Assessing the effect of age on the sensorimotor adaptation during object manipulation

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ABSTRACT

Have you ever been a victim of a sibling passing you an empty milk box while pretending it was full? When you lifted the milk box, your arms moved upwards rapidly. This trick reveals that when we interact with objects, we predict the forces required to grasp and lift the object. Before grasping an object, the brain adjusts the grip and the load forces to object shapes, weights, and frictional properties. These changes in grip and load forces usually occur before lifting the object. Although it may occasionally result in significant movement errors, predictive control is essential for skilled object manipulation. The other control strategy, reactive control, involves sensory feedback. This strategy becomes crucial when predictions are erroneous, or feedback is unavailable. To learn and maintain predictive control, the brain must learn to predict the sensory consequences of motor commands. Such learning develops during childhood. Children learn to adjust their grip and load forces to the object’s properties by processing visual and haptic sensory information. The quality of the transmission and processing of fingertip haptic information might be associated with the ability to scale fingertip forces. This study assessed the age effect on sensorimotor adaptation between children, adolescents, and adults during object manipulation. We studied the transmission of haptic sensory information through the somatosensory cortices by measuring sensory evoked potentials (SEPs). We hypothesized that adolescents and adults would show symmetrical SEPs. This symmetry will be associated with effective predictive control and transfer of sensorimotor adaptation between hands. We measured the brain’s electrocortical activities to verify this hypothesis (electroencephalography, 64 electrodes). To evoke tactile afferent, we applied vibrotactile stimulation (frequency 200 Hz) to both thumbs simultaneously and in succession. Then, to study predictive control and sensorimotor adaptation, we measure the changes in grip and lifting forces when lifting objects of different weights (200 and 500g) with the right and left hands. So far, we have tested 19 adolescents and 11 adults. Preliminary results revealed that participants learned to adjust their grasping and lifting forces within five trials. Further, participants transferred sensorimotor adaptation from one hand to the other. Following the recruitment of adults, we will be able to compare SEPs between and evaluate their association with the learning of predictive control and sensorimotor adaptation. This work is partly funded by the research chair in cerebral palsy at Université Laval and NSERC.