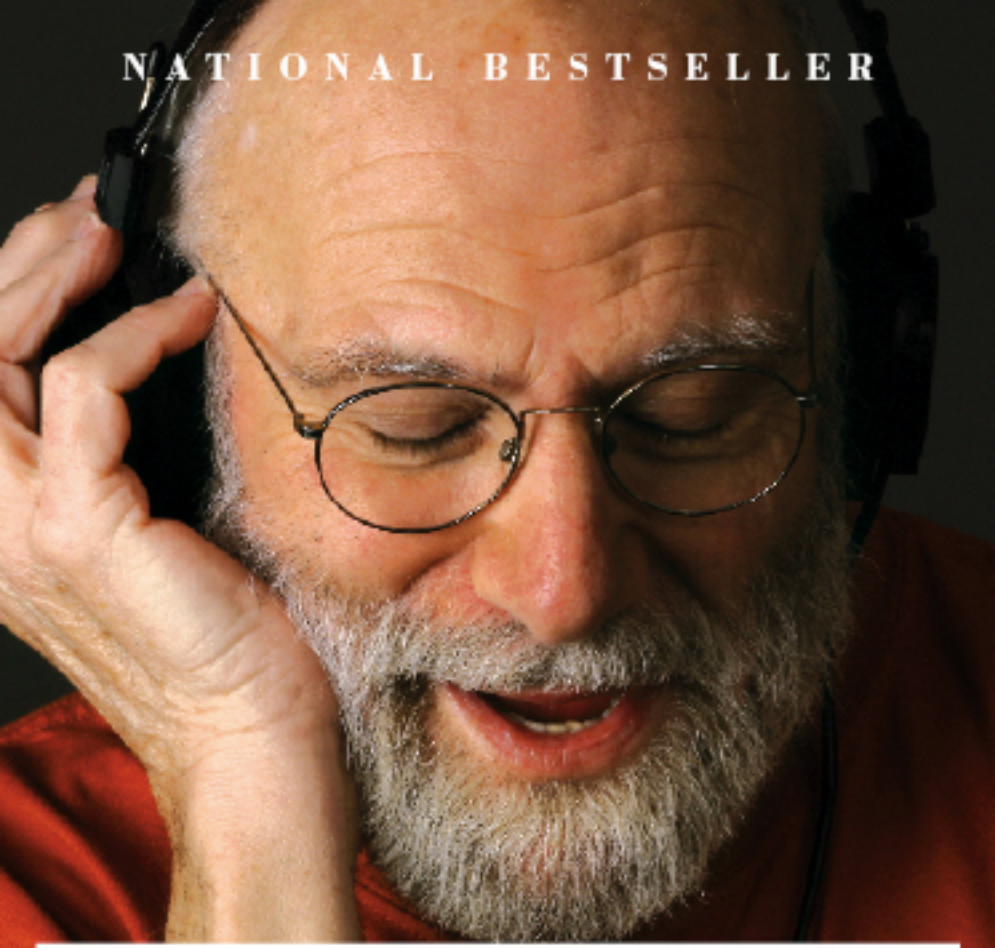

NATIONAL BESTSELLER

MUSICOPHILIA

Tales of Music and the Brain

Revised and Expanded

OLIVER SACKS

Author of *The Man Who Mistook His Wife for a Hat*

"Powerful and compassionate. . . . A book that not only contributes to our understanding of the elusive magic of music but also illuminates the strange workings, and misfirings, of the human mind." —*The New York Times*

16

Speech and Song: Aphasia and Music Therapy

Samuel S. developed severe expressive aphasia following a stroke in his late sixties, and he remained totally speechless, unable to retrieve a single word, despite intensive speech therapy, two years later. The break for him came when Connie Tomaino, the music therapist at our hospital, heard him singing one day outside her clinic—he was singing "Ol' Man River" very tunefully and with great feeling, but only getting two or three words of the song. Even though speech therapy had been given up with Samuel, who was by then regarded as "hopeless," Connie felt that music therapy might be helpful. She started to meet with him three times a week for half-hour sessions in which she would sing with him or accompany him on the accordion. Mr. S. was soon able, singing along with Connie, to get all the words of "Ol' Man River," and then of many other ballads and songs he had learned growing up in the 1940s—and as he did this, he started to show the beginnings of speech. Within two months, he was making short but appropriate responses to questions. For

instance, if one of us asked Mr. S. about his weekends at home, he could reply, "Had a great time," or "Saw the kids."

Neurologists often refer to a "speech area" in the premotor zone of the brain's dominant (usually left) frontal lobe. Damage to a particular part of this—an area first identified by the French neurologist Paul Broca in 1862—whether from a degenerative disease, a stroke, or a brain injury, may produce expressive aphasia, a loss of spoken language. In 1873 Carl Wernicke had described a different speech area in the left temporal lobe—damage to this area was apt to produce difficulty understanding speech, a "receptive" aphasia. It was also recognized, at much the same time, that brain damage could produce disturbances of musical expression or appreciation—amusias—and that while some patients might suffer from both an aphasia and an amusia, others could have aphasia without amusia.[1]

We are a linguistic species—we turn to language to express whatever we are thinking, and it is usually there for us instantly. But for those with aphasia, the inability to communicate verbally may be almost unbearably frustrating and isolating; to make matters worse, they are often treated by others as idiots, almost as nonpersons, because they cannot speak. Much of this can change with the discovery that such patients can *sing*—sing not only tunes, but the words of operas, hymns, or songs. Suddenly their disability, their cut-offness, seems much less—and though singing is not propositional communication, it is a very

1. John C. Brust, in his extensive review of the literature on music and the brain, points out that such a case was recorded as early as 1745—this patient had severe expressive aphasia, and his speech was limited to the word "yes." But he could nonetheless sing hymns, if someone else sang along.

Similarly, the Russian composer Vissarion Shebalin suffered a series of strokes which produced a profound receptive aphasia. But, as Luria et al. described, he was able to continue composing at his previous level. (Shostakovich called Shebalin's Fifth Symphony, composed after his stroke, a "brilliant creative work, filled with highest emotion [and] optimism and full of life.")

basic existential communication. It not only says, "I am alive, I am here," but may express thoughts and feelings that cannot be expressed, at this point, by speech. Being able to sing words can be a great reassurance to such patients, showing them that their language capacities are not irretrievably lost, that the words are still "in" them, somewhere, even though it may take music to bring them out. Whenever I see patients with expressive aphasia, I sing "Happy Birthday" to them. Virtually all of them (often to their own astonishment) start to join in, singing the tune; about half of them will get the words, too.[2]

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

2. Autistic children may have specific difficulties both in speaking and in recognizing the spoken word (Isabelle Rapin has referred to this as verbal auditory agnosia)—but they may be able to sing or to understand speech if it is set to music. I have received many letters about this from their parents. Arlyn Kantz, a musician, wrote:

> When my son was diagnosed with autism, one of the first things I noticed when he was a preschooler was that he could sing entire theme songs but could not respond to simple social questions like "What is your name?" He would echo the question or simply ignore us. When I set this speech lesson to music, leaving gaps for him to fill in, he quickly began to respond correctly. When I faded out the music, his correct responses continued. This led to setting more and more of his speech development drills to music, with the same successful results.

Kantz went on to form a singing-based curriculum for language-impaired children, which is now used in a number of institutions.

Similarly, Melanie Mirvis, a British speech and language therapist, wrote:

> I was working with a very musical boy with autism, who had the typical difficulties with language; specifically he took a long time to "process" language and then questions would often have to be repeated several times before he produced a verbal response. I did, however, notice that when I sung him a question, he could sing me an answer immediately.

Another parent, Tracy King, wrote about her son, Sean (now twenty-one), who has Asperger's syndrome: "The most profoundly helpful 'therapy' in his life has been music. It has filled him with purpose and has often bridged the social gaps that have been so difficult for him to navigate. He uses his guitar and singing as a way to connect with others."

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.[3]

Patients with so-called nonfluent aphasia not only have an impairment of vocabulary and grammar, but have "forgotten" or lost the feeling of the rhythms and inflections of speech; hence the broken, unmusical, telegraphic style of their speech, to the extent that they still have any words available. It is such patients who, as a rule, do best with music therapy, and who feel most excited when they are able to sing lyrics—for in doing so, they discover not only that words are still available to them, but that the flow of speech is also accessible (though bound, apparently, to the flow of song).[4]

This may also be the case with a different form of aphasia, so-called dynamic aphasia, where it is not the structure of sentences

---

3. One might expect some coupling or correlation of musical and linguistic abilities, especially in regard to learning the accents, inflections, and prosody of a new language. This is often, but not necessarily, the case. Thus Steve Salemson, a former French horn player, wrote to me contrasting his superb ability to recognize linguistic accents with his "mediocre" musical skills and lack of absolute pitch:

> I can readily distinguish a major scale from a minor scale, but have no sense of any particular key without some point of reference. I know the keys of most symphonic works, but if you were to play me a recording of Brahms' Second Symphony (the "blue one" in D major) that had been transposed into E-flat or C-sharp major, I doubt whether I'd be likely to notice. I've tried to will myself to hear a difference in keys, but—alas!—to no avail. [But] I am an accomplished linguist, being totally bilingual in French and English, and also speaking excellent Hebrew, along with German and Macedonian (I'm a long-time Balkan folk dancer and fan of irregular Balkan meters). I've always had an outstanding ear for accents, so can only assume that this ability resides elsewhere in the brain than does that of pitch recognition.

But there *are* overlaps and, indeed, deep similarities between the brain's processing of language and of music (including their grammar), and these are especially the subject of Aniruddh D. Patel's book *Music, Language, and the Brain.*

4. The most common speech disorder is stuttering, and here—as the Greeks and Romans knew very well—even those who stutter so badly as to be almost incomprehensible can nearly always sing fluently and freely and, through singing or adopting a singsong manner of speech, can often overcome or bypass their stuttering.

that is affected but the initiation of speech. Patients with dynamic aphasia may speak very sparingly, yet produce syntactically correct sentences on the rare occasions when they do speak. Jason Warren et al. described how an elderly man with mild frontal lobe degeneration and extreme dynamic aphasia was nonetheless unimpaired in musical initiative. He played the piano, could read and write music, and took part in a weekly singing group. He was also able to recite, as Warren et al. noted: "He was able to read a passage chosen at random from the Torah using the heightened intonation (distinct from both singing and ordinary reading) reserved for reading aloud."

Many aphasic patients can get not only the words of songs, but can learn to repeat sequences or series—days of the week, months of the year, numerals, etc. They may be able to do this *as* a series, but not to disembed a particular item from the series. So one of my patients, for instance, can recite all the months of the year in order (January, February, March, April, May . . .); he knows what the current month is, but when I ask him, he cannot respond, simply, "April." Indeed, aphasics may be able to reproduce much more elaborate familiar sequences—a prayer, or lines from Shakespeare, or an entire poem—but only as automated sequences.[5] Such sequences unfold, once they are started, in much the same way as music does.

Hughlings Jackson long ago distinguished "propositional" speech from what he called, variously, "emotional," "ejaculate,"

5. In *Brave New World,* Aldous Huxley describes how sleep-teaching, hypnopedia, is used to feed information to the brains of sleeping children. Its powers are remarkable, but so are its limitations. Thus one child is able to give, in a single unbroken recitation, the names of all the longest rivers in the world and their lengths—but when he is asked, "What is the length of the Amazon?" he cannot bring this fact to explicit, conscious knowledge, cannot disembed it from the automated sequence.

One often has similar experiences in restaurants. Once, after a waiter reeled off a list of specials, I asked him to repeat what came after the tuna. He was unable to extract this one item from the sequence he held in memory, and had to reel off the entire list again.

or "automatic" speech, stressing that the latter could be preserved in aphasia, sometimes to a startling extent, even when the former was grossly impaired. Cursing is often cited as a dramatic form of automatic speech, but singing familiar lyrics can be seen as equally automatic; a person with aphasia may be able to sing or curse or recite a poem but not to utter a propositional phrase.

The question of whether singing has any use in the recovery of speech, then, can be formulated another way: can language embedded in unconscious automatism be "released" for conscious, propositional use?

During the Second World War, A. R. Luria began to investigate the neural basis of speech and language, of different forms of aphasia, and of methods for restoring speech. (His work was published in Russian in a massive monograph, *Traumatic Aphasia,* in 1947, and in a small, startling book, *Restoration of Function After Brain Injury,* in 1948—though neither was translated or known in the West until several decades later.) Given an acute injury to the brain such as he saw in the stroke patients or injured soldiers he studied, Luria emphasized, there would always be two levels of disturbance. First, there was a "core" of tissue destruction, which was irreversible; and second, a larger, surrounding area, or "penumbra," of depressed or inhibited function, which under certain conditions, he felt, might be reversible.

When one first meets a patient immediately after a stroke or head injury, one sees only the total effects of injury: paralysis, aphasia, or other disabilities. It is difficult to distinguish disabilities produced by anatomical damage from those produced by inhibition of the surrounding neural tissue. Time will show the difference in most patients, for inhibition tends to lift spontaneously, usually in a matter of weeks. But in some patients, for reasons that are still unclear, it does not. At this point (if not before), it is crucial to start therapy, to promote what Luria called "de-inhibition."

Speech therapy may lead to de-inhibition, but it may sometimes fail; if it fails, one may wrongly assume that the patient's aphasia is due to permanent anatomical damage and is thus irreversible. But music therapy, for some patients, can succeed where conventional speech therapy has failed, as in the case of Samuel S. It may be that cortical areas previously inhibited but not destroyed can be de-inhibited, kick-started into action, by reexperiencing language, even if it is of a wholly automatic sort, language embedded in music.

A VERY CRUCIAL ASPECT of speech or music therapy for the aphasic patient is the relationship between therapist and patient. Luria emphasized that the origin of speech was social no less than neurological—it required the interaction of mother and child. It is likely that the same is true of song, and in this sense, music therapy for patients with aphasia is profoundly different from music therapy for a movement disorder like parkinsonism. In parkinsonism, it is the motor system which is being activated, almost automatically, by music—and a tape or CD, in this limited sense, can do as much as a therapist. But with speech disorders like aphasia, the therapist and her relationship with the patient—a relationship which involves not only musical and vocal interaction but physical contact, gesture, imitation of movement, and prosody—is an essential part of the therapy. This intimate working together, this working in tandem, depends on mirror neurons throughout the brain, which enable the patient not only to imitate but to incorporate the actions or abilities of others, as Rizzolatti et al. have explored.

The therapist not only provides support and an encouraging presence, but literally leads the patient into more and more complex forms of speech. With Samuel S., this involved drawing lan-

guage out until he could sing all the words of "Ol' Man River," then leading him on to sing a whole range of old songs, then, by the right sort of questions, drawing him into short responsive phrases. Whether there is a chance of going beyond this, of restoring fluent narrative or propositional speech to patients with long-standing aphasia, remains an open question. Saying "Had a great time" or "Saw the kids" may be as far as Samuel S. can go. It might be said that such verbal responses are modest, limited, and formulaic—but they do represent a radical advance from purely automatic speech, and they can have an enormous effect on the daily reality of an aphasic person's life, allowing a formerly mute and isolated person to reenter a verbal world, a world he had seemingly lost forever.

In 1973 Martin Albert and his colleagues in Boston described a form of music therapy they called "melodic intonation therapy." Patients were taught to sing or intone short phrases—for example, "How are you today?" Then the musical elements of this were removed slowly until (in some cases) the patient regained the power to speak a little without the aid of intonation. One sixty-seven-year-old man, aphasic for eighteen months—he could only produce meaningless grunts, and had received three months of speech therapy without effect—started to produce words two days after beginning melodic intonation therapy; in two weeks, he had an effective vocabulary of a hundred words, and at six weeks, he could carry on "short, meaningful conversations."

What is happening in the brain when melodic intonation, or any type of music therapy, "works"? Albert et al. originally thought that it served to activate areas in the right hemisphere, areas homologous to Broca's area. Albert's close colleague, Norman Geschwind, had been fascinated by the way in which children could recover speech and language even after the removal of the entire left hemisphere of the brain (this was sometimes done

in children with uncontrollable seizures). Such a recovery or reacquisition of language suggested to Geschwind that, though linguistic ability was generally associated with the left hemisphere, the right hemisphere also had linguistic potential and could take over language functions almost completely, at least in children. Albert and his colleagues thus felt, without clear evidence, that this might be the case, at least to some degree, even in aphasic adults, and that melodic intonation therapy, calling as it did upon right-hemisphere musical skills, could help to develop this potential.

Detailed imaging of patients undergoing MIT was not possible during the 1970s, and a 1996 PET scan study by Pascal Belin et al. seemed to show that there was no activation in the right hemisphere of such patients. They reported, moreover, that there was not only an inhibition of Broca's area in aphasic patients, but hyperactivity of a homologous area in the right hemisphere (we may call it, for convenience, the "right Broca's area"). This sustained hyperactivity on the right side exerts an active inhibiting action on the "good" Broca's area, which, in its weakened state, is powerless to resist. The challenge, then, is not only to stimulate the normal, left Broca's area, but to find a way to damp down the "right Broca's area," with its malignant hyperactivity. Singing and melodic intonation seem to do exactly this: by engaging the right-hemisphere circuits in normal activity, they disengage them from pathological activity. This process has a certain self-sustaining momentum of its own, for as the left Broca's area is released from inhibition, it can exert a suppressant action on the "right Broca's area." A vicious circle, in short, is replaced by a therapeutic one.[6]

6. There is some preliminary evidence that the same effect may be accomplished by using repetitive bursts of transcranial magnetic stimulation applied to the "right Broca's area" to suppress its hyperactivity. Paula Martin and her colleagues have recently tried this

For various reasons, little research attention was paid during the 1980s and 1990s to melodic intonation therapy for people with severe, nonfluent Broca's aphasia—or to the mechanisms by which it might work. Nonetheless, music therapists continued to observe that, in many cases, such therapy could allow very significant improvement.

Recent work by Gottfried Schlaug and his colleagues carefully documents the brain activity of eight patients undergoing melodic intonation therapy (this involves seventy-five sessions of intensive therapy). All of these patients, Schlaug et al. report, "showed significant changes in speech output measures and in a right-hemispheric fronto-temporal network while repeating simple words/phrases in the MRI scanner." Schlaug showed me a number of videos of such patients, and the change in their ability to speak was indeed striking. Initially many were incapable even of responding clearly to the question, "What is your address?" Following MIT, they were able to reply much more easily to such questions, even offering additional details beyond those asked for. They had clearly achieved at least a measure of propositional speech. These changes, both behavioral and anatomical, were retained even several months after the course of treatment had ended.

As Schlaug points out, "the neural processes that underlie post-stroke language recovery remain largely unknown and thus, have not been specifically targeted by most aphasia therapies." But MIT, at least, has been shown to be "ideally suited for facilitating language recovery in non-fluent aphasic patients, particularly in those with large left hemisphere lesions for whom the

technique in four patients who have been intractably aphasic for more than five years. Though they need confirmation, Martin et al.'s results are promising, and may lead, they propose, to "a novel, complementary treatment for aphasia."

only route to recovery may be the engagement of right hemispheric language regions."

We have become accustomed, in the last twenty years or so, to dramatic revelations of cortical plasticity. Auditory cortex, it has been shown, can be reallocated for visual processing in congenitally deaf people, and the visual cortex in blind people may be recruited for auditory and tactile functions. But perhaps even more remarkable is the notion that the right hemisphere, which in normal circumstances has only the most rudimentary linguistic capacities, can be turned into a reasonably efficient linguistic organ with less than three months of training—and that music is the key to this transformation.