Brain Region for Musical Talent Found, Says New Study

Cynthia Fox, Science Writer

Musical talent has been located in the human brain, according to research led by a Montreal Neurological Institute (MNI) team, and reported in *Cerebral Cortex* [1]. Also discovered, the teams reported: a part of the brain that changes as people acquire musical skills—entirely apart from talent.

“In the past decades, the possibility of changing the adult brain through training and experience has raised a lot of interest, and musical training has proven an excellent model to study this,” lead author and German Center for Neurological Diseases neuroscientist Sibylle Herholz, Ph.D., told *Bioscience Technology*. “Only recently researchers have begun to study individual differences regarding predisposition for learning. In our study, we find evidence for both training-related plasticity, and predisposition for learning. And we were able to distinguish the corresponding neural correlates.”

Read More: [2]Music Accelerates Neurodevelopment of Teen Minds, Says Study [3]

In other words, she said, activity in some parts of the brain “changed after training compared to before, and activity before training in other parts of the brain predicted how fast people would learn. Thus, it’s not nature *or* nurture, but both, and different parts of the brain are more affected by one or the other.”

Agreed senior author Robert Zatorre, Ph.D., co-director of Montreal’s International Laboratory for Brain, Music, and Sound Research: “The whole issue of musical training and the changes that it may engender in the brain is of great current interest to many labs.”

Commented Nina Kraus, Ph.D., Northwestern University Auditory Neuroscience Laboratory director, to *Bioscience Technology*: “This elegant study not only provides clear evidence that making music changes the nervous system, but it advances the field to one of the new frontiers of neuroscience -- individual differences—and makes a compelling case that both our intrinsic wiring, and our experiences, shape our brains." Kraus was uninvolved with the study.

Brains changed after musical training

For the study, the teams examined 15 healthy, right-handed young adults (seven, male) who were 20 to 34 years old. The average age was 25.6.

Fourteen people completed the work. One person (female) dropped out pre-training due to reasons unrelated to the study. People were chosen with little to no musical background, a judgment made with the help of the online version of the Montreal Music History Questionnaire [4], MRIs, availability at the time of the study, and personal commitment. None of those involved had trained musically any more than two years. None of the participants were making music at the time. And none had ever received instruction in playing a keyboard.

Participants were scanned before and after six weeks of musical training. They were

required to learn simple piano pieces at home for most of the week, remotely monitored by the lab. They came in for training once a week.

 Brain activity in certain areas were consistently altered after learning, indicating training impact. More intriguingly, tests revealed activity in certain brain areas could predict which players would learn fast or slow.

Brain scans can predict wide talent divides

There were some very major divides in ability, Herholz told *Bioscience Technology*. “We saw some quite individual differences in the learning rates. Some participants were progressing so fast they learned to play all the required melodies after a few sessions, and we had to keep them busy with additional melodies. Other participants were struggling a lot, and only barely managed to perform the required minimum set of melodies by the end of the training. We also had everything in between these extremes. These individual differences made it possible to study which parts of the brains were different in fast, compared to slow, learners.”

The association between brain activity before and after training “was strong enough to be statistically significant at the group level,” Herholz said.

Subjective aspects like expressivity

Herholz said she wanted to stress three issues. “Firstly, in order to progress in the training, participants had to play the melodies correctly. They had to strike the right piano keys at the right time. However, we did not look specifically at the quality of the music in quite the same way as a piano teacher would. That is, we did not evaluate highly subjective aspects of the musical performance such as expressivity.”

Secondly, Herholz said, the association found was at the group level. “This means that we cannot say so-and-so-many participants had predisposition and the others didn't. Rather, we identified brain areas that were less active during certain musical tasks before training in slow learners, and more active in fast learners, which tells us a lot about how the brain works. At this point, we cannot use this as a diagnostic tool for new individuals. If we had the brain scan of someone new who did not

participate in the study, we wouldn't be able to make a precise prediction of how well he or she would do in our training."

Thirdly, Herholz told *Bioscience Technology*, it is important to note that the study's slower learners might have done much better with a different kind of training.

"We are not saying that they have no musical talent whatsoever," she said. "Our training required participants to listen to melodies and then play them by ear. We can only draw conclusions for this type of auditory-motor learning. Some of our slower learners might have done much better if, for example, we had asked them to play melodies from a visual template, because their brains might be more suited to learn such a task. Indeed, for clinical and educational applications, it might be less relevant to distinguish fast from slow learners, than to predict from which type of training an individual will benefit most."

It is possible some subjects deemed more "talented" could have practiced secretly on a non-monitored instrument, she said. "We cannot exclude this. But we think it's very unlikely. We were grateful our participants were willing to fit our demanding training schedule in their busy agendas, and to our knowledge none of them practiced secretly on another instrument. Anecdotally, at the end of the training program, one or two of our most enthusiastic participants expressed the intention to pick up `real' piano lessons, because they had enjoyed the training so much."

Herholz also noted—as her team did in the study—that a key next step will be to suss out what other areas of ability might play a role in music predisposition. For it is possible some of her team's "talented" musical subjects may simply have done a lot of practicing in some related, but different, areas of auditory-motor learning.

"This is a very good point," she concluded to *Bioscience Technology*. "We don't know yet to what extent the predisposition we identified in our study is, in itself, a result of previous experiences, or of genetic and anatomical differences, or both. The idea that previous learning experiences may enhance subsequent learning and plasticity is called meta-plasticity. We are only beginning to understand how this works in the human brain."

Finally, Herholz said, the team did not control for IQ--and for many reasons. Many factors may drive musical talent. "IQ is likely one of the least predictive. Things like parental influence, personality, socioeconomic status, attentional ability, and auditory working memory, to name a few, would all be more relevant than IQ."

The point of the study was not to identify behavioral or social factors impinging on musical ability, she said. The goal was to ask if some people learn more quickly due to different neural systems. "That we found auditory (and hippocampus) areas actually pretty much rules out IQ or any other global cognitive effects."

Their study in no way found that "those other factors would not be important, especially in a real-life situation. But that was not the question. Those factors have been identified in many other studies. What was not known was whether, when tested under controlled conditions, differences in rate of learning could be predicted

from anything we can measure in the brain. The answer is `yes.' The reason that's valuable is that now we have a candidate system--auditory and memory related--we can explore more fully. It gives us insight into underlying mechanisms. Simply showing that performance on one test (e.g. IQ) is correlated with performance on another test (e.g. music learning) doesn't tell us anything about mechanisms by which people's abilities differ."

Links:
[1] http://cercor.oxfordjournals.org/content/early/2015/07/01/cercor.bhv138.abstract
[2] http://www.biosciencetechnology.com/articles/2015/08/music-accelerates-neurodevelopment-teen-minds-says-study?
[3] http://www.biosciencetechnology.com/articles/2015/08/music-accelerates-neurodevelopment-teen-minds-says-study?&cmpid=horizontalcontent
[4] http://icmpc-escom2012.web.auth.gr/sites/default/files/papers/432_Proc.pdf