Overview

Background: One method for isolating implicit adaptation is to use ‘error clamped’ visual feedback1,2,3. Participants reach towards a target while receiving false, clamped visual feedback missing the target at a constant offset. They are told to ignore the feedback, thus eliminating any strategic corrections.

Aim: Here, we test a central assumption of this method, that participants understand the dissociation between their hand and the cursor. We also assess whether participants are aware of their ongoing adaptation.

Conclusion: Participants understand the instructions and are largely unaware of their adaptation in the error clamp paradigm.

Methods

Error Clamp Paradigm

Left: Participants reach towards target while receiving clamped feedback. Over time, reaching heading angle shifts away from the clamp, indicative of adaptation. Right: Adaptation converges on common asymptote, independent of error size.

Verbal report of estimated heading angle

Participants instructed to shoot past target and maintain final position. After 1s, ring of numbers is presented and participants report number corresponding to felt hand position when passing target.

Experimental Design

4 targets (45°, 135°, 225°, 315°). Shooting movements with online feedback. Clamp directions counterbalanced CW/CCW.

Experiment 1: 15° Error clamp

In the early clamp cycles (cycles 3-7), participants were biased to report feeling as though their heading angle was closer to the clamped feedback (mean -1.7°, p = 0.012).

Group results

By the end of the clamp block (last 10 cycles), participants felt their heading angle was biased towards their true heading angle (mean 2.26, p = 0.045).

Possible Interpretation

Hand report data may reflect operation of two processes: 1. Attraction towards clamp (visual signal) 2. Attraction towards hand position (proprioceptive signal)

Visual attractor is always at maximal value but with a lower saturation. The hand report data reflects greater influence from this signal, since hand location is near target.

Motor adaptation occurs more slowly and has a larger saturation. The hand report data reflects greater influence from the proprioceptive signals, since hand location is far from target.

Discussion

Participants show only small shift in perceived hand position, indicating negligible awareness of clamp-induced adaptation. Likely reflects strong prior to expect hand at aimed location.

However, systematic biases are present which we hypothesize reflect two processes (see Possible Interpretation). This is consistent with previous work from Ruttle et al showing proprioceptive recalibration in response to perturbed visual feedback can occur quickly and with a lower saturation than motor adaptation.

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