Effect of Methylphenidate on Motor Skill Learning and Consolidation

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Problem: Methylphenidate (MPH) is one of the most commonly prescribed drugs to treat attention-deficit and hyperactivity disorder (ADHD), but the effect of methylphenidate, especially at low, cognitive-enhancing doses, on motor learning has not been explored in depth. Existing literature shows numerous experiments using high doses of methylphenidate that greatly exceed human therapeutic doses. This study addresses a gap in existing literature surrounding methylphenidate’s effect on motor learning and memory; if methylphenidate enhances motor skill acquisition it could be useful in therapeutic settings where motor skills are being trained or rehabilitated. This experiment seeks to explore whether methylphenidate enhances motor learning as measured by Rotarod acquisition and retention.

Methodology: C57BL/6J x 129S1/SvImJ (129B6) hybrid mice were randomly assigned to drug (n=10) and control (n=9) groups. Both sexes were represented in both groups. Mice were given 1 mg/kg methylphenidate HCl, i.p., or an equivalent injection of saline vehicle (10 ml/kg). This dose was chosen from our lab’s previous work finding this dose enhanced fear conditioning and water maze retention (Carmack et al., 2014,a, b). 15 min later, mice were placed on a 5-slot accelerating Rotarod (3 to 30 rpm across 5 min). Three training trials were completed within 90 min of injection, and the subjects’ Rotarod positions were counterbalanced to control for any unknown differences in slot environment. One week later, two retention tests, one with drug and one without, were held on separate days to examine any differences in motor learning and retention of mice trained with and without methylphenidate.

Major Findings: Mice given methylphenidate during training showed improved motor memory at 7 days retention compared to the saline control mice. Although only minor improvements were exhibited during training, when tested one week later mice given methylphenidate during training showed substantial enhanced retention regardless of whether they were tested on or off drug. This suggests that methylphenidate given during motor skill acquisition may enhance consolidation of motor memory.

Figure 1: Average speed is shown for each of 3 training trials (on drug) and 2 one week retention tests. Mice given 1 mg/kg methylphenidate showed improved motor skill retention one week after training, regardless of whether or not they were tested on or off drug.