Together in Time

Dr Kelly Jakubowski

Music Psychologist

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Durham University

MUSIC & SCIENCE LAB

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Durham University

Overview

- Musical rhythm: Introduction
- Rhythm and movement
- Rhythm and language
- Rhythm and social engagement

Introduction

Engaging with music can teach timing skills that are needed for cognitive, motor, and language development

Moving together through music also shows prosocial benefits in both children and adults

Musical Beat

Most Western music has a regular **beat** or pulse

Music varies greatly in terms of how easy it is to find the beat

Engaging with music over a range of **difficulty** levels in terms of beat-finding can help develop the ability to flexibly parse sound sequences into meaningful units (necessary for language development)

Musical Tempo

Musical tempo = speed of the beat

-Average pop song = 120 beats per minute (bpm)

-Adult preferred tempo = 100-120 bpm, children's (under age 10) preferred tempo = approx. 150-180 bpm

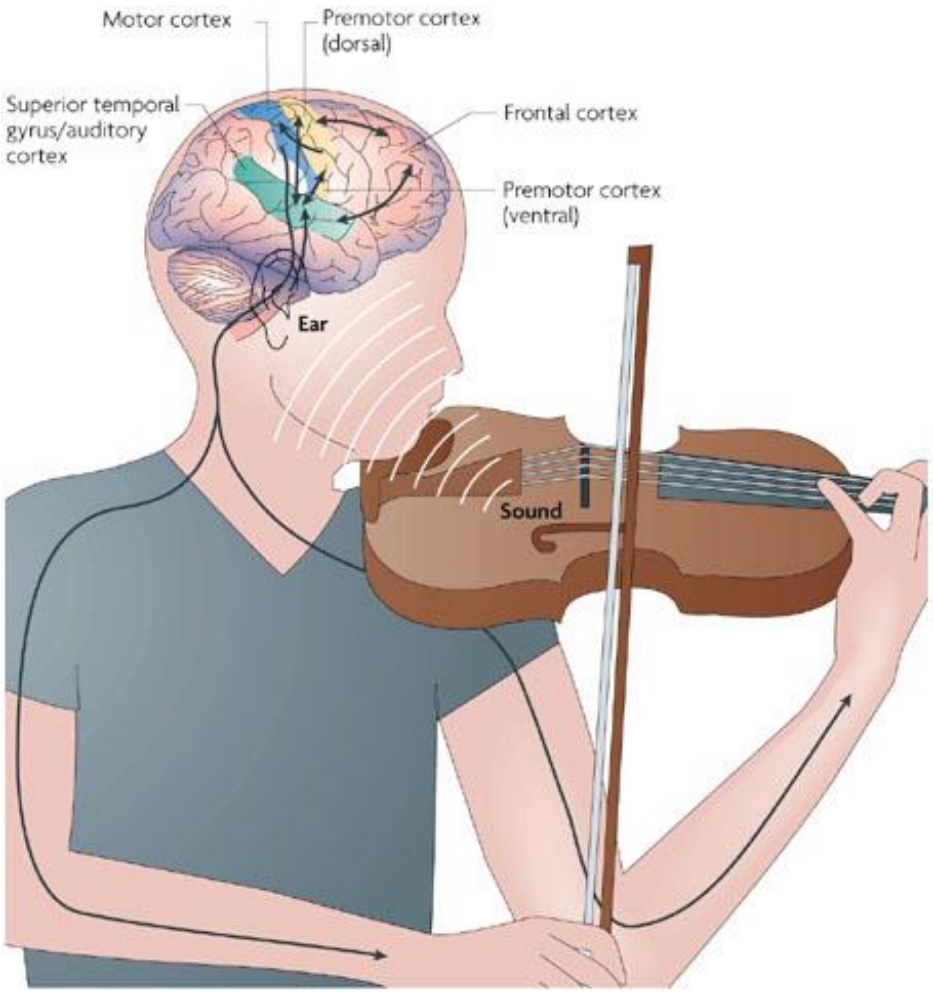
Actively engaging with music from **different** tempos and music that **changes** tempo can develop temporal flexibility and prediction abilities, which are also needed for motor and language development

Types of musical rhythm games

- Coordination/synchronisation
- Turn taking/imitation or call & response
- Beat finding
- Adaptive timing
- Self-paced timing

Rhythm and Movement

The auditory and motor systems in the brain are closely linked (Zatorre et al., 2007)



Nature Reviews | Neuroscience

Motor areas of the brain are activated even when *perceiving* rhythms (Grahn & Brett, 2007)

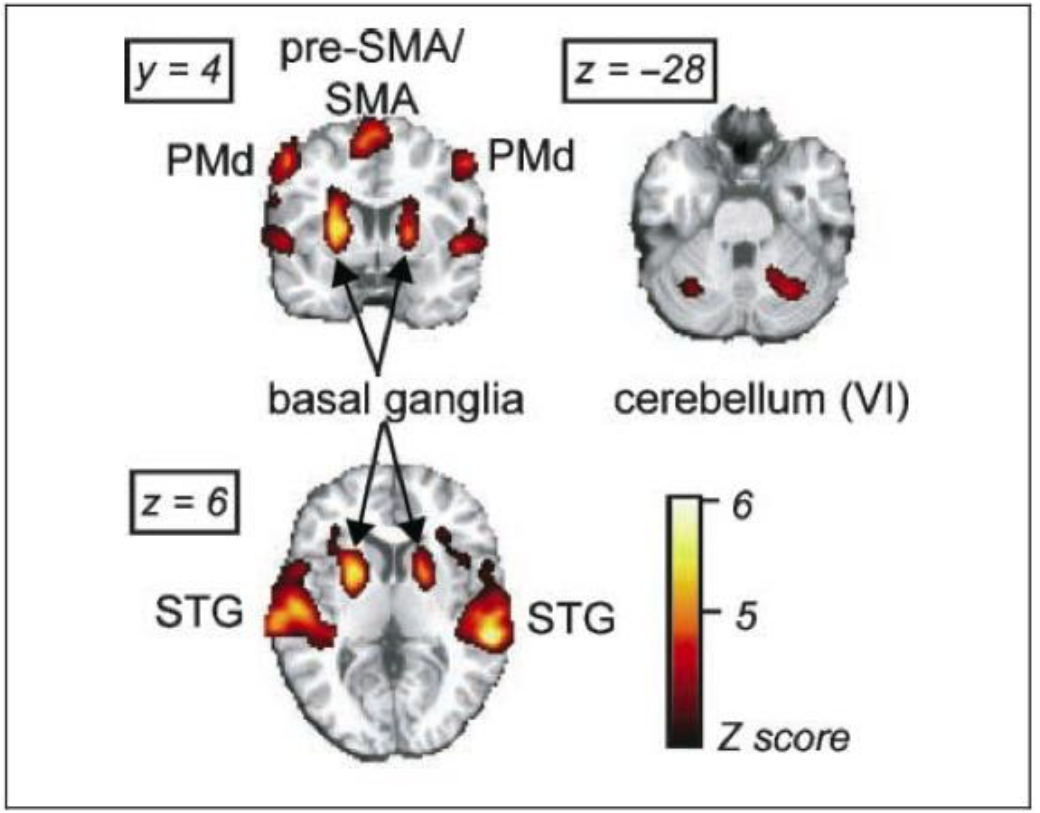


Figure 4. Brain activation during all rhythm conditions–rest. The cortical and cerebellar activations from this contrast defined functional ROIs for further analysis. *Z* score of 3.3 = $p < .01$, whole-brain corrected (FDR). PMd = dorsal premotor area; SMA = supplementary motor area; STG = superior temporal gyrus; VI = cerebellar crus VI. *x*, *y*, and *z* refer to axes in stereotaxic space.

Music and movement development

A study of 4-6 year-olds showed improvements in jumping and balance in children in a 2-month music & movement programme compared to a physical education programme (Zachopoulou et al., 2004)

Instrumental training may improve fine motor skills (Costa-Giomi, 2005)

Musical movement interventions

Engaging with music can aid people with motor difficulties

Music can serve as a **pacing signal to cue movement** due to its regular and predictable timing structure

Music is also an **emotionally motivating** stimulus

https://www.youtube.com/watch?v=fbDKHGg9upQ&t=39s

Rhythm and Language

Rhythm and language

Both music & language make use of pitch, timbre, and **timing** information

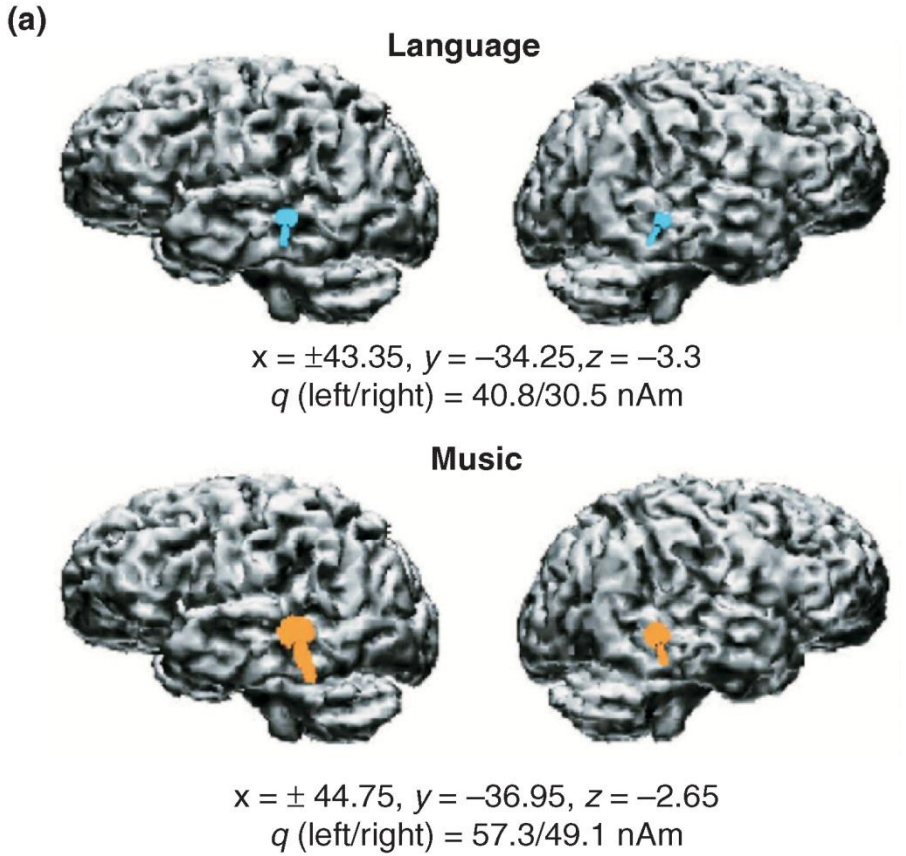
Require similar memory and attention skills

Rhythm and language

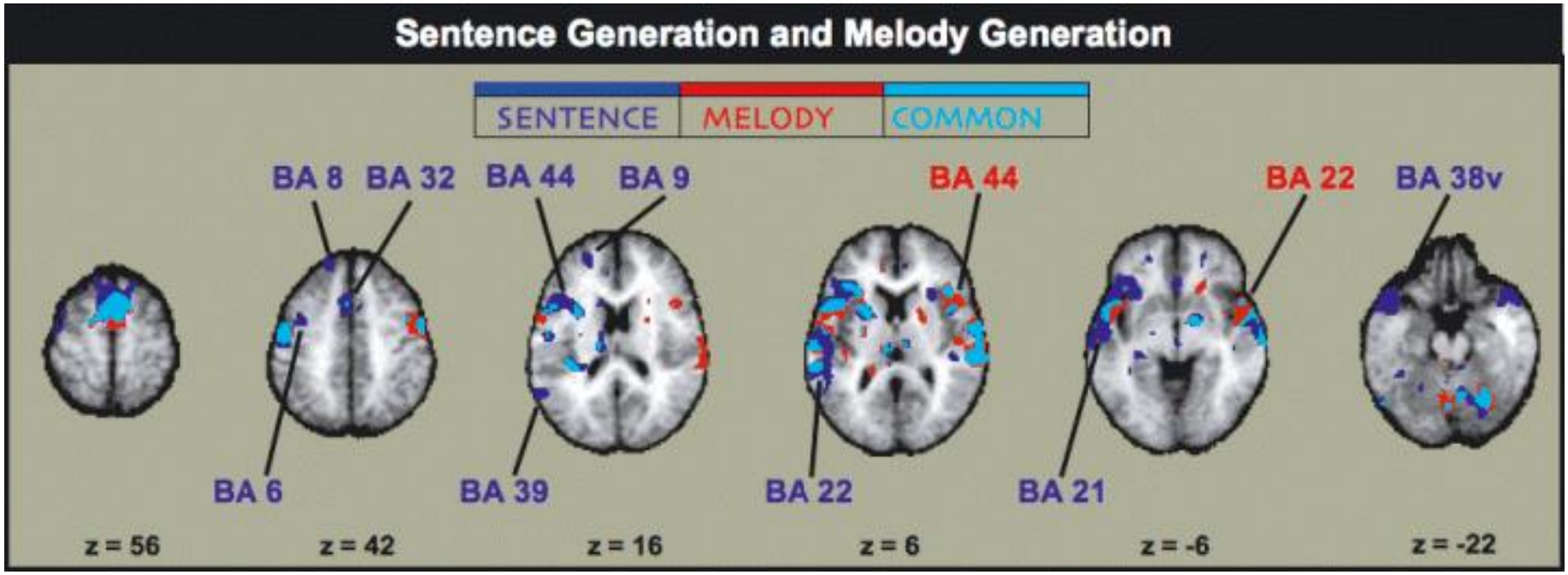
Musical notation uses many properties of written language. Music reading skills can facilitate word reading development due to its regular temporal structure.

Rhythm and language

Music and language share several processing resources within the brain



Koelsch, 2005



Brown et al., 2006

“Akin to physical exercise and its impact on body fitness, music is a resource that tones the brain for auditory fitness” –Kraus & Chandrasekaran (2010)

Musical rhythm & Dyslexia

Overy (2003), Dyslexia and Music:

“Rapid temporal processing” hypothesis

- Music may enhance the ability to parse and process words

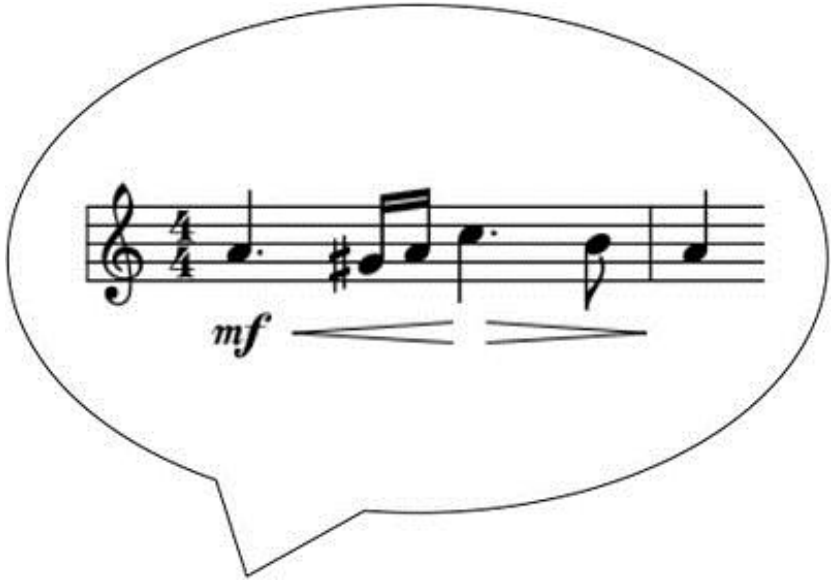
Singing and musical rhymes are a natural way of slowing down the speech signal and adding predictability to language

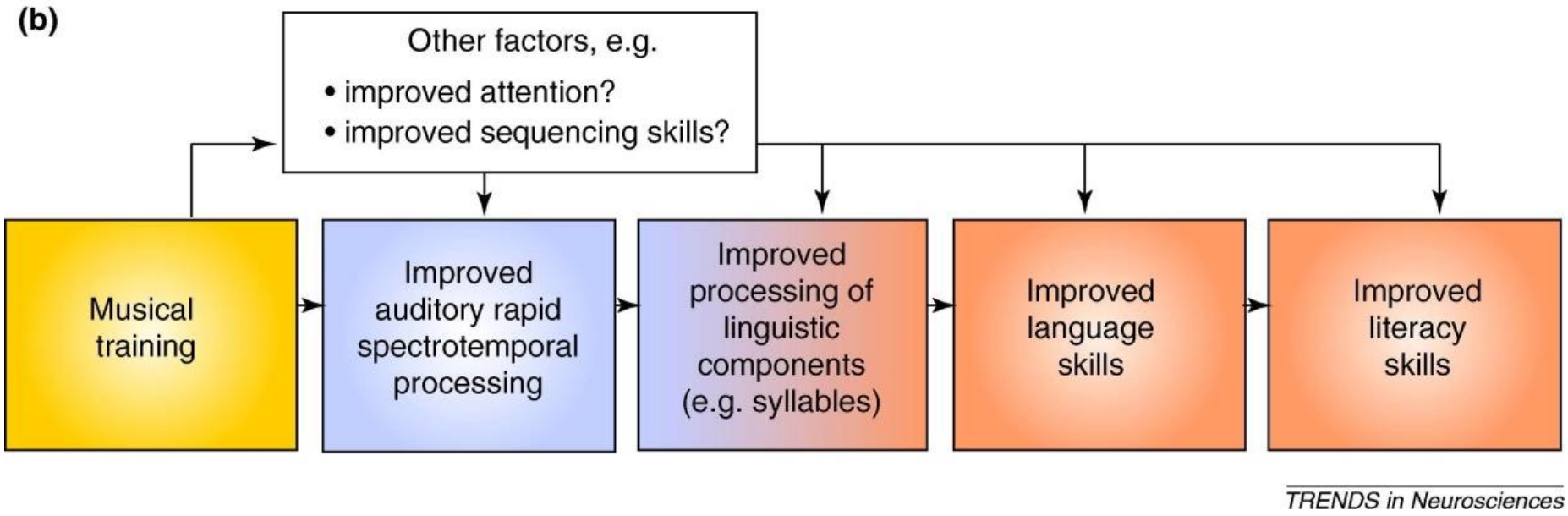
15 weeks of classroom music lessons (rhythm & singing games, 3*20 minute sessions) ages 7-11

Musical rhythm & Dyslexia

Children with dyslexia were impaired on tests of musical rhythm but not musical pitch abilities

Phonological & spelling skills significantly improved, but not single word reading





Tallal & Gaab, 2006

Music and dyslexia: RCT

First randomised control trial on the effects of music training for children with dyslexia (Flaugnacco et al., 2015)

Children ages 8-11, 7 months of musical rhythm-focused intervention (control group- painting class)

Only the music group showed improvement in phonological segmentation and reading accuracy

Rhythm and language

Musical rhythm interventions have been shown to have similar effects to computerised phonological training software (GraphoGame Rime) (Bhide et al., 2013)

Children with **specific language impairment** and some children with **autism** also show deficits in both language processing and musical timing skills

Rhythm and Social Engagement

Music and prosociality

Music increases prosocial attitudes in 4-year-old children (Kirschner & Tomasello, 2010)

One year of musical group interaction can increase empathic behaviour (ages 8-11) (Rabinowitch et al., 2013)

Rhythm and social effects

Moving in synchrony with another person increases affiliation ratings in adults (Hove & Risen, 2009)

Such prosocial effects extend to as young as 14 months of age (Cirelli et al., 2014)

https://www.youtube.com/watch?v=IaqWehfDm7c&t=5s

Why Music?

Cognitively and emotionally engaging

No adverse side effects

Lifelong engagement opportunities

Website: **musicscience.net/resources**

Email: kelly.jakubowski@durham.ac.uk

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