Subjective Uncertainty & Suboptimal Inference

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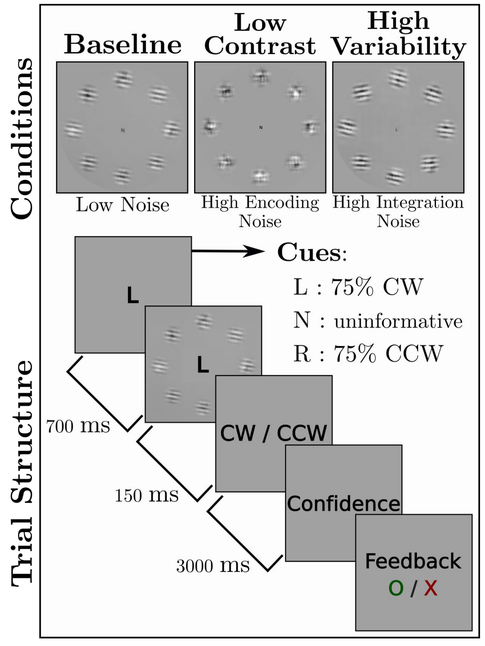
Introduction

1. When we make decisions, we have a **sense of confidence** over whether we made the right choice.
   a. Our sense of confidence is correlated with the amount of evidence presented.[1]
   b. Ability to calibrate confidence in one's performance diminishes when there is higher-level noise in the signal, resulting on relative **under- or over-confidence.**[2,3]
2. We replicate & extend Castañón et al., 2019.
   a. Subjects perform a decision-making task when faced with high encoding noise & integration noise in separate task conditions. To learn more about the types of noises, please click on the mic & text **icons above**.

Hypothesis

Subjects' **confidence will be less aligned to their accuracy** in the presence of **integration noise**, than that of **encoding noise**.

Methods



Task

Subjects (n=10, 3 informed) estimate whether mean orientation of patches was clockwise (**CW**) or counterclockwise (**CCW**), w.r.t, horizontal.

Cue(present in 1/2 trials)

A letter indicated the correct answer with 75% accuracy.

Report

Post-decision, subjects rate their confidence: Low, Medium, High.

Each subject: 3 sessions; 25 blocks each session; 36 trials each block.

1 session = 1 hr.

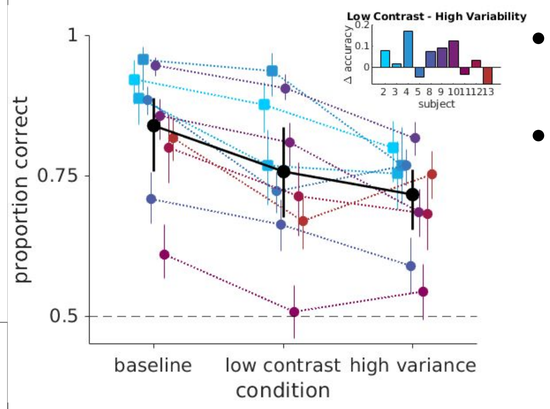
Pay = 10$/hr.

By-Subject Analyses

In the *presence of integration noise* subjects **relied less on our cue**; however, we found **no misalignment between confidence and accuracy**.

We found noticeable differences in these trends across subjects.

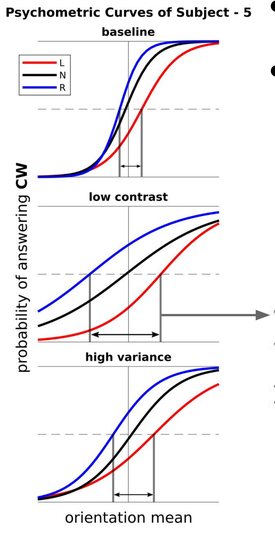
Lower Accuracy in 'high variability'



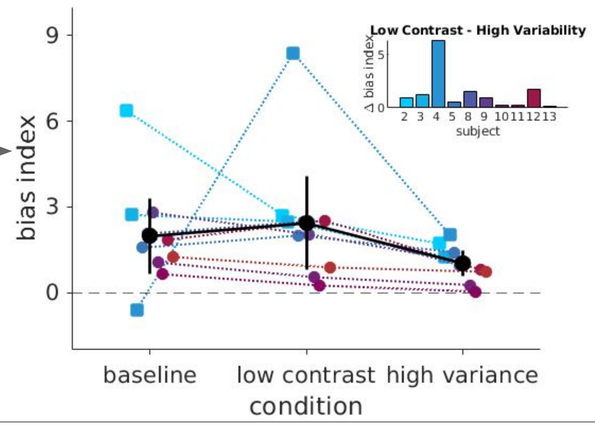
- On average, accuracy is lower in *low contrast* and *high variability*.
- **By subject bar plot***:* Most subjects perform better in low contrast than high variability

IMPLICIT CONFIDENCE MEASURE - CUE RELIANCE

Lower Cue Reliance in 'high variability'

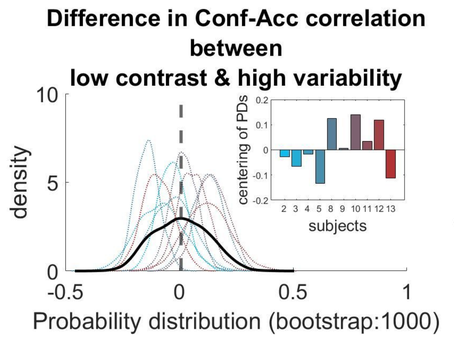


- Bias index **(below)** = difference in bias terms of (separation between) red & blue curves **(left).**
- **By subject bar plot**: Most subjects show higher cue reliance in low contrast than in high variability.



EXPLICIT CONFIDENCE MEASURE - CONFIDENCE REPORTS

Similar confidence-accuracy alignment in 'high variability' and 'low contrast'



- On average, difference in alignment correlation) between conditions **is centered at 0,** which implies no misalignment in high variability, when compared to low contrast
- **By subject bar plot:** some subjects show positive centering instead of 0), some negative.

Discussion

Conclusions:

1. Increase in **integration noise (high variability),** when compared to an increase in encoding noise (low contrast), produced:
   - **Overconfidence**, as measured by lower reliance on our cue. This replicated the original study's findings.
   - **No misalignment** between confidence and accuracy, as measured by analysis of self-reported confidence levels This deviated from the original study's findings.
2. Subjects showed **considerable variability** among themselves. This was our extension to the original study's findings.

Limitations:

- Deviation from the original study's methodology - Confidence reports were 3-scaled (L,M,H) instead of continuous, 0-100 scaled.

Future steps:

- A comparison between cue usage (implicit measure of confidence) and self-reports (explicit measure of confidence).

References

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2. Herce Castañón, S., Moran, R., Ding, J., Egner, T., Bang, D., & Summerfield, C. (2019). Human noise blindness drives suboptimal cognitive inference. *Nature Communications*, 10(1), 1719. https://doi.org/10.1038/s41467-019-09330-7
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4. Zylberberg, A., Fetsch, C. R., & Shadlen, M. N. (2016). The influence of evidence volatility on choice, reaction time and confidence in a perceptual decision. *eLife,* 1–31. https://doi.org/10.7554/eLife.17688