The effect of Type and Timing of Error Signals on Initial Implicit Changes in Visuomotor Adaptation

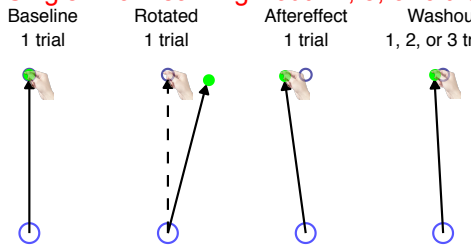
Z. Nabaee-Tabriz, P. Rahimpoor-Marnani, A. Khan, K. Bassi, B.M. 't Hart, D.Y.P. Henriques
York University, Toronto, Canada.

Centre for Integrative and Applied Neuroscience
Centre pour l'Intégration et l'Application des Neurosciences
Centre for Vision Research

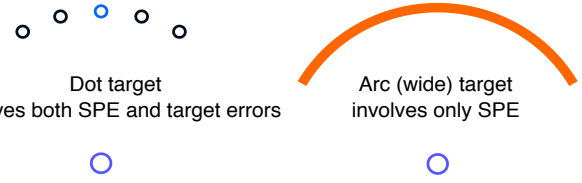
Initial Implicit Change

Although implicit visuomotor adaptation is well studied, little is known about the earliest stages—especially effects of error type, magnitude, and timing. We used single-trial learning (STL) to quantify initial implicit changes during movement-contingent adaptation to altered visual feedback. Across varying perturbation magnitudes, we examined how different error signals and their timing contribute to early recalibration.

Single-Trial Learning Bout: 4, 5, or 6 trials



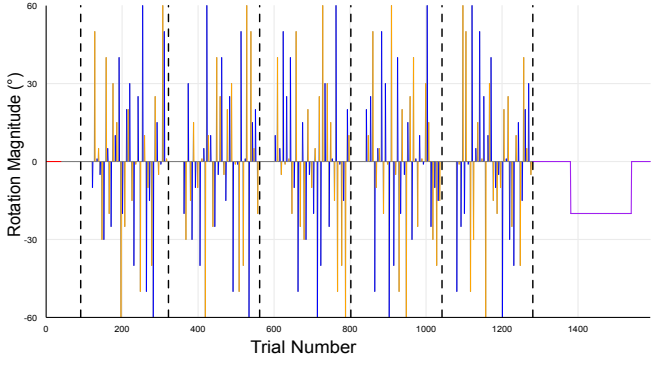
Training Target Types



Dot target
involves both SPE and target errors

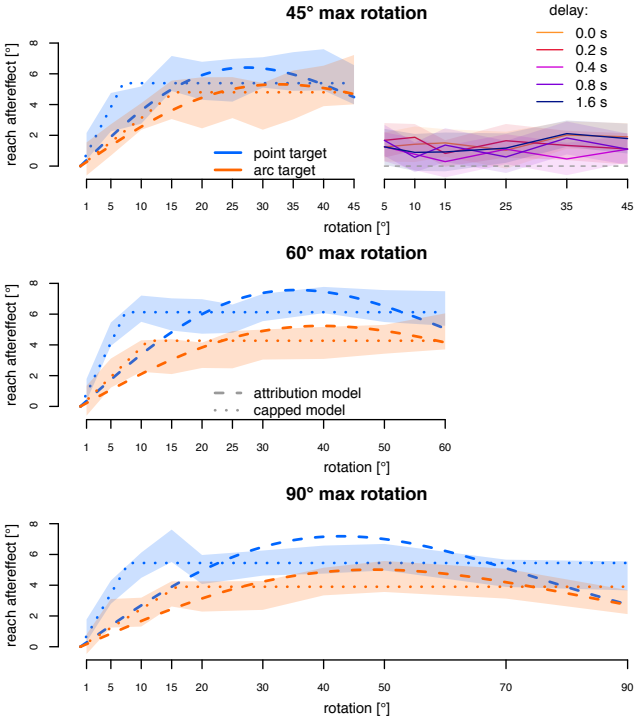
Arc (wide) target
involves only SPE

Trial Structure



Error Magnitude & Target Type

Initial aftereffects occurred for rotations as small as 1°, scaled for smaller rotations (1° - 15°), and settled at around ~6° for larger perturbations (15° - 90°), with no attenuation at higher magnitudes. Trials with sensory prediction error (SPE) and target error (dot target) lead to larger afteraffects than with SPE only (arc target).



Terminal & Delayed Feedback

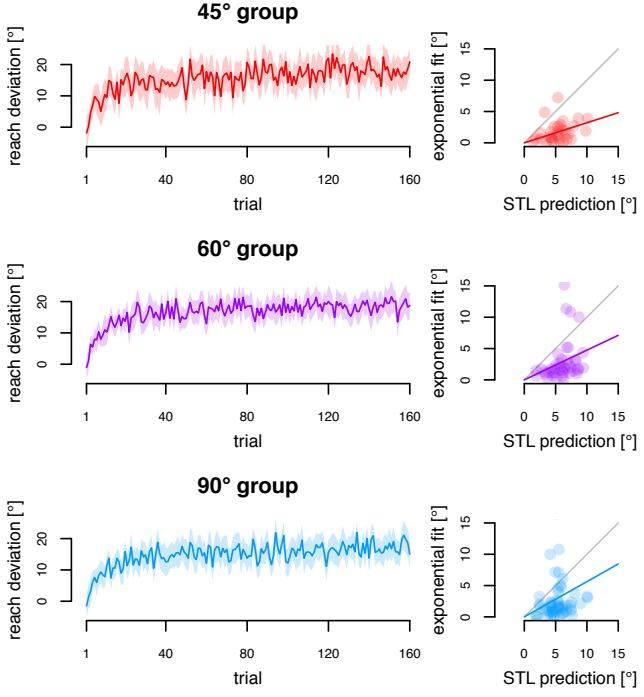
Initial aftereffects were smaller when single-trial learning occurred with endpoint feedback compared to continuous cursor feedback. However, introducing feedback delays of up to 1.6 seconds did not lead to further reductions in aftereffect magnitude.

NSERC CRSNG

Contact: zach568@yorku.ca

STL Predicts Early Adaptation

STL predictions moderately tracked early adaptation during long exposure but tended to overestimate it, with model slopes falling below unity. Exponential fits did not underestimate actual behavior, suggesting STL captures early adaptation reasonably well, though with slight inflation.



Take Aways

Initial implicit adaptation scales with errors up to ~15°and are then capped at ~6°.

STL predicts to regular adaptation paradigms.

Task errors do contribute to initial implicit adaptation.

Initial aftereffects are reduced with terminal, but not with delayed feedback.