Babies Flying Drones: Examination of infant-robot interactions in a novel mobile kicking contingency paradigm

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Overview: In this pilot study, we build on prior work on the mobile paradigm to develop and assess the feasibility of a robot-assisted learning environment to promote, via contingent reinforcement, limb movement in infants with or at risk for motor delays. The mobile in our work takes the form of a small aerial robot allowing for motion in different directions, amplitudes, and velocities; thus, providing opportunities for examining the potential ability of infants to alter their movements to match various motion patterns by the robot. If the latter is true, we can use this information to develop interventions where the robot, in turn, may perform these complex motion patterns to 'induce' selective motor patterns in infants with or at risk for motor delays and across different developmental stages.

<u>Abstract</u>: Inability to move early in life can have an impact on infants' later development and understanding of the connection between their actions and the physical world. Providing infants with opportunities to experience movement early on has been a major focus of early intervention research, with the mobile contingency paradigm being one of the most well-known research tools for studying associative motor learning in infancy. Previous research has shown that infants can learn to alter the frequency, amplitude, and coordination of their kicking movements to meet task demands through the use of an overhead mobile toy linked to their kicks. In most of these studies, however, infants' actions elicited a single motion response type from the mobile (e.g., rotation of toy). Our proposed environment utilizes adaptive and dynamic technology, through the form of an aerial robot, to provide various specialized reward options (e.g., by varying the direction, amplitude, and velocity) to encourage self-generated movement variability and multi-modal exploration in infants. This paradigm design will allow us to examine the potential ability of infants to select movement patterns to match various motion patterns by the aerial robot.

This pilot study will assess the feasibility of our robot-assisted learning environment with a cohort of typically developing infants and will provide information on infants': i) engagement with the aerial robot by measuring changes in their visual attention and arousal across different conditions (baseline, acquisition, extinction), and ii) ability to learn the association between their own motor actions and the aerial robot's motion. If feasible, information from this pilot study may be used to develop early interventions in which an aerial robot may be programmed to perform complex motion patterns to provide selective motor training in infants with or at risk for motor delays and across different stages of their development.