

Musical training boosts attention, working memory in children.

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New research out of Chile suggests kids that play musical instruments, regularly practicing and performing, benefit from improved attention and working memory.

For the study, published Thursday in the journal *Frontiers in Neuroscience*, researchers measured attention control and auditory encoding processes in the brains of musically trained children and a control group of children.

"There were no differences between groups in age, IQ and parental education, a proxy of socioeconomic status," lead study author Leonie Kausel, a violinist and neuroscientist at the Pontifical Catholic University of Chile, told UPI in an email.

"This is important, because these three factors are known to have an influence on the functioning of executive functions," said Kausel, a neuroscientist at the Pontifical Catholic University of Chile, who also plays violin.

All of the musically trained children, ages 10 to 13, had been playing an instrument for at least two years and practiced at least two hours per week.

Researchers had the two groups of children perform tasks that tested their auditory-visual attention and working memory. Functional magnetic resonance imaging allowed scientists to detect small changes in blood flow within the brain as the children performed the tasks.

Study participants were asked to focus on either one, both or neither of two stimuli: a visual abstract figure and a short melody. The stimuli were presented simultaneously for four seconds.

Two seconds later, the children were replayed various stimuli and asked if they recognized them. The replayed stimuli were sometimes the same as the original stimuli and other times novel.

Children who **played and practiced** musical instruments more accurately recognized the stimuli and had faster reaction times.

The fMRI images helped scientists identify two main neural mechanisms explaining the difference in attention and working memory performance: a domain-general attention mechanism and a domain-specific auditory encoding mechanism.

"The domain-general attention mechanism controls our attentional resources and is used when we pay attention to something -- independent of what we pay attention to, for example, stimuli in different sensory modalities," Kausel said. "So in our study this mechanism seems to play a role in the encoding of both visual and auditory stimuli."

"The domain-specific auditory encoding mechanism on the other hand is more specific to support auditory encoding, independent of whether you are paying attention to the auditory stimuli or not," Kausel said.

By asking participants to pay attention or not pay attention to one or both of the stimuli, and imaging the resulting brain activity, researchers were able to isolate the different neural mechanisms.

"When you subtract the activity from paying attention minus not paying attention, the 'difference' can be attributed to the cognitive process of paying attention or encoding of the stimuli," Kausel said.

The tests revealed higher activity of the **fronto-parietal** attention control network in the musically trained group of children. There was also higher functioning of the **phonological loop**, the **inferior frontal gyrus** and **supramarginal gyrus**, among the instrument-playing children.

While the latest study showed a correlation between the two neural mechanisms and improved attention and working memory task

performance, research suggests future studies could prove causality by directly modulating the activity of these areas of the brain.

"This can be achieved by using another method called Transcranial Magnetic Stimulation, which can inhibit or activate the functioning of very precise regions in the brain," Kausel said. "So for example, if we inhibit the superior parietal lobe that was part of the fronto-parietal attention network we would expect that the performance on the task diminishes if this brain region is causally involved in this function."

Even without proof of causality, the research suggests children benefit from musical training. Enhanced activity in the brain regions responsible for attention control and auditory encoding have been linked with improved reading, greater creativity and a better quality of life.

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