Dynamic Visual Localisation with Moving Dot Clouds

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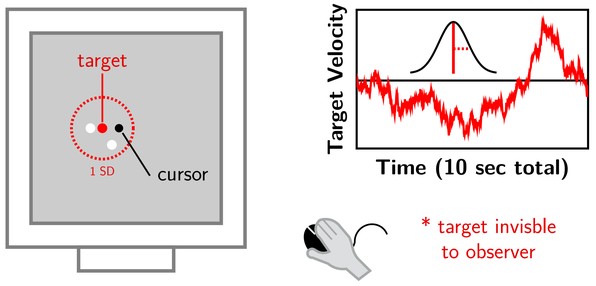
Motivation

Can we monitor our sensorimotor uncertainty to judge the precision of complex actions?

Tracking Task

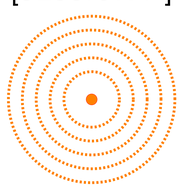
Stimulus



Two dots independently drawn from 2D Gaussian every frame (17 ms). The generative mean follows a horizontal random walk trajectory in velocity space.

Difficulty Manipulations

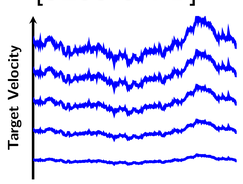
[SESSION A]



cloud size (obvious)

$\sigma_{cloud} = 1, 1.5, 2, 2.5, 3°$

[SESSION B]



velocity stability (subtle)

$\sigma_{walk} = 0.05, 0.1, 0.15, 0.2, 0.25°/s$

2AFC Confidence Report

"Relative to all trials in this session, do you think your performance in the current trial was better or worse than average?"

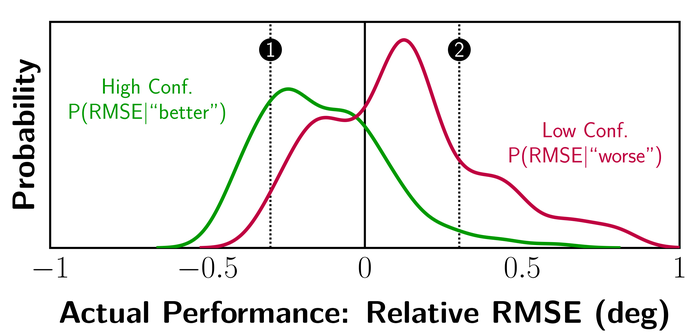
"better" → high conf.

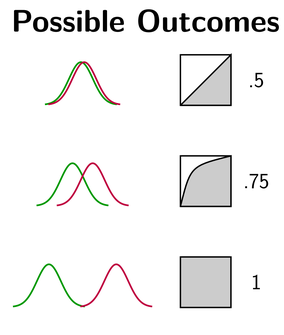
"worse" → low conf.

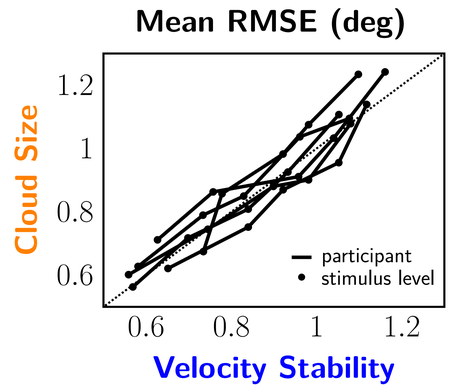
Result 1: Meta-Cognitive Sensitivity

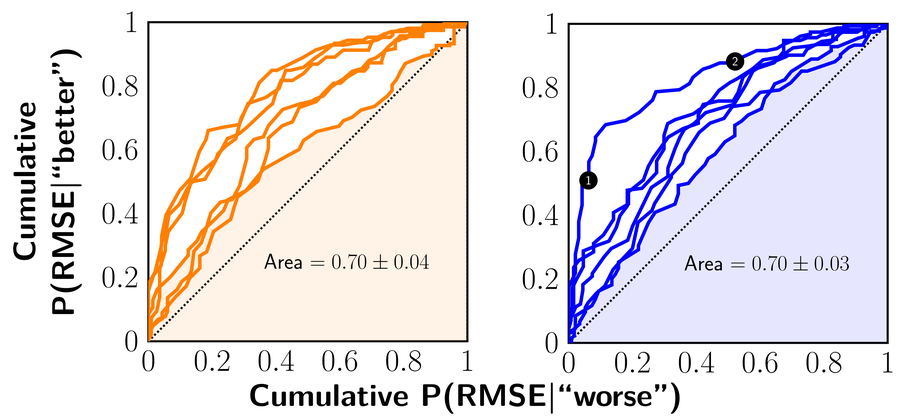
Relationship between actual tracking performance and confidence report?

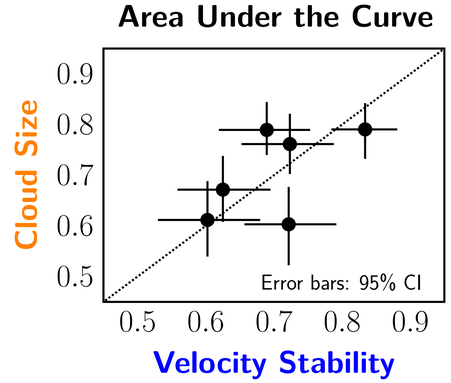
The ROC-like curves reflect the separation of the high- and low-confidence distributions. The area under the ROC-like curve is a non-parametric measure of meta-cognitive sensitivity that indicates how well we can predict confidence from performance.





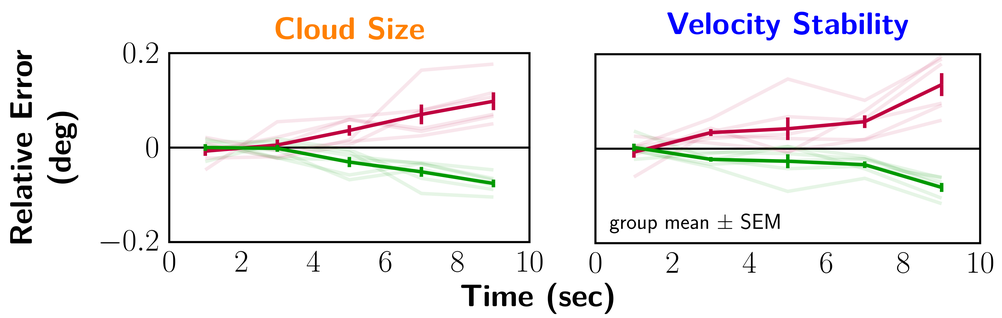






Meta-cognitive sensitivity is above chance and similar for the obvious and subtle difficultly manipulations.

Result 2: Temporal Analysis of Confidence Judgement



Tracking error later in the trial is a better predictor of confidence.

Conclusion

YES! Because participants monitored performance beyond obvious visual cues.

But, temporal analysis indicated a lossy monitoring of tracking error over time.

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