4

Music on the Brain: Imagery and Imagination

Heard melodies are sweet, but those unheard are sweeter.

—JOHN KEATS, *"Ode on a Grecian Urn"*

Music forms a significant and, on the whole, pleasant part of life for most of us—not only external music, music we hear with our ears, but internal music, music that plays in our heads. When 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.

I became aware of this huge variation early in life, for my parents stood at opposite ends of the spectrum. My mother had

difficulty voluntarily calling any tune to mind, but my father seemed to have an entire orchestra in his head, ready to do his bidding. He always had two or three miniature orchestral scores stuffed in his pockets, and between seeing patients he might pull out a score and have a little internal concert. He did not need to put a record on the gramophone, for he could play a score almost as vividly in his mind, perhaps with different moods or interpretations, and sometimes improvisations of his own. His favorite bedtime reading was a dictionary of musical themes; he would turn over a few pages, almost at random, savoring this and that—and then, stimulated by the opening line of something, settle down to a favorite symphony or concerto, his own *kleine Nachtmusik*, as he called it.

My own powers of musical imagery, and of musical perception, are much more limited. I cannot hear an entire orchestra in my head, at least under normal circumstances. What I do have, to some degree, is a pianist's imagery. With music I know well, such as Chopin's mazurkas, which I learned by heart sixty years ago and have continued to love ever since, I have only to glance at a score or think of a particular mazurka (an opus number will set me off) and the mazurka will start to play in my mind. I not only "hear" the music, but I "see" my hands on the keyboard before me, and "feel" them playing the piece—a virtual performance which, once started, seems to unfold or proceed by itself. Indeed, when I was learning the mazurkas, I found that I could practice them in my mind, and I often "heard" particular phrases or themes from the mazurkas playing by themselves. Even if it is involuntary and unconscious, going over passages mentally in this way is a crucial tool for all performers, and the imagination of playing can be almost as efficacious as the physical actuality.

Since the mid-1990s, studies carried out by Robert Zatorre and his colleagues, using increasingly sophisticated brain-imaging

techniques, have shown that imagining music can indeed activate the auditory cortex almost as strongly as listening to it. Imagining music also stimulates the motor cortex, and conversely, imagining the action of playing music stimulates the auditory cortex. This, Zatorre and Halpern noted in a 2005 paper, "corresponds to reports from musicians that they can 'hear' their instrument during mental practice."

As Alvaro Pascual-Leone has observed, studies of regional cerebral blood flow

> [suggest that] mental simulation of movements activates some of the same central neural structures required for the performance of the actual movements. In so doing, mental practice alone seems to be sufficient to promote the modulation of neural circuits involved in the early stages of motor skill learning. This modulation not only results in marked improvement in performance, but also seems to place the subjects at an advantage for further skill learning with minimal physical practice. The combination of mental and physical practice [he adds] leads to greater performance improvement than does physical practice alone, a phenomenon for which our findings provide a physiological explanation.

Expectation and suggestion can greatly enhance musical imagery, even producing a quasi-perceptual experience. Jerome Bruner, a very musical friend, described to me how once, having put a favorite Mozart record on his turntable, he listened to it with great pleasure, and then went to turn it over to play the other side—only to find that he had never played it in the first place. Perhaps this is an extreme example of something we all experience occasionally with familiar music: thinking we hear

music faintly when the radio has been turned off or a piece has come to an end, we wonder whether the music is still playing softly or we are simply imagining it.

Some inconclusive experiments were performed in the 1960s on what the researchers called "the 'White Christmas' effect." When the then universally known Bing Crosby version of the song was played, some subjects "heard" it when the volume was turned down to near zero, or even when the experimenters announced they would play the song but never turned it on. Physiological confirmation of such "filling in" by involuntary musical imagery has recently been obtained by William Kelley and his colleagues at Dartmouth, who used functional MRI to scan the auditory cortex while their subjects listened to familiar and unfamiliar songs in which short segments had been replaced by gaps of silence. The silent gaps embedded in familiar songs were not consciously noticed by their subjects, but the researchers observed that these gaps "induced greater activation in the auditory association areas than did silent gaps embedded in unknown songs; this was true for gaps in songs with lyrics and without lyrics."[1]

Deliberate, conscious, voluntary mental imagery involves not only auditory and motor cortex, but regions of the frontal cortex involved in choosing and planning. Such deliberate mental imagery is clearly crucial to professional musicians—it saved the creative life and sanity of Beethoven after he had gone deaf and could no longer hear any music other than that in his mind.[2] (It is possible, indeed, that his musical imagery was even intensified by deafness, for with the removal of normal auditory input, the auditory cortex may become hypersensitive, with heightened

1. See David J. M. Kraemer et al., 2005.

2. Indeed, for any professional musician, voluntary imagery may dominate much of conscious and even subconscious life. Basically, any artist is always at work, even when he

powers of musical imagery.) The rest of us frequently call upon our musical imagery, too. Nevertheless, it seems to me that most of our musical imagery is not voluntarily commanded or summoned but comes to us apparently spontaneously. Sometimes it just pops into the mind; at other times it may play there quietly for a while without our even noticing it. And though voluntary musical imagery may not be easily available to the relatively unmusical, virtually everyone has involuntary musical imagery.

One sort of involuntary musical imagery is related to intense and repeated exposure to a particular piece or sort of music. I tend to fall in love with a certain composer or artist and to play their music over and over, almost exclusively, for weeks or months, until it is replaced with something else. In the past six months, I have had three such fixations, one after another. The first was on Janáček's opera *Jenufa*, after I had gone to hear a beautiful performance of this directed by Jonathan Miller; themes from *Jenufa* kept going through my mind, even entering my dreams, for two months, reinforced by my getting CDs of the opera and playing them constantly. Then I switched to a profoundly different experience after meeting Woody Geist, a patient who sang for me some of the music he performed with his a cappella jazz group, the Grunyons. This intrigued me, though I had never before been interested in this type of music; once again, I played his CD constantly, and *Jenufa* vanished from my mental concert hall, replaced by the Grunyons singing "Shooby Doin'." Most recently, I have turned to constant playing of recordings by Leon Fleisher, and his renditions of Beethoven, Chopin, Bach, Mozart, and Brahms have swept the Grunyons out

appears not to be. This is well brought out by Ned Rorem, in *Facing the Night*: "I'm never not working. Even as I sit here chatting of Kafka or cranberries, sodomy or softball, my mind is simultaneously glued to the piece I'm currently creating; the physical act of inserting the notes on a staff is merely a necessary afterthought."

of my head. If I ask what *Jenufa*, "Shooby Doin'," and Bach's Chromatic Fantasy and Fugue have in common, I would have to say nothing musically and probably nothing emotionally (beyond the pleasure they have all given me at different times). What they do share is the fact that I have bombarded my ears and brain with them, and the musical "circuits" or networks in my brain have been supersaturated, overcharged, with them. In such a supersaturated state, the brain seems ready to replay the music with no apparent external stimulus. Such replayings, curiously, seem to be almost as satisfying as listening to the actual music, and these involuntary concerts are rarely intrusive or uncontrollable (although they have the potential to be so).

In a sense, this type of musical imagery, triggered by overexposure, is the least personal, the least significant form of "music on the mind." We are on much richer, much more mysterious terrain when we consider tunes or musical fragments we have perhaps not heard or thought of in decades, that suddenly play in the mind for no apparent reason. No recent exposure, no repetition can explain such tunes, and it is almost impossible to avoid asking oneself, "Why this tune at this particular moment? What put it into my mind?" Sometimes the reason or association is obvious, or seems so.

As I write, in New York in mid-December, the city is full of Christmas trees and menorahs. I would be inclined to say, as an old Jewish atheist, that these things mean nothing to me, but Hanukkah songs are evoked in my mind whenever an image of a menorah impinges on my retina, even when I am not consciously aware of it. There must be more emotion, more meaning here than I allow, even if it is of a mostly sentimental and nostalgic kind.

But this December is also marked by a darker melody, or train of melodies, which forms an almost constant background to my

thoughts. Even when I am hardly conscious of this, it produces a feeling of pain and grief. My brother is gravely ill, and this music, plucked out from ten thousand tunes by my unconscious, is Bach's *Capriccio on the Departure of a Most Beloved Brother.*

As I was dressing this morning after a swim, I was reminded, now I was on land again, of my painful, arthritic old knees—and I thought too about my friend Nick, who would be visiting that day. With this there suddenly popped into my head an old nursery rhyme that was popular in my childhood but that I had probably not heard (or thought about) for two-thirds of a century: "This Old Man," and, in particular, its refrain: "Knick-knack, paddy whack, give a dog a bone; / This old man came rolling home." Now I myself was an old man with painful knees who wanted to be rolled home—and Nick (punned as knick-knack) had entered into it too.

Many of our musical associations are verbal, sometimes to the point of absurdity. Eating some smoked whitefish (which I adore) earlier in this Christmas season, I heard in my mind "O Come Let Us Adore Him." Now the hymn has become associated with whitefish for me.

Often such verbal associations are subconscious and only become explicit after the fact. One correspondent wrote to me about her husband, who, though well able to remember tunes, was unable to recall the words which went with them—nevertheless, like many people, he might make unconscious verbal associations to the lyrics. "For example," she related, "we could have been saying something like, 'Gee, it's getting dark really early these days,' and, a half-minute later, he would start whistling 'The Old Lamplighter'—a fairly obscure song which he has heard just a few times in his life. . . . Obviously, the lyrics are stored in his brain and linked to the music, but are somehow only retrievable through the music without the words!"

I recently spent several hours with a composer, grilling him about his musical imagery. He finally excused himself and went to the loo. On emerging, he told me that he had heard a song in his head—a song that had been popular forty years earlier but that, at first, he could not identify. He then recalled that the first line of the song was "Only five minutes more . . ." I accepted this as a hint from his unconscious, and made sure to keep him only five minutes more.

Sometimes there are deeper associations which I cannot fathom by myself—the deepest of these I seem to keep, as if by a sort of agreement with my unconscious, for sessions with my analyst, who is encyclopedically musical, and often able to identify the fragmentary and off-key sounds that are sometimes as much as I can reproduce.

And, of course, the greatest literary analysis of a musical association is that given by Proust, in his deciphering of "the little phrase" of Vinteuil's that runs through the entire structure of *Remembrance of Things Past.*

But why this incessant search for meaning or interpretation? It is not clear that any art cries out for this and, of all the arts, music surely the least—for while it is the most closely tied to the emotions, music is wholly abstract; it has no formal power of representation whatever. We may go to a play to learn about jealousy, betrayal, vengeance, love—but music, instrumental music, can tell us nothing about these. Music can have wonderful, formal, quasi-mathematical perfection, and it can have heartbreaking tenderness, poignancy, and beauty (Bach, of course, was a master at combining these). But it does not *have* to have any "meaning" whatever. One may recall music, give it the life of imagination (or even hallucination) simply because one likes it—this is reason enough. Or perhaps there may be no reason at all, as Rodolfo Llinás points out.

Llinás, a neuroscientist at New York University, is especially interested in the interactions of the cortex and the thalamus—which he postulates to underlie consciousness or "self"—and their interaction with the motor nuclei beneath the cortex, especially the basal ganglia, which he sees as crucial to the production of "action-patterns" (for walking, shaving, playing the violin, and so on). He calls the neural embodiments of these action-patterns "motor tapes." Llinás conceives of all mental activities—perceiving, remembering, and imagining no less than doing—as "motor." In his book *I of the Vortex*, he writes repeatedly of music, mostly of musical performance, but sometimes of that odd form of musical imagery when a song or tune suddenly pops into the mind:

> The neural processes underlying that which we call creativity have nothing to do with rationality. That is to say, if we look at how the brain generates creativity, we will see that it is not a rational process at all; creativity is not born out of reasoning.
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> Let us think again of our motor tapes in the basal ganglia. I should like to suggest to you that these nuclei *do not* always wait for a tape to be called up for use by the thalamocortical system, the self. . . . In fact, the activity in the basal ganglia is running all the time, playing motor patterns and snippets of motor patterns amongst and between themselves—and because of the odd, re-entrant inhibitory connectivity amongst and between these nuclei, they seem to act as a continuous, random, motor pattern noise generator. Here and there, a pattern or portion of a pattern escapes, without its apparent emotional counterpart, into the context of the thalamocortical system.

"And suddenly," Llinás concludes, "you hear a song in your head or out of seemingly nowhere find yourself anxious to play tennis. Things sometimes just come to us."

Anthony Storr, a psychiatrist, writes eloquently in *Music and the Mind* of his own musical imagery and wonders "what purpose is served by music running in the head unsummoned and perhaps unwanted?" He feels that such music generally has a positive effect: "It alleviates boredom, makes . . . movements more rhythmical, and reduces fatigue." It buoys the spirits, is intrinsically rewarding. Music drawn from memory, he writes, "has many of the same effects as real music coming from the external world." It has the additional bonus of drawing attention to otherwise overlooked or repressed thoughts, and in this way may serve a function similar to that of dreams. All in all, Storr concludes, spontaneous musical imagery is basically "beneficent" and "biologically adaptive."[3]

Our susceptibility to musical imagery indeed requires exceedingly sensitive and refined systems for perceiving and remembering music, systems far beyond anything in any nonhuman primate. These systems, it seems, are as sensitive to stimulation from internal sources—memories, emotions, associations—as to external music. A tendency to spontaneous activity and repetition seems to be built into them in a way that has no analogue in other perceptual systems. I see my room, my furniture every day, but they do not re-present themselves as "pictures in the mind." Nor do I hear imaginary dog barks or traffic noises in the background of my mind, or smell aromas of imaginary meals cooking,

3. William James, by contrast, wrote about our "susceptibility to music"; he presumably meant this to include our susceptibility to musical imagery as well. But he saw this as having "no zoological utility," as reflecting no more than "a mere incidental peculiarity of the nervous system."

even though I am exposed to such perceptions every day. I do have fragments of poetry and sudden phrases darting into my mind, but with nothing like the richness and range of my spontaneous musical imagery. Perhaps it is not just the nervous system, but music itself that has something very peculiar about it—its beat, its melodic contours, so different from those of speech, and its peculiarly direct connection to the emotions.

It really is a very odd business that all of us, to varying degrees, have music in our heads. If Arthur C. Clarke's Overlords were puzzled when they landed on Earth and observed how much energy our species puts into making and listening to music, they would have been stupefied when they realized that, even in the absence of external sources, most of us are incessantly playing music in our heads.

5

Brainworms, Sticky Music, and Catchy Tunes

Music is playing inside my head
Over and over and over again
. . . There's no end . . .

—CAROLE KING

Sometimes normal musical imagery crosses a line and becomes, so to speak, pathological, as when a certain fragment of music repeats itself incessantly, sometimes maddeningly, for days on end. These repetitions—often a short, well-defined phrase or theme of three or four bars—are apt to go on for hours or days, circling in the mind, before fading away. This endless repetition and the fact that the music in question may be irrelevant or trivial, not to one's taste, or even hateful, suggest a coercive process, that the music has entered and subverted a part of the brain, forcing it to fire repetitively and autonomously (as may happen with a tic or a seizure).