Abstract Preview

Abstract title: **EFFECTIVENESS OF REWARD-AND ERROR-BASED MOVEMENT LEARNING IN ENHANCING SELF-INITIATED PRONE LOCOMOTION IN INFANTS WITH OR AT RISK FOR CEREBRAL PALSY**

Author(s): Kolobe H.A.[1], Fagg A.[2], Pidcoe P.[3], Williams P.[4]

Affiliation(s): [1]University of Oklahoma Health Sciences Center, Rehabilitation Sciences, Oklahoma City, United States of America, [2]University of Oklahoma, Computer Science, Norman, United States of America, [3]Virginia Commonwealth University, Physical Therapy, Richmond, United States of America, [4]University of Oklahoma Health Sciences Center, Pediatrics, Oklahoma City, United States of America

Background: Prone locomotion, a core of early infant learning, is extremely compromised in infants with Cerebral Palsy (CP). Despite research supporting its centrality to diverse psychological processes that have lasting effects on learning, no tested interventions exist to promote this skill. Equally lacking are successful movement learning approaches that take advantage of current technological innovations and learning theories. The self-initiated prone progression crawler (SIPPC), a robotic system recently developed to simultaneously augment and measure infants' self-produced movement effort during prone locomotion, provides a unique opportunity to study movement learning.

Purpose: This study examined the effects of robotic reinforcement movement learning in promoting self-initiated prone locomotion. We hypothesized that infants at risk for CP who are exposed to a combination of reward- and error-based training experience, supported by the SIPPC and a kinematic suit (SIPPC-E), will show goal directed prone locomotion on the SIPPC and do so earlier than a comparison group that is exposed to reward-based training using the SIPPC alone (SIPPC-C).

Methods: We used a repeated measures experimental design with 31 infants, 4.5–6.5 month old. Infants at risk for CP were randomly assigned to the experimental (SIPPC-E) or control group (SIPPC-C). Infants at low risk for CP comprised the reference group (SIPPC-T). Training in prone locomotion using the SIPPC robotic system occurred twice a week for 12 weeks in the infants' homes. All training sessions were videotaped for coding behavioral changes. The SIPPC system gathered robot and infant limb movement performance data. To test the hypothesis we compared changes in the weekly distance travelled, range and frequency of arm and leg movements, and frequency of goal directed movements within and between the groups using descriptive statistics and a randomized three-way ANOVA with repeated measures.

Results: Distance travelled increased for all groups over the 12 week period with the largest mean increase in the SIPPC-T group ($p=.00001$) followed by the SIPPC-E group ($p=.024$). The mean change for infants in the SIPPC-C was not statistically significant ($p=0.2$). Similarly, the SIPPC-T and SIPPC-E groups displayed goal-directed prone mobility between 4-6 weeks and 7 – 9 weeks, respectively, but not those in the SIPPC-C group. The range and frequency of the arm movements increased significantly in the SIPPC-T group ($p=0.007$), but not the other 2 groups ($p=0.15$). The ability to reach for toys by 7 – 9 weeks was correlated with increased distance travelled.

Conclusion(s): The findings suggest that reward-based movement learning alone may be insufficient to change movement learning in infants at high risk for CP, but that adding error-based components to reinforcement learning may. The results also suggest that the ability to reach may be a key limiting factor in acquisition of self-initiated prone locomotion. Future studies will explore this, and the contributions of cognition, brain changes, and dosing parameters.

Implications: Understanding movement learning in infants with CP is paramount in designing appropriate interventions. Our findings do not only support the use of task-specific and self-produced movement training, but also highlight the importance of blending error- with reward-based learning when targeting motor skill learning with these infants.

Key-Words: Cerebral palsy; Robotics; Movement learning

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