Adaptation to Pong bounce perturbations is quick and independent from wall tilt

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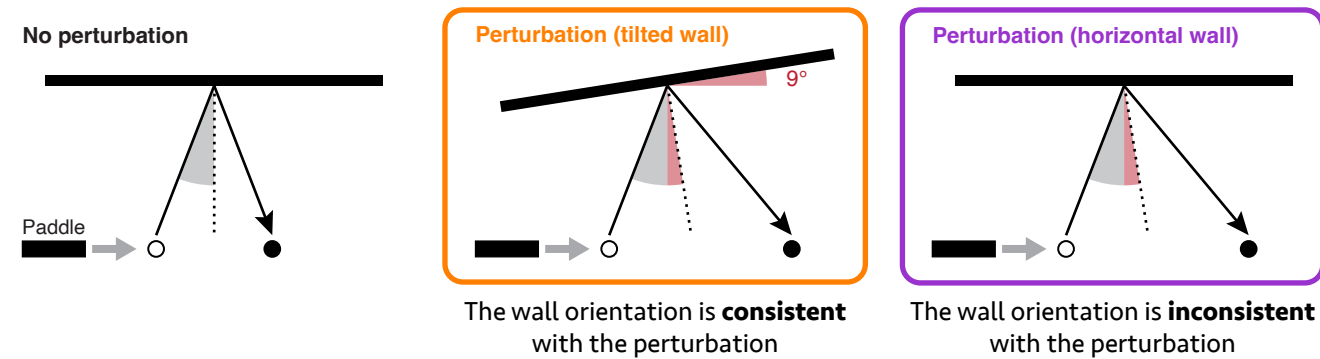## Motor adaptation to external perturbations

Most studies have focused on how we adapt to perturbations applied to our moving hand. But less is known about motor adaptation to perturbations applied to moving objects we interact with. We therefore designed a web-browser Pong game to investigate:

Whether participants adapt to bounce ball perturbations

Whether visual cues about the tilt of the bouncing wall improve adaptation

The Pong task

Participants intercepted a ball bouncing off a wall using a paddle controlled by their computer mouse or trackpad. A perturbation (9° rotation) was applied to the post-bounce ball trajectory and we manipulated the orientation of the wall.

No perturbation

Perturbation (tilted wall) — 9°
The wall orientation is **consistent** with the perturbation

Perturbation (horizontal wall)
The wall orientation is **inconsistent** with the perturbation
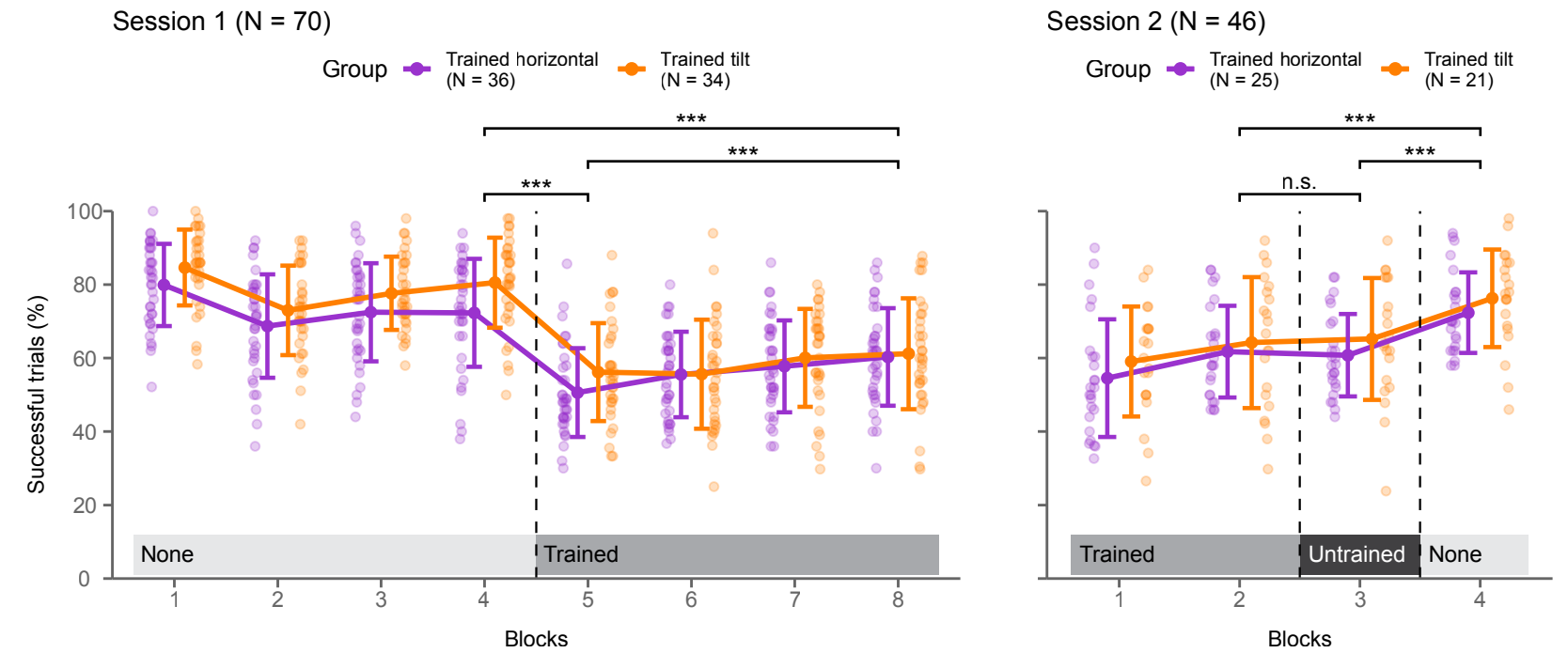
Experimental schedule

Session 1: After a baseline without perturbation, the **trained horizontal group** adapted to the **horizontal wall** perturbation and the **trained tilt group** adapted to the **tilted wall** pertubation.
Session 2: Both groups first re-adapted to their respective trained perturbation and then adapted to the **untrained** perturbation. Finally, trials with no perturbation were presented.

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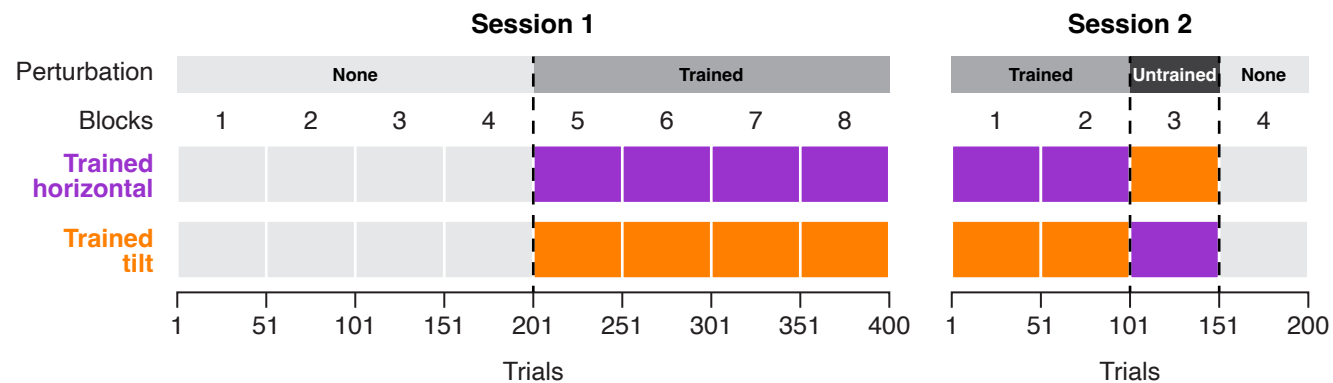
Bounce perturbations decrease interception succcess rates

In session 1, interception performance decreased when the bounce perturbation was introduced, and did not return to baseline levels. In session 2, interception performance did not change when the untrained perturbation was presented, but it improved after the bounce perturbation was removed.

Session 1 (N = 70)
Group — Trained horizontal (N = 36) — Trained tilt (N = 34)

Session 2 (N = 46)
Group — Trained horizontal (N = 25) — Trained tilt (N = 21)

Fast adaptation to bounce perturbations

Both the trained horizontal and the trained tilt groups showed typical markers of adaptation: large initial errors followed by rapid error reduction, and after-effects (errors in the opposite direction) when the perturbation was removed.
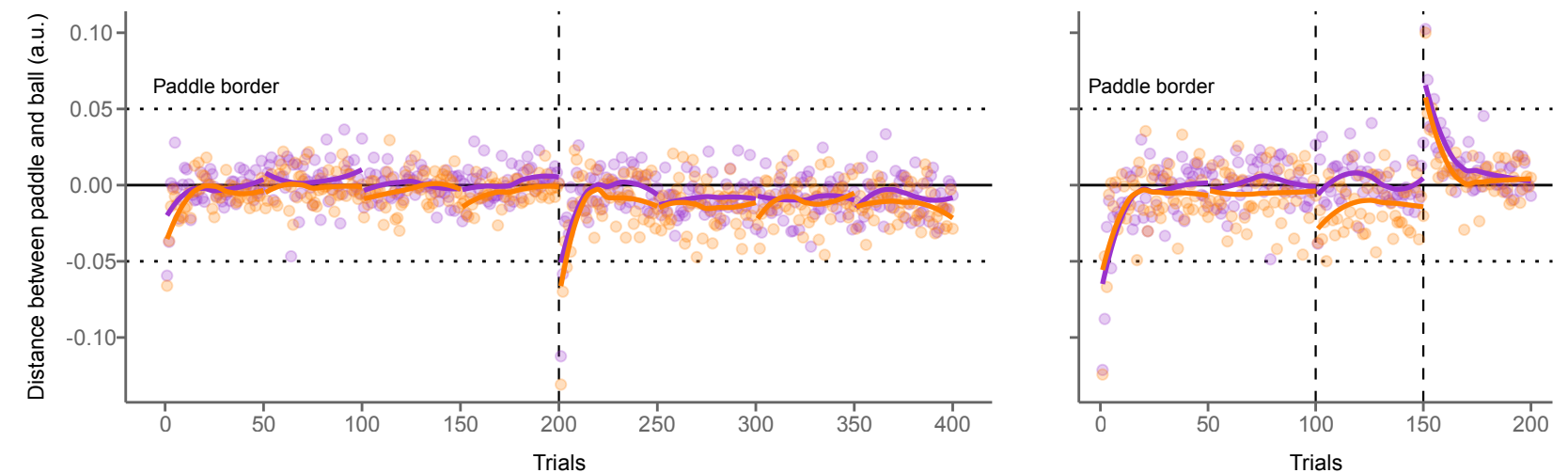
Participants are able to quickly adapt their movements to bounce perturbations in an online Pong game.
However, visual cues about the tilt of the bouncing wall did not improve their performance.