



Visual but not proprioceptive signals contribute to detection of sensory-motor perturbation

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Motivation

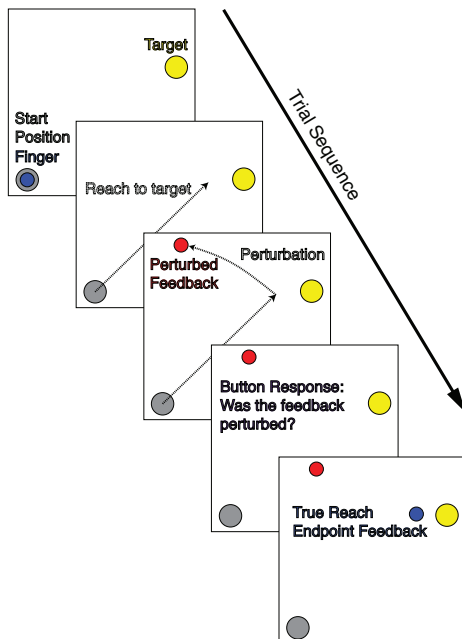
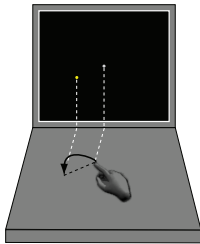
- Motor planning studies perturb visual feedback to measure compensation
- Large (noticeable) perturbations evoke different compensation processes from unnoticed ones

Research Questions

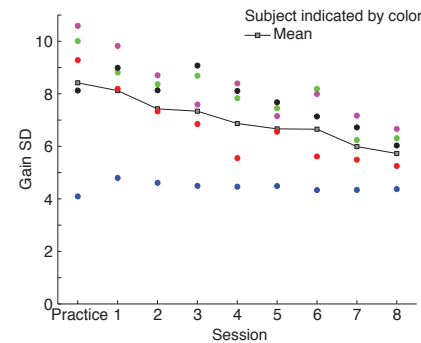
- Q1: How large can a perturbation be without being detected?
- Q2: How do people combine cues to decide if there was a perturbation?

Task

- Center-out reaches
- Finger and target represented on screen
- Reach endpoint perturbed in gain or direction
- Perturbation magnitudes were 1-5 times individual motor variability
- Detection task: "Was the feedback perturbed?"

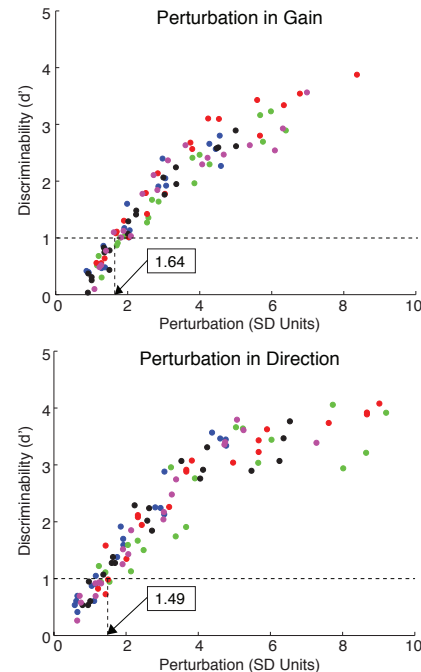


Motor Learning



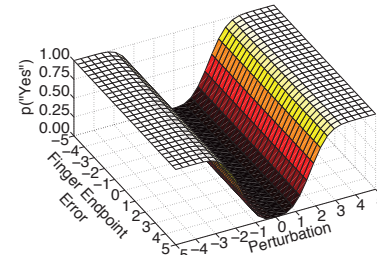
A1: Detection Performance

Perturbations greater than ~1.5 times motor SD could be reliably detected ($d' = 1$)



Comparison Observer

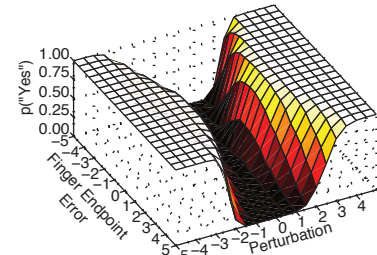
Compares (subtracts) proprioceptively and visually sensed finger locations



Ideal Observer

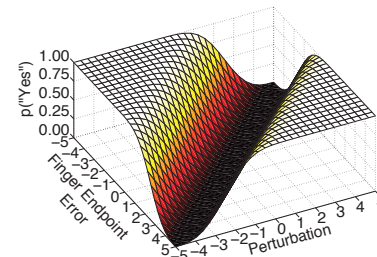
Calculates signal likelihoods:

$$\frac{p(\text{sensory signals} | \text{perturbation})}{p(\text{sensory signals} | \text{no perturbation})}$$



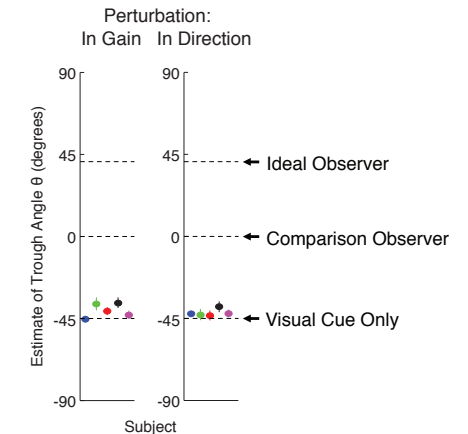
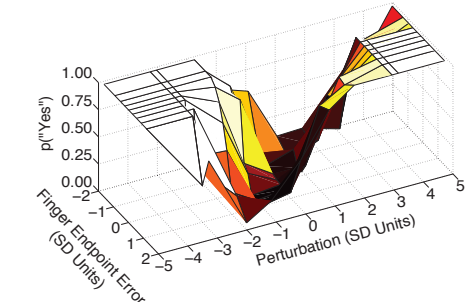
Visual Cue Only

Responses based on the visually displayed error alone



A2: Cue Weights

- Subjects believe errors are self-generated when visual feedback is near the target
- Data are fit by the prediction that only the visual cue is used



Conclusions

- A1: Subjects believed errors to be externally generated when perturbations are greater than ~1.5 SD of their own motor noise
- A2: Subjects ignored proprioceptive cues

Support

- NIH R01 EY008266-25 (MSL)
- NSF GRFP DGE 1342536 (EGC)

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