Confidence Biases on detection & discrimination

A research on metacognition

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`Detection & Discrimination`

> `Detection` and `Discrimination` are fundamental cognitive processes to understand perception, decision-making and confidence

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- Behavioral Aspects (Mazor, 2020)
  - Detection refers to stimulus is present or not
  - Discrimination refers to identifying specific attributes of stimulus
- Theoretical Aspects (King & Deheane, 2014)
  - Detection is often framed within SDT(Signal Detection Theory), separates sensitivity from decision criteria
  - Discrimination also framed within SDT, but focus on the ability to differenciate between different stimuli . . .

What is `confidence`? (Fleming, 2023 & Dayan, 2023)

- Metacognition refers to the ability to reflect on and evaluate one's cognitive processes

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- Confidence is the key aspect, the assessment of one's own abilities and certainty in judgments or decisions.

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- The neural basis of confidence
  - individual's internal states and beliefs about their cognitive processes.
  - Prefrontal Cortex is the key brain region related

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- The computational basis of confidence(different models to compute confidence)

- First-order evidence accumulation, where sensory information is processed to form a judgment
- Second-order metacognitive processes, which reflect on the first-order judgment to form a confidence estimate

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What's the confidence on detection & discrimination task?

Noise effect to confidence(Mazor, 2020)

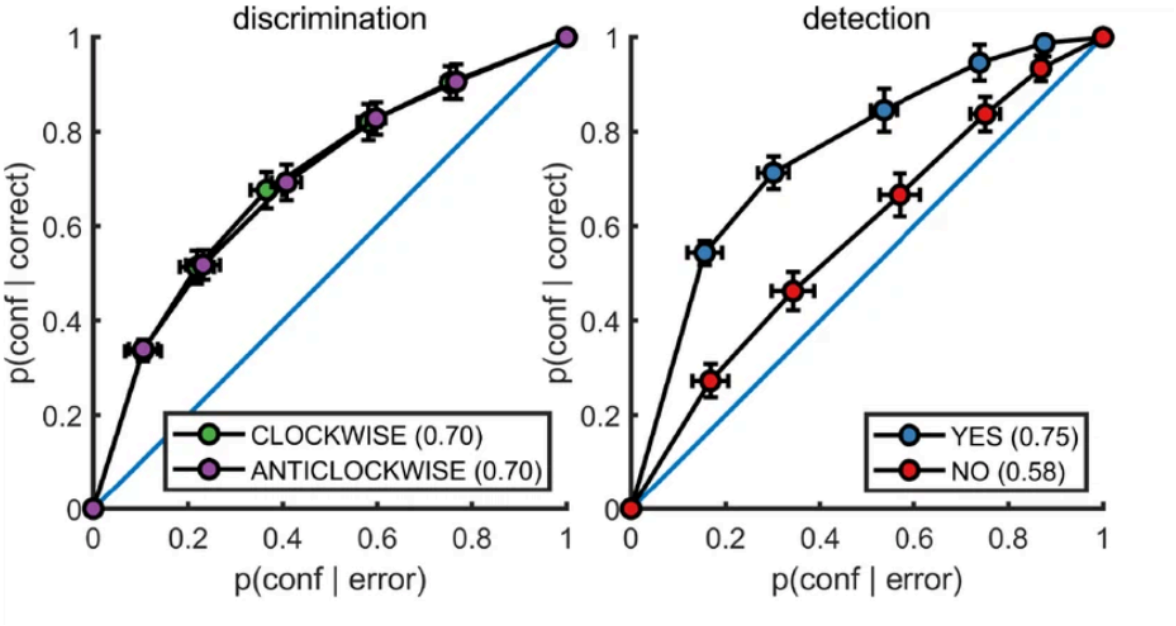

Figure 1: Figures for response conditional Type-2 ROC curves

- Metacognitive sensitivity quantified as the area under the ROC curve.(AUROC)
  - Significantly higher for 'yes' compared to 'no'
  - confidence ratings the presence are more accurate than ratings the absence for detection
  - confidence ratings the similar for discrimination

Results here shows the selctive asymmetry in the fidelity of metacognitive evaluation following judgments about target absence.(Kanai, 2010)

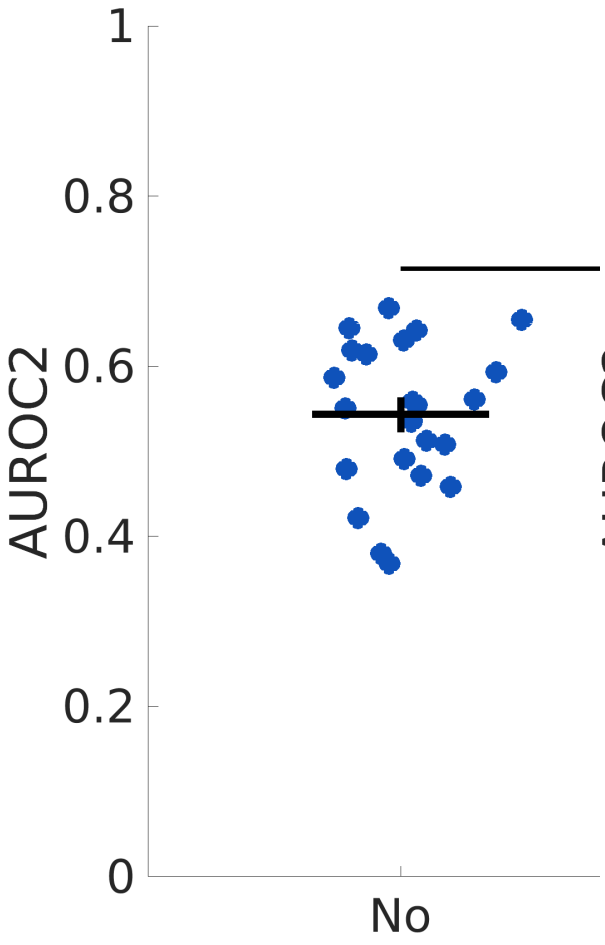

Figure 2: detection

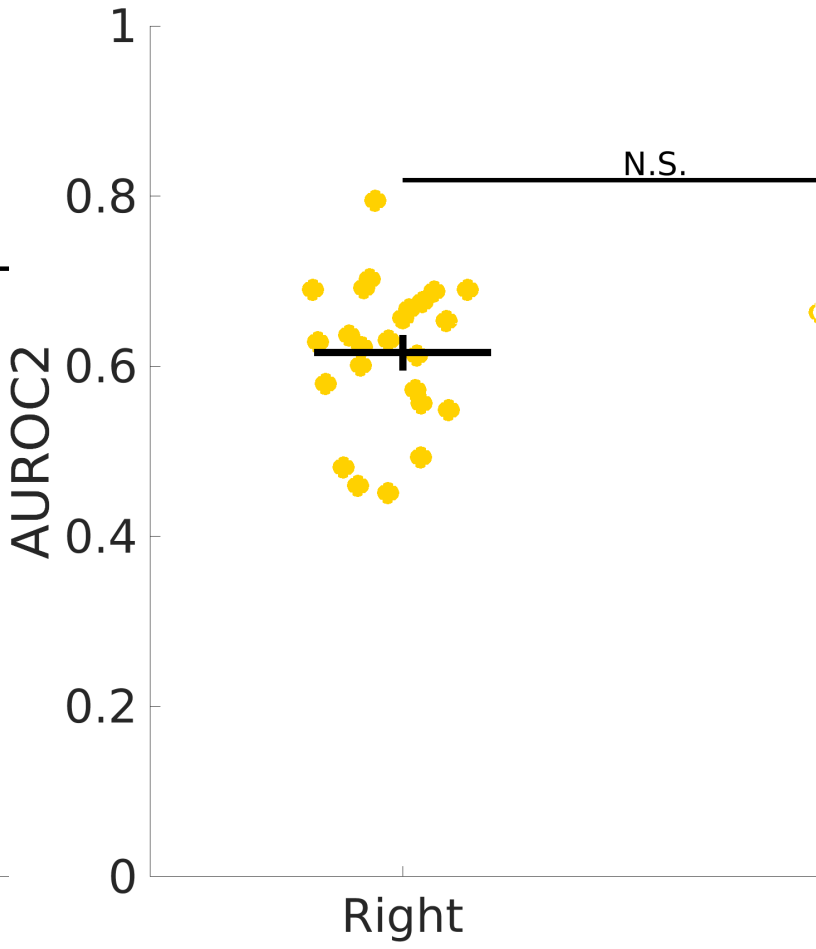

Figure 3: discrimination

Figure 4: AUROC per response for two tasks

Hugo's insight

- Interests from Hugo's experiments
  - Confidence ratings for discrimination keep the similar pattern with Mazor's
  - Confidence ratings the absence are more accurate than ratings the presence, inverse from Mazor's
  - This experiment perform on a sample balanced dataset(environmental setting)

The computational modelling measurements

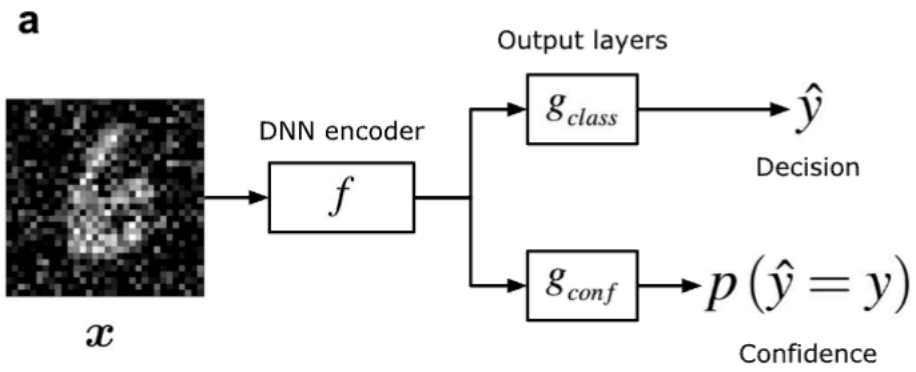

Figure 5: Figure of the DNN structure

To analyze the paradox of how stimuli objectively inversed for perceptual detection task

Taylor Webb's DNN helps us to certify the confidence rating for perceptual tasks

Hypothesis

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  The confidence levels in determing the presence or absence of objects may paradoxical affected by the levels of environmental settings in which the detection and discrimination tasks are performed.

  - Different rules for sample balancing reflects to different environmental settings
  - Perform the perceptual task on unblanced or different combinations for balancing could reflect different results
  - Aim to find the the computational and neural mechanisms of confidence