Investigating de novo learning online:
Learning of a mirror reversal task is fast and generalizes across the workspace and hands

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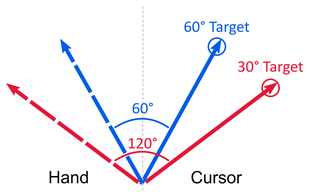
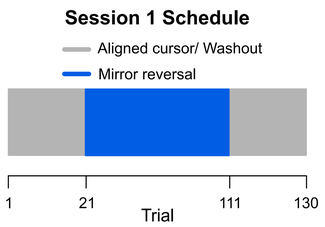
De novo learning and the mirror reversal task

People may commit movement errors as circumstances in an environment change. When acquiring a new motor skill (de novo learning), we process these errors and learn to produce the correct movement. Previous studies on de novo learning have used a mirror reversal task to distinguish it from motor adaptation. Here, we developed an online version of the mirror reversal task to further investigate its mechanisms.

Session 1: Instructions and de novo learning

Participants reached to targets using their computer mouse or trackpad. During mirror reversed trials, the cursor feedback was flipped in the opposite direction of the hand position, relative to a mirror axis.

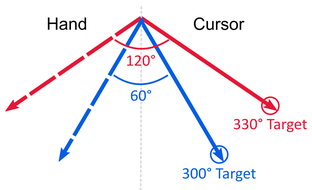


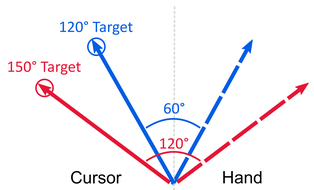


Before mirror reversal training, participants either received written instructions about the nature of the perturbation (N = 105), or not (N = 645). There were two targets, presented at the upper-right quadrant of the workspace relative to a starting position at the centre.

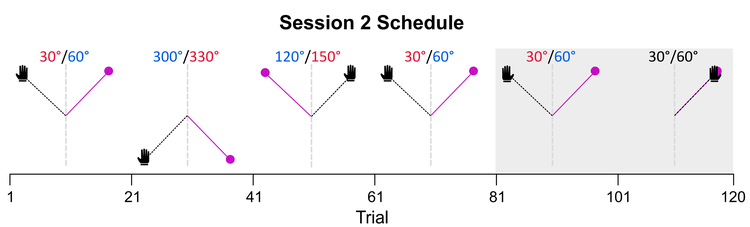
Session 2: Generalization across the workspace and hands

Non-instructed participants returned for a second session (N = 434; days apart: M = 16.22, SD = 16.41). We tested for retention by having participants reach to the same target locations as in session 1.



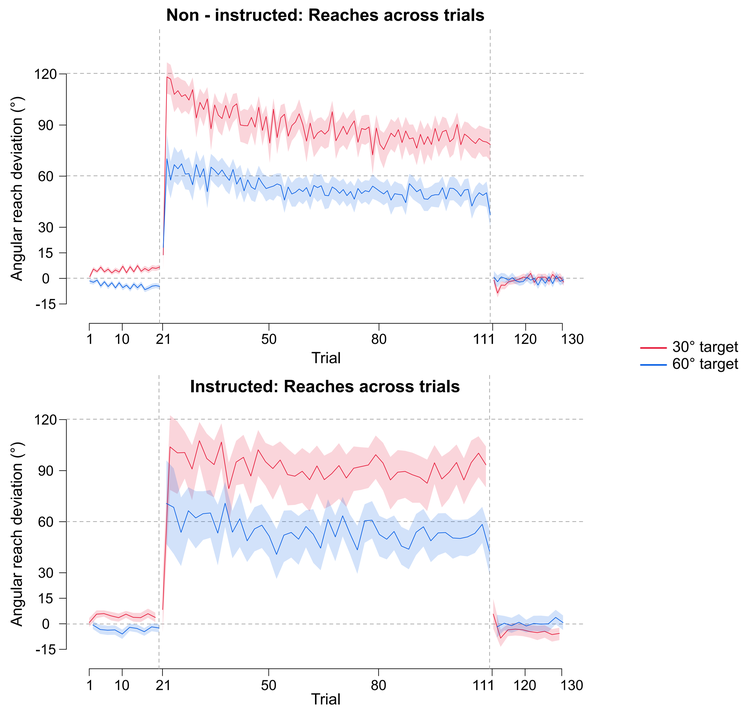


To test for generalization across the workspace, we presented targets located at the lower-right and upper-left quadrants of the workspace. For generalization across hands, we instructed participants to reach to targets in the upper-right quadrant using their untrained hand.

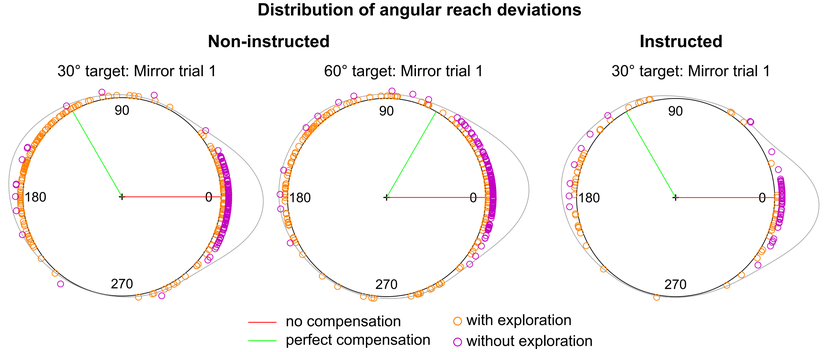


Learning progresses quickly, but does not benefit from instructions

In **session 1**, participants in both groups compensated quickly, but asymptotic learning was dependent on target location. Instructions about the nature of the mirror reversal did not provide an advantage for reach deviations during early learning. No reach aftereffects were observed.

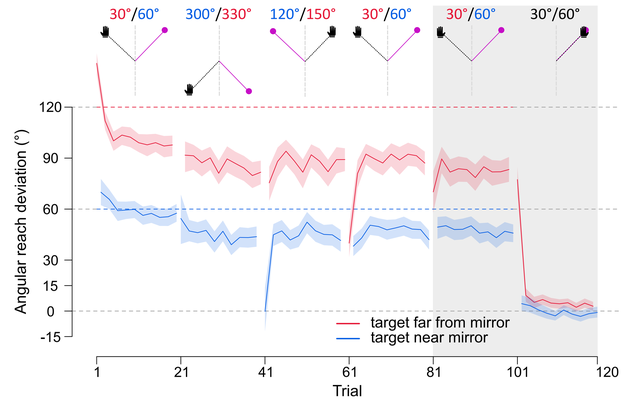


Exploration of the workspace led some participants to reach immediately towards the correct direction.

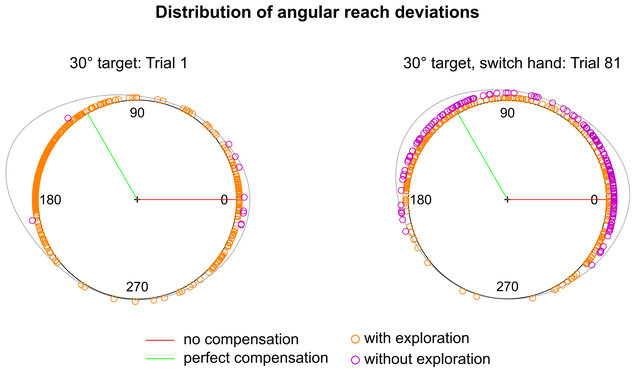


There is retention and generalization of mirror reversal learning

Non-instructed participants returned for **session 2** after a mean of 16 days. They immediately reached towards the correct direction, suggesting retention of learning from the first session.



Learning is maintained for the different target locations and when switching to the untrained hand. However, it is unclear whether generalization is confounded by fast learning. No reach aftereffects were observed after training with the other hand.



Workspace exploration was mostly observed in trial 1 and the first trial after switching hands.

In an online paradigm, the development of de novo learning can occur quickly, is retained across multiple days, and generalizes across the workspace and to the untrained hand.

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