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Jingle bells not merry for tone-deaf individuals

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A new neuroimaging study conducted by researchers from the Montreal Neurological Institute of McGill University and the Université de Montréal at the International laboratory for Brain Music and Sound Research (BRAMS), has found that tone-deaf or amusic individuals have more grey matter in specific regions of the brain related to processing musical pitch, namely the right interior frontal gyrus and the right auditory cortex, as compared to those who are musically intact.

The study, published in a recent issue of the prestigious *Journal of Neuroscience*, sheds light on the neurological basis for congenital amusia.

Music, at all times of the year, but especially during the holidays, produces a kind of pleasure which human nature cannot do without, according to Confucius. Unfortunately, for about 4% of the population, music is less pleasure and more cacophony.

Congenital amusia, or tone-deafness is a life-long disorder that impairs a person's ability to perceive or produce music, preventing otherwise normal functioning individuals from developing even the most basic of musical skills or deriving any enjoyment from music. As one tone-deaf individual describes it, listening to music is like listening to "pots and pans being thrown on a kitchen floor."

"Overall, behavioral evidence indicates that congenital amusia is due to a severe deficit in the processing of pitch information. However, until now, very little was known about the neural correlates of this disorder,"

says Dr. Krista Hyde, a post-doctoral research fellow at the Montreal Neurological Institute and lead-investigator for the study in collaboration with Drs. Robert Zatorre at the MNI and Isabelle Peretz at the Université de Montréal.

“Using sophisticated computerized brain imaging techniques/methods developed by Dr. Alan Evans at the MNI, we were able to quantify differences in brain structure between a tone-deaf group and a musically-intact group. Specifically, we found that tone-deaf individuals had a thicker cortex (or grey matter) in particular brain regions known to be involved in auditory and musical processing. This parallels what has been observed in the learning disability dyslexia, in which the cortex is thicker in areas of the brain involved in reading ability.

The study employed a neuroimaging technique developed by Dr. Alan Evans and colleagues in the McConnell Brain Imaging Centre at the MNI that measures the thickness of grey matter (or cortex) using MRI brain scans.

All amusics had normal intellectual, memory and language skills, but were impaired compared to normal controls on a standardized battery of musical tests, the MBEA, used to diagnose congenital amusia. The MBEA involves six tests including melodic, rhythmic, metric and recognition memory tests. In order to better understand the nature of brain anatomical differences, the study correlated musical performance with cortical thickness measures. The lower the score on the MBEA the thicker the cortex in musically-relevant regions of the brain.

A uniquely human capability that predates language, music is a fundamental aspect of life, providing a unique window into brain function. “Listening to and creating music involves many different regions of the brain, the auditory system, the visual system, the motor system, as well as memory and emotion etc – making music an excellent

tool for gaining insight into all of these systems and studying the human brain," adds Dr. Hyde.

Cortical thickness differences in the right inferior frontal gyrus and right auditory cortex of amusic brains relative to controls may be due to abnormal neuronal migration or atypical cell pruning during development. Abnormal migration occurs when nerve cells do not reach their target or proper location in the brain and therefore do not make the right connections. Cell pruning is the process by which frequently-used nerve cells and connections (synapses) are strengthened while pathways that are of little use are eliminated.

The compromised development of the right fronto-temporal pathway linking regions of the brain crucial for musical processing, may contribute to the musical impairments in congenital amusia. These findings have implications for the understanding of normal acquisition of musical abilities and will lead to further studies on the neurological basis of congenital amusia.

Source: Montreal Neurological Institute and Hospital