A Comparison of Motor Outcomes between *In Vitro* and *In Vivo* Rat Locomotion

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For over half a century, we have known that the neural circuitry responsible for locomotion is entirely contained within the spinal cord. Recent advances have allowed detailed study of the central pattern generator in isolated rodent maintained *in vitro*, in which locomotor activity is induced by neuromodulators and monitored electroneurographically at the motor roots. However, functionally relevant muscle activation and kinematic patterns of such *in vitro* behavior remain unknown. Work in the intact animal has also contributed greatly to the field of motor control, elucidating possible control strategies through behavioral observation. Most behavioral studies, however, treat the underlying neural network as the proverbial "black box", providing little insight into the neural correlates of the observed motor behavior.

To fully utilize the isolated cord as a tool to study locomotor mechanisms, we must better understand the functional and behavioral outcomes of the locomotor-like activity observed *in vitro*. As a first step towards this goal, we compared the muscle activation patterns and kinematics in the ventral-up isolated neonatal rat (*Rattus norvegicus*) cord with attached hindlimbs (*in vitro* air-stepping) to those observed in normal adult rat locomotion (*in vivo* locomotion). In the *in vitro* preparation, locomotion was induced by bath application of N-methyl D-aspartate (~5µM) and serotonin (~35µM). The *in vitro* air-stepping patterns had substantial similarities to those observed in *in vivo* locomotion, but also exhibited some substantial differences during the extension phase. The differences likely result from the reversal of gravitational forces and lack of sensory feedback during stance.