Transfer Between Saccade and Reach Adaptation Using Concurrent Sine-Wave Perturbations

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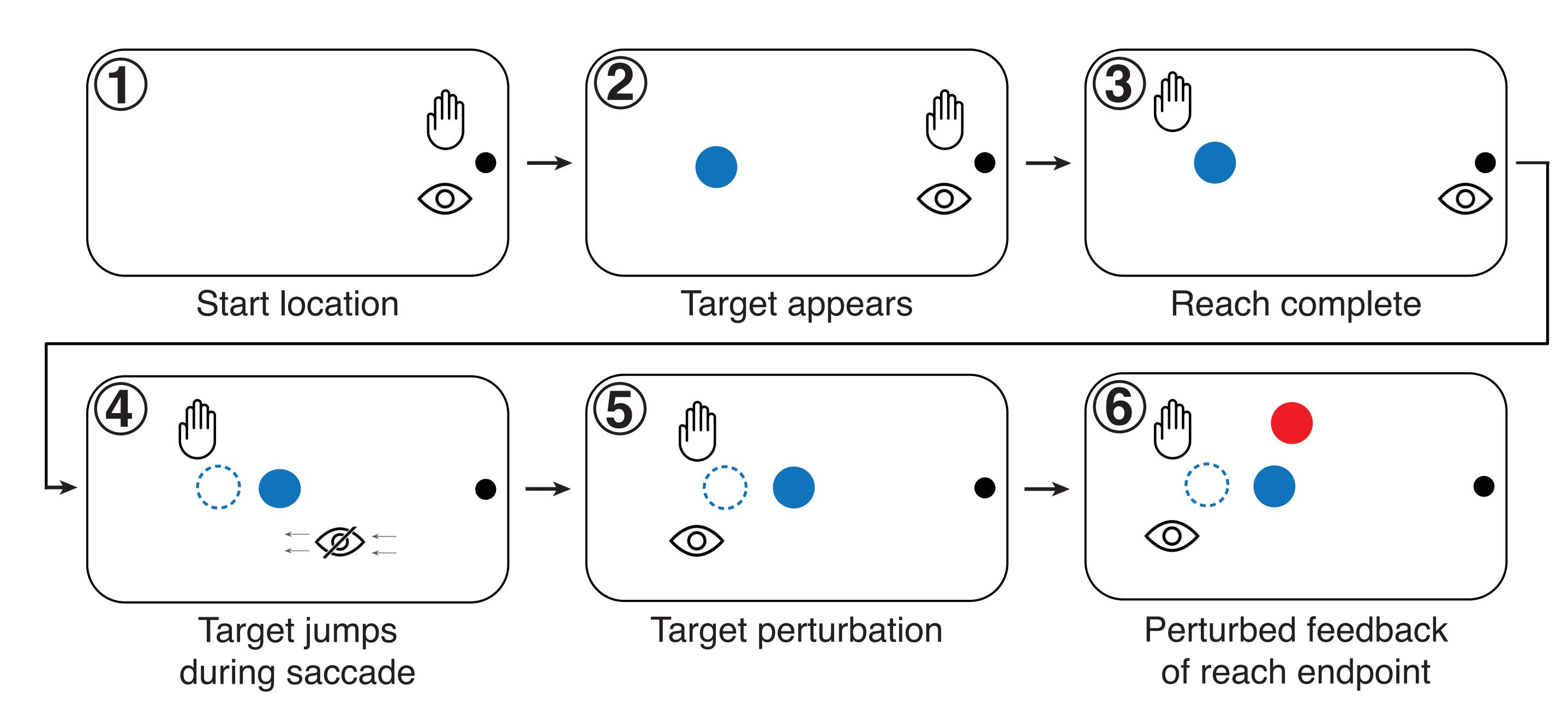
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Background

- Multiple studies suggest that saccade and reach planning share a common spatial representation:
  - Reach accuracy improves with a saccade (even in darkness)[1].
  - Reach endpoints are consistently biased toward gaze location[2].
- If both effectors use a common map, then systematic biases in one should also appear in the other.

Question
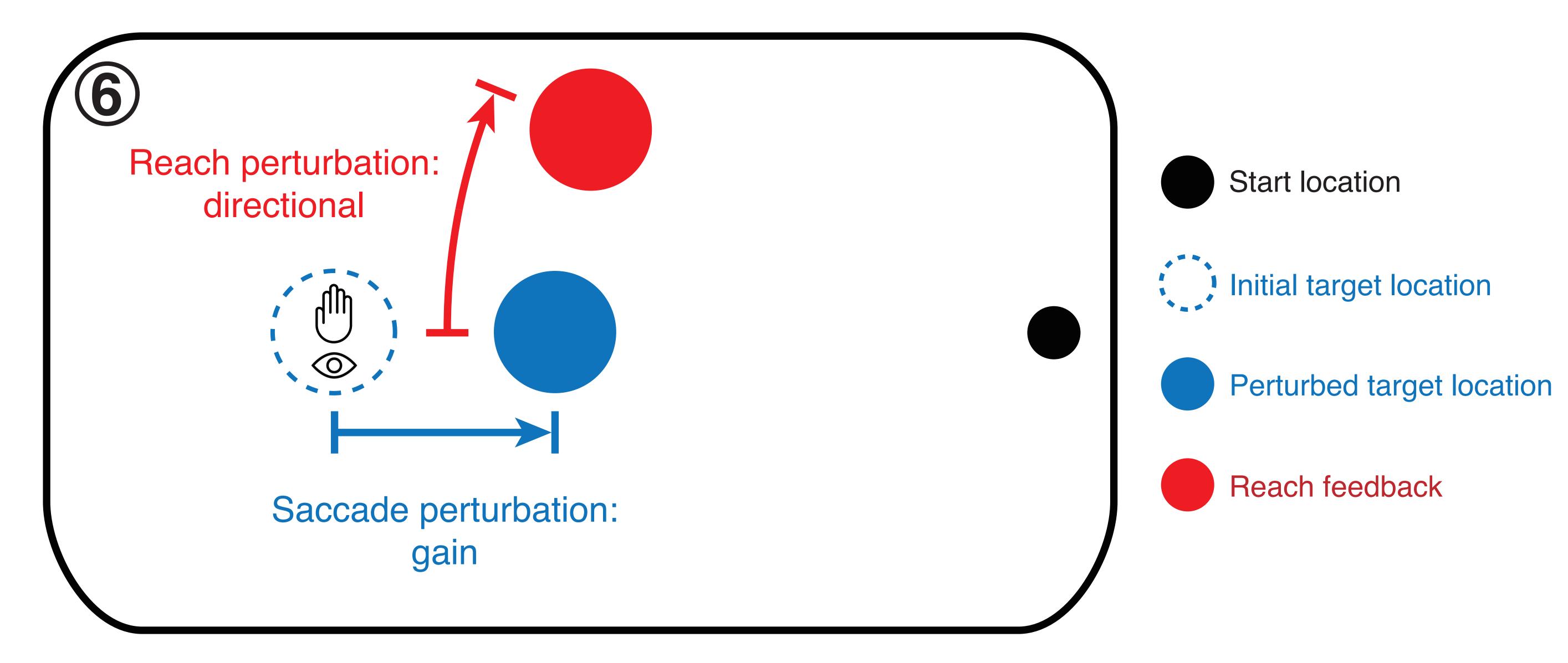
If we adapt saccades and reaches concurrently, will we observe transfer of adaptation from one effector to the other?

Procedure

- Both effectors adapted concurrently
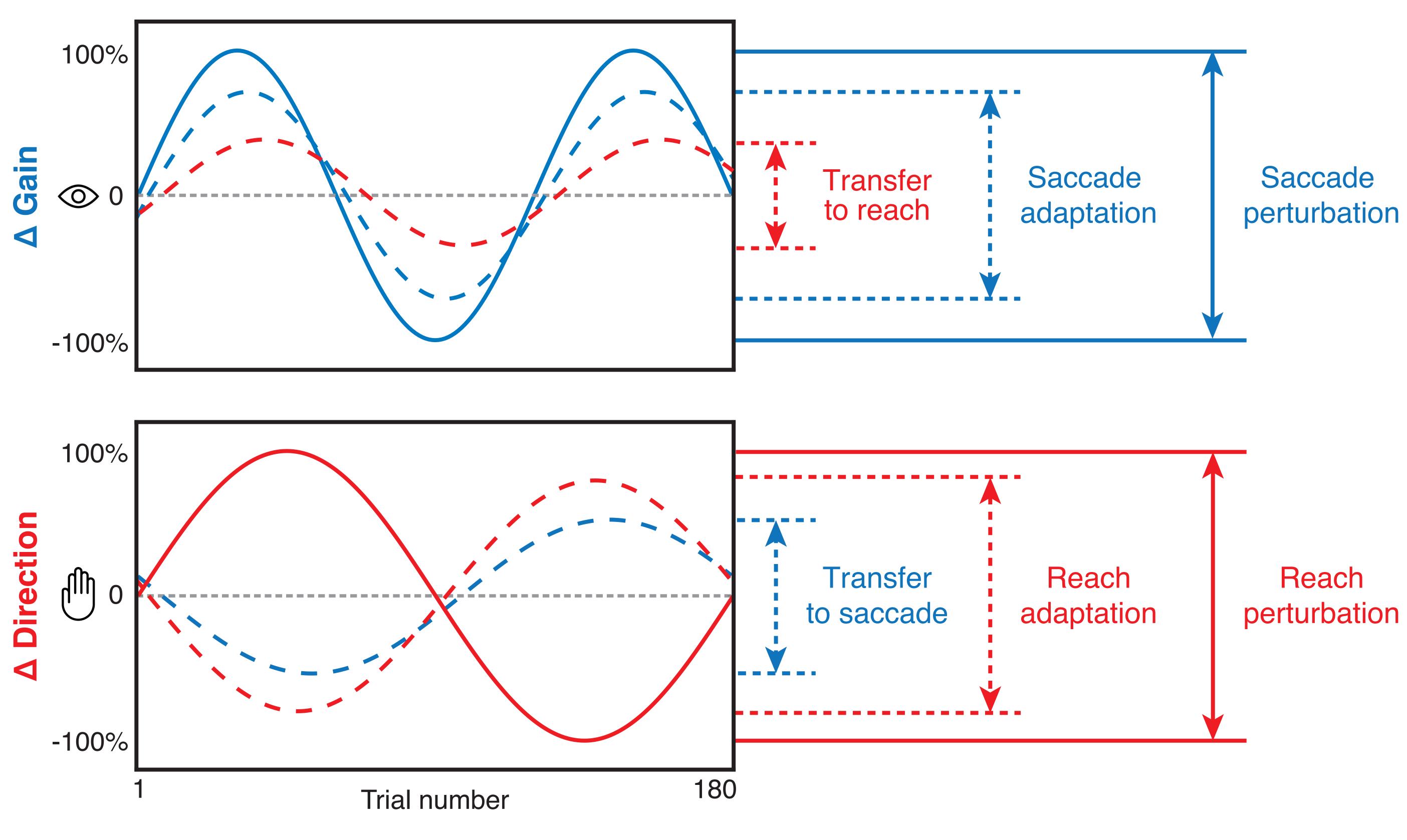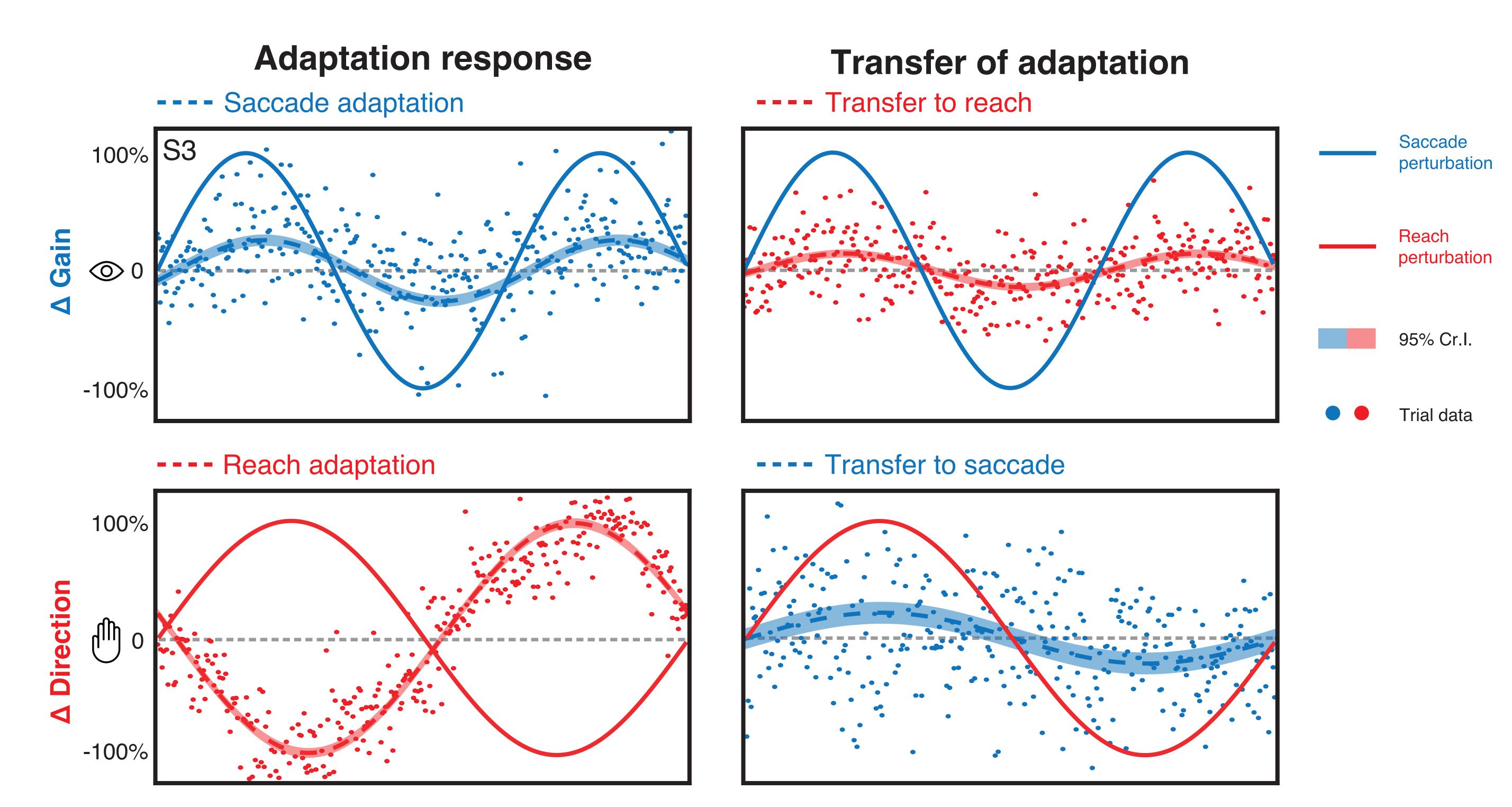- Perturbation magnitude follows a sinusoidal time course across trials[3].

① Start location
② Target appears
③ Reach complete
④ Target jumps during saccade
⑤ Target perturbation
⑥ Perturbed feedback of reach endpoint

Perturbation: Spatially orthogonal

⑥ Reach perturbation: directional
Saccade perturbation: gain

- Start location
- Initial target location
- Perturbed target location
- Reach feedback

Perturbation: Temporally distinct

Predictions:

Δ Gain

Transfer to reach — Saccade adaptation — Saccade perturbation

Δ Direction

Transfer to saccade — Reach adaptation — Reach perturbation

1 — Trial number — 180

Results

Adaptation response
- Saccade adaptation
- Reach adaptation
S3
Δ Gain: 100% / -100%
Δ Direction: 100% / -100%

Transfer of adaptation
- Transfer to reach
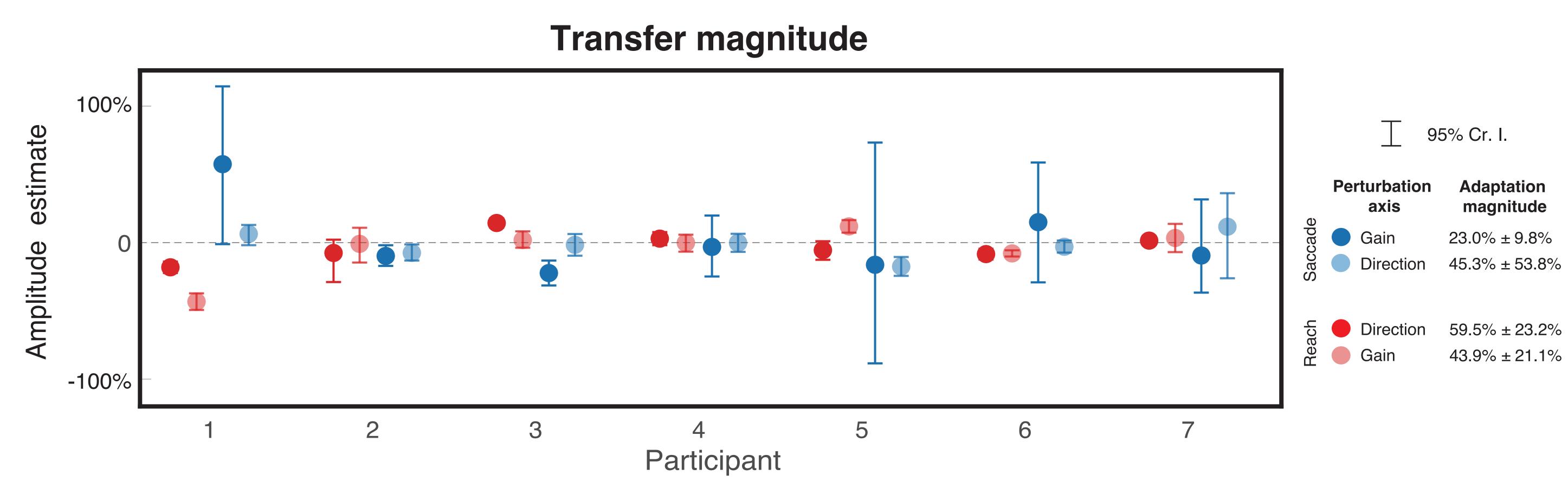- Transfer to saccade

- Saccade perturbation
- Reach perturbation
- 95% Cr.I.
- Trial data

In this example participant, transfer can be found from saccade to reach, but transfer from reach to saccade is in the opposite direction than predicted.

Transfer magnitude

Amplitude estimate: 100% / 0 / -100%
Participant: 1 2 3 4 5 6 7

95% Cr. I.

Perturbation axis	Adaptation magnitude
Saccade Gain	23.0% ± 9.8%
Saccade Direction	45.3% ± 53.8%
Reach Direction	59.5% ± 23.2%
Reach Gain	43.9% ± 21.1%

- Across participants, we found no significant amount of transfer between effectors.
- In individual conditions where transfer was significant, the direction of the transfer was not consistent across participants or conditions.

References
1. Bock, O. *Exp Brain Res* (1986).
2. Vazquez, Y. et al. *J Neurophysiol* (2017).
3. Hudson, T. E. and Landy, M. S. *J Neurosci Methods* (2012).