Sensorimotor adaptation to an environment with non-standard physics

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Abstract text

It is known that humans are able to predict the outcome of a physical scene and it has been suggested that this is due an internal model, which approximates the principles of Newtonian mechanics. Such internal physics representations might be already learned during childhood. With humans being exposed to non-standard physical environments (low gravity, deep sea diving), questions arise if and how fast we can adapt to these novel laws for physics. Is this new environment learned as a scene-specific task or do humans modify their internal physical model?

To answer these questions, a virtual environment was developed where participants performed two ball tasks - bouncing and aiming – in an artificial gravity field. Two groups of participants trained the bouncing task, one group under normal gravity and the other under artificial space-variant gravity. The two groups were then tested with the second (ball aiming) task, both under artificial gravity. Performance in both tasks was rewarded with scores. We hypothesized that training of one task under artificial gravity will yield better performance in a novel task under the same artificial gravity.

Both subject groups performed well in the ball bouncing task and showed comparable learning rate, suggesting that the participants were able to learn the task in both gravity environments. Contrary to our hypothesis, there was no significant difference in performance of each group during the aiming task. Hence, the hypothetical internal model was not updated due to our artificial gravity manipulation. Rather, results are consistent with a scene-specific adaptation.