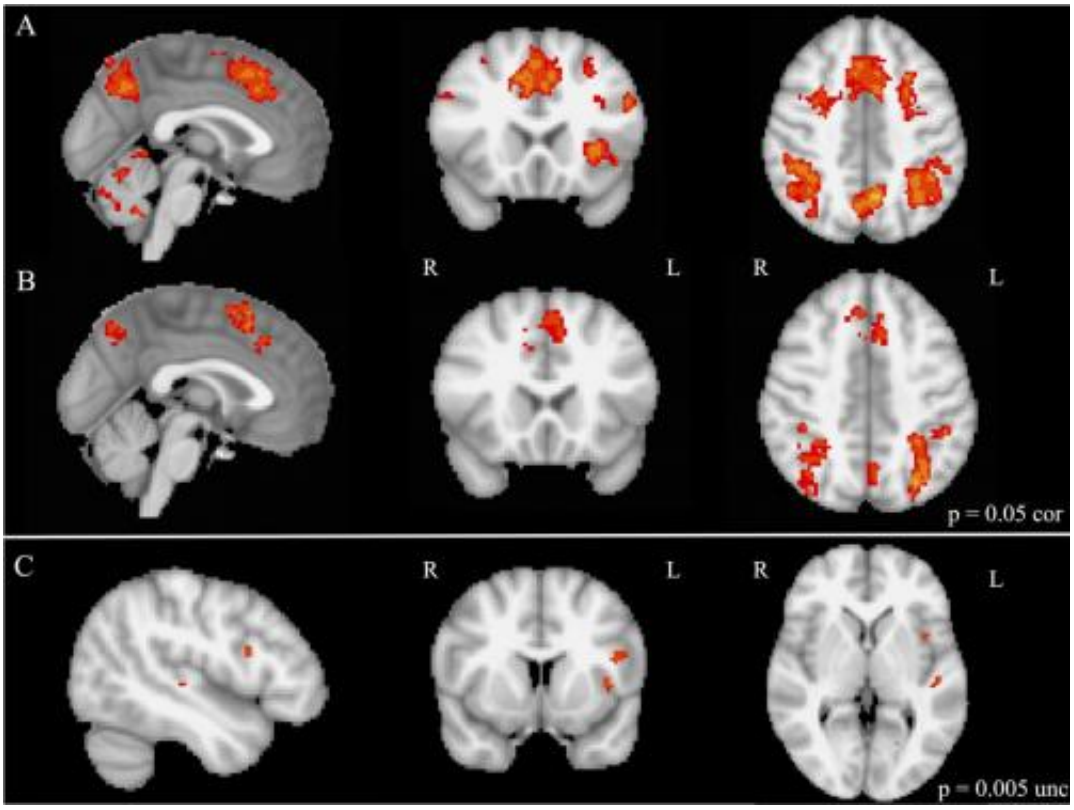
Brain imaging shows enhanced executive brain function in people with musical training

June 17 2014



This image shows functional MRI imaging during mental task switching: Panels A and B shows brain activation in musically trained and untrained children, respectively. Panel C shows brain areas that are more active in musically trained than musically untrained children. Credit: Laboratories of Cognitive Neuroscience, Boston Children's Hospital

A controlled study using functional MRI brain imaging reveals a possible biological link between early musical training and improved executive functioning in both children and adults, report researchers at Boston Children's Hospital. The study, appearing online June 17 in the journal *PLOS ONE*, uses functional MRI of brain areas associated with executive function, adjusting for socioeconomic factors.

Executive functions are the high-level cognitive processes that enable people to quickly process and retain information, regulate their behaviors, make good choices, solve problems, plan and adjust to changing mental demands.

"Since executive functioning is a strong predictor of academic achievement, even more than IQ, we think our findings have strong educational implications," says study senior investigator Nadine Gaab, PhD, of the Laboratories of Cognitive Neuroscience at Boston Children's. "While many schools are cutting music programs and spending more and more time on test preparation, our findings suggest that musical training may actually help to set up children for a better academic future."

While it's already clear that musical training relates to cognitive abilities, few previous studies have looked at its effects on executive functions specifically. Among these studies, results have been mixed and limited by a lack of objective brain measurements, examination of only a few aspects of executive function, lack of well-defined musical training and control groups, and inadequate adjustment for factors like socioeconomic status.

Gaab and colleagues compared 15 musically trained children, 9 to 12, with a control group of 12 untrained children of the same age. Musically trained children had to have played an instrument for at least two years in regular private music lessons. (On average, the children had played for

5.2 years and practiced 3.7 hours per week, starting at the age of 5.9.) The researchers similarly compared 15 adults who were active professional musicians with 15 non-musicians. Both control groups had no musical training beyond general school requirements.

Since family demographic factors can influence whether a child gets private music lessons, the researchers matched the musician/non-musician groups for parental education, job status (parental or their own) and family income. The groups, also matched for IQ, underwent a battery of cognitive tests, and the children also had functional MRI imaging (fMRI) of their brains during testing.

On cognitive testing, adult musicians and musically trained children showed enhanced performance on several aspects of executive functioning. On fMRI, the children with musical training showed enhanced activation of specific areas of the prefrontal cortex during a test that made them switch between mental tasks. These areas, the supplementary motor area, the pre-supplementary area and the right ventrolateral prefrontal cortex, are known to be linked to executive function.

"Our results may also have implications for children and adults who are struggling with executive functioning, such as children with ADHD or [the] elderly," says Gaab. "Future studies have to determine whether music may be utilized as a therapeutic intervention tools for these children and adults."

The researchers note that children who study music may already have executive functioning abilities that somehow attract them to music and predispose them to stick with their lessons. To establish that musical training influences executive function, and not the other way around, they hope to perform additional studies that follow children over time, assigning them to musical training at random.

Provided by Children's Hospital Boston