

# **The impact of music training on reading and mathematical abilities of normal and reading disabled children: A behavioral and neuroimaging longitudinal study**

## **ABSTRACT:**

### **Background**

Music training is a well-established model of brain plasticity. Most studies compare professional musicians with non-musicians or examine effects of individual instrumental training in childhood. Effects of collective music training conducted in regular schools remain poorly understood.

### **Aims**

To determine near and far transfer effects in behaviour and neural correlates of a relatively short collective Orff-based music training program in school-age children, as compared to an analogous program in sports and to a passive control group.

### **Method**

Longitudinal training study with pre-test (T1), training, post-test (T2) and follow-up (T3), in three groups of 8-year-old children: music, basketball and no specific training. Children were matched on major cognitive and demographic variables and pseudorandomly assigned to one of the groups. Behavioural measures on musical and other cognitive abilities, and on brain structural MRI and resting-state fMRI, were collected at T1, T2 and T3.

### **Results**

Learning effects were found for all groups. Specific behavioural benefits driven by music training were mostly near transfer effects in the music domain and fine motor abilities, but far transfer effects in simple arithmetics and phonological decoding were also found. Music training induced plasticity on gray-matter volume of the left cerebellum that related to rhythm discrimination at T1 and correlated with gains in motor performance; it also led to higher connectivity between the auditory and sensorimotor networks suggesting enhanced audio-motor coordination.

### **Conclusions**

A resource-lean music training program was sufficient to induce specific behavioural benefits associated in part with plastic changes in gray matter volume and functional neural connectivity.

### **Keywords**

Brain plasticity, Cognition, Children, Longitudinal, Music training, Sports training, MRI

### **Published Work:**

Correia, A. I., Branco, P., Martins, M., Reis, A. M., Martins, N., Castro, S. L., & Lima, C. F. (2019). Resting-state connectivity reveals a role for sensorimotor systems in vocal emotional processing in children. *NeuroImage*, *201*: 116052. doi: 10.1016/j.neuroimage.2019.116052

Martins, M., Silva, S., & Castro, S. L. (2019). Perceiving rhythmic repetition and change across development: Effects of concurrent pitch. *Empirical Studies of the Arts*. doi: 10.1177/0276237418822895

Martins, M., Neves, L., Rodrigues, P., Vasconcelos, O., & Castro, S. L. (2018). Orff-based music training enhances children's manual dexterity and bimanual coordination. *Frontiers in Psychology*, *9*, 2616. doi: 10.3389/fpsyg.2018.02616

Castro, S. L., & Martins, M. (2015). Rhythm perception in children: The roles of age, sex and prematurity. *Proceedings of the 17th European Conference on Developmental Psychology* (pp. 151-156). Bologna, Italy: Medimond Publishing Company.

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