The effect of instructions on *de novo* learning and the mechanisms that distinguish it from motor adaptation

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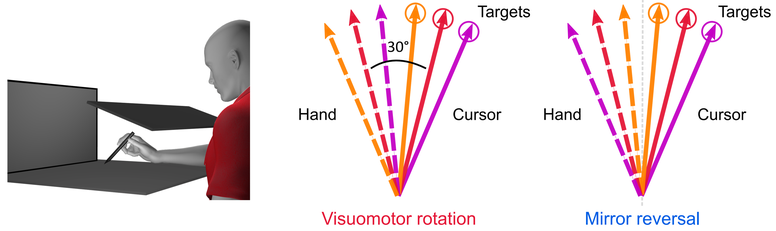
Two types of motor learning

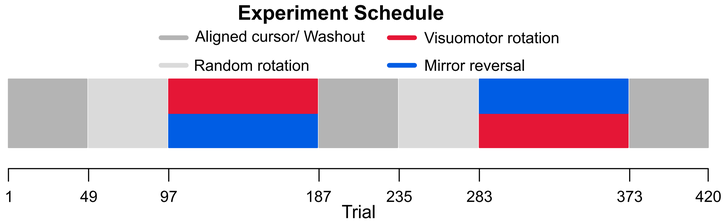
People account for movement errors as conditions within their environment change. This error-processing occurs in both *de novo* learning, which involves the establishment of a new response mapping in the brain as we learn a new motor skill, and in motor adaptation, where an existing response mapping is modified to bring performance back to an ideal level. Here, we conducted two experiments that investigated these two types of motor learning.

Experiment 1: Motor adaptation versus *de novo* learning

Participants (N = 16) reach to targets, while training with two perturbations.
Visuomotor rotation (motor adaptation): the cursor is rotated 30° relative to the hand position.
Mirror reversal (*de novo* learning): the cursor feedback is flipped in the opposite direction of the hand position, relative to a mirror axis.

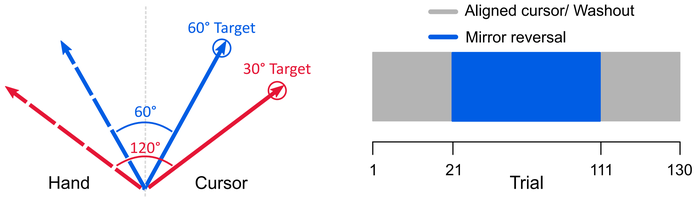


Movements required to reach the target were matched for both perturbations. Participants compensated for a fixed rotation magnitude, but compensated by 15°, 30°, or 45° in the mirror task, depending on the target location in relation to the mirror axis.



No effects were observed after counterbalancing for perturbation order, location of the perturbation in the workspace (vertical or horizontal axis), and the target locations relative to this directional axis.

Experiment 2: Instructions and *de novo* learning



Participants completed an online version of the mirror reversal paradigm, and reached to targets using their computer mouse or trackpad. They were either instructed about the nature of the perturbation (N = 109), or not (N = 106). Only two targets were used in the experiment.

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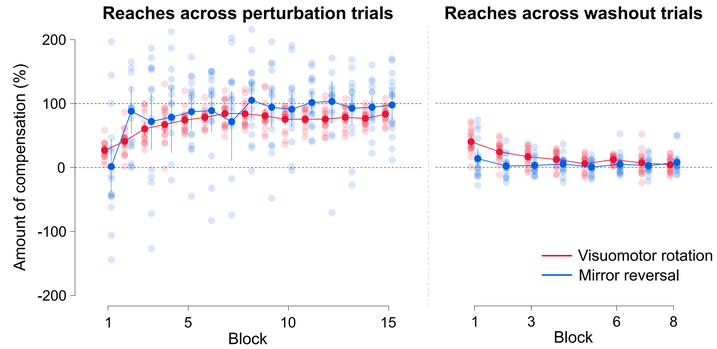
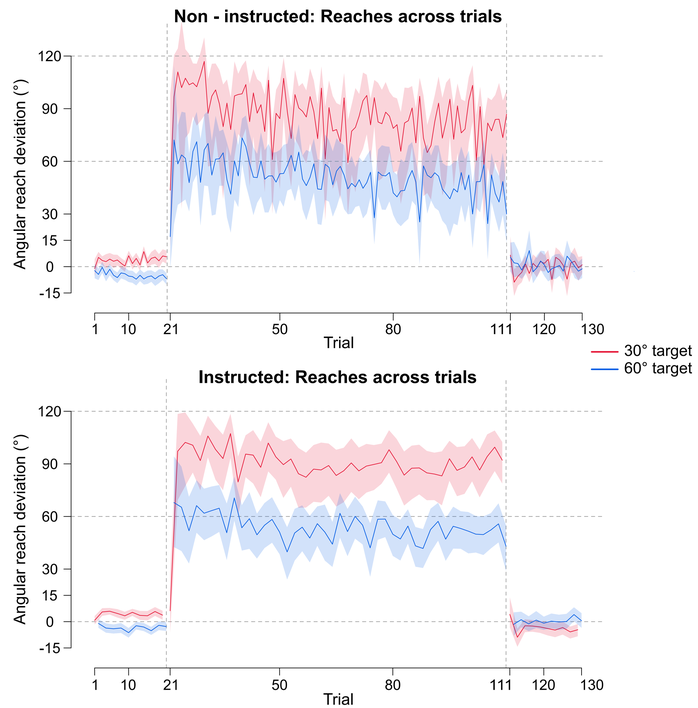
Reach aftereffects emerge only after visuomotor rotation training

In **experiment 1**, participants countered for both perturbations within only 90 trials. Learning for the rotation developed gradually, while variability in learning was greater for the mirror reversal.



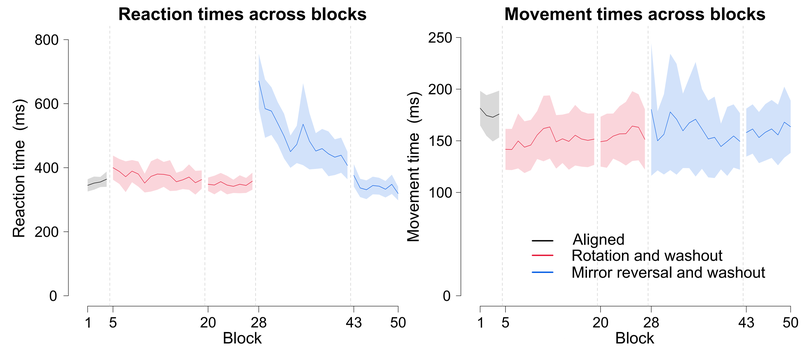
Instructions do not provide an advantage in learning

In **experiment 2**, instructions about the nature of the mirror reversal did not provide an advantage for reach deviations during early learning. No reach aftereffects were observed.



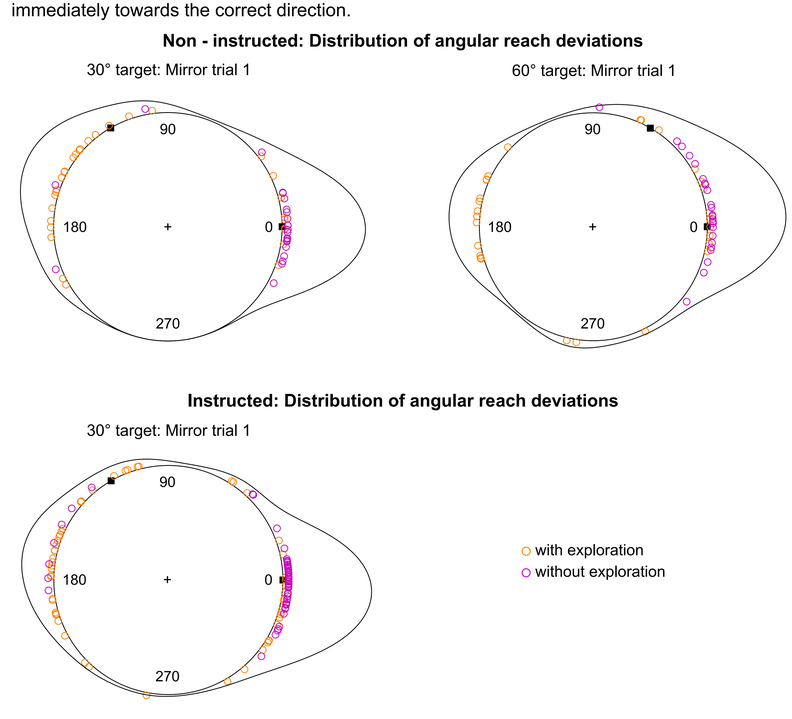
Mirror reversal training slows down movement initiation and execution

Reaction (RTs) and movement times (MTs) were slower for the mirror reversal compared to the rotation. RTs eventually return to baseline levels for the rotation, but not for the mirror reversal.



Workplace exploration is linked to reaches in the correct direction

Participants learned to compensate quickly for both target locations, but reaches were already deviated in the first trial. Exploration of the workspace led some participants to reach immediately towards the correct direction.



Behavioral mechanisms underlying *de novo* learning are distinct from adaptation. Online paradigms may be used to further investigate motor learning.