The Benefits of Music Education

An Overview of Current Neuroscience Research
Your Child’s Development: Music Study may be the Best Tool

A WEALTH OF SCIENTIFIC RESEARCH over the last decade is proving that music education is a powerful tool for attaining children’s full intellectual, social, and creative potential.

- It speeds the development of speech and reading skills
- It trains children to focus their attention for sustained periods
- It helps children gain a sense of empathy for others

Music study requires a high degree of precision in auditory processing: being almost in tune is not good enough. This means that musically trained children are better able to distinguish subtle details of speech, leading to improved reading, better comprehension, and also a greater ability to interpret what other people – children and adults – are really saying.

Musically-trained children develop to their full potential because participation in music is inherently rewarding, making children more likely to devote the time and practice necessary to develop strong cognitive and social abilities.

Most importantly, music gives children a means to express themselves, to unleash their creativity, and to be inspired by their own boundless capacity for personal growth.

For more than 127 years, The Royal Conservatory of Music has contributed to the musical education of millions of Canadians, as well as to their academic success and social well-being. The research we highlight in this document offers compelling insights into the powerful, long-term value children gain through music study.

“Musical activity involves nearly every region of the brain that we know about, and nearly every neural subsystem.”  
Daniel Levitin, This is Your Brain on Music, p.299

Brains of Musically Trained Individuals

- STRONGER NEURAL CONNECTIONS
- MORE GREY MATTER
- BETTER INFORMATION PROCESSING
- HIGHER IQ
- BETTER MEMORY AND ATTENTION
- BETTER MOTOR COORDINATION
The Royal Conservatory
2 The Benefits of Music Education — Quick Facts

The Backstory
Over the past 20 years, several large-scale studies of school achievement have found a strong correlation between learning to play an instrument and academic success.

One decade-long U.S. study found that students who participated in at least nine hours of arts education a week (including music study) were four times more likely than their peers to have won recognition for their academic achievement, and three times more likely to have won an award for school attendance.¹

Research shows that participating in music study benefits both brain structure and brain function. Just like well-exercised muscles protect the bones and joints, reduce blood pressure and increase energy levels, music education produces bigger, better-functioning brains — a benefit to people of any age.

A research report by Dr. Sylvain Moreno et al showed that 90% of the children who participated in their study showed a remarkable gain in intelligence after only 20 days of musical training.²

“ Our data have confirmed a rapid transfer of cognitive benefits in young children after only 20 days of music training. The strength of this effect in almost all of the children was remarkable.”

Dr. Sylvain Moreno, Rotman Research Institute

Scientific Proof
Now, in a research breakthrough, neuroscientists are demonstrating that there is a causal connection between music study and cognitive growth.

The use of technologies such as functional Magnetic Resonance Imaging (fMRI) and electroencephalography (EEG) has given researchers a better understanding of exactly what happens inside the brain when it processes music and how this activity contributes to better learning and functioning.

The research is showing that learning to play an instrument leads to changes in a child’s brain that make it more likely they will reach their full cognitive potential.

Participating in musical activities — whether playing an instrument, singing or listening — stimulates a whole network of brain areas, each interacting with the others to contribute to enjoyment and understanding of the music. This brain workout leads to improved structure and function through a process called neuroplasticity — the brain’s ability to reorganize itself by forming new neural connections.

The improvements are responsible for many of the benefits of active participation in music.

IQ, Memory and Focus
Many researchers have linked music lessons with improved IQ and academic performance. In a formal study conducted through the University of Toronto and published in 2004, researchers compared the IQ performance of children in music lessons with those in drama lessons or no extra lessons at all. IQ was measured before and after the lessons.

The students in the music group showed greater increases in full-scale IQ scores than those in either of the other groups.² IQ scores are widely accepted as standardized predictors of academic achievement.

Recent studies have also indicated that individuals who are musically trained show better working memory abilities than those who are not. Working memory is the type of memory that allows us to remember things even while our minds are busy with other matters — crucial for such essential tasks as mental arithmetic and reading comprehension.

Much has been written about the importance of developing focus or self-discipline in children as preparation for success in life. Current research shows this is one of the key outcomes of music instruction.

Learning to play an instrument or sing requires significant levels of attention and concentration. There is evidence that children who take music lessons have greater abilities to focus their attention. Music training seems to be a very active form of mental training that increases children’s cognitive capacities, enabling them to perform better in many other aspects of their life.

The Royal Conservatory
2011 White Paper The Arts and Human Development, p.22

¹ S.B. Heath, 1998, cited in National Endowment for the Arts
² E. Glenn Schellenberg, Music Lessons Enhance IQ (Psychological Science, 15)

FOR MORE INFORMATION, PLEASE CALL 1.800.461.6058 OR VISIT RCMUSIC.CA

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A CONVERSATION WITH DR. SYLVAIN MORENO
Lead Scientist, Centre for Brain Fitness, Rotman Research Institute

"MUSIC IS AN INCREDIBLY POWERFUL TOOL, WE'RE LEARNING." Dr. Sylvain Moreno

DR. MORENO IS STUDYING HOW TRAINING AND REHABILITATION CAN AFFECT HIGHER ORDER PROCESSES, SUCH AS LANGUAGE AND INTELLIGENCE.

THE RCM: TELL US ABOUT YOUR WORK.

DR. MORENO: My area of expertise is in human development, and how we can impact the brains of children through musical training.

THE RCM: WHAT HAVE YOU LEARNED?

DR. MORENO: Musical training impacts a set of processes in the brain that are related to a whole host of other activities, from intelligence and reading to the ability to focus and do well in school. When we understood that musical training is beneficial, we set out to learn the exact benefits and limits.

We started this way because there is a link between music and language. They’re both auditory activities and they share the same acoustic parameters. They even share the same goal of communicating to a human being.

So we studied reading and we have shown that musical training improves reading. We looked at verbal intelligence and there was an absolute trend of improvement. These were some of the positive intellectual benefits that we measured.

THE RCM: ANY SURPRISES IN YOUR RESEARCH?

DR. MORENO: It was really astonishing to see how quickly the brain changed in response to musical training. We provided musical training to young children, and within 20 days we would see a shift in a number of cognitive areas.

We started with one simple question: “Is musical training beneficial?” and the answer that we got was a resounding “YES.” Musical training has a positive impact on a set of core neural processes that are related to focus, intelligence, reading, academics and more.

Music is an incredibly powerful tool, we’re learning.

THE RCM: HOW CONCLUSIVE WERE YOUR FINDINGS?

DR. MORENO: The standard for a typical scientific study is 60 to 70%. That is, we would have to show that musical training impacts the percentage of the participants. Our research showed that musical training impacted over 90% of the children we studied. We asked three different people to reanalyze our data to confirm our findings.

THE RCM: THIS CERTAINLY VALIDATES WHAT SO MANY CANADIAN PARENTS HAVE ALWAYS BELIEVED ABOUT THE VALUE OF MUSIC LESSONS.

A FEW WORDS ABOUT HOW DR. MORENO CONDUCTED HIS RESEARCH

DR. MORENO AND COLLEAGUES conducted a pair of studies designed to examine the effect of musical training on the developing brain. In the first of these studies, 32 eight-year-old children were given free music or painting lessons over a six-month period.

None of the children had any prior music or painting training. They were randomly assigned to either the music or the painting group (so the researchers could ensure that any outcomes did not come from a biased selection).

The children were tested before and after training. These tests included measurements of reading skills, cognitive abilities, and listening abilities. Following the training, the music group (but not the painting group) showed improvement in reading skills. They were better able to connect written words with their spoken sounds – a critical component of literacy.

The children taking music lessons were also better at hearing changes in intonation – not only in music, but also in speech – which is critical for understanding emotion and nuance in conversation.

The researchers also monitored the children’s brains using neuroimaging techniques. This research showed increased activity in regions associated with careful listening to speech and music.

In the second study, 48 preschool children between the ages of four and six were tested in a similar program. These children engaged in a computerized training program, led by an instructor, over the course of one month. Again, children were randomly assigned to either a music or visual art group.

At the end of the training, the children who had been given music (but not visual art) lessons, improved in measures of verbal intelligence and attention. Over 90% of the children taking music lessons showed this improvement. These children also showed significant changes in their brains’ processing of items requiring a controlled response, or attention.

SOURCES

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Musical Training Influences Language Abilities in Eight-year-old Children: More Evidence for Brain Plasticity, Sylvain Moreno, Carla Marques, Andrea Santos, Marcelo Santos, Salo Langa, Carlos Nogueira, and Frédéric Berthoz, Cerebral Cortex, Volume 18, Issue 10, 2009

Speech and Reading Ability

Reading, understanding and speaking a language requires the ability to identify where syllables and words begin and end. This skill is called phonological ability and uses the same areas of the brain used to identify and break up sounds. These are important skills that we gain through experience, and they help us understand our native language and new ones.

Studies have shown that musically-trained children have better phonological skills, which can help them to learn words faster, develop a richer vocabulary, and learn to read sooner.

In a 2009 Canadian study, young children taking music lessons showed dramatic improvement in their verbal intelligence scores after only four weeks of training. The gains from studying music were much greater than for other types of arts training. Improvements in speech and reading are critical to success in school, where strong literacy is a pre-requisite for nearly every subject area, including mathematics.

RAW VOCABULARY SCORES

The theory of relativity occurred to me by intuition, and music is the driving force behind this intuition. My parents had me study the violin from the time I was six. My new discovery is the result of musical perception.”

Albert Einstein

Creativity

Another study found a marked difference in inter-hemispheric communication (communication between the right and left sides of the brain) in individuals with musical training versus those without musical training. Scientists involved in this area of study believe the greater connectivity between brain regions may help foster increased creativity.
Empathy and Social Awareness

Recent studies have shown that collaborative music making can increase empathy in toddlers. Empathy, in part, comes from being sensitive to subtle changes in the human voice that indicate mood and emotion. Children need to develop empathy if they are to thrive in family life, at school, and later, at work. This connection between music and empathy may be due to improved verbal intelligence. Playing music improves a child’s ability to listen and pick up nuances of speech – the way something is said and the emotions underneath the words, not just the words themselves, which in turn is a key element of empathy and emotional intelligence.

Music is inherently emotional, and musical memories are among the most visceral and vivid. Consequently, musicians must learn how to connect with people on an emotional level. Whether harmonizing in a choir or performing in a string quartet or simply jamming with friends, music students of any age, even the very young, learn how to share attention, co-operate and collaborate. These are extremely valuable skills for both personal relationships and in the workplace. Studies have even shown that collaborative musical activities can increase toddlers’ pro-social behaviours, making them more likely to help someone in need.

High-quality Music Education Makes a Difference

The quality of a child’s music education is linked to their academic achievement. Elementary school students in high-quality music education programs outperformed those in lower-quality programs in standardized tests of English and mathematics. While music education by itself may not be responsible for the entirety of the 20% improvement in test scores, scientists now believe that the changes in the brain caused by music training can lead to improvements in general cognitive skills like memory, attention, and reading ability, all of which are predictive of educational outcomes.

Areas of Greater Cortical Thickness in Musicians

The brain areas that show the greatest thickness in musicians include:

- **Right Hemisphere**
  - Greater difference in thickness
- **Left Hemisphere**
  - Smaller difference in thickness

Research has shown that musicians have larger areas of the brain associated with speech and language, as well as the inherent enjoyment of music, strong parallels between music and speech, and empathy. Consequently, the brains of musically trained individuals are typically larger in the temporal cortex – an area on the side of the brain that controls hearing, among other things – and in the frontal cortex – an area in the front of the brain in charge of abstract thought, planning, and complex behaviours, as well as controlling our intended movements.

Health and Resilience

Parents will be heartened to know that studying music also brings children inter-related health benefits. Scientific research is starting to emerge showing that life-long music training can offer improved cognitive function as we age. We already know that music therapy has helped people recover from strokes, and can be useful in treating a variety of neurological disorders, such as stuttering, autism, and Parkinson’s disease. Music training has even been shown to delay the onset of dementia. Consequently, the strong parallels between music and speech, as well as the inherent enjoyment of music, make it a useful and flexible rehabilitative technique at many ages. And music study can compensate for hearing loss in adults. Studies show that seniors with musical training are able to pick out sounds in noisy environments – such as restaurants – and can carry on conversations better than those without this training, even though they’ve suffered hearing loss.

Increases in the Capacity of Key Brain Regions

Important regions of the brain that are significantly larger in musically trained people – the brighter the colour, the bigger the difference. The brains of musically trained individuals are typically larger in the temporal cortex – an area on the side of the brain that controls hearing, among other things – and in the frontal cortex – an area in the front of the brain in charge of abstract thought, planning, and complex behaviours, as well as controlling our intended movements.

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Brenda Yamuna Pakday and Brian C. Capell, *Frontiers of Human Neuroscience, Recent and past musical activity predicts cognitive aging variability: direct comparison with general hippocampal atrophy, 2012*


12. Natalie Berendes et al., *Neuroanatomical Correlates of Musicianship as Revealed by Cortical Thickness and Total Brain Atrophy*, *Cerebral Cortex* July 2009, *19:1583–1596*
Simply put, I would not be in the phase of my musical career.

my classical learning into every aspect of my preparation for my career that was crucial to my development as a performer. With extremely high standards, I was motivated in my studies, and more likely to win academic awards.

Thanks to the groundbreaking research of neuroscientists, we now have a clear scientific explanation for this phenomenon. Music study leads to lasting changes in children’s brains, increasing their capacity to perform tasks that require sustained attention and careful listening and reading. Parents can be more confident than ever that an investment in music lessons will deliver lifelong benefits for their child.

To Learn More

Music instruction is beneficial for individuals of all ages, however the research suggests the benefits are greatest when a child begins at a young age. To learn about the many music education options available, visit rcmusic.ca/learning or call 1.800.461.6058.

CONCLUSION

We know that from early childhood through to retirement age, whether involved in recreational music making or training for a professional career, people who are engaged in music study are sharpening their cognitive skills and developing social connections.

Over the past two decades, several large-scale studies have found that music students outperform academically compared to other students, often by large margins. Music students tend to be more engaged and motivated in their studies, and more likely to win academic awards. We know that from early childhood through to retirement years, whether involved in recreation or training for a professional career, music study leads to lasting changes in children’s brains, increasing their capacity to perform tasks that require sustained attention and careful listening and reading.

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RELATED READING

THE ROYAL CONSERVATORY is committed to advancing the study of the benefits of music education and sharing those results with Canadian parents. To this end, we are pleased to provide a comprehensive list of sources for further reading. We will continue to report new research findings on our website at rcmusic.ca/research.

- Music, The Brain, And Ecstasy: How Music Captures Our Imagination, Roberts Rubin
- This Is Your Brain on Music: The Science of a Human Obsession, Daniel Levitin
- The Tao of Music: Sound Psychology, John Ortiz
- Music, Language, and the Brain, Anirudh Patel
- Listen to This, Alex Ross
- Musicophilia: Tales of Music and the Brain, Oliver Sacks
- Music and the Mind, Anthony Storr
- Music Lessons: Enhance IQ (Psychological Science, 15), E. Glenn Schoenberg, 2004; the online version of this article can be found at: http://psp.sagepub.com/content/15/5/511
- Short-Term Music Training Enhances Verbal Intelligence and Executive Function, Sylvain Moreno, Ellen Bialystok, Raksha Barac, E. Glenn Schoenberg, Nicholas J. Capella and Tom Chau; Psychological Science published online 3 October 2011, and can be found at: http://psp.sagepub.com/content/early/2011/10/03/0956797611416999
- Musical Training Influences Linguistic Abilities in Eight-year-old Children: More Evidence for Brain Plasticity, Sylvain Moreno, Carlos Marques, Andrea Santos, Manuela Santos, S¿o Luís Castro and Mireille Besson; Cerebral Cortex, (Volume 19, Issue 3, March 2009)
- Neuroanatomical Correlates of Musicianship as Revealed by Cortical Thickness and Voxel-Based Morphometry, Patrick Bermudez1,2, Jason P. Lerch3, Alan C. Evans1 and Robert, and J. Zatorre; Cerebral Cortex (July 2009)
- Examination of Relationships between Participants in School Music Programs of Differing Quality and Standardized Test Results, CM Johnson and JE Memmott, Journal of Research in Music Education (Winter 2006), Volume 54, Number 4
- TO TORONTO STAR: Everything | I Need to Know | I learned in School Music Class at http://www.thestar.com/news/opinion/2013/06/15/everything_i_need_to_know_in_school_music_class.html
- UNIVISION NEWS: Neuronanatomical Correlates of Musicianship as Revealed by Cortical Thickness and Voxel-Based Morphometry, Patrick Bermudez1,2, Jason P. Lerch3, Alan C. Evans1 and Robert, and J. Zatorre, Cerebral Cortex (July 2009)
- THE DAILY TELEGRAPH (UK): Music – a gift for language learners at http://www.telegraph.co.uk/education/educationadvice/10435498/Mus
- U.S. NEWS & WORLD REPORT: Musicians’ Brains Might Have an Edge on Aging at http://health.usnews.com/health-news/articles/2013/08/02/musicians-brains-might-have-an-edge-on-aging
- THE DAILY TELEGRAPH (UK): Music – a gift for language learners at http://www.telegraph.co.uk/education/educationadvice/10435498/Mus
ABOUT THE ROYAL CONSERVATORY OF MUSIC

The Royal Conservatory is one of the largest and most respected institutions in the world dedicated to music and arts-based education. Providing the definitive standard of excellence in music education through its curriculum, assessment, performances, and teacher education programs, The Conservatory has had a substantial impact on the lives of millions of people globally. In addition, the organization has helped to train a number of internationally celebrated artists including Glenn Gould, Oscar Peterson, David Foster, Sarah McLachlan, Angela Hewitt, and Diana Krall.

Motivated by its powerful mission to develop human potential through leadership in music and arts education, The Royal Conservatory is committed to the advancement of research and science in the field. Consequently, The Conservatory has emerged over the last two decades as a leader in the development of arts-based programs that address a wide range of social issues.