Institute Probes Music's Therapeutic Potential

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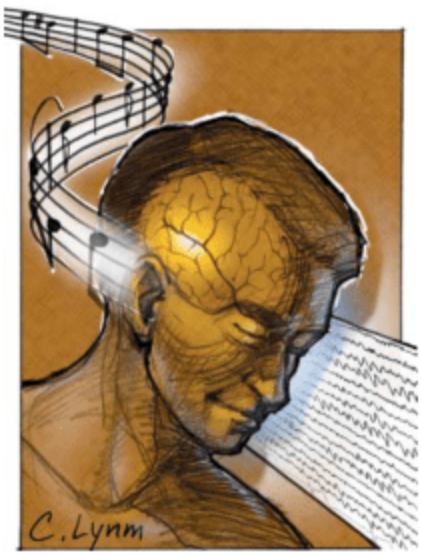
THE HEALING QUALITIES OF MUSIC have been appreciated since ancient times. Today, music continues to occupy a therapeutic niche in a range of settings and is gaining recognition as a valuable complement to conventional medical treatment in a number of areas, such as relieving pain during childbirth (*Pain Manag Nurs*. 2003;4:54-61).

Rigorous evaluation of such effects is needed to ensure that music is used most effectively in patient care. Such an effort is one of the aims of neurologist Mark Jude Tramo, MD, PhD, founder and director of the Institute for Music and Brain Science at Harvard Medical School, in Boston. Throughout his career, Tramo has used music as a lens to examine brain function. He envisions the nascent institute as an entity that will bring a multidisciplinary perspective to research on how the auditory cortex functions—not only to gain insight into fundamental auditory processes, but also to apply that insight to such problems as hearing loss and brain damage.

LAYING GROUNDWORK

Tramo has spent the last 2 years laying the groundwork for the institute's activities. The group currently includes a number of investigators affiliated with Harvard Medical School. But a host of researchers with different areas of expertise will be required to fulfill the institute's goal of finding out "how music is understood by the brain, from the single cell on up to global processing" and applying that knowledge clinically, said Nicholas Zervas, MD, professor of neurosurgery at Harvard Medical School and an executive board member of the institute.

Accordingly, the institute is expected to draw from the large community of research scientists, clinicians, and other experts in the Boston area who are involved in auditory-related



studies, from the very technical to more cognitive and therapeutic areas. A center such as this, said Zervas, a former president of the Boston Symphony Orchestra, can encourage collaboration among these experts.

ROCK 'N' ROLL HEART

A musician and composer as well as a physician-scientist, Tramo, a neurologist at Massachusetts General Hospital and an assistant professor of neurology at Harvard Medical School, represents the convergence of music and science. Growing up in the 1960s in an area of the Bronx that was home to Dion and the Belmonts and the Young Rascals, he played guitar in a rock band while in grade school, performing at the New York World's Fair in 1965. In high school he began composing songs, including a rock musical, "Apotheosis of the King Who Lost His Kingdom," which he recorded for Columbia Records.

Tramo's musical pursuits eventually took a back seat to his research in neuroscience, but not without strongly influencing his research path. He now studies how the auditory cortex processes pitch, harmony, melody, and other aspects of music, and works with patients with epilepsy, stroke, and other conditions to understand how brain damage affects music perception. Intuition from his musical background "helps me be creative with experiments, thinking about how the brain functions," he said.

The institute's mission is ambitiously broad, ranging from advancing knowledge of the neurobiological foundations of music, to rigorously evaluating and quantifying the healing effects of music on various disease states. In addition, Tramo foresees that insights from the work could lead to new technologies to promote health and treat disease, or improve established technologies, such as cochlear implants.

NAME THAT TUNE

Christine Koh, PhD, a postdoctoral fellow at Harvard Medical School, is collaborating with Tramo to study music perception in patients with brain lesions caused by stroke or epilepsy. Like Tramo and many others who study the neurobiology of music, Koh (who studied violin for 12 years) is a musician as

well as a scientist. She is combing a large database of stroke patients at Massachusetts General Hospital, looking for individuals with specific types of lesions in the auditory cortices. These patients are undergoing a variety of tests designed to provide a broad picture of the nature of their deficits in music perception.

Koh and Tramo are also studying patients with epilepsy who plan to undergo a therapeutic temporal lobectomy or excision of a piece of their auditory cortex—dramatic procedures used to alleviate seizures that severely compromise quality of life. Unlike individuals who have experienced a stroke, this group of patients will allow the researchers to compare musical capabilities before and after the procedure.

Simple tests—such as asking patients to decide if one tone is higher or lower, longer or shorter, or louder or softer, than a second tone—assess pitch discrimination. Other tests probe such abilities as being able to determine whether two melodies are the same or different.

"The remarkable thing—and one of the reasons that music research is so fascinating—is that you can do a lot of this testing with people who don't have any musical training," noted Koh. Due to early exposure or intuitive sense, human beings seem to have an inherent musical sense, she said.

One of the goals of Koh's research is to determine whether low-level functions such as pitch discrimination are related to higher-level cognitive functions such as melody processing. "While some of this work is very basic, it will provide us with the foundation to get a better understanding of how the auditory system is laid out," she said. "That will help direct us to practical therapeutic applications."

BREAKING THE CODE

Another member of the institute, Peter Cariani, PhD, assistant professor of neurocomputation and neurophysiology at Harvard Medical School, wrestles with the issue of how the brain represents sounds, from music to speech. A key problem concerns understanding how information is encoded by neuronal spike patterns.

Cariani likens this problem to the conundrum biologists faced before the discovery of DNA. "Classical geneticists knew that information was encoded somehow, they knew there was a mechanism of inheritance, that it was precise and reliable," he said. But they did not know whether the information was encoded by proteins or DNA, or how the code worked.

Neuroscientists face an analogous dilemma in trying to understand the nervous system without knowing the "neural code," he said. "We don't understand the neural codes, we don't understand the nature of the coding of the information in the central nervous system," Cariani explained. "It's hard to understand informational processes if you don't understand this."

A better understanding of neural coding has practical applications, said Cariani. For example, cochlear implants have been developed by trial and error, to a large extent, without a very explicit notion of neural coding in the auditory nerve. But if scientists succeed in cracking the neural code, the advance could lead to improvements in the devices.

SOUNDSCAPING

While basic neuroscience research is an integral aim of the institute, it is important not to lose sight of the fact that music and other components of the acoustic environment can help patients feel better, said Tramo.

With that in mind, part of the institute's mission is to raise awareness about the importance of improving the "acoustic ecology," or soundscaping, of hospitals and clinics. Tramo believes that just as attention is paid to the art that adorns the walls of hospital corridors and patient rooms, the soundscaping of these areas should also be addressed.

A pleasing acoustic environment with music and natural sounds can help to mask background noise—and perhaps even speed the healing process, said Tramo. Some studies have shown that enriching the acoustic environment of neonatal units with music can increase the speed at which preterm infants gain weight and reduce their length of stay in the unit, he noted (*Int J Arts Med*. 1997;5:4).

Future research plans include identifying the types of music and environmental sounds that have positive health effects on mood, blood pressure, or immunologic measures, for example. Bernie Krause, PhD, a bioacoustic researcher and member of the institute's advisory board, noted that although he and others have gathered anecdotal information on the beneficial effects of natural sounds—such as reducing the amount of pain medication patients require in some situations—more objective data are needed.

To this end, Tramo and Krause (president of Wild Sanctuary Inc, a California-based company that produces natural sound recordings for soundscape design, and a former member of the folk group, The Weavers) hope to evaluate the effects of such sounds on individuals with such conditions as anxiety, depression, and pain.

As the research proceeds, efforts are also under way to secure a funding base from public and private sources to take the institute to the next phase, from a loose collection of like-minded collaborators to an entity with a full-time complement of researchers and others, said Douglas Brightbart, JD, the institute's chief operating officer.

Tramo predicts that exploring the neurobiological foundations of music is likely to provide insights into the neurobiology of perception, performance, development, plasticity, emotion, and learning. But it's important to keep the focus on trying to help people, he said. "That's a major goal of the institute, to carry out studies well, and if they really do show positive effects [on health], to deliver these benefits to patients."