Learning in a mirror reversal task provides distinct mechanisms between de novo learning and motor adaptation

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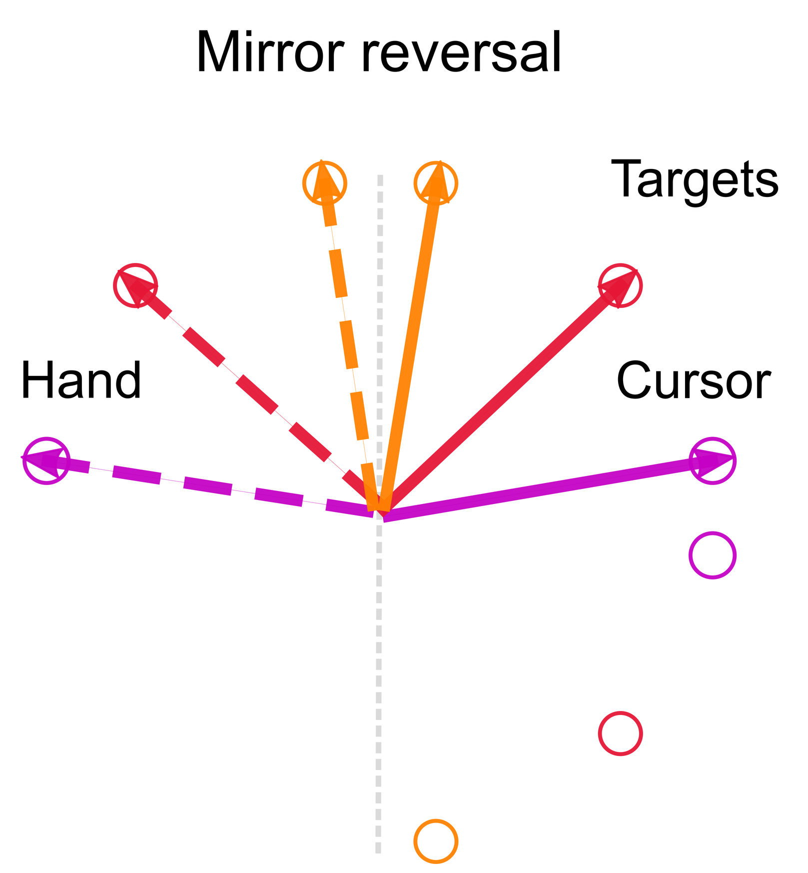
Motor adaptation versus de novo learning

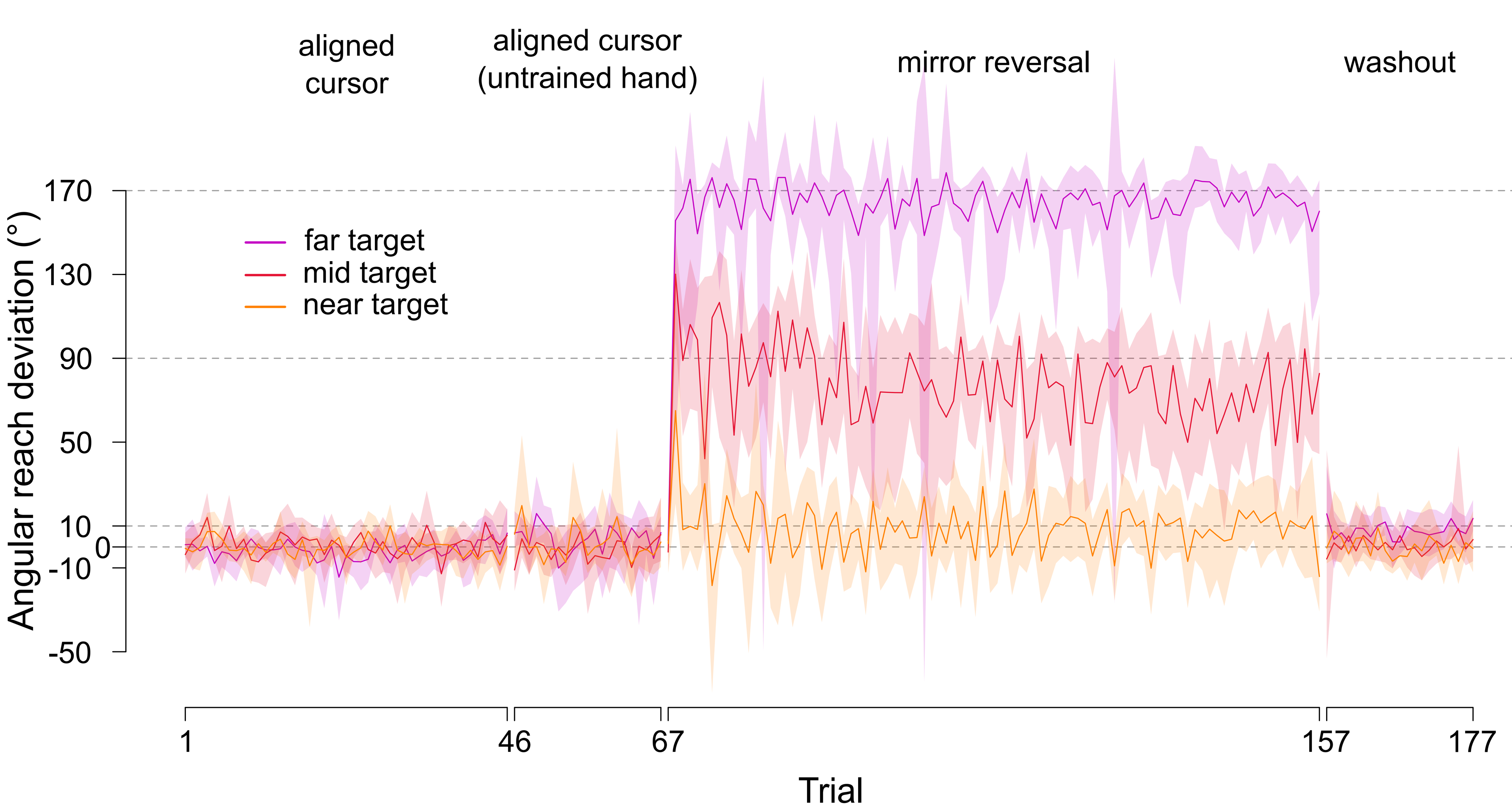
When people commit movement errors, they process these errors to correct for ensuing movements. This error-processing occurs in two types of motor learning: de novo learning and motor adaptation. De novo learning involves the establishment of a new response mapping in the brain as we learn a new motor skill, while adaptation modifies an existing response mapping to bring performance back to an ideal level. Here, we have participants reach to targets in a browser-based version of the mirror reversal task, to investigate the mechanisms of de novo learning, including its retention and generalization.



In session 1 (N = 63), the training targets were located in the upper-right quadrant of the workspace and were either 5°, 45°, or 85° away from the vertical mirror axis (near, mid, far targets).

Participants returned for a second session (N = 48; days apart: M = 4.77, SD = 2.52) and reached to corresponding target locations in the lower-right and upper-left quadrants of the workspace. These were followed by reaches using their non-dominant or untrained hand.

Learning progressed quickly and did not differ across target locations



Although targets farther from the mirror axis produced larger errors, participants learned to move towards the correct direction almost immediately regardless of target location. Asymptotic learning also did not differ across targets. We also do not observe reach aftereffects. This confirms how one may switch between response mappings in de novo learning, but must modify existing mappings in adaptation.

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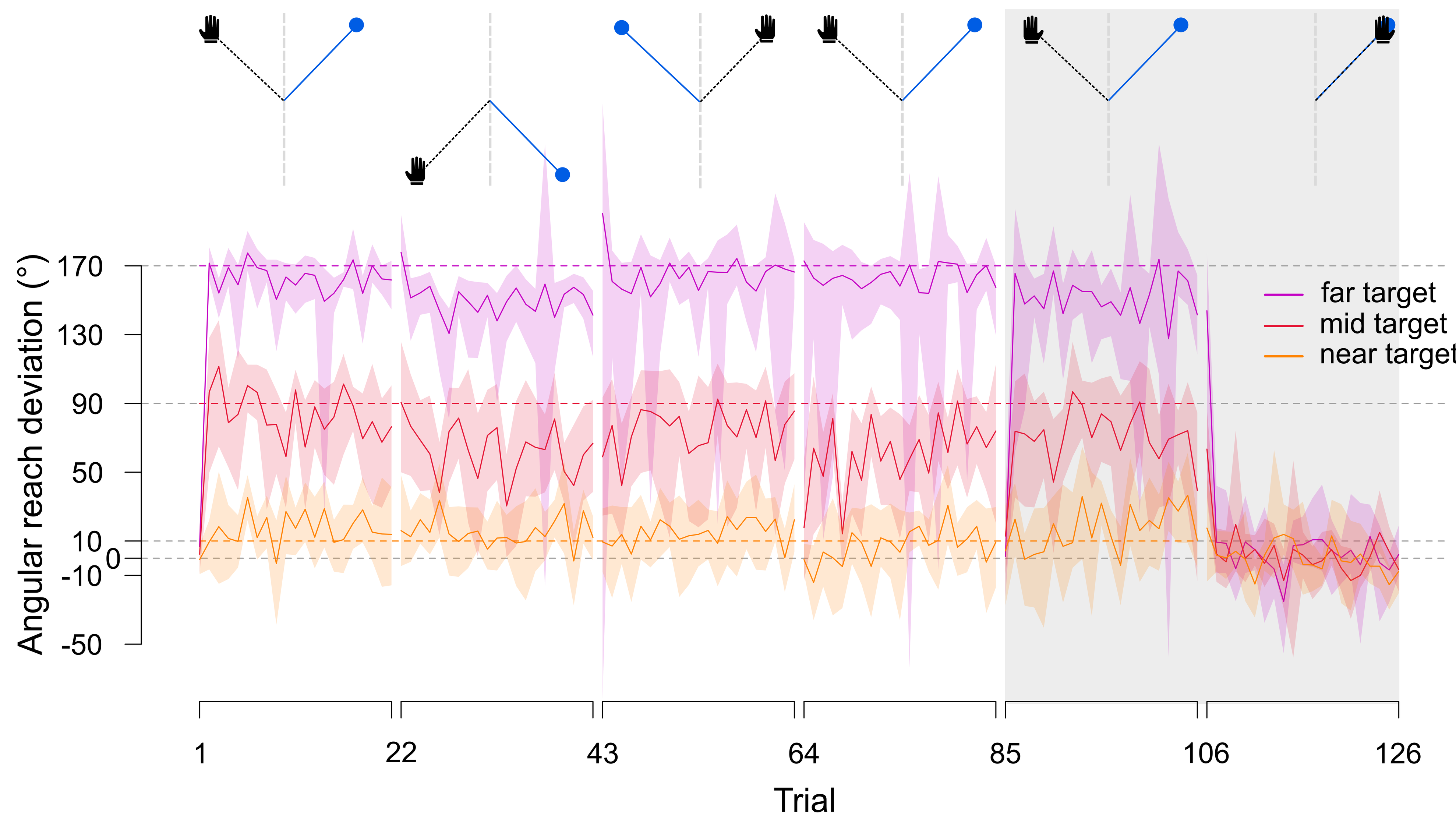
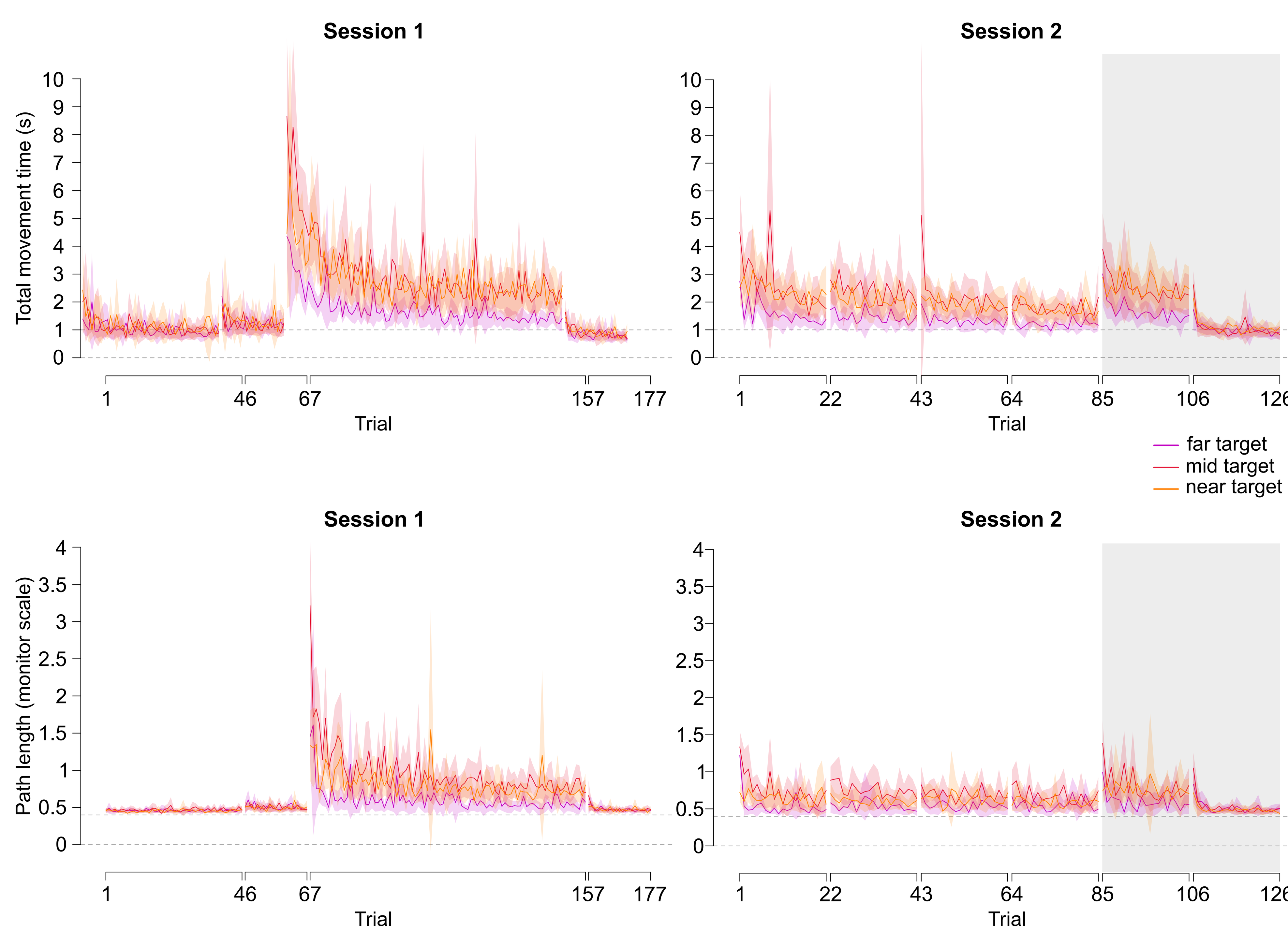
Learning was retained and generalized across the workspace and hands



Participants reached towards the correct direction upon re-experiencing the perturbation, suggesting retention of learning. We also observed almost complete and near immediate generalization to targets across the workspace and to the untrained hand. There was no evidence of reach aftereffects for the untrained hand.

Movement speeds and trajectories were dependent on target location

We measured the total movement time or time to complete a trial and found that reaches were fastest towards the far targets. Conversely, movement times were slowest when reaching towards the middle targets.



Path length measures the reach trajectory from the start position to the target (start to target distance equals 40% of participant's monitor height). Path lengths were shorter for far targets, and longer for middle targets.

The development of de novo learning can occur quickly, is retained across multiple days, and generalizes across the workspace and hands. These behavioral mechanisms show how de novo learning is distinct from motor adaptation.