

# Brain and Body Percussion: The relationship between motor and cognitive functions

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In: Jakubowski, K., Farrugia, N., Floridou, G.A., & Gagen, J. (Eds.)

Proceedings of the 7th International Conference of Students of Systematic Musicology (SysMus14)

London, UK, 18-20 September 2014, <http://www.musicmindbrain.com/#!systemus-2014/cfmp>

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Body Percussion is a motor, rhythmic learning method within music education used to teach rhythmic structures. This activity is also used in common classrooms to improve students' concentration and attention. Although the intervention is applied to enhance cognitive functions, effects of this method have not been studied neuroscientifically before. This study investigates embodied motor rhythmic exercises' (e.g. Body Percussions) ability to enhance cognitive functions (planning skills). As the method has been applied successfully in music education for decades, results of this study were hypothesized to be positive.

The long-term effects of Body Percussion on *planning skills* were studied with pre- and post-measures of an executive functions test (computed neuropsychological test Tower of London). The training period lasted 2.5 months and consisted of 10-20 minutes of weekly Body Percussion training sessions (altogether ten sessions). Twenty-four 5th graders (average age: 11 years) from a local elementary school participated in the study. After the Body Percussion training period the experiment group (N=12) performed better compared to the control group (N=12).

Keywords: music education, rhythm, brain, executive functions

Within the subject of music education in Finland there is a sub-subject called *Music and Motion*. Body Percussion is a part of a wide variety of different percussive rhythm exercises common for this sub-subject (Juntunen et al., 2010). In this research, and in a previous study with ASD<sup>1</sup>-populations (Ahokas, 2012), Body Percussion was selected as a method to observe the possible effects of rhythmical exercise on students' cognitive and motor abilities.

The way we are able to move, control and use our body correlates with our cognitive functions. Our motor and cognitive functions are intertwined (Haapala et al., 2013). Cognitive and motor functions share

parallel mechanisms in the central nervous system (Kujala et al., 2012).

In this study *learning abilities* are seen as abilities to execute certain cognitive functions needed in learning (Streen & Strauss, 1998). This experiment investigated the effect of Body Percussion on one executive function (*planning*) with a *planning* test (computed neuropsychological test Tower of London) that was executed before and after a 2.5-month period of Body Percussion training.

## The Body Percussion training

Body Percussion is only a marginal part of the wide variety of different percussive rhythm

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<sup>1</sup> Autism Spectrum Disorder

exercises that are common for Dalcroze<sup>2</sup> or Orff<sup>3</sup>-oriented educators (teaching the subject 'Music and Motion') in Finland (Juntunen et al., 2010). The method itself can be described as a rhythmic, motor, dance-like activity. Important parts of the function are attention and memory processes, as well as foot and arm coordination. Movements of various limbs of the body (slaps, taps, claps, stomps, finger snaps etc.) produce sounds with different amplitudes causing the shared *rhythm* (Fross, 2000).

As a teaching method Body Percussion can support other instrumental studies (to help practice difficult rhythmical structures), or Body Percussion compositions can be produced all the way up to the stage level (Kivelä-Taskinen, 2008).

In addition to the musical objectives, one of the aims of the training is also to create more fluid connections between the limbs of the body e.g. enhance motor abilities (Fross, 2000).

In this research Body Percussion was chosen as the training method because it can be done without any extra instruments; the method only needs the participant itself. It could fit into quite small laboratory surroundings, and it can easily be moved into any preferred surrounding available.

## Method

### Participants

Twenty-four 5<sup>th</sup> graders (all aged 11 or 12) from one class of a normal elementary school

<sup>2</sup> Dalcroze Eurythmics teaches concepts of rhythm, structure, and musical expression using movement. The application focuses on allowing the student to gain physical experience and awareness of music. Diverse training takes place through all of the senses, particularly kinesthetic.

<sup>3</sup> Orff Schulwerk combines movement, music, speech and drama into lessons that are similar to child's world of play. The approach is largely improvisational, songs contain ostinatos, are within singing range, and can be played in round, or ABA form.

participated in the study. The class was randomly divided into two groups (experiment and control group).

The class belonged to the University of Jyväskylä Teacher Training School. Parents of these school's pupils have agreed on certain research and teacher training practices to be undertaken during lessons, and therefore additional ethics permission for conducting such research was not required.

### Materials

In order to study the possible effect of Body Percussion training on *planning skills*, the Tower of London (TOL)- test was used, which is a neuropsychological, executive functions test. The experiment was provided by PEBL (Psychology Experiment Building Language, <http://pebl.sourceforge.net/>) TOL-test battery.

The chosen TOL-test consisted of 12 trials. Participants were asked to arrange piles of sheaves with minimum amount of moves to achieve the sequence of target stacks (see Figure 1.). The test was designed with progressive difficulty and move restrains. Participants were given no time restrains on solving the tasks.

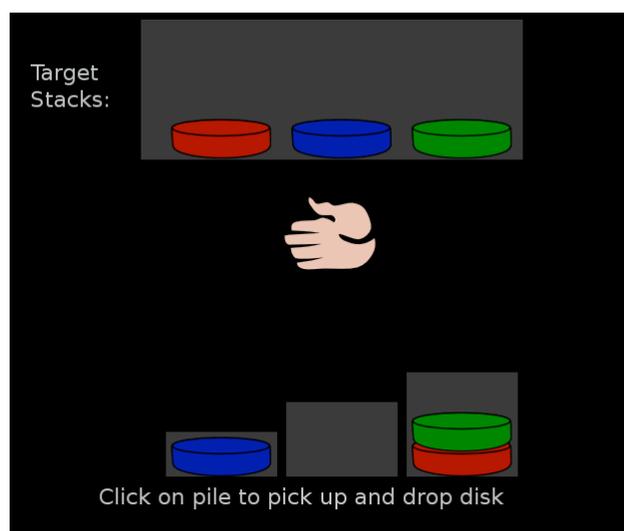


Figure 1. Example of the Tower of London test interface.

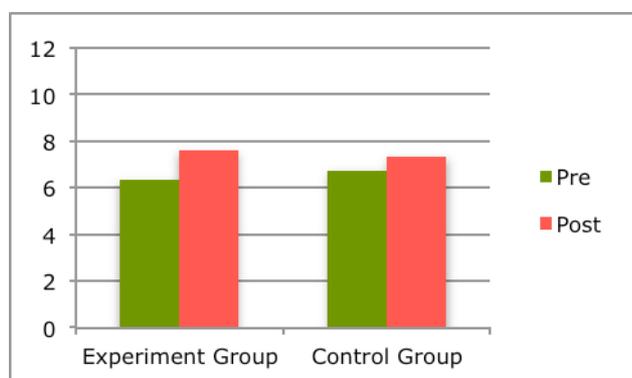
## Procedure

The study was carried out in Spring 2014. The training period lasted 2.5 months, and consisted of 10-20 minutes of weekly Body Percussion training sessions (ten sessions altogether). While the experiment group participated in a Body Percussion work- shop, the controls were participating in their normal music lessons, or recess. In the beginning of the period all the participants completed the chosen TOL-trial, and the same test was again executed with all the participants after the Body Percussion training period.

To maximize ecological validity, training and testing were executed within the school's premises, during recess, and partly during music lessons.

## Results

After the training period the experiment group performed better in the Tower of London-test (see Figure 2.).



**Figure 2.** Above the TOL-tests combined pre- and post-results. (Experiment group from pre  $M=6.33$  to post  $M=7.58$ ; control group from pre  $M=6.75$  to post  $M=7.33$ .)

## Discussion

In the light of the highly limited resources of this research the results were promising. This study supported other studies regarding the significance of motor abilities in learning processes (Haapala et al., 2013; Kujala et al.,

2012). And it also gave promising results for possible further studies with similar design.

In this study the slot given for the training on behalf of the school was not sufficient enough, which effected the motivation of students and the standard of the teaching. In further use of this setting the amount of high-quality training, performed by professionals, should reach a standard of 40 min on weekly basis. Preferably the training could be executed twice a week. In general, the co-operation with the school to ensure high ecological research validity requires big efforts, both from the institutions (school) and scientists' side.

The open source (free) PEBL-environment where the TOL-test was provided was proven to be easy and handy to use. In addition to the pre- and post- measures, further settings should include also a follow up with the designed test-battery.

This study design permitted the children to function normally during their school day. They did not have to move into any unfamiliar laboratory surroundings that might potentially affect the ecological validity of the research. The training was executed as part of their normal school day schedule, and in that way it was hoped not to cause any undesired, additional stress for the participants. It also gave preliminary data via observation about the functionality of Body Percussion sessions carried out as a part of the normal school day. The Body Percussion training was organized inside the students' own familiar classroom, and the computed TOL-test was executed in the same premises.

Taken the cognitive enhancement into account, the method, Body Percussion, and multiple other percussive rhythm exercises of music education share a beneficial common ground with *music therapy*. Neurologic Music Therapy (NMT) Cognition Training Techniques share similar goals with music education (Thaut, 2005). This research is aiming to reinforce the unrecognized and unexploited common ground between these two important professions, music education, and music therapy.

*The Author would like to thank Anu Penttinen from the Jyväskylä Universities Faculty of Sport and Health Sciences for her expertise on consulting with the teaching of Body Percussion. The Author would also like to thank Juho Strömmer from the Jyväskylä Universities Faculty of Social Sciences (Department of Psychology) for consulting with the neuropsychological tests.*

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