

Oliver Sacks, Musicophilia: Tales of Music and the Brain, 2007.

Preface

-“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 thing called 'music,' [an alien] would have to concede, is in some way efficacious to humans, central to human life. Yet it has no concepts, makes no propositions; it lacks images, symbols, the stuff of language. It has no power of representation. It has no necessary relation to the world.”

-there exists a small minority of human who lack the neural apparatus for appreciating tones or melodies but for most of us music has great power over us and this 'musicophilia' is so prevalent among all cultures and across time that it seems to innate and basic to human existence

-one comparison might be made to birdsong but that has a relatively fixed structure within the bird's physical makeup and purpose whereas the origin and purpose of human music is less easy to understand

-quote by Steven Pinker: “What benefit could there be to diverting time and energy to making plinking noises? ... As far as biological cause and effect are concerned, music is useless.... It could vanish from our species and the rest of our lifestyle would be virtually unchanged.”

-Pinker goes on to argue that many of the arts have no adaptive function at all but are by-products of two other adaptive traits: “motivational systems that give us pleasure when we experience signals that correlate with adaptive outcomes (safety, sex, esteem, information-rich environments), and the technological know-how to create purified and concentrated doses of these signals”

-our musical power are made possible by using, or recruiting, or co-opting brain systems that have already developed for other purposes, which can explain why there is no single 'music center' in the brain, but it involves a dozen scattered networks throughout the brain

-almost all humans have the ability, in varying degrees, to perceive music, perceive tones, timbre, pitch intervals, melodic contours, harmony and rhythm; we can construct music in our mind, music can reproduce emotion in us, we involve our muscles in the listening of music as we keep time and allow ourselves to physically feel the emotion of it, we sometimes put images to music, music can be therapeutic

-“Our auditory systems, our nervous systems, are indeed exquisitely tuned for 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, or feedbacks in the immensely complex, multilevel neural circuitry that underlies musical perception and replay, we do not yet know.”

-the machinery that allows us to appreciate music is vulnerable to damage that can lead to various distortions, excesses, and breakdowns, which is what this book discusses in order to try to understand the multitude of ways that music impacts our mind and our lives

PART I: HAUNTED BY MUSIC

Chapter 1 -A Bolt from the Blue: Sudden Musicophilia

-tells the story of Dr. Cicoria, an orthopedic surgeon who was hit by lightning when he was 42 years old, had a near-death, out-of-body experience and six or seven weeks later developed an insatiable desire to listen to and play piano music when prior to this he had no real interest in music

-in time, he started hearing strong music in head pretty much all the time, although he could turn it off with some effort, he was compelled to write it down even though he could not read music let alone compose it

- tells the story of Salimah, a previously serious chemist who, after she had a tumor removed from her brain, was a much warmer person and had a strong passion for listening to music when she hadn't really cared for it before
- tells a sort of reverse story of a woman with temporal lobe epilepsy who developed musicophilia after her seizures got under control, leading doctors to conclude that her seizures had disrupted a connection in the brain that was responsible for emotion in some way, adding that many people who get temporal lobe epilepsy treated see an emergence of unexpected artistic, sexual, mystical, or religious feelings
- some patients with degeneration of the front parts of the brain, so-called frontotemporal dementia, sometimes also develop a startling emergence or release of musical talents and passions as they lose the powers of abstraction and language
- tells the stories of Grace M and Eliza Bussey who, like Cicoria, developed a rather sudden onset of musicality at the in their 50s that involved hearing music in their head and then composing it when they had no musical desire or skill prior to this, but unlike Cicoria had no physical reason they could point to for the change

Chapter 2 -A Strangely Familiar Feeling: Musical Seizures

- recounts the experiences of several individuals who heard loud music just before they had seizures, people whose seizures are not triggered by music but music is invariably a part of them and the individuals are unable to recognize the music that plays in their head without some sort of investigation or prompting from hearing it elsewhere afterwards
- each of the individuals report that they entered into a sort of dissociative state and the music exerts a frightening and almost dangerous spell on them that they can't control

Chapter 3 -Fear of Music: Musicogenic Epilepsy

- discusses people who have epileptic seizures induced by music, detailing how the type of music that caused it in different individuals was quite varied as was the type of seizure that music provoked (varying between severe grand mal and the doubling of consciousness where part of the brain disconnects from current reality to focus on another reality, be it an image, music, a feeling, a place, etc.)
- in some cases monotonous sounds also caused the seizures in them, sounds like an airplane engine, church bells, or machinery in a workshop -tones that fall within a certain frequency range

Chapter 4 -Music on the Brain: Imagery and Imagination

- points out the range of music imagery ordinary people hold in their heads, ranging from 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 that is pretty much like actual perception
- discusses the advanced abilities that professional musicians have with brain scans showing that mental imaging of music activating the auditory cortex almost as strongly as listening to it and this activating ties to the central neural structures required for the movements ties to a performance of the piece
- points out that our minds will fill in the gaps in familiar music if there are gaps in the song, similar to the way that our eyes often fill in gaps in scenes in front of us
- pretty much everybody has musical imagery, for most of us we are unable to develop a strong skill for voluntary imagery that will help us compose but virtually everyone has involuntary musical imagery that comes from intense and repeated exposure to songs, songs that we can easily call to mind and that get stuck in our heads
- discusses associations that music has in our mind that certain words or emotions can call to mind different tunes, often causing us to try to figure out why this is

-“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.”**

-neuroscientist Rodolfo Llinás argues that there is a part of our brain that is always playing motor patterns and snippets of motor patterns in the form of tunes and other auditory things that have struck our mind and once in a while one of these tunes is pulled to the conscious mind, that there really is no reason for it although this tune may trigger an emotion or memory that we then use to give meaning to why we are thinking of that tune

-psychiatrist Anthony Storr says that music in our mind alleviated boredom, makes movements more rhythmical, and reduces fatigue

-“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, 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.”

Chapter 5: Brainworms, Sticky Music, and Catchy Tunes

-discusses the phenomenon when a fragment of music repeats itself incessantly, music that has subverted a part of the brain and forcing it to repeat without any control over it, like a tic or mild seizure
-certain tunes like theme music and jingles in advertisements are purposefully meant to be "catchy" and bore into the ear or mind as an "earworm" or "brainworms"

-“What is happening, psychologically and neurologically, when a tune or a jingle takes possession of one like this? What are the characteristics that make a tune or a song “dangerous” or “infectious” in this way? Is it some oddity of sound, of timbre or rhythm or melody? Is it repetition? Or is it arousal of special emotional resonances or associations?”

-some of the most powerful earworms come from songs learned in our youth

-in other cases it matters if there is a repetition in tones or words

-in some cases an unusual tone or alteration in the music sets it off

-for some people these earworms are a constant part of a disease such as Parkinson's, autism, or Tourette's

-“Brainworms are usually stereotyped and invariant in character. They tend to have a certain life expectancy, going full blast for hours or days and then dying away, apart from occasional after-spurts. But even when they have apparently faded, they tend to lie in wait; a heightened sensitivity remains, so that a noise, an association, a reference to them is apt to set them off again, sometimes years later. And they are nearly always fragmentary. These are all qualities that epileptologists might find familiar, for they are strongly reminiscent of the behavior of a small, sudden-onset seizure focus, erupting and convulsing, then subsiding, but always ready to reignite.”

- some drugs have been found to exacerbate earworms
- compares the impact that music has in on us in this way and the way visual imagery can get stuck in the mind (play a video game for too long or stare at repetitive images to a day and you can see these when you close your eyes), saying that there is something fundamentally different going on with earworms
- “There are attributes of musical imagery and musical memory that have no equivalents in the visual sphere, and this may cast light on the fundamentally different way in which the brain treats music and vision. This peculiarity of music may arise 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. A visual or social scene can be constructed or reconstructed 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 timbre and pitch—tend to be preserved with remarkable accuracy. **It is this fidelity—this almost defenseless engraving of music on the brain—which plays 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.**”
- there are, of course, inherent tendencies to repetition in music itself and our music sensitivity might just be a sign of our brain's vulnerability to finding repetition

Chapter 6: Musical Hallucinations

- discusses the case of a woman who had gradually lost her hearing then went on a drug that restored some of her hearing but also led to continuous music hallucinations in which familiar tunes would constantly play in her head unless she was sleeping, playing bridge or otherwise concentrating on something
- explains that these were "release" hallucinations that came about because her brain had been denied auditory input so it created spontaneous activity of its own
- discusses the case of a man who at first started having musical hallucinations only when he was on a plane, triggered by the drone of the plane engine but after one flight the music continued non-stop, varying in volume depending on the loudness of the environment he was in, kept him awake and woke him from sleep, playing songs he did not care for and even songs that disturbed him (Nazi marching songs he had heard as a Jewish youth growing up in Hamburg)
- tells of another case of a man in his 60s with no hearing loss, an eminent composer who started hearing songs that were popular in his childhood and adolescence, music he had no taste for but had been exposed to growing up
- describes other people who all of a sudden have tunes in their heads from their youth that they had long forgotten, often just shorted lived hallucinations that faded after a few days or a weeks and the flood of letters he received after he responded to someone asking about this phenomenon in "Dear Abby" which led him to believe it was much more widespread than the medical community thought it be
- emphasizes that those who have these experiences stress that they are not imagining the music, they are actually hearing it, sometimes at such a level that it is impossible to function normally with them happening
- most people with music hallucinations have had some sort of hearing loss and many, but not all, also had some sort of noise in the ear, a rumbling, hissing, or other forms of tinnitus, or on the other extreme recruitment, an abnormal and often unpleasant loudness of certain voices or noises
- discusses cases where the hallucinations are temporary or not as intrusive, highlighting several cases where they only happen when the person is lying down as well as cases of young people who suffer temporary blackout during sports and hear music when coming to

- most cases of musical hallucination there are qualities that are similar to epilepsy, migraines and Tourette's syndrome and drugs that are useful for treatment of epilepsy often help
- there is some suggestion of persistent, uninhabitable spreading electrical excitement in the musical networks of the brain
- hallucinations of many sorts often come from extreme sensory deprivation that can come from loss of senses or from cutting oneself off from usual stimulation such as at meditation retreats or long sailing trips
- discusses the fairly new research into "hallucinations in the sane" that come about from disease in the sensory organs rather than psychosis
- some of this research contends that there are strong links going not only from the sensory organs but also to them and questions why we don't suffer from hallucinations that originate in the mind on a more regular basis
- particularly points out a theory that we generally have a constant flow of sensory input from eyes, ears, and other sense organs which normally inhibits any backflow of activity from the highest parts of the cortex to the periphery but if there is a critical deficiency of input then the flow can reverse, supported by brain scans that show widespread activation during musical hallucinations of the same neural networks that are normally activated during the perception of actual music
- while there is no doubt of the physiological basis of the musical hallucinations, there is something to be said about them having some psychological factors, something behind the selection of hallucinatory music

PART II: A RANGE OF MUSICALITY

Chapter 7: Sense and Sensibility: A Range of Musicality

- discusses whether 'musicality' -a particular musical sensibility demands a specific neurological potential, an ability that is very particular to those who are gifted and beyond the reach of the average person
- sometimes this musicality can get out of control of the individual, an obsession that they feel bullied by and in the control of it
- it is difficult to tell if strong musical ability is a result of a special brain that someone is born with or due to training, since most begin intensive musical training in early childhood
- brain scans have shown that professional musicians have an enlarged corpus callosum, the great commissure that connects the two hemispheres of the brain
- they also show that a part of the auditory cortex, the planum temporale, has an asymmetric enlargement in musicians with absolute pitch
- "Anatomists today would be hard put to identify the brain of a visual artist, a writer, or a mathematician -but they could recognize the brain of a professional musician without a moment's hesitation."
- the anatomical changes that have been observed with musicians' brains were strongly correlated with the age at which musical training began and with the intensity of practice and rehearsal
- there is also evidence that listening to music, particularly complex music like classical pieces, can enhance abstract spatial reasoning that can produce strong artistic and math skills
- "The implication of all this for early education is clear. Although a teaspoon of Mozart may not make a child a better mathematician, there is little doubt that regular exposure to music, and especially active participation in music, may stimulate development of many different areas of the brain—areas which have to work together to listen to or perform music. For the vast majority of students, music can be every bit as important educationally as reading or writing."

- asks can music competence be like language competence, an ability that pretty much all humans have just needing to be exposed at an early age?
- answers by pointing out that there is a critical period in youth when language acquisition is critical and if it isn't obtained then it is extremely difficult to pick up later, which is not the case with music acquisition

Chapter 8: Things Fall Apart: Amusia and Dysharmonia

- we take for granted our ability to sense things on many different levels and form incoming information into a coherent understanding of the world up until we lose our ability to do so, such as the impact that the lose of the perception colour or depth has on our vision
- the perception of music depends on not just hearing a multitude of tones but also on decoding tunes and a synthesis of sound and time, and thus there are many forms of amusia (not able to hear music in the same way the majority of the public does)
- discusses rhythm and tone deafness and how the culture one is raised in makes one predisposed to certain rhythms and tones
- total amusia happens when one is completely unable to comprehend music -tones are not recognized as tones, and music, therefore, is not experienced as music, instead hearing toneless banging or irritating sounds without melody (oddly not affecting the way one hears other sounds such as voices)
- it is interesting to note the dystimbria that accompanies many extreme cases of amusia -the hearing of music as an offensive noise like pots banging together or screeching
- researchers have found that there are two basic categories of musical perception, one involving the recognition of melodies and the other the perception of rhythm or time intervals; impairments of melody usually go with right-hemisphere lesions, but representation of rhythm is much more widespread and robust and involves not only the left hemisphere, but many subcortical systems in the basal ganglia, the cerebellum, and other areas
- amusia can also appear as an impairment of the ability to perceive dissonance (ie the discordant sound produced by a major second, something that even infants normally react to) which is thought to be tied to extensive damage to the parahippocampal cortex, an area of the brain involved in emotional judgments, which is interesting because the people haven't lost the ability to understand or feel the emotion that music can produce (discussed in chapter 24) but they do not have the normal response to dissonant music
- there is also tune deafness or amelodia, which is when someone can distinguish complex tones perfectly and thus are unlike those discussed earlier who couldn't hear tones variation at all, but rather have lost the ability to recognize melodies, something like losing sentence or meaning even though one can understand the words themselves; they can hear the sequence of notes, but the sequence seems arbitrary and makes no musical sense, the problem being wholly one of auditory processing, an inability to hold an auditory sequence of notes in memory

Chapter 9: Papa Blows His Nose in G: Absolute Pitch

- people with absolute pitch can tell the pitch of any note, not only with what they hear but also what they imagine in their heads, being able to recognize as completely unique upwards of seventy tones in the middle region of the auditory range
- people with absolute pitch can become very distressed if an instrument is even slightly out of tune or if they hear a familiar piece of music played in the wrong key
- absolute pitch seems to be an isolated ability with little inherent connection to musicality or anything else, although there seems to be some connection between early music training and those who have it as well as a greatly increased level of those who have absolute pitch in the populations of those who speak more melodic languages like Vietnamese and Mandarin

-some theorists hold that infants have the ability to acquire absolute pitch and it is only as we age that the majority of us lose the skill

Chapter 10: Pitch Imperfect: Cochlear Amusia

-discusses the way that the ear works, all the detailed parts that go into the variety of sounds we can hear, how delicate and vulnerable these parts are, and how protected our hearing tools are in our body
-goes on to discuss the loss of hearing and how, when the range of discernable sounds shrinks, the notes along the hearing-impaired range can become sharp or flat by a quarter tone before they are lost
-people have compared the cochlea, the spiral organ of the ear that is lined with series of about thirty-five hundred small hairs, to a stringed instrument, differentially tuned to the frequency of notes
-studies have shown that the mind has an ability to modulate cochlear function, allowing us to focus on sound and tune out background noise

Chapter 11: In Living Stereo: Why We Have Two Ears

-discusses a case of someone losing hearing in one ear and music changing to sound flat, two-dimensional and lifeless but after some time how his brain was able to adjust and create some dimensions with just using the left ear, a "pseudostereo" correction
-amusia is when one loses one or more of the attributes of music that include tone, pitch, timbre, loudness, tempo, rhythm, and contour, but lose of hearing in one ear does not impact how all off these things are perceived by the other ear so what is experienced is not amusia
-instead, what is lost is a sort of spatial location and depth perception which helps to make music pleasurable to us by giving it spaciousness, voluminousness, richness, resonance
-the ability for the body to create "pseudostereo" effect with the remaining hearing can be an argument for how hearing can adapt, new connections can be made and new area recruited to make up for the loss, but it could also be due to using other senses such as sight to make up for what has been lost in hearing

Chapter 12: Two Thousand Operas: Musical Savants

-discusses the case of a mentally handicapped man who had a phonographic memory, whatever he read he heard in his mind's ear and could remember with full detail every note of every instrument and every voice in more than two thousand operas
-more than a third of all musical savants are blind or have very poor vision
-musicality is the most common of savant talent and it involves the development of skills that depend on the recognition (which may be implicit and unconscious) of essential musical structures and rules and while this skill is not an anomaly it is remarkable in a mind that is drastically undeveloped in the areas of verbal and abstract thought
-"It is a characteristic -indeed, the defining characteristic—of savant syndromes that there is a heightening of certain powers along with an impairment or poor development of other powers. The powers that are heightened in savant skills are always of a concrete sort, whereas those that are impaired are abstract and often linguistic—and there have been many speculations as to how such a conjunction of strength and weakness may come about."
-it is hypothesized that when the left hemisphere of the brain (thought to be responsible for abstract and verbal powers) is severely underdeveloped or damaged that there may be a compensatory overdevelopment of the right hemisphere, an actual enlargement made possible by neuronal migration
-some researchers have put forward the theory that the mechanism for savant skill might reside in all of us in early life, or at least a third of us, but as the brain matures they are inhibited and savants might have privileged access to lower levels of information not normally available

Chapter 13: An Auditory World: Music and Blindness

-discusses the increased musical ability blind people can sometimes have

Chapter 14: The Key of Clear Green: Synesthesia and Music

-for centuries humans have sought a relationship between music and colour and for most of us this has remained at the level of metaphor but for some there is a joining of one sensory experience provoking another, i.e. literally seeing colours with music, called synesthesia

-after treating a painter who suddenly became colour blind following a head injury, who also lost his synesthesia, caused the author to conclude that there is a physiological basis for this condition

-interesting to note that each synesthete has their own colour correspondences

-function brain imaging has confirmed that there is activation of visual areas when synesthetes "see" colours in response to music

-there are theories that we are all born with our senses intermingled and some level of synesthesia until we develop a separation of them and there is a much higher rate of synesthesia in children

-later in life temporal lobe seizures can bring about temporary synesthesia and blindness can cause one to permanently acquire it

PART III: MEMORY, MOVEMENT, AND MUSIC

Chapter 15: In the Moment: Music and Amnesia

-tells the story of people who have severe amnesia, only able to remember minutes at a time, especially focusing on the story of a man named Clive who was a musician and an encyclopedic musicologist before he suffered herpes encephalitis, a devastating brain infection

-Clive could hardly remember anything past a few seconds, including if he knew a song or not, but his musical powers were totally intact, not only able to read music, but to pick up a tune from hearing it, conduct his choir and know how the various parts of a musical piece fit together

-this and other cases lead one to conclude that there are two different places memories are stored in the brain, one section for a conscious memory of events (episodic memory) and an unconscious memory for procedures: "Clive's performance self seems, to those who know him, just as vivid and complete as it was before his illness. This mode of being, this self, is seemingly untouched by his amnesia, even though his autobiographical self, the self that depends on explicit, episodic memories, is virtually lost. The rope that is let down from heaven for Clive comes not with recalling the past, as for Proust, but with performance—and it holds only as long as the performance lasts. Without performance, the thread is broken, and he is thrown back once again into the abyss."

-“What is the relationship of action patterns and procedural memories, which are associated with relatively primitive portions of the nervous system, to consciousness and sensibility, which depend on the cerebral cortex? Practice involves conscious application, monitoring what one is doing, bringing all one's intelligence and sensibility and values to bear—even though what is so painfully and consciously acquired may then become automatic, coded in motor patterns at a subcortical level.”

-says this sort of memory could be a part of motor function, like walking since we do not consciously think of placing each foot down: "It may be that Clive, incapable of remembering or anticipating events because of his amnesia, is able to sing and play and conduct music because remembering music is not, in the usual sense, remembering at all. Remembering music, listening to it, or playing it, is entirely in the present."

Chapter 16: Speech and Song: Aphasia and Music Therapy

- discusses the case of a man who had lost all power of speech for years and no amount of speech therapy helped, but then through music therapy started to sing many ballads that he had grown up with and this led him to regain his ability to speak in a limited sense
- damage to the premotor zone of the brain's dominant (usually left) frontal lobe can cause a loss of the ability to speak (aphasia) as well as the loss of the ability to recognize speech (receptive aphasia)
- it is actually common that people with aphasia can still sing songs
- “Speech itself is not just a succession of words in the proper order—it has inflections, intonations, tempo, rhythm, and “melody.” Language and music both depend on phonatory and articulatory mechanisms that are rudimentary in other primates, and both depend, for their appreciation, on distinctly human brain mechanisms dedicated to the analysis of complex, segmented, rapidly changing streams of sound. And yet there are major differences (and some overlaps) in the representation of speech and song in the brain.”
- some have thought that the regaining of speech through music therapy may be the right side of the brain building connections that activate areas on that side that have, until then, undeveloped language capabilities

Chapter 17: Accidental Davening: Dyskinesia and Cantillation

- dyskinesia is an unusually movement disorder which can take the form of rhythmic pulses
- compares it to the purposeful rhythm of chanting that is a part of many religions

Chapter 18: Come Together: Music and Tourette's Syndrome

- describes the effect that music has on people with Tourette's syndrome, similarly with people who have Parkinson's, that some music allows them to escape from their conditions and have motor freedom while other music will increase the symptoms
- some people with Tourette's Syndrome prove to have exceptional musical talents, finding some freedom when playing
- “Tourette’s brings out in stark form questions of will and determination: who orders what, who pushes whom around. To what extent are people with Tourette’s controlled by a sovereign “I,” a complex, self-aware, intentional self, or by impulses and feelings at lower levels in the brain-mind? Similar questions are brought up by musical hallucinations, and brainworms, and varied forms of quasi-automatic echoing and imitation. Normally we are not aware of what goes on in our brains, of the innumerable agencies and forces inside us that lie outside or below the level of conscious experience—and perhaps this is just as well. Life becomes more complicated, sometimes unbearably so, for people with eruptive tics or obsessions or hallucinations, forced into daily, incessant contact with rebellious and autonomous mechanisms in their own brains. They face a special challenge; but they may also, if the tics or hallucinations are not too overwhelming, achieve a sort of self-knowledge or reconciliation that may significantly enrich them, in their strange fight, the double lives they lead.”

Chapter 19: Keeping Time: Rhythm and Movement

- describes how something difficult, repetitive and even painful can be made easier by doing it to the rhythm of a song
- sometimes music is used to help people re-learn physical things like walking and people report limbs that they couldn’t purposefully make move after injury moved to music
- it has also been found that people who cannot remember how to do many of the basic skills of life such as getting dressed or bathing can do it when instructions are put into a song and even many normal functioning people use melodic devices to remember (think alphabet song)
- preliterate cultures used music to maintain the memory of their history

-“The embedding of words, skills, or sequences in melody and meter is uniquely human. The usefulness of such an ability to recall large amounts of information, especially in a preliterate culture, is surely one reason why musical abilities have flourished in our species.”

-every culture has music with a periodic pulse that elicits synchronized motor response from listeners

-research has shown that responses to rhythm actually precede the external beat, we anticipate the beat, we get rhythmic patterns as soon as we hear them, and we establish internal models or templates of them that are very accurate

-brain imaging has shown that even listening or imagining music can stimulate the same part of the brain that is activated when we move to music

-the combination of movement and sound seems to heighten our abilities makes difficult things easier and helps us to learn new skills

-we have an internal and often unconscious propensity to impose a rhythm to sounds, giving meaning to what would otherwise be meaningless sound or movement, and we become irritated when things are rhythmically disjointed

-“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 and dance together in every culture, and one can imagine them having done 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, with the rest of us often reduced to passive listening. We have to go to a concert, or a church, or a musical festival to reexperience music as a social activity, to recapture the collective excitement and bonding of music. In such a situation, music is a communal experience, and there seems to be, in some sense, an actual binding or “marriage” of nervous systems, a “neurogamy” (to use a word the early mesmerists favored).”

-“The binding is accomplished by rhythm—not only heard but internalized, identically, in all who are present. Rhythm turns listeners into participants, makes listening active and motoric, and synchronizes the brains and minds (and, since emotion is always intertwined with music, the “hearts”) of all who participate. It is very difficult to remain detached, to resist being drawn into the rhythm of chanting or dancing.”

-it is very difficult to resist the pull of a crowd partaking in music expression when you are amongst it (concerts, military music, war drums, sports chants, religious services) and this most likely was an essential factor in the development of community and culture and perhaps even language

-“Neuroscientists sometimes speak of “the binding problem,” the process by which different perceptions or aspects of perception are bound together and unified. What enables us, for example, to bind together the sight, sound, smell, and emotions aroused by the sight of a jaguar? Such binding in the nervous system is accomplished by rapid, synchronized firing of nerve cells in different parts of the brain. Just as rapid neuronal oscillations bind together different functional parts within the brain and nervous system, so rhythm binds together the individual nervous systems of a human community.”

Chapter 20: Kinetic Melody: Parkinson's Disease and Music Therapy

-many neurologists say that the body has a normal movement, a naturalness and fluency, a “kinetic melody”

-in Parkinson's and other disorders there is a “kinetic stutter” when the regular rhythmical stream is lost

-discusses the cases of the victims of encephalitis lethargica, the epidemic of sleeping sickness that swept the globe just after WWI, who he discusses in his other book *Awakenings* who were frozen but could move on some occasions, sometimes even with ease and grace, always triggered by music (important to note that these were extreme types of Parkinson's disease)

- details the development of music therapy in the second half of the 20th century and that it has proven to be "as powerful as any drug" in treating conditions such as Parkinson's, relieving the clenching, jerking, and tics and giving a person the ability to freely move
- the movements of people with Parkinson's are either too fast or too slow but, if music is present, its tempo and speed take precedence over the parkinsonism
- parkinsonian patients are always getting stuck or frozen because of the damage in the basal ganglia and they may become paralyzed in a sense of being locked in, unable by themselves to initiate any movement but able to respond to stimuli, such as throwing a ball or, as it has been discovered, playing music (or in the case of a talented pianist with playing it)
- discusses the use of music with purposeful movement, mixing music therapy with dance therapy
 "Nietzsche was intensely interested, throughout his life, in the relationship of art, and especially music, to physiology. He spoke of its "tonic" effect—its power of arousing the nervous system in a general way, especially during states of physiological and psychological depression (he was himself often depressed, physiologically and psychologically, by severe migraines). He also spoke of the "dynamic" or propulsive powers of music—its ability to elicit, to drive, and to regulate movement. Rhythm, he felt, could propel and articulate the stream of movement (and the stream of emotion and thought, which he saw as no less dynamic or motoric than the purely muscular). And rhythmic vitality and exuberance, he thought, expressed itself most naturally in the form of dance. He called his own philosophizing "dancing in chains" and thought the strongly rhythmic music of Bizet as ideally suited to this. He would often take his notebook to Bizet concerts; he wrote, 'Bizet makes me a better philosopher.'"
- says that before he came across L-dopa, the drug that "awakened" the encephalitis lethargica patients, music had the same effect but only for a brief time

Chapter 21: Phantom Fingers: The Case of the One-Armed Pianist

- discusses the case of a pianist who had lost his arm in WWI and still actively triggered the muscles in his right arm to run through the playing of music he was teaching his students, hypothesizing that it might be possible in the near future to fitted such a pianist with an artificial limb so sophisticated that he could play the piano again

Chapter 22: Athletes of the Small Muscles: Musician's Dystonia

- discusses the tendency of musicians to develop problems with numbness that don't seem to be related to muscle or nerve injuries but are still very real, a so-called focal dystonia
- this is a phenomenon found in those who do a variety of activities that demand continuous, rapid movements of the hands (or other parts of the body) over long periods
- it is thought that rapid, repetitive movements might cause a sensory overload which could then cascade into a focal dystonia, caused by a disturbance in the sensory system
- it has been found that one form of botulinum toxin (Botox), which in large doses causes paralysis, can be used in tiny doses to control various conditions in which muscles are so tense or over worked that they can hardly be moved

PART IV: EMOTION, IDENTITY, AND MUSIC

Chapter 23: Awake and Asleep: Musical Dreams

- says that most people have dreams that pertain to music and the feelings that go with it, pointing out that if we flood our waking hours with a particular piece it will invade our dreams
- talks about musicians who can figure out compositions from dreams
 "Irving J. Massey points out that "music is the only faculty that is not altered by the dream environment, whereas action, character, visual elements and language may all be modified or distorted in dreams."

More specifically, he writes, “music in dream does not become fragmented, chaotic or incoherent, neither does it decay as rapidly as do the other components of dreams on our awakening.” Thus Berlioz, on awakening, could recall nearly the whole of the first movement of his dream symphony, and he found it as pleasing in form and character as he had in his dream.”

-“Massey concludes that “Music in dreams then is the same as music in our waking life.... One might say that music never sleeps.... It is as if it were an autonomous system, indifferent to our consciousness or lack of it.” His conclusion also seems supported by the accuracy and seemingly indelible quality of musical memory as it is manifest in musical imagery, brainworms, and, most strikingly, in musical hallucinations—as well as the apparent imperviousness of music to the ravages of amnesia or dementia.”

Chapter 24: Seduction and Indifference

-“There is a tendency in philosophy to separate the mind, the intellectual operations, from the passions, the emotions. This tendency moves into psychology, and thence into neuroscience. The neuroscience of music, in particular, has concentrated almost exclusively on the neural mechanisms by which we perceive pitch, tonal intervals, melody, rhythm, and so on, and, until very recently, has paid little attention to the affective aspects of appreciating music. Yet music calls to both parts of our nature—it is essentially emotional, as it is essentially intellectual. Often when we listen to music, we are conscious of both: we may be moved to the depths even as we appreciate the formal structure of a composition.”

-“We may, of course, lean to one side or the other, depending on the music, our mood, our circumstances.”

-there are many who lack the ability to understand the mechanics of music but are strongly moved by it and there are others with the opposite balance, they may have a good ear, be finely sensitive to the formal nuances of music, but nevertheless do not care for it greatly or consider it a significant part of their lives

-the impact that music has on a person can go up and down and there is a connection between depression, the ability to feel complex emotion, and the ability to be impacted by music

-concussions and strokes can also cause the emotionality of music to be suddenly lost

-even people with amusia have reported being able to enjoy music, leading researchers to believe that there must be a particular functional architecture underlying the emotional interpretation of music

-indifference to music's emotional power may occur in people with autism and Asperger's syndrome too, able to get intellectual pleasure from music but not understanding its emotional aspect

-there are some who are wholely indifferent to music's emotional pull while others are so distracted by it that they cannot have music on in the background while they try to work, others who are moved by it but refuse it so that they can maintain control of their emotions

Chapter 25: Lamentations: Music, Madness, and Melancholia

-talks about how music is sometimes the only thing that can break through severe depression

-“Music, uniquely among the arts, is both completely abstract and profoundly emotional. It has no power to represent anything particular or external, but it has a unique power to express inner states or feelings. Music can pierce the heart directly; it needs no mediation. One does not have to know anything about Dido and Aeneas to be moved by her lament for him; anyone who has ever lost someone knows what Dido is expressing. And there is, finally, a deep and mysterious paradox here, for while such music makes one experience pain and grief more intensely, it brings solace and consolation at the same time.”

-“As music seems to resist or survive the distortion of dreams or of parkinsonism, or the losses of amnesia or Alzheimer's, so it may resist the distortions of psychosis and be able to penetrate the deepest states of melancholia or madness, sometimes when nothing else can.”

Chapter 26: The Case of Harry S.: Music and Emotion

- discusses a patient who had a severe brain aneurysm and had bled extensively into both frontal lobes, severely damaging the right and somewhat the left, causing severe emotional impairment
- reading all of the things he used to do did not bring up any emotional reaction but this changed when he sang, he showed every emotion appropriate to the music without a need to fake it

Chapter 27: Irrepressible: Music and the Temporal Lobes

- discusses a woman who most likely suffered from Frontotemporal Dementia, causing a decrease of inhibition and, as a part of it, would spontaneously burst out in song and had unusual musical tastes
- it has been found that those who suffer from such dementia in the left temporal lobe often have an emergence of artistic and musical skills, able to sing several songs although they often can't say what the individual words mean
- prevailing theory: "Normally there is a balance in each individual, an equilibrium between excitatory and inhibitory forces. But if there is damage to the (more recently evolved) anterior temporal lobe of the dominant hemisphere, then this equilibrium may be upset, and there may be a disinhibition or release of the perceptual powers associated with the posterior parietal and temporal areas of the non-dominant hemisphere."
- there are many stories of people who have developed artistic talent following left-hemisphere strokes - often becoming less constrained formally and freer emotionally
- the musical or artistic power that may be released in frontotemporal dementia or other forms of brain damage do not come out of the blue, it is presumed that they were there prior but inhibited and undeveloped
- unfortunately, as the disease progresses, these abilities are lost as well

Chapter 28: A Hypermusical Species: Williams Syndrome

- describes people impacted by a congenital disorder called Williams syndrome that leave most with an IQ of less than 60 and a personality of extraordinary sociability and inquisitiveness, along with a strong love of music
- this was a part of a general sensitivity to sounds, able to hear tiny background sounds the rest of us do not hear or are not conscious of
- they also have unusual linguistic skills, using a vocabulary that is far outside their IQ level
- those with Williams syndrome also show a special feeling for narrative, using special sound effects and other devices to convey feeling and heighten the impact of that they are saying
- the three dispositions that are so heightened in people with Williams syndrome -the musical, the narrative, and the social -seem to go together
- it has been found that the brains of people with Williams syndrome were, on average, twenty percent smaller than normal brain, and their shape was quite unusual as the decrease in size and weight seemed to be exclusively at the back of the brain, in the occipital and parietal lobes, whereas the temporal lobes were of normal and sometimes supernormal size
- the primary auditory cortex is larger in people with Williams syndrome, and there seems to be significant changes in the planum temporale -a structure known to be crucial for the perception of both speech and music, as well as for absolute pitch
- brain scans show that people with Williams syndrome process music very differently from others, they employ a much wider set of neural structures to perceive and respond to music, particularly in the amygdala that leads to sometimes overwhelming emotional reactions to it

Chapter 29: Music and Identity: Dementia and Music Therapy

-points out that the response to music is preserved, even when dementia is very advanced, and the response of people with dementia to music therapy is different from those with speech disorders or Parkinson's, it is more emotion driven, bringing up memories and done to try to find a surviving "self" in the patient

-musical perception, musical sensibility, musical emotion, and musical memory can survive long after other forms of memory have disappeared; music of the right kind can serve to orient and anchor a patient when almost nothing else can

-talks about a patient who couldn't recount his memories until he was asked to put them to song, to sing his life story (however, it is questioned if this is really remembering or just memorizing a song)

-while singing a song cannot bring back the memory of having heard that song in the past, it can bring back the emotion that song created in that person in the past

-“Sometimes music therapy is communal, sometimes individual. It is astonishing to see mute, isolated, confused individuals warm to music, recognize it as familiar, and start to sing, start to bond with a therapist. It is even more astonishing to see a dozen deeply demented people—all in worlds or nonworlds of their own, seemingly incapable of any coherent reactions, let alone interactions—and how they respond to the presence of a music therapist who begins to play music in front of them. There is a sudden attention: a dozen pairs of distracted eyes fasten on the player. Torpid patients become alert and aware; agitated ones grow calmer. That it may be possible to gain the attention of such patients and hold it for minutes at a time is itself remarkable. Beyond this, there is often a specific engagement with what is being played (it is usual, in such groups, to play old songs that everyone of a similar age and background will have known).”

-music gives these patients a sense of "together" when they live with a disease that is incredibly isolating, they are able for a short time to bond with others

-“There are many levels at which music can call to people, enter them, alter them—and this is as true for demented patients as it is for the rest of us. We bond when we sing together, sharing the specific affects and connections of a song; but bonding is deeper, more primal, if we dance together, coordinating our bodies and not just our voices. “The body is a unity of actions,” Luria wrote, and if there is no unity, nothing active or interactive going on, our very sense of being embodied may be undermined. But holding someone, making the movements of dance with them, may initiate a dancing response (perhaps in part by the activation of mirror neurons). In this way, patients who are otherwise inaccessible can be animated, enabled to move and to regain, at least for a while, a sense of physical identity and consciousness -a form of consciousness that is perhaps deepest of all.”

-“Rhythm can restore our sense of embodiment and a primal sense of movement and life.”

-“The perception of music and the emotions it can stir is not solely dependent on memory, and music does not have to be familiar to exert its emotional power. I have seen deeply demented patients weep or shiver as they listen to music they have never heard before, and I think that they can experience the entire range of feelings the rest of us can, and that dementia, at least at these times, is no bar to emotional depth. Once one has seen such responses, one knows that there is still a self to be called upon, even if music, and only music, can do the calling.”

-“Music is part of being human, and there is no human culture in which it is not highly developed and esteemed. Its very ubiquity may cause it to be trivialized in daily life: we switch on a radio, switch it off, hum a tune, tap our feet, find the words of an old song going through our minds, and think nothing of it. But to those who are lost in dementia, the situation is different. Music is no luxury to them, but a necessity, and can have a power beyond anything else to restore them to themselves, and to others, at least for a while.”