Metacognition in audiovisual spatial integration

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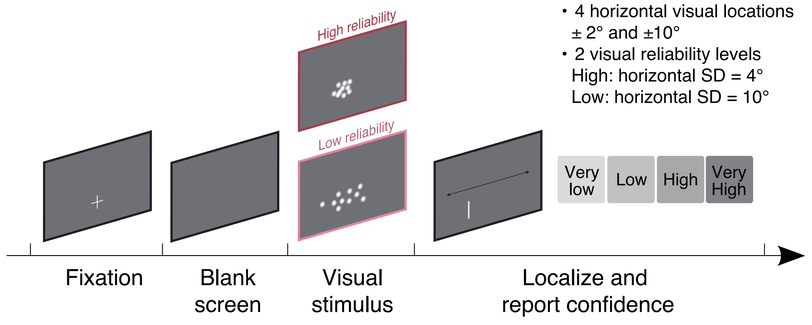
Background

- Humans are often optimal in multisensory cue integration by combining sensory cues weighted by relative reliability[1,2].
- Humans retain access to unisensory cues in cross-modal integration[3].
- Do humans also have access to reliability estimates of unisensory cues for metacognition?
- Are humans also optimal in confidence report by using the same posterior distribution as was used for multisensory estimation?

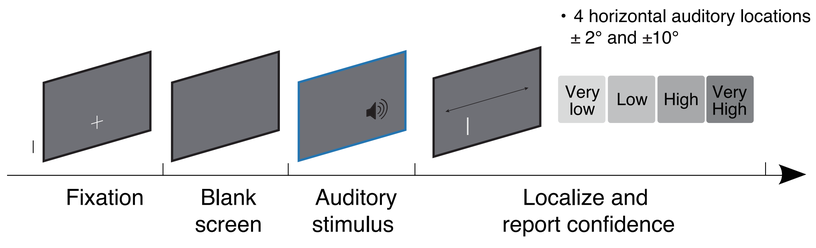
Experiment

Unimodal visual localization task



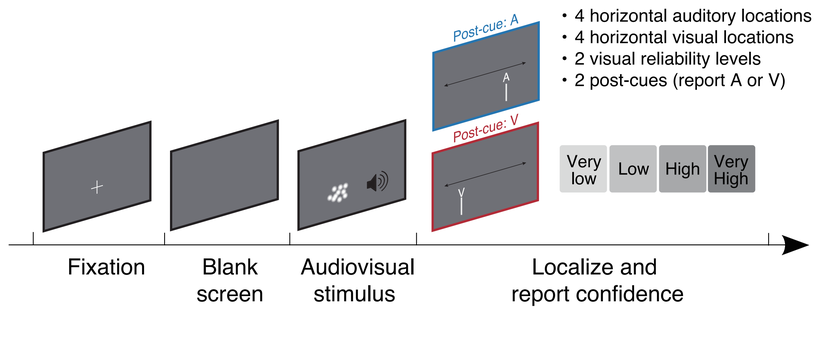
- 4 horizontal visual locations ± 2° and ±10°
- 2 visual reliability levels
  High: horizontal SD = 4°
  Low: horizontal SD = 10°

Unimodal auditory localization task



- 4 horizontal auditory locations ± 2° and ±10°

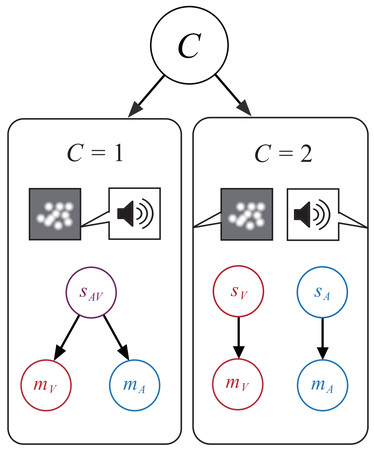
Bimodal audiovisual localization task



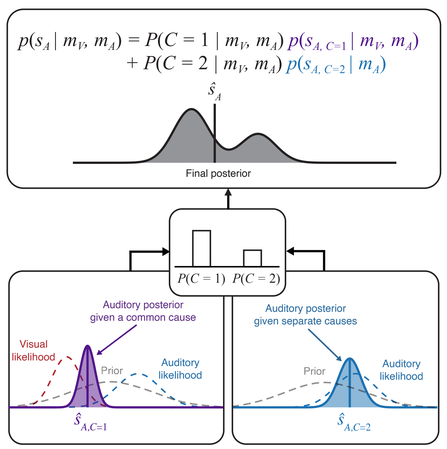
- 4 horizontal auditory locations
- 4 horizontal visual locations
- 2 visual reliability levels
- 2 post-cues (report A or V)

Causal-Inference Model[4,5,6]

Generative model



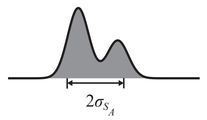
Bayesian inference model of auditory location as an example



Confidence Models

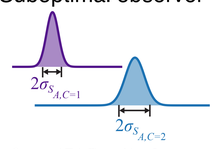
Three confidence models base confidence θ on variances at different stages of the causal-inference process.

Optimal observer



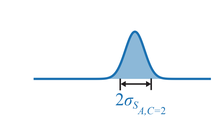
$\theta_A = \sigma^{-2}_{S_A}$

Suboptimal observer

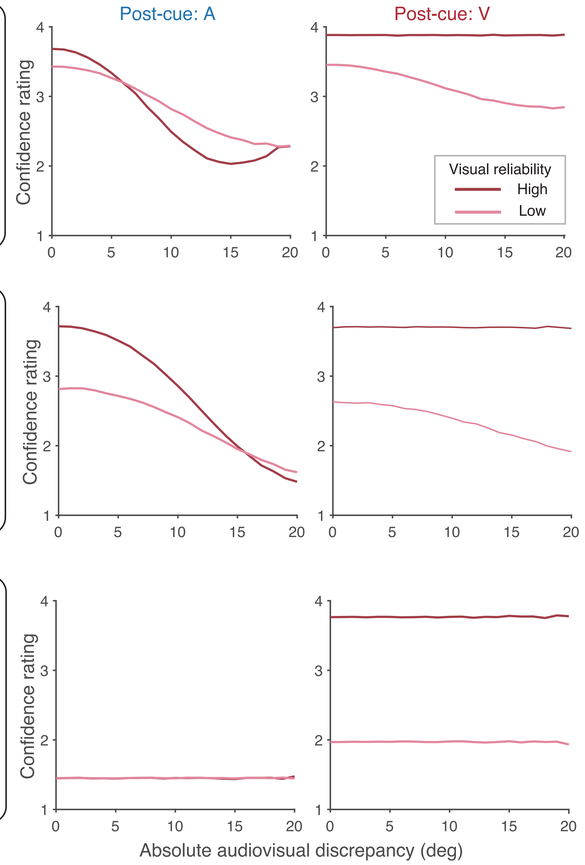


$\theta_A = (P(C = 1)\, \sigma^2_{S_{A,C=1}} + P(C = 2)\, \sigma^2_{S_{A,C=2}})^{-1}$

Heuristic observer

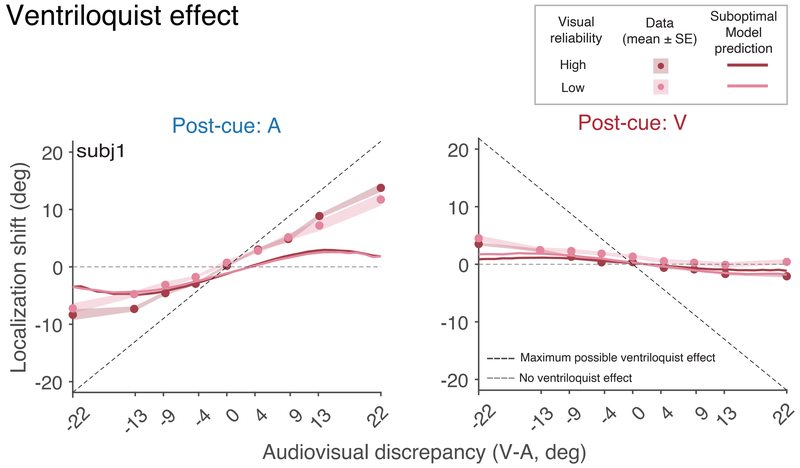


$\theta_A = \sigma^{-2}_{S_{A,C=2}}$

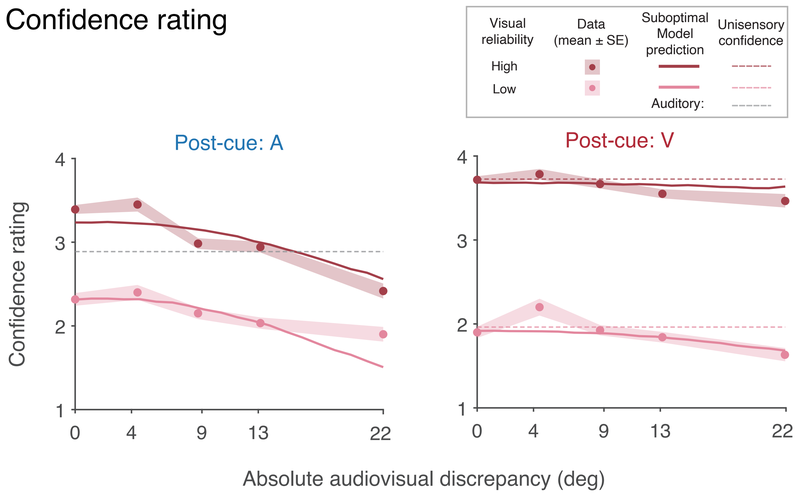


Results

Ventriloquist effect



Confidence rating



- Example participant is best fit by the suboptimal model.
- Two out of the three participants so far are best fit by the suboptimal model and one by the heuristic model.

Conclusions

- Observers have access to reliability estimates of unisensory cues but do not use them optimally to report confidence.
- Confidence reports of multisensory spatial integration are not consistent with the Bayesian confidence hypothesis[7].

References

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