The exercising brain – integrated physical and cognitive training induces increases in functional connectivity.

Traute Demirakca¹, Vita Cardinale¹, Sven Dehn¹, Matthias Ruf¹, Gabriele Ende¹

¹Department of Neuroimaging, Central Institute of Mental Health, Medical Faculty Mannheim, Heidelberg University

**Background:** This study investigated the impact of “life kinetik” training on brain plasticity in terms of an increased functional connectivity during resting state functional magnetic resonance imaging (rs-fMRI). The training is an integrated multimodal training that combines motor and cognitive aspects and challenges the brain by introducing new and unfamiliar coordinative tasks with emphasis on the novelty. We searched for functional connectivity increases between brain regions expected to be involved in the exercises mainly in motor regions.

**Methods:** Twenty-one subjects completed at least 11 times one hour “life kinetik” trainings in 13 weeks as well as pre and post rs-fMRI scans. Additionally, 11 control subjects with 2 rs-fMRI scans were included. The CONN-toolbox was used to conduct several seed to voxel analyses (Whitfield-Gabrieli, 2012) and review the network parameter. The GIFT-toolbox was used perform an independent component analysis to identify brain regions with similar time-courses. 2x2 ANOVAs were used to test for increases in trainees and no decrease in controls. The significance level was set to p=0.05 FWE corrected on cluster level.

**Results:** Connections to brain regions representing parts of the default mode network, such as medial frontal cortex and posterior cingulate cortex, did not change. This result was comparable for the seed to voxel and the ICA analysis. With the seed to voxel analysis we found significant connectivity alterations between the visual cortex and parts of the superior parietal area (BA7). The premotor area and the cingulate gyrus were also affected. These changes could not be corroborated with the ICA analysis. Network parameter like Global efficiency or average path length showed no changes.

**Conclusions:** The changes in functional connectivity could only be detected by seed t voxel analysis. ICA components and network parameter showed no changes. The tasks include the handling of balls and other objects – throwing, catching, juggling or balancing. The parietal lobe or BA7 is important for visuo-motor coordination. Changes in connectivity between several parts of the parietal cortex reflect functional differentiation of this area. We can conclude that the constant challenge of unfamiliar combinations of coordination tasks, combined with visual perception and working memory demands seems to induce brain plasticity expressed in enhanced connectivity strength of brain regions due to coactivation. Changes seem be more obvious in seed to voxel analysis.

Disclosure: Parts of these results are published in Demirakca et al.2016, Neural Plasticity