

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

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

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

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

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

- are better than [the] control [group] at rhythm perception and temporal discrimination tasks
- have more consistent sensorimotor timing
- demonstrate enhanced cognitive function, including attention, inhibitory control 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

You can see in the table that Slater & Tate included in their paper that they compare the ADHD disruptions with the musician enhancements in a very clear way.

	Cognitive Function	Sensorimotor Timing	Rhythm Perception	Neural Dynamics	Neural Pathways	Neuromodulatory systems
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 frequency bands.	Decreased volumes in frontal, parietal and motor regions, including cerebellum and basal ganglia. Decreased connectivity within motor and cognitive control networks.	Disrupted dopaminergic signaling, linked to genetic variation in dopamine receptors and transporters.
Musicians	Enhanced attention, inhibitory control and working memory.	More consistent sensorimotor timing, correlated with enhanced inhibitory control.	Improved accuracy in beat perception and duration discrimination tasks.	Functional changes in oscillatory activity linked to music training, including increased coherence between frequencies.	Increased cerebellar and basal ganglia volumes. Increased connectivity within motor and cognitive control networks.	Preliminary evidence for increased dopamine receptor expression in musicians (potentially indicating genetic predisposition to music).

Image source: Slater, J. L., & Tate, M. C. (2018). Timing deficits in ADHD: Insights from the neuroscience of musical rhythm.

Let's just take the first column – Cognitive function. Typically, with ADHD, there are deficits in attention, inhibitory control and working memory. The table indicates that musicians have enhanced attention, inhibitory control and working memory. Therefore, it could be interpreted that music learning would be a great intervention for ADHD. This may well be true, and music learning is already widely used as an intervention and therapeutic tool for children with ADHD. If you continue to look along the table, it is fascinating to see that not just one, but 13 different areas have been outlined by the researchers to be connected with ADHD.

While it is great to see the links between music learning and ADHD broken down so clearly, it must be remembered this is a perspective paper which is a well-researched and supported theory. Yet, as music educators, it would be interesting to think through what type of music learning activities support each one of these developmental areas. Here are some examples, I am sure you could come up with more.

Cognitive function enhances –

1. attention,
2. inhibitory control, and
3. working memory.

Group music learning requires both a heightened level of attention as well as the ability to adjust or shift attention rapidly to a new rhythm, a change in the music or a silence.

Inhibitory control can be developed in a group music learning activity, where students learn to wait, only play on their beats, to maintain a shared tempo or pulse and not go too fast or slow, and remaining attentive yet controlled when it is not their turn to play.

Working memory is the memory type that holds temporary information like instructions in class. Music learning activities have multiple instructions that then need to be executed in a sequence, such as verse 1 followed by the chorus, followed by verse 2 with only the high singers etc. If a student is learning an instrument, there are often multiple

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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.”

Puyjarinet, F., Bégel, V., Lopez, R., Dellacherie, D., & Dalla Bella, S. (2017). Children and adults with Attention-Deficit/Hyperactivity Disorder cannot move to the beat. *Scientific reports*, 7(1), 1-11.



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

Many of the examples I have used are 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

skills. The researchers state that “children and adults with ADHD struggled when moving to the beat of rhythmic sounds, and when detecting deviations from the beat.”

In music learning terms, these two issues are the bread and butter of almost all activities. The use of a consistent beat and then the variation of that beat is one of the most commonly used musical variations. This could occur in an early childhood music game where students walk to a consistent beat and then stop on a particular word, in a primary/elementary class activity where students play two pieces of music at different tempos on xylophones and percussion, in a string ensemble where students play a piece that begins at a slow tempo and then switches to a fast tempo after the introduction or in a concert band where a piece has multi-tempo sections which use accelerando and rubato as a technique to shift between sections. The maintaining and shifting of a beat is a common element of music-making and learning and exposure to such a tool for ADHD students could be extremely beneficial.

Read More

Slater, J. L., et al. (2018). Timing deficits in ADHD: Insights from the neuroscience of musical rhythm. *Frontiers in computational neuroscience*, 12, 51.

Puyjarinet, F., Bégel, V., Lopez, R., Dellacherie, D., & Dalla Bella, S. (2017). Children and adults with Attention-Deficit/Hyperactivity Disorder cannot move to the beat. *Scientific reports*, 7(1), 1-11.

Researcher to Follow

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Professional Reflection • Part 1

Personal Brain Buzz

In reference to the Slater & Tate table, which one or more of the columns did you feel matches your professional and personal experience of students and adults with ADHD and which ones, if any, were a surprise? Give at least one reason why for both.

Experiment Time

Using the Slater & Tate table, describe in no more than five sentences how music learning could improve and enhance the brain functions of children with ADHD.

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Professional Reflection • Part 2

Teaching Brain Buzz

Look at the Sensorimotor Timing column in the Slater & Tate table and give at least five examples of how you might enhance motor timing and inhibitory control with your students, both those with ADHD and those without.

Experiment Time

How many of these teaching techniques do you currently use, and what have you observed with your ADHD and non-ADHD students in terms of development and dysfunction?

Questioning Brain Buzz

After completing this professional reflection, write at least two questions you have about this topic.