the specific neurobiological basis of these. An eminent psychologist friend of mine, who is intensely sensitive to music, cannot have it on as background when he works; he must attend to music completely, or turn it off, for it is too powerful to allow him to focus on any other mental activity. States of ecstasy and rapture may lie in wait for us, if we give ourselves totally to music, and these, of course, also carry the danger of excess. A common scene during the 1950s was to see entire audiences swooning in response to Frank Sinatra or Elvis Presley—seized by an emotional and perhaps erotic excitement so intense as to induce fainting. Richard Wagner, too, was a master of the musical manipulation of

emotions, and this, perhaps, is a reason why his music is so intoxicating to some, and so avoided by others.

The motor and emotional effects of music are visible, largely, whereas the perception or the imagining of music is internal, and we are dependent here on reports from listeners (though now we are beginning to visualize the neural basis of their experiences by functional brain imaging). When Francis Galton wrote on ‘mental imagery’ in the 1880s, he concerned himself only with visual imagery, and not at all with musical imagery. But a tally of one’s friends will suffice to show that musical imagery has a range no less varied than the visual. There are some people who can scarcely hold a tune in their heads, and others who can hear entire symphonies in their minds, with a detail and vividness little short of actual perception.

There are some singular attributes of musical imagery (and musical memory) that have no equivalents in the visual sphere, and these may cast light on the fundamentally different way in which the brain treats music. This peculiarity of music may be in part because we have to construct a visual world for ourselves, and a selective and personal character therefore infuses our visual memories from the start—whereas we are given pieces of music already constructed, musical objects that will be retained, if they are retained, with an almost phonographic fidelity. A visual or social scene can be represented in a hundred different ways, but the recall of a musical piece has to be close to the original. We do, of course, listen selectively, with differing interpretations and emotions, but the basic musical characteristics of a piece—its tempo, its rhythm, its melodic contours, even its pitch—tend to be preserved with remarkable fidelity. It is this fidelity—this almost defenceless engraving of music on the brain—which may play a crucial part in predisposing us to certain excesses, or pathologies, of musical imagery and memory, excesses that may even occur in relatively ‘unmusical’ people.

All of us have experienced the involuntary, helpless mental replaying of songs or tunes, or snatches of music we have just been exposed to, by chance, even, perhaps, without ‘listening’ consciously. We call such tunes ‘catchy’—and they are sometimes referred to as ‘earworms,’ for they may burrow into us, entrench themselves and then persevere internally hundreds of times a day, only to evaporate, fade away, in a day or two, perhaps to be followed by the next earworm. This often meaningless perseveration is quite unlike voluntary musical imagery, and unlike the involuntary musical imagery that may be evoked by a sight, a sound, a word, with some significant, though often unconscious, association (although this may then turn into an earworm). Perseverative music has much more the character of a cerebral automatism, suggesting cerebral networks, perhaps both cortical and subcortical, caught in a circuit of mutual excitation. I do not think there are comparable phenomena with other types of perception—certainly not with visual experience. For instance, I am a verbal creature myself, and though sentences often permute themselves in my mind and

suddenly surface as I am writing, I never have verbal ‘earworms’ comparable with musical ones.

Unlike these earworms, true musical hallucinations are experienced by those who have them as unprecedented and deeply disquieting. There is insufficient awareness among physicians of musical hallucinations, in part because patients are reluctant to report them, fearing that they will be dismissed or seen as ‘crazy’. But musical hallucinations are surprisingly common, affecting at least 2% of those who are losing their hearing, as well as patients with a variety of other conditions. Working with a population of elderly patients (though I have seen it in younger people as well), I am often given vivid descriptions of musical hallucinosis, and I think it is by far the most common form of non-psychotic hallucination. I related two stories of musical hallucination in my 1985 book *The Man Who Mistook his Wife for a Hat*, and since then have received hundreds of letters from people with this condition. With musical hallucinations it is common for several voices or instruments to be heard simultaneously, and such experiences are almost always attributed, initially, to an external source. Thus in 1995 I received a vivid letter from June M., a charming and creative woman of 70, telling me of her musical hallucinations:

‘most of the music I hear is from my past—many of the songs are hymns, some are folk music, some pop up from the forties and fifties, some classical and some show tunes. All the selections are sung by a chorus—there is never a solo performance or any orchestration. This first started last November when I was visiting my sister and brother in law in Cape Hatteras, NC, one night. After turning off the TV and preparing to retire, I started hearing ‘Amazing Grace’. It was being sung by a choir, over and over again. I checked with my sister to see if they had some church service on TV, but they had Monday night football, or some such. So I went onto the deck overlooking Pamlico Sound. The music followed me. I looked down on the quiet coastline and the few houses with lights and realized that the music couldn’t possibly be coming from anywhere in that area. It had to be in my head’.

It was not clear why June M. started to have musical hallucinations, or why she still has them, 11 years later. She has excellent hearing, is not epileptic, has no known medical problems and is intellectually quite intact. With her, as with many other patients, the most searching examination may fail to pinpoint the cause of musical hallucinations; though if she had a PET scan, it would, I suspect, show the widespread activation of cortical and subcortical networks that T. D. Griffiths has found in several subjects with musical hallucinations—an activation very similar to what occurs when one is actually listening to music.

Musical hallucinations sometimes emerge insidiously, bit by bit, but more commonly come on suddenly and full-blown, and without obvious ‘cause.’ They most commonly ‘replay’ music heard in childhood, but perhaps not

consciously recalled for decades. Musical hallucinations tend to be highly repetitive, sometimes with a single theme or sequence of notes being repeated again and again. One of my patients, tiring of an endless megaphonic rendering of 'O Come, All Ye Faithful', tried to block this by playing a Chopin étude, only to find that four bars of the Chopin then iterated themselves in her mind non-stop for the next 24 h. This sort of experience is common among those afflicted with musical hallucinations—not only regurgitation of early musical experiences but also a tendency to instant 'replay' of music just heard—a sort of palimusia. Musical hallucinations cannot be stopped by an effort of will, though they can sometimes be changed, especially to music with a similar rhythmic or melodic character. Another correspondent wrote in this regard of his 'intracranial jukebox.' Musical hallucinations can be very loud and interfere with perception or conversation in a manner that never occurs with normal musical imagery.

The term 'release hallucination' was coined in the early 1970s for the occurrence of visual or auditory hallucinations associated with impaired sight or hearing. But the concept of 'release' goes back a century or more to Hughlings Jackson's notions of neural functions or phenomena being held in check by inhibition, and 'released,' therefore, if inhibition is sufficiently diminished. There are rich reciprocal connections between our sense organs and the brain—essential for understanding the central modulation of perception—and it is postulated that normal sensory activity serves to inhibit too much retrograde activity in these. But if this inhibition is critically diminished, through sensory impairment or lack of stimulus, then a sort of reflux may occur in the form of hallucinations. (One might suppose that restoring hearing with hearing aids or cochlear implants would stop this reflux, but it rarely does; one profoundly deaf patient of mine with musical hallucinations was given a cochlear implant, and while this has given her a whole new auditory world, it has done little to change her musical hallucinations.) Yet deafness almost never leads to hallucinations of voices, only to hallucinations of music (voices may be heard in the words of a lyric, but not muttering or talking). That musical hallucinations thus take precedence over all other auditory hallucinations shows again the special and potent character of the neural processing of music.

Although musicogenic epilepsy has probably existed as long as epilepsy itself, the condition was only formally recognized and named by Macdonald Critchley in the early 1930s (he himself preferred the more euphonious term 'musicolepsia'). Musicogenic epilepsy is generally considered to be very rare, but Critchley wondered if it might be notably more common than supposed. For many people, he thought, might start to get a queer feeling—disturbing, perhaps frightening—when they heard certain music, but then would immediately retreat from the music, turn it off, or block their ears, so that they did not progress to a full-blown seizure. He wondered, therefore, if 'formes frustes' of musical epilepsy might be relatively common. (This has certainly been my own

impression, and I think there may also be similar formes frustes of photic epilepsy, when blinking lights or fluorescent lights may produce a peculiar discomfort without producing a full-blown seizure.)

Working in an epilepsy clinic, I have seen a number of patients with seizures induced by music, and others who have musical auras associated with seizures—occasionally both. Both types of patient have temporal lobe seizures, and, in most cases, temporal lobe lesions identifiable with brain imaging. Among the patients I have seen recently is G.G., a young man who was in good health until June 2005, when he had a severe attack of herpes encephalitis that started with a high fever and generalized seizures, followed by coma, and severe amnesia. Remarkably, a year later, his amnesic problems have virtually cleared (though his encephalitis had involved both temporal lobes), but he remains highly seizure-prone, with occasional grand mal seizures and, much more commonly, complex partial seizures. Initially, all of these were 'spontaneous,' but within a few weeks they started to occur almost exclusively in response to sound—'sudden, loud sounds, like ambulance sirens'—and, especially, music. Along with this G.G. developed hyperacusis, becoming able to detect sounds too soft or distant for others to hear. He enjoyed this, and felt that his auditory world was now 'more alive, more vivid,' but wondered, too, whether it played any part in his now epileptic sensitivity to music and sound.

Unlike another patient, Mrs N., who has seizures only in response to Neapolitan songs, G.G.'s attacks may be provoked by a large range of music, from rock to classical (the first time I saw him, he played a Verdi aria on his cell phone, and after about half a minute this induced a complex partial seizure). He speaks of 'romantic' music as being the most provocative, especially Frank Sinatra's songs ('He touches a chord in me'). He says that the music has to be 'full of emotions, associations, nostalgia'—it is almost always music he has known from childhood or adolescence. It does not have to be loud to provoke a seizure; soft music may be equally effective. His seizures start with, or are preceded by, a special state of intense, involuntary, almost forced, attention or listening. In this already altered state, the music seems to grow more intense, to swell, to take possession of him, and at this point, he cannot stop the process, cannot turn off the music or walk away from it. Beyond this point he retains no consciousness or memory, although various ictal automatisms and automatic behaviours ensue. For Mr G., music does not just provoke a seizure, it seems to constitute an essential part of the seizure, spreading (one imagines) from its initial perceptual locus to other temporal lobe systems, as these are activated in temporal lobe seizures and occasionally reaching the motor cortex, when he has generalized seizures.

I have sometimes been given similar descriptions by patients whose seizures are not provoked by music, but contain hallucinatory music as a prominent feature. (Perhaps this is not surprising, for, as Penfield remarked, 'The localization for production of [epileptic] music is in the

superior temporal convolution . . . and, as such, close to the point associated with so-called musicogenic epilepsy'.) One such patient, Eric M., who has an astrocytoma and temporal lobe seizures, hears music during his seizures that he cannot identify, even though he is a musician, but he finds this music hauntingly familiar. 'Once I become aware of that strange yet familiar confusion,' he says, 'and realize it is in fact a seizure, I seem to try not to figure out what the music could be . . . I am afraid that if I pay too much attention to it, I may not be able to escape it—like quicksand, or hypnosis.' He may, nonetheless, be drawn deeper and deeper into it, until he realizes that it is out of his hands.

Our auditory systems, our nervous systems, are tuned for music. Perhaps we are a musical species no less than a linguistic one. But there seems to be in us a peculiar sensitivity to music, a sensitivity that can all too easily slip out of control, become excessive, become a susceptibility or a vulnerability. Too-muchness lies continually in wait, whether this takes the form of 'earworms', musical hallucinations, swoons and trances, or music-induced seizures. This is the other side of the otherwise wonderful power of music. How much this is due to the intrinsic characteristics of music itself—its complex sonic patterns woven in time, its logic, its momentum, its unbreakable

sequences, its insistent rhythms and repetitions, the mysterious way in which it embodies emotion and 'will'—and how much to special resonances, synchronizations, oscillations, mutual excitations, feedbacks, and so forth, in the immensely complex, multi-level neural circuitry that subserves musical perception and replay, we do not know. We do not even know why, for instance, simple stroboscopic light displays can excite hallucinations, myoclonus and seizures, and this is an infinitely simpler matter than the powers of music.

When Crichtley and Henson's *Music and the Brain* was published in 1977, functional brain imaging still lay in the future, and neuroscience had yet to approach the neural correlates of musical perception, imagery and memory or their disorders. In the last 20 years, there have been huge advances here, but we have, as yet, scarcely touched the question of why music, for better or worse, has so much power. It is a question that goes to the heart of being human.

Oliver Sacks
Clinical Professor of Neurology,
Albert Einstein College of Medicine, New York, USA
E-mail: mail@oliversacks.com