

NEURODIVERSITY

The Neurodiversity bundle is filled with research, tools, and information. These tools can either be shared with parents to enhance their knowledge or used by teachers to increase their own confidence and effectiveness in communicating with parents.

DEVELOP YOURSELF

These tools have been designed to facilitate your learning and understanding of the research on music learning and brain development.

Discover practical ways to apply the research directly to your teaching.

SHARE DIRECTLY WITH PARENTS

These tools have been exclusively tailored to be shared directly with parents.

Use these resources as a tool to connect with parents, gain their support for the work that you do and help them understand the powerful benefits of music learning.



WHAT'S INCLUDED?

GET YOUR MESSAGE OUT

Communication Bundle

\$30AUD

8 x Social media ready Research bites

2 x Shareable Music Learning Infographics

- Music learning helps Autism
- Learning music and ADHD

2 x Easy to share research Ebooks

- Music learning helps Autism
- Music learning helps ADHD

4 x News Articles that you can share at the click of a button

SUPERCHARGE YOUR ADVOCACY

Development Bundle

\$50AUD

Includes everything in the "Get your message out" set

PLUS

2 x Actionable research articles with Teaching Reflections

- I want to eat the chocolate cake
- ADHD and Music Learning

2 x Research Quick Reads

- Music learning helps learning difficulties
- Music learning helps Dyslexia

1 x Shareable Music Learning Infographic

- Music learning helps ADHD

Which bundle will you choose?

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GET YOUR MESSAGE OUT

COMMUNICATION BUNDLE

SOCIAL MEDIA READY RESEARCH BITES

These bite-sized gems of information are tailored to enhance your emails, newsletters, and parent presentations, making it effortless for parents to grasp the advantages of music education.

Easy to add to newsletters, emails and social media

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“Owing to the link between rhythmic and cognitive functions, rhythmic training ... may hold some promise for remediation of cognitive disorders in ADHD.”

Pujariinet, F., Biegel, V., Lopez, R., Dellacherie, D., & Dalla Bella, S. (2017). Children and adults with Attention-Deficit/Hyperactivity Disorder cannot move to the beat. Scientific reports.




An auditory-motor synchronization task may serve as an important, early indicator of a child's ability to understand spoken and written language.

Bonacina, S., Huang, S., White-Schwach, T., Krizman, J., Nicol, T., & Kraus, N. (2021). Rhythm, reading, and sound processing in the brain in preschool children. npj Science of Learning.


“From the beginning of life, music and language are connected with each other; both consist of auditory stimuli, are generically structured, and deliver messages.”

Patscheko, H., Degk, F., & Schwarzer, G. (2016). The effects of training in music and phonological skills on phonological awareness in 4-to 6-year-old children of immigrant families. Frontiers in psychology.



“Parallels between music and language suggest that musical training may lead to enhanced verbal abilities.”

Wan, C. Y., & Schlaug, G. (2010). Music making as a tool for promoting brain plasticity across the lifespan. The Neuroscientist.



Ready to print and hand out to your community

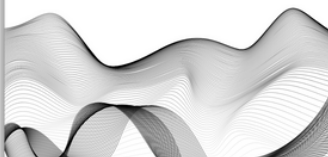
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HOW MUSIC LEARNING HELPS ADHD

Present complex research in a reader-friendly format, helping you grasp the profound connection between music education and brain development.

BIGGER BETTER BRAINS

HOW MUSIC LEARNING HELPS ADHD



MUSIC LEARNING HELPS ADHD

Sensory Input [1] Neural Connectivity [2] Auditory Processing [1] Sensorimotor Tasks [2]

How could music learning improve auditory processing to improve language skills for children with ADHD?

Music learning has been found to improve auditory processing significantly. Auditory processing is one of our first and largest data gathering senses, and deficits in auditory processing lead to learning delay and difficulties.

Improved auditory processing has been found to transfer into improvement in language acquisition, language syntax, language prosody, and specifically in the area of verbal memory. Students with ADHD have underactive auditory processing and therefore, often struggle with their language skills.

Music learning works to improve the underlying brain network so that language interventions can achieve better results for the student.

Journal Article: A. Besson, M. & Scherf, J. (2015). Brain development of auditory cortex promotes verbal fluency and phonological skills in children. Journal of Neuroscience, 35(21), 7488-7494.

MUSIC LEARNING HELPS ADHD

How could music learning decrease variability in behaviour that can assist learning for children with ADHD?

Music learning is a fantastic way to develop inhibitory control, mainly because it uses both explicit instruction (telling a student how you want them to behave or which behaviours to stop) and implicit instruction (setting up a class/ensemble or learning culture where there are implied rules, rules every student abides by without being told).

Implicit instruction is far more powerful in changing behaviour because it uses the very human need to fit in and be accepted as part of a group.

Group music learning has the bonus of being about working towards a common goal and being personally responsible for being a part of that goal.

Attention [1] Language Disorders [1] Literacy [1] Behaviour Variability [4]

Journal Article: A. Besson, M., & Scherf, J. (2015). Brain development of auditory cortex promotes verbal fluency and phonological skills in children. Journal of Neuroscience, 35(21), 7488-7494.

MUSIC LEARNING HELPS ADHD

How could music learning improve neural processing of competing sensory input for children with ADHD?

Students with ADHD have been found to have both overdeveloped and underdeveloped connectivity between the auditory, visual and motor cortices. These differences in connectivity result in behavioural and learning issues.

Learning a musical instrument creates a high level of demand on the consistent connectivity between the three cortices, and this consistency helps manage behavioural variations and learning efficiency.

This improvement in auditory, visual and motor consistency then allows the sensory network to be enhanced.

In a music learning activity, this would most likely be evident when a student with ADHD could select to focus on his or her part in the music while simultaneously blocking out another part while also not get distracted by a student moving next to them.

GET YOUR MESSAGE OUT

COMMUNICATION BUNDLE

MUSIC LEARNING HELPS INFOGRAPHICS

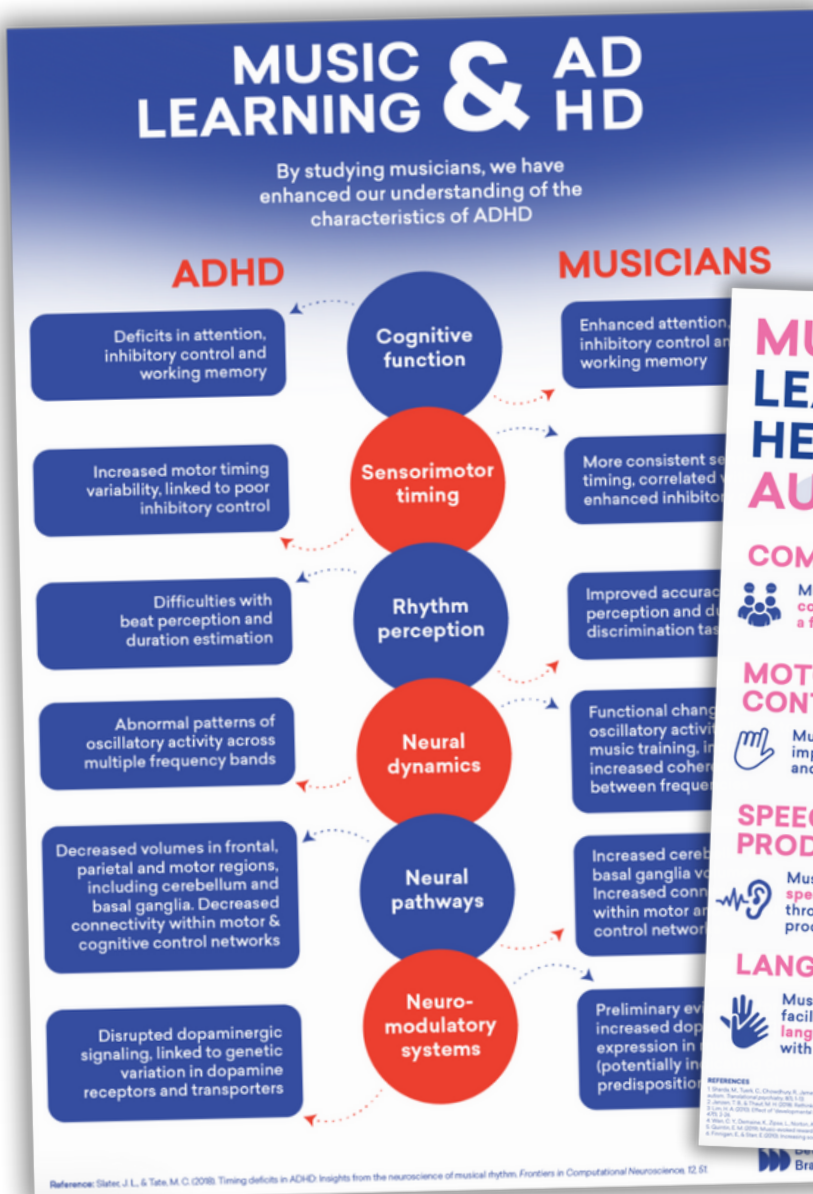
These research backed infographics have been designed to help your community understand how music learning can help with ADHD and autism.

Amplify your program booklet or add into your concert invitation

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Great for A4 printing



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SUPERCHARGE YOUR ADVOCACY DEVELOPMENT BUNDLE

2 X PROFESSIONAL READINGS WITH TEACHING REFLECTIONS

Authored by Dr. Anita Collins, these professional readings provide a comprehensive analysis of research findings and offer practical strategies for incorporating them into your teaching practices.

Discover how you can apply the research to your teaching

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ADHD and music learning

The study of Attention-Deficit/Hyperactivity Disorder (ADHD) and music learning have been closely connected for decades. The reason is that many of the cognitive functions that music learning seems to develop are the very cognitive functions that ADHD seems to disrupt. This can be through either lower capabilities in areas such as attention or increased variability in areas such as motor control. Using music learning as a comparative tool from a research perspective could yield some new understanding about the nature of ADHD, as well as point to effective interventions for ADHD.

How are they connected?

Let's start with a very interesting perspective paper. A perspective paper in peer research is a paper where researchers get to put forward their thoughts and of a given topic. These thoughts and opinions are, of course, heavily supported by done by other researchers in the field, but a perspective paper provides the res the licence to float a new concept. Often those researchers go on to test that their next study.

This perspective paper is by Dr Jessica Slater and Prof Matthew Tate Northwestern University at the time of writing this paper. They begin their outlining the connection between neuromusical and ADHD research.

"Everyday human behavior relies upon extraordinary feats of coordination brain. In this perspective paper, we argue that the rich temporal structure provides an informative context in which to investigate how the brain its complex activities in time, and how that coordination can be disrupted insights from the neuroscience of musical rhythm to considerations of time in Attention-Deficit/Hyperactivity Disorder (ADHD), highlighting the significance between neural systems involved in processing musical rhythm and those in ADHD."

The researchers are pointing out that processing musical rhythm involves of the neural systems that are disrupted by ADHD. The paper goes on to a fascinating research you may well be interested in, but I wanted to jump the end of the paper. The table sums up the possible connections between functions of people with ADHD and the brain functions of musicians. They use the term musician to refer to the field of neuromusical research, rather specific description, of musically trained people.

The researchers highlight (see the paper by Slater & Tate for citations) that m

- are better than [the] control [group] at rhythm perception and discrimination tasks
- have more consistent sensorimotor timing
- demonstrate enhanced cognitive function, including attention, inhibition and working memory
- have enhanced inhibitory control linked to more consistent sensorimotor timing
- have larger volumes in motor areas including the cerebellum and basal ganglia, as well as frontal and parietal regions associated with cognitive control
- have functional changes to oscillatory dynamics

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ADHD and music learning

instructions that need to be executed simultaneously when they make a sound, such as placement of the mouth on the mouthpiece while creating a steady airflow while moving your fingers in time with their tongue.

All of these music learning examples require high degrees of cognitive function but also use a lot of repetition and variation, which could help the ADHD brain to improve deficits in these cognitive functions.

Rhythm perception improves -

1. accuracy in beat perceptions, and
2. duration discrimination tasks.

From the very start of music learning activities for babies, music educators work on beat perception. This includes moving to the beat as well as finding the beat within a piece of music. Moving to the beat sounds easy, but it is a very difficult task for our brains. Not only do we need to hear where the beat is, but we also have to predict when to start moving our body with it. With beat perception in mind, a music learning intervention that focuses on rhythm through the body and instruments, such as percussion, may be very useful for students with ADHD.

"Owing to the link between rhythmic and cognitive functions, rhythmic training ... may hold some promise for remediation of cognitive disorders in ADHD."

Reviewed by: Roger W. Adams, S. D. Taylor, and J. G. Taylor. Copyright © 2017. All rights reserved. This document is for personal use only. All other rights reserved.



The second point, duration discrimination, is the ability to know and feel how long something will take. This could be used for anything from measuring time when we don't have a watch to being able to estimate how long an assignment will take to complete. Music learning is mostly about working with time, from the short time of how long is a crotchet rest at a given tempo to how long does a bar feel if it is full of rests. These seemingly small activities are the building blocks to "feeling" time and improving the accuracy of duration discrimination for students with ADHD.

Cannot move to the beat

related to rhythm, and it seems to be students and adults with ADHD find many rhythm-based activities very difficult.

In the year prior to the Slater & Tate paper publication, another paper entitled "Children and adults with Attention-Deficit/Hyperactivity Disorder cannot move to the beat" was released. A team of researchers at the University of Montpellier, led by Dr Frédéric Puyjarinet, looked more closely at this issue of rhythm and hearing the differences between sound lengths. The paper starts by outlining the simple connection between the inability of adults with ADHD to distinguish if two sounds were of different lengths. This deficit has previously been connected with poor reading, attention, and language

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2 X EASY TO SHARE RESEARCH QUICK READS

Present complex research in a reader-friendly format, helping you grasp the profound connection between music education and brain development.

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MUSIC LEARNING HELPS LEARNING DIFFICULTIES

Music processing has been used as a tool to better understand Autism, Attention Deficit Hyperactivity Disorder and Dyslexia from a neural perspective. The way in which the human brain processes sound has led to a greater understanding of how the human brain processes sensory information.

In all three disorders, the identification of inconsistencies and deficiencies with sound processing have enhanced our understanding of the neural behaviours associated with Autism, ADHD and Dyslexia. These fields of research are still fairly new but point to why music therapy and learning may have been effective in treating these three disorders.

Music Education and Autism (ASD)

Autism Spectrum Disorder (ASD) is a developmental disability that can cause significant social, communication and behavioural challenges. There is often nothing about how people with ASD look that sets them apart from other people, but people with ASD may communicate, interact, behave, and learn in ways that are different from most other people.

The combination of music and movement activities' over 8 week to 6 month periods have shown measurable improvements for children with Autism. Music interventions which combine music therapy with music education...

MUSIC LEARNING HELPS DYSLEXIA

Music learning can be effective for ASD children for both therapeutic and educational outcomes. Children with Autism, as well as their families and carers, may benefit enormously from music learning as a therapy and these benefits have the capacity to transfer to improvements in learning outcomes.

Music Education and ADHD

Attention Deficit Hyperactivity Disorder (ADHD) is a chronic condition that affects millions of children and often continues into adulthood. ADHD includes a combination of persistent problems, such as difficulty sustaining attention, hyperactivity and impulsive behaviour.

ADHD is now understood as a mistiming between the auditory, motor and visual cortices². Music learning, especially on an instrument, has been found to greatly improve the timing and data processing between these three areas of the brain.

Music learning has been investigated as an effective intervention for ADD & ADHD and has found that learning on a musical instrument may:

- Improve **neural connectivity** associated with **perceptual and sensorimotor tasks**¹
- Decrease **variability** in behaviour²
- Improve **auditory processing** deficits associated with **language disorders**³
- Improve **neural processing** of competing sensory input⁴
- Improve **gray matter volumes** associated with **attention and literacy issues**⁵

The length of music training has a significant impact on these findings, **the longer children learn, the better**. The improvements in auditory processing on reading skills are most significant when formal music learning is commenced **between the ages of 4 and 9 years of age**.

Here is a summary of research into the typical neural development of a person with ADHD and the corresponding neural developments that have been found in musicians.

| Cognitive Function | Sensomotor Timing | Rhythm Perception | Neural Dynamics | Neural Pathways | Neuroanatomical Features |
|--|--|---|--|--|--|
| ADHD: Deficits in attention, inhibitory control and working memory. | Increased motor timing variability linked to poor inhibitory control. | Difficulties with beat perception and duration estimation. | Abnormal patterns of oscillatory activity across multiple areas, including beta, delta, and gamma, with motor and cognitive task control deficits. | Decreased volume in frontal, parietal & motor regions, including cerebellum & basal ganglia, with motor and cognitive task control deficits. | Overlapped dysplasticity regarding white matter tracts, including corpus callosum, superior longitudinal fasciculus, and arcuate fasciculus. |
| Musicians: Enhanced attention, inhibitory control and working memory. | More consistent sensorimotor timing and duration, enhanced inhibitory control. | Improved accuracy in beat perception and duration discrimination tasks. | Functional changes in oscillatory activity linked to more consistent connectivity within motor and cognitive control networks. | Increased cerebral and basal ganglia volumes, increased connectivity within motor and cognitive control networks. | Enhanced white matter for increased dopamine receptor expression in musicians potentially indicating genetic pre-disposition to music. |

Source: Satoris, J. L., & Talsi, M. C. (2018). Timing deficits in ADHD: Insights from the neuroscience of musical rhythm. *Frontiers in Computational Neuroscience*, 12, 31.

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BIGGER BETTER BRAINS

HOW MUSIC LEARNING HELPS DYSLEXIA

How could music learning improve impaired perception of speech in background noise for children with Dyslexia?

Finding and keeping the beat in a song, identifying similar sounds such as rhymes and different sounds and hearing the small changes in language sounds and melodies are all very similar concepts.

The great thing about music learning is students can start learning these concepts well before they begin school, and therefore, they can exercise the pathways they need for phonological awareness through their music learning experiences.

Speech Perception [1] **Speech Processing [4]** **Reading Difficulties [3]**

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