

# Effects of exercise on human cognitive functions, motor learning and memory

Background and objectives:

During the recent years, there has been an increasing focus on exercise, neuroplasticity and on the processes underlying memory formation and learning, and several studies documented positive interactions between exercise, memory and learning. Here, I will present a number of experiments, which have been conducted in able-bodied human subjects to explore:

- Effects of acute aerobic exercise on specific aspects of cognition
- The role of timing and intensity of aerobic exercise in relation to motor skill acquisition and motor memory consolidation
- Effects of exercise on biomarkers, neurophysiological parameters and potential relation to behavioral effects.

Key findings:

- Moderate intensity acute aerobic exercise can benefit executive functions post exercise.
- Intense acute aerobic exercise can promote motor memory consolidation when it is performed before but in particular after motor practice.
- Changes in peripheral concentrations of specific biomarkers with exercise correlated with offline changes in motor performance.
- When acute exercise is performed following motor practice, the effects on motor memory are both timing- and intensity-dependent. Exercise performed in close temporal proximity to motor practice and at higher intensity leads to better motor performance in delayed retention tests 24 hours and 7 days later.
- Preliminary evidence suggests that timing of exercise may also be important in longitudinal studies and for other types of learning.

Implications:

- Moderate intensity exercise prior to learning can have positive after-effects on e.g. executive functions. Consolidation of motor learning benefits from high intensity aerobic exercise before, but in particular following motor practice.
- We argue that strategically scheduled exercise performed in close temporal proximity to motor practice sessions may promote the effects of exercise on learning and memory in part through an effect on consolidation.
- The findings obtained in basic research are promising, but further studies in clinical populations are required before strategically combined rehabilitation training and aerobic exercise paradigms may be employed clinically.

Dr. Cameron Mang will continue the symposium and present a series of experiments exploring specific effects of acute aerobic exercise on motor learning, motor cortical circuits and (epi)genetic contributions to interindividual response variations.