Sensorimotor Learning in Environments with Unnatural Physics

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It has been hypothesized that human cognition might rely on an internal representation of physics that guides our predictions in motor behavior. Such internal physics representations might be already learned during childhood. Following this hypothesis, the questions arise if and how fast we are able to learn novel laws for physics, and more importantly whether such newly learned laws of physics can be transferred to arbitrary novel tasks.

To answer these questions, we have designed an experiment in a virtual environment where we manipulated gravity in a position-dependent manner for two different tasks: juggling and pole balancing. Two groups of participants received training with the juggling task, either with normal or the modified gravity field. Then both groups were tested with a new task (pole balancing) in the space-variant gravity field. Performance in both tasks was rewarded with scores. We tested whether the training with the unnatural gravity field improved learning of this test task.

Both subject groups learned the virtual reality task well in the normal gravity field. Participants trained with the space-variant gravity field showed the same learning rate for the juggling task during training as the group that was trained with normal gravity. This result suggests that the participants were able to learn the task easily in an environment with unnatural physical law. The pole balancing task so far did not reveal any evident differences between the two differently trained groups. However, since participants developed various individual strategies in the tasks, the group sizes still need to be increased significantly for valid statistical comparisons.