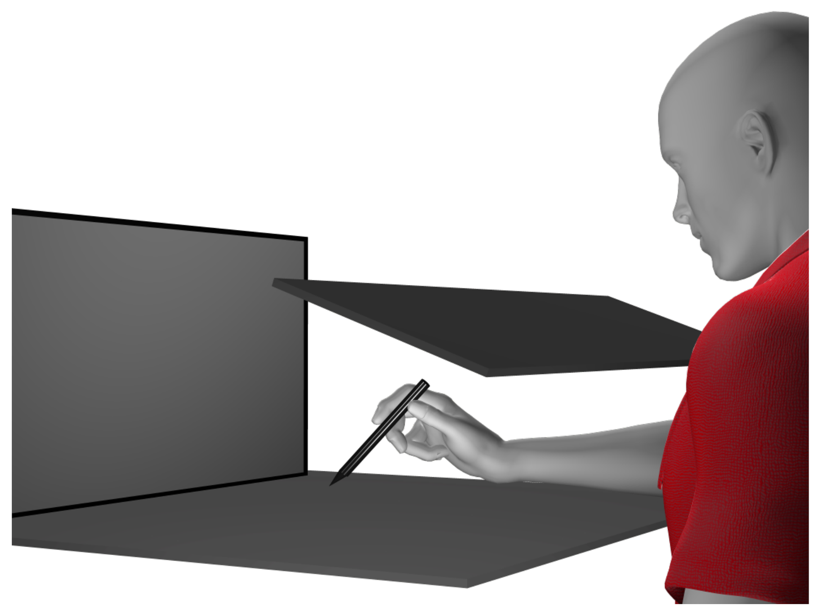
Skill acquisition and adaptation are both quick but rely on distinct mechanisms

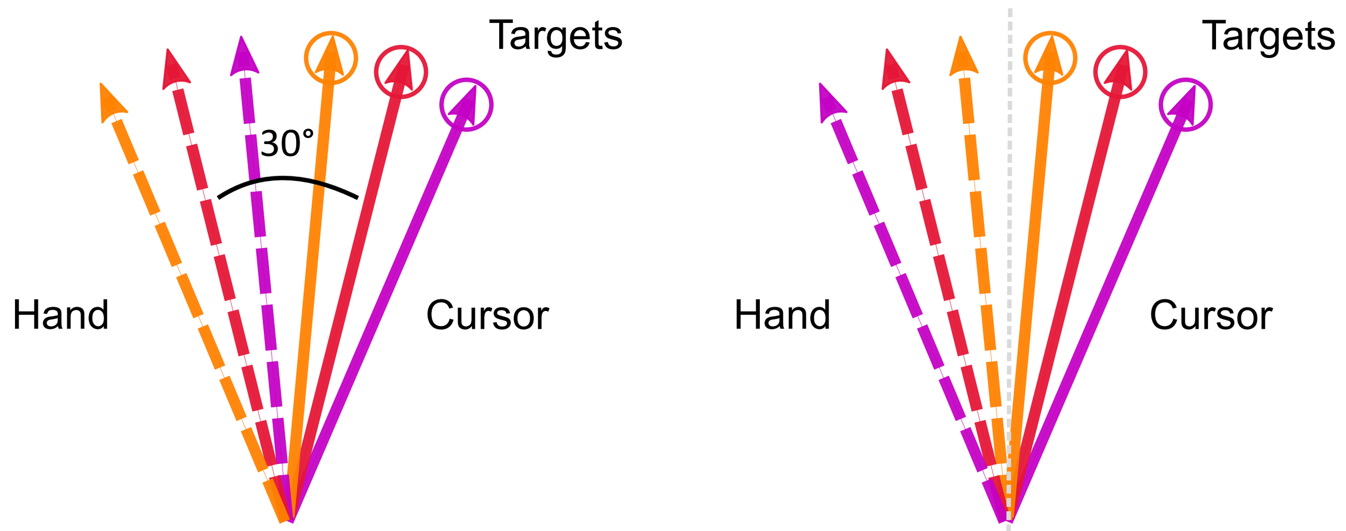
Raphael Q. Gastrock, Bernard Marius 't Hart, & Denise Y. P. Henriques
Centre for Vision Research, York University, Toronto, ON, Canada

Motor adaptation versus *de novo* learning

People take into account the errors they encounter to correct for ensuing movements. This error-processing occurs in two types of motor learning: *de novo* learning and motor adaptation. *De novo* learning involves the establishment of a new response mapping in the brain as we learn a new motor skill, while adaptation modifies an existing response mapping to bring performance back to an ideal level. Here, we distinguish between the two by having each participant (N = 16) reach to targets, while training with two perturbations.



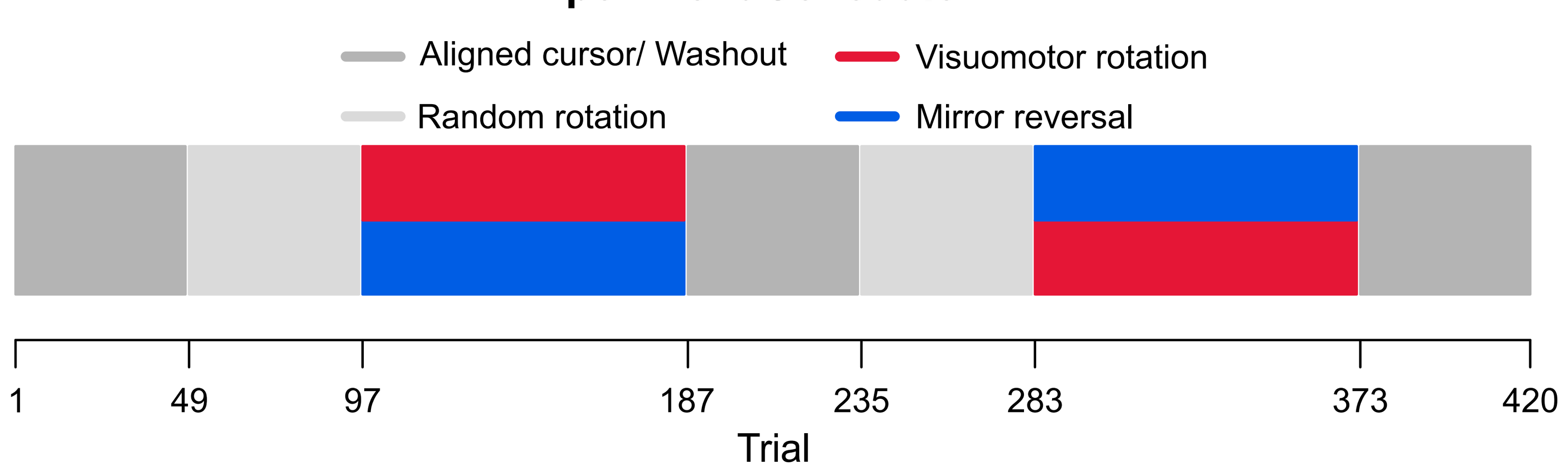
Visuomotor rotation (motor adaptation): the cursor is rotated 30° relative to the hand position.
Mirror reversal (*de novo* learning): the cursor feedback is flipped in the opposite direction of the hand position, relative to a mirror axis.



Visuomotor rotation Mirror reversal

The two tasks were matched, such that movements required to reach the target were the same in either perturbation. 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.

Experiment Schedule



The perturbation that each individual started with was counterbalanced across participants. We also counterbalanced where each perturbation was presented (vertical or horizontal axis of the workspace), as well as the target locations relative to this directional axis. No effects were observed for perturbation order, axis, and target locations.

Contact:
raphaelgastrock@gmail.com
@rqgastrock

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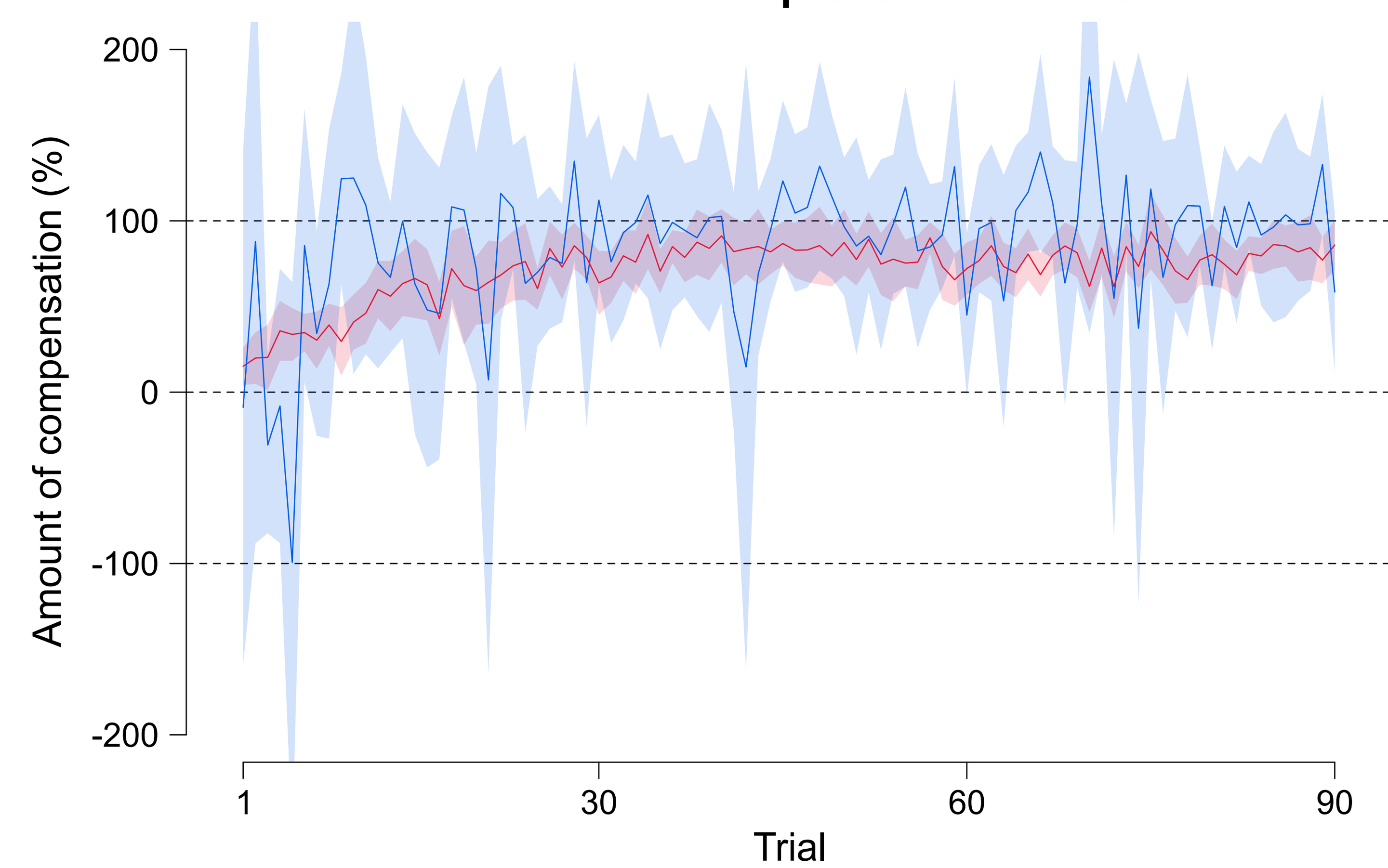
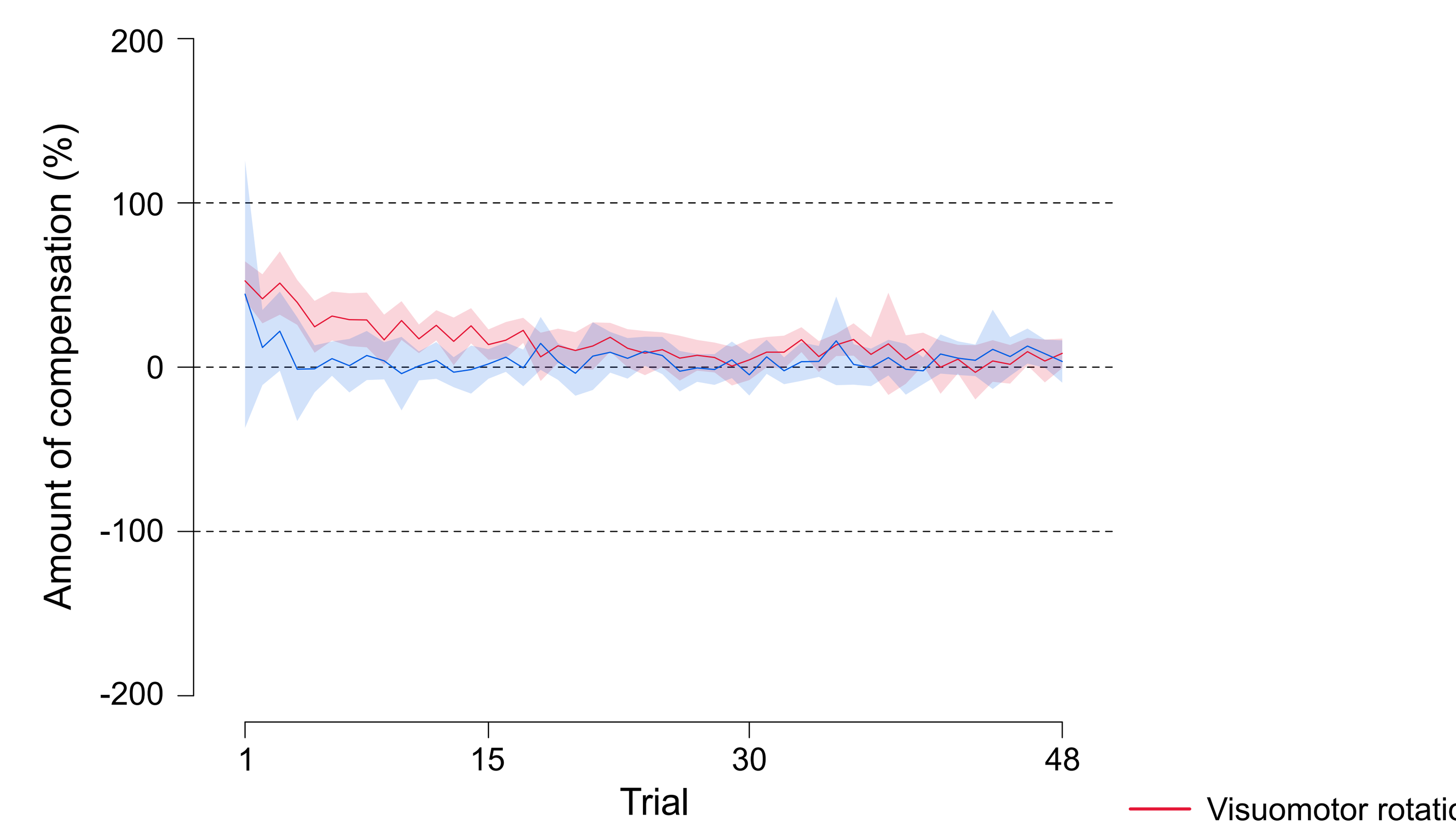
Learning for both perturbations progressed quickly, but reach aftereffects emerge following visuomotor rotation training only

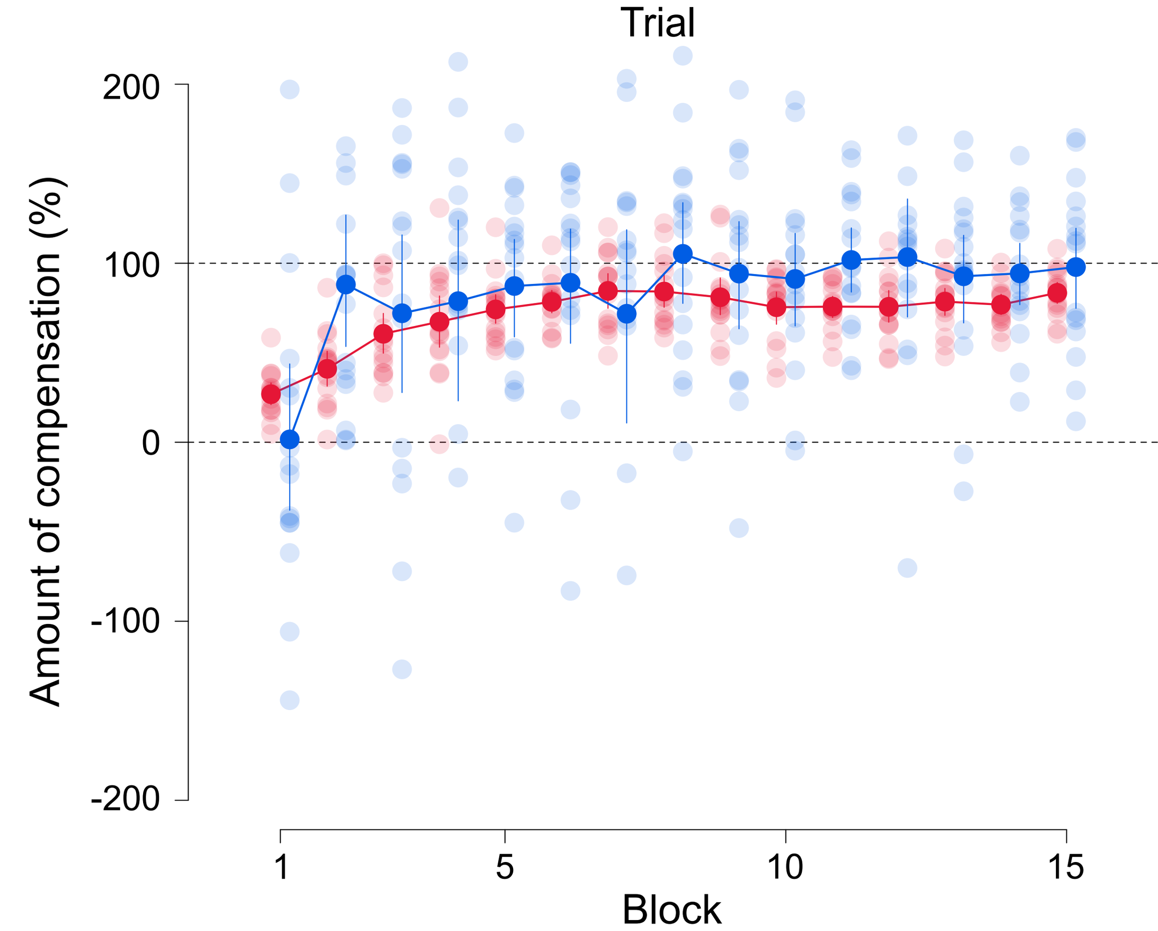
Participants countered for both perturbations within only 90 trials. Learning for the rotation developed gradually, but had a greater variability for the mirror reversal. Reach aftereffects were observed following visuomotor rotation training, but not for the mirror reversal. This confirms how one may switch between response mappings with *de novo* learning, but must modify existing mappings with adaptation.

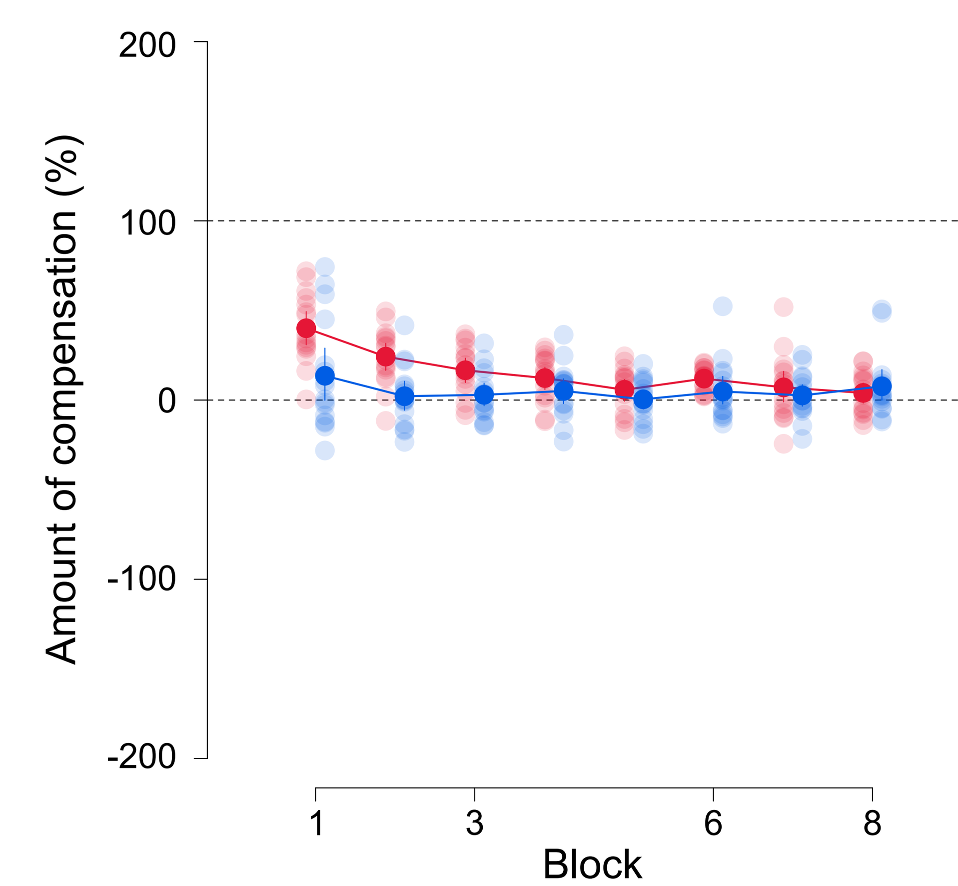
Reaches across perturbation trials



Reaches across washout trials



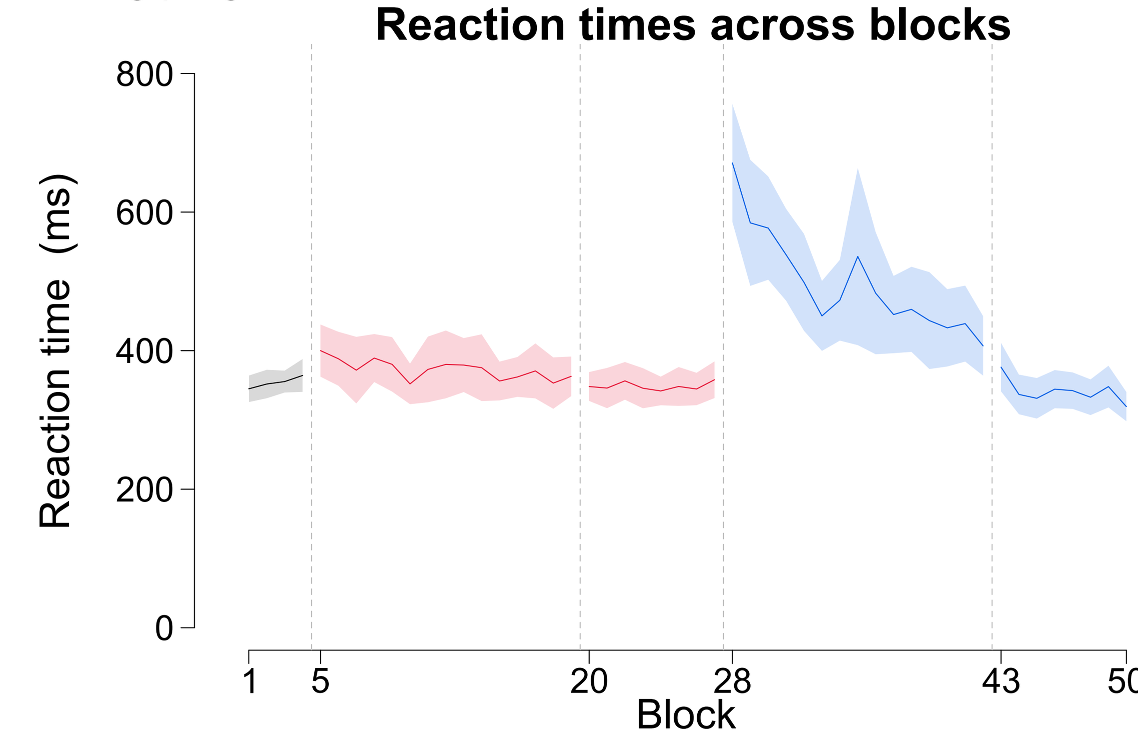




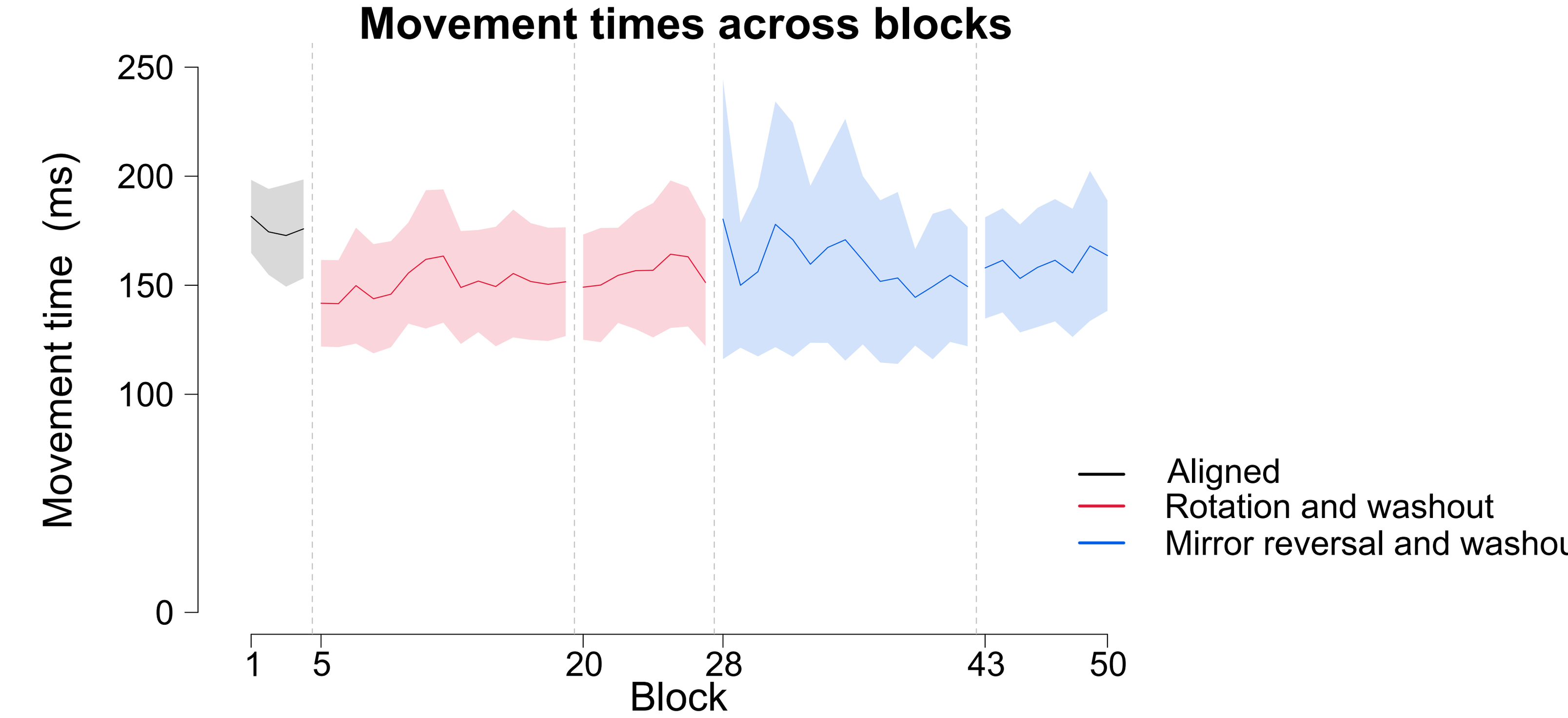
Training with a mirror reversal slows down the initiation and execution of movements

Reaction times (RTs) are initially slower for both perturbations when compared with those in the aligned trials, with mirror reversal trials being much slower. RTs eventually return to baseline levels for the rotation, but not for the mirror reversal. RTs during washout trials do not differ from baseline. Movement times (MTs) are marginally faster in rotation trials and its corresponding washout trials, compared to baseline aligned trials. MTs during mirror reversal and its corresponding washout trials do not differ from aligned trials, but there is an indication that MTs improve as mirror reversal training progresses.

Reaction times across blocks



Movement times across blocks



Behavioural measures show that *de novo* learning and motor adaptation rely on distinct mechanisms.
The paradigm in this study will be useful for investigating the neural processes underlying these two types of motor learning.