

Task dependent modulation of implicit visuomotor adaptation



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Overview

When multiple feedback cursors are presented, implicit adaptation is sensitive specifically to the rotation of the task relevant cursor, as opposed to the rotation of all the cursors. These results indicate that, in certain contexts, implicit adaptation is sensitive to task instructions.

Task Design

Center out reaches. Baseline and After-effect trials to 24 generalization targets (15° apart). Training trials to 3 targets (120° apart).

Baseline trials – Three cursors have a mean rotation of 0° (-45°, 0°, 45°). Subjects told to hit target with middle 0° cursor.

Training trials – 3 Groups:

With different **Mean Cursor Rotations**.

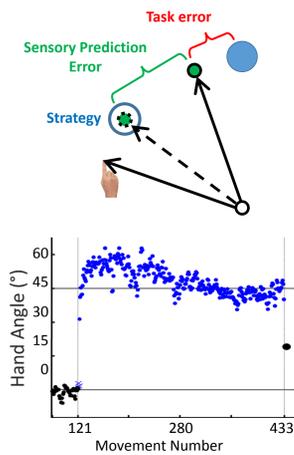
- Groups 1, 2: 45° (0°, 45°, 90°)
- Groups 3: 0° (0°, 45°, 90°)

Instructed to hit the target specifically with the **Task Relevant Cursor** (indicated by a color).

- Groups 1, 3: 45°
- Groups 2: 0°

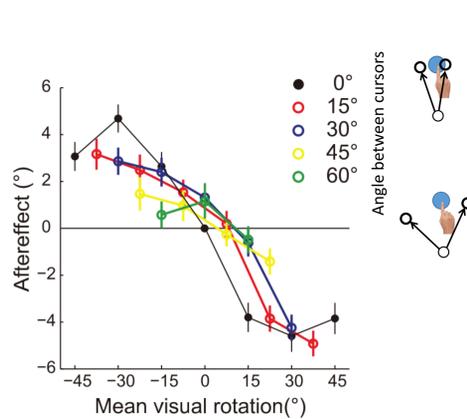
After effect trials – No feedback reaches to generalization targets.

Background



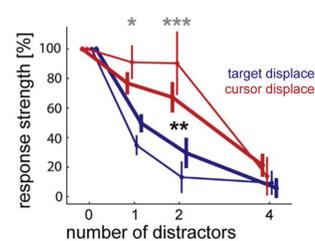
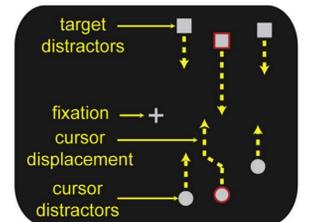
Taylor & Ivry 2011

Implicit sensorimotor adaptation is automatic and obligatory, even when detrimental to task success [1,2]. One explanation is that sensory predictions are generated relative to the motor command, irrespective of the task or context.



Kasuga et al. 2013

Single trial aftereffect to multiple cursors approximate an averaged response to all cursors. Here however, multiple cursor trials were randomly interleaved with mainly veridical feedback trials, making it ambiguous which cursors were relevant.



Reichenbach et al. 2014

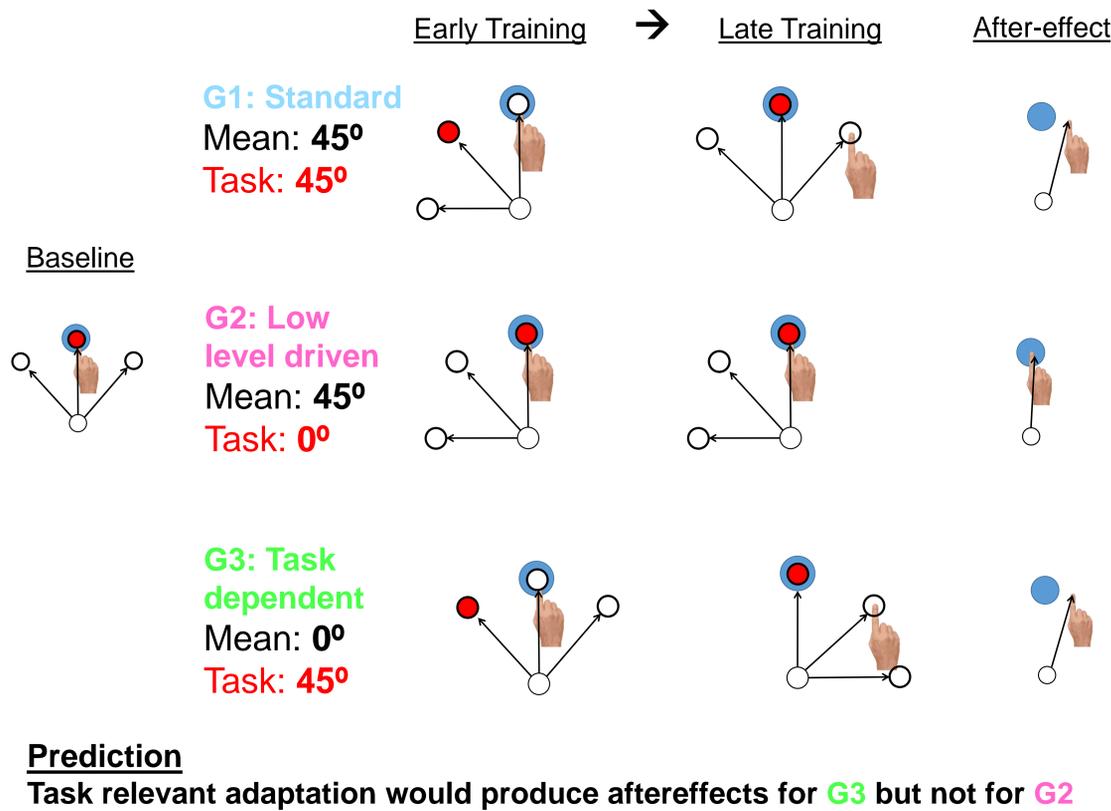
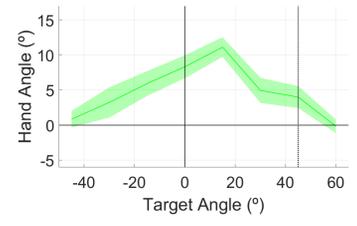
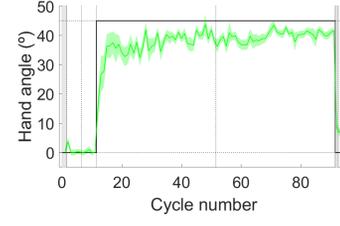
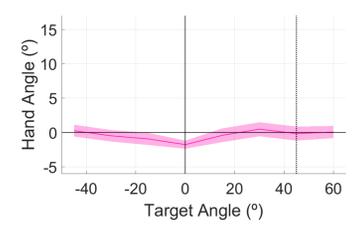
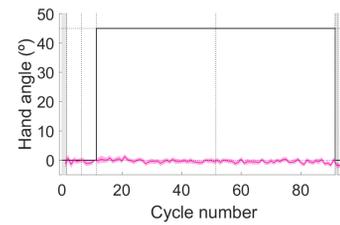
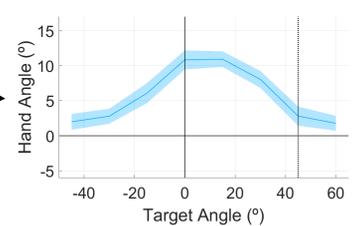
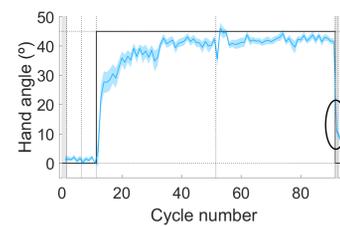
Online feedback corrections to cursor jumps show high selectivity for the task relevant cursor among 'distractor cursors'. Whether such a process (*visuomotor binding*) could influence adaptation is yet unknown.

Results

- Equal magnitude for **Standard** and **Task Dependent** despite difference in mean rotation.
- No effect in **Low Level Driven** despite presence of mean rotation.

Training

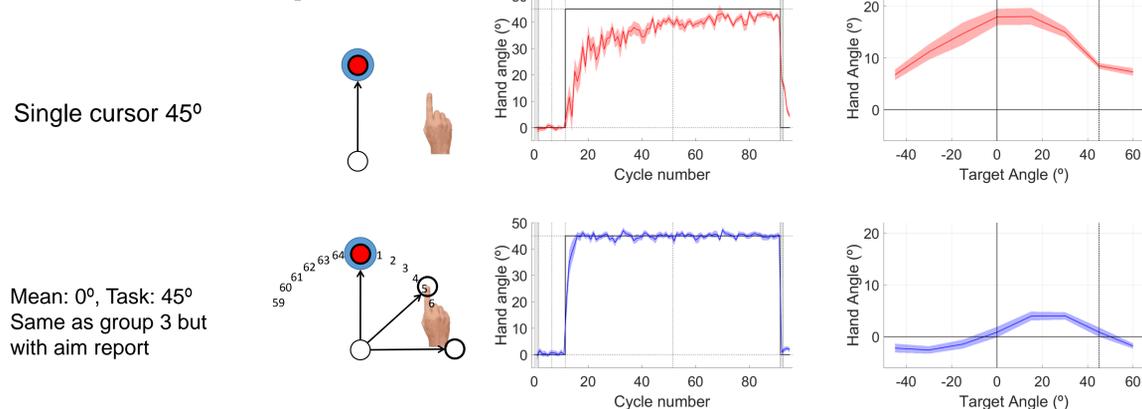
After-effect Generalization



Prediction

Task relevant adaptation would produce aftereffects for **G3** but not for **G2**

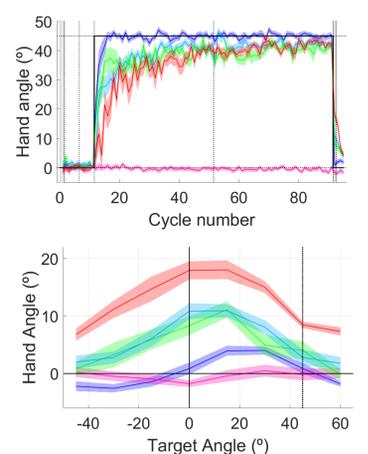
Control Groups



Single cursor condition has a larger after-effect than the 3 cursor conditions. This suggests that the two task-irrelevant cursors are not completely filtered out.

Aim-report version of **Task Dependent** shows strong attenuation of after-effect, despite similar performance during reaching. This suggests that aftereffect is due to which cursor is being 'used' by the subject.

Group Comparisons



Bottom: Interestingly, the generalization functions are not shifted towards the expected 'aim location' to the extent you would expect (~30°) given the amount of implicit adaptation [5].

Conclusion

Our results suggest that the adaptation system is capable of filtering feedback based on the task. This selectivity is consistent with an extension of a *visuomotor binding* mechanism [4] which links the hand representation in visual and motor systems.

References & Acknowledgements

1. Mazzoni & Krakauer 2006
2. Taylor & Ivry 2011
3. Kasuga, Hirashima and Nozaki 2013
4. Reichenbach, Franklin, Zatska-Haas and Diedrichsen 2014
5. Day, Roemmich, Taylor, Bastian 2016

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