Task dependent modulation of implicit visuomotor adaptation

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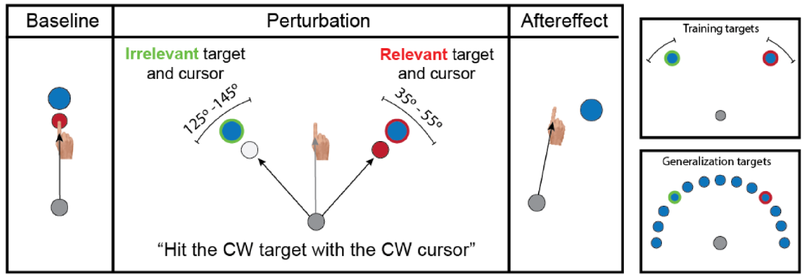
Overview

- Previous studies have shown that implicit adaptation to sensory prediction errors occur even when detrimental to success, or when participants are explicitly told to ignore the feedback.(Mazzoni & Krakauer 2006, Morehead et al 2016).
- To explore whether implicit adaptation is truly insensitive to the task conditions, we manipulated the relevance of the sensory feedback. By using multiple redundant cursors (Kasuga et. al. [2010]) and targets, the movements and visual feedback could be held constant while instructions were used to manipulate the task relevance of the feedback signals.
- We find that both the presence and relevance of the target(s) can influence the generalization of implicit adaptation.

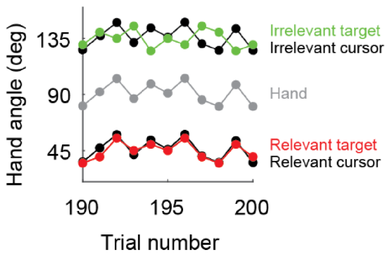
Task Design

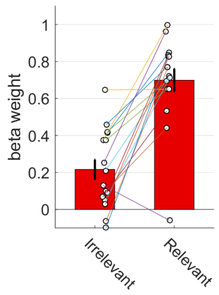
N = 16 (Counterbalanced)



8 baseline trials/tgt 200 Perturbation trials 3 aftereffect trials/tgt

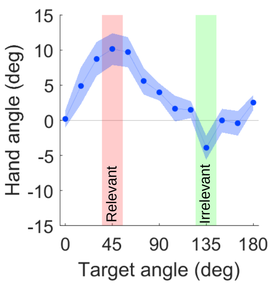
Participants track relevant target more than irrelevant target





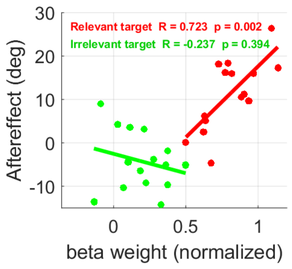
Multiple regression beta weights quantify how the target locations on trial n predicts hand angle on trial n.

Aftereffect generalized around relevant target



Aftereffect at relevant target in the expected direction for the relevant cursor, and centered on the target rather than the reach hand angle.

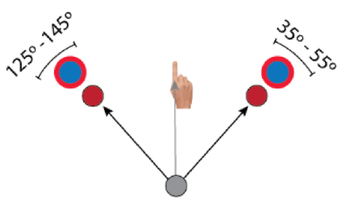
Aftereffect for relevant target correlates with beta weight



x-axis: beta weight for the relevant or irrelevant training target divided by the sum of both beta weights. y-axis: aftereffect at the irrelevant or relevant training target.

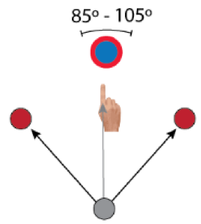
Task Design

"Hit both targets with both cursors"

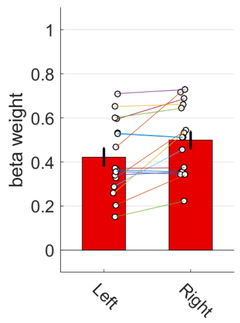


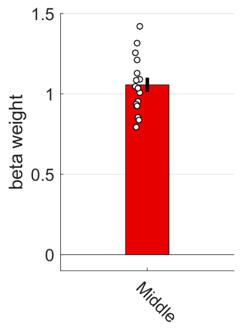
N = 16/group

"Hit the target with your hand"

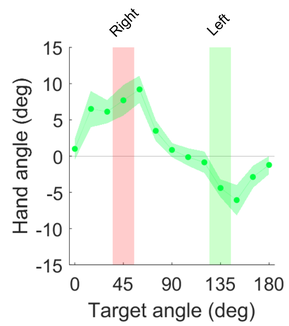


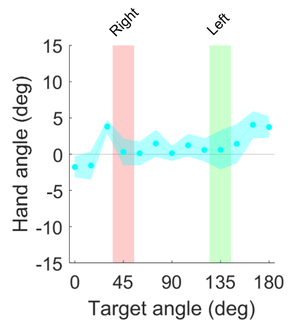
Subjects Track Relevant Target





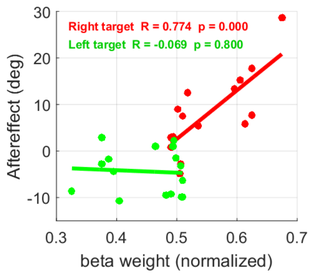
Relevant Target Location Affects Adaptation



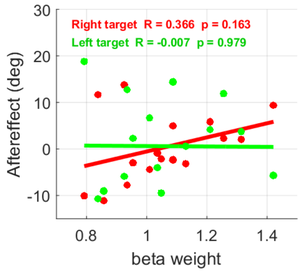


Target Tracking vs Aftereffect

x-axis: beta weight for the right or left training target.
y-axis: aftereffect at the left or right training target.



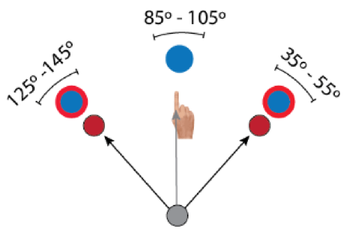
Despite both targets having equal relevance, participants appeared to be biased to tracking the right target more than the left target. A significant correlation between beta weight and aftereffect is present in the expected direction for the right target, but not for the left target.

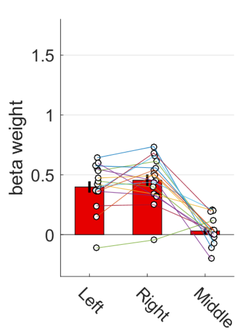


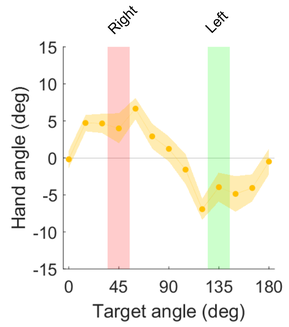
As expected, participants have a stronger weight when tracking a single target which requires no re-aiming. No significant aftereffect present, consistent with either no adaptation, or the error signals from both cursors being applied to the same target and cancelling each other out.

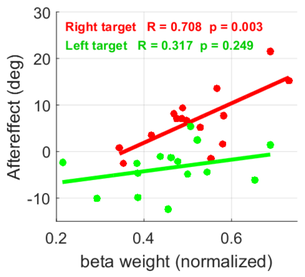
Below: Same conditions as above but with additional distractor targets to make the visual display identical across both conditions

"Hit the outer targets with both cursors"



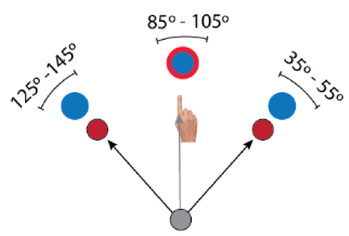


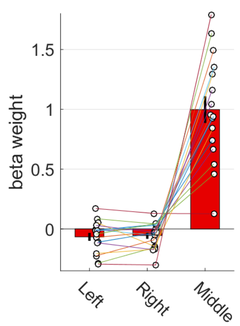


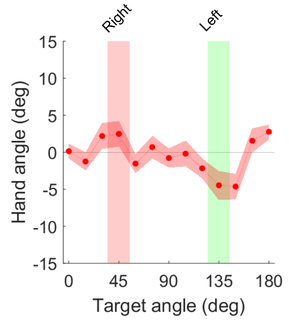


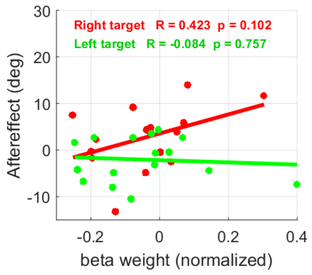
Overall results are similar to the previous "Hit both target" condition but with smaller effect sizes, presumably due to the presence of the irrelevant target.

"Hit the middle target with your hand"









Beta weight is more variable compared to the previous one target group, suggesting that the distractor targets affected tracking ability. Small aftereffects were present in the expected direction, further indicating that the distractor targets directed attention toward the cursors. However, there was no significant correlation between the beta weights and aftereffect.