Expected precision and perceptual confidence

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Background

Cognitive scientists think that metacognitive mechanisms estimate the reliability or 'precision' of incoming sensory signals. However, little is known about how these estimates are formed [1]. Bayesian models suggest that observers form meta-level beliefs about the precision of their percepts and that these expectations about the reliability of sensory signals bias perceptual confidence [2,3]. Here we will test this possibility.

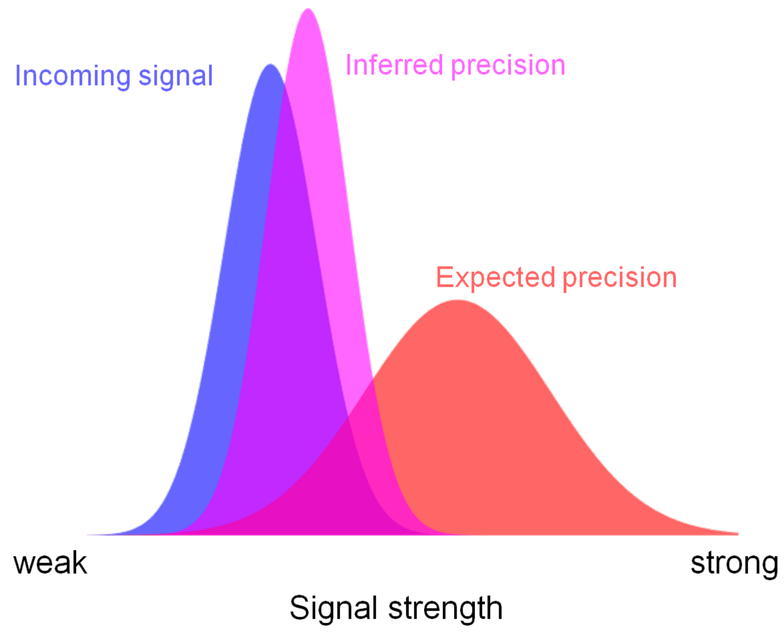

Fig. 1: Bayesian models of metacognition propose that prior expectations (red curve) can bias observer's beliefs in the reliability of incoming signals (blue curve), leading them to be overconfident in their perceptual decisions (pink curve) even when signals are actually weak or ambiguous.

Experiment 1: Methods

Ps discriminated patterns of left- or rightward moving dots while also rating confidence in their decisions. **Probabilistic cues (colour) manipulated expectations** about signal strength for each trial. Across trials, stimuli varied in signal strength; weak (lower coherence), middle (medium coherence) and strong signals (higher coherence). Ps completed training phase and test phase (see Fig. 3). Medium coherence trials in the test phase probed whether we could bias confidence in perceptual metacognition.

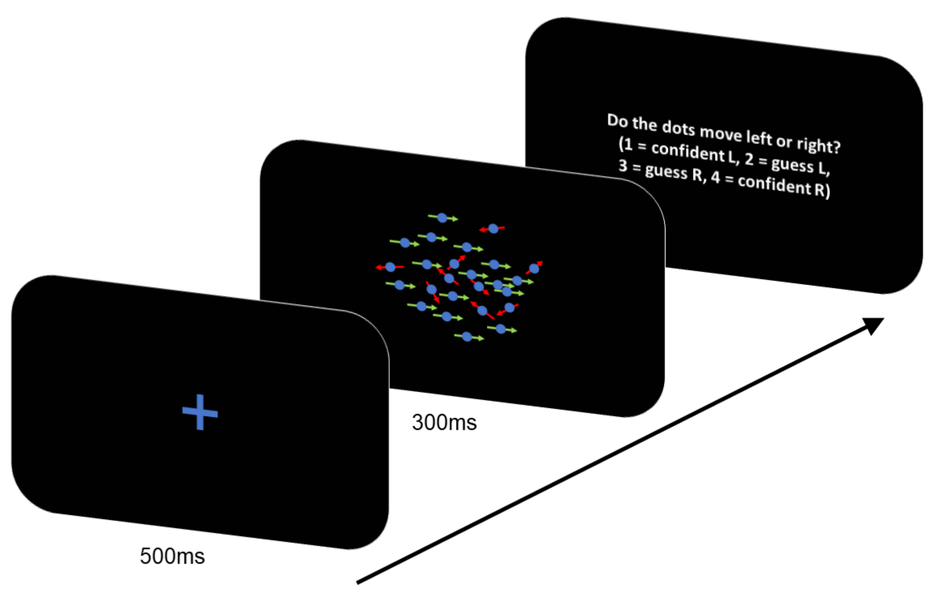

Fig. 2: Trial sequence.

Ref: [1] Yon & Frith, (2021) Current Bio 17, [2] Fleming & Daw, (2017) Psych Rev 1, [3] Pereira et al., (2020) Proceedings of the National Acd of Sci USA 15

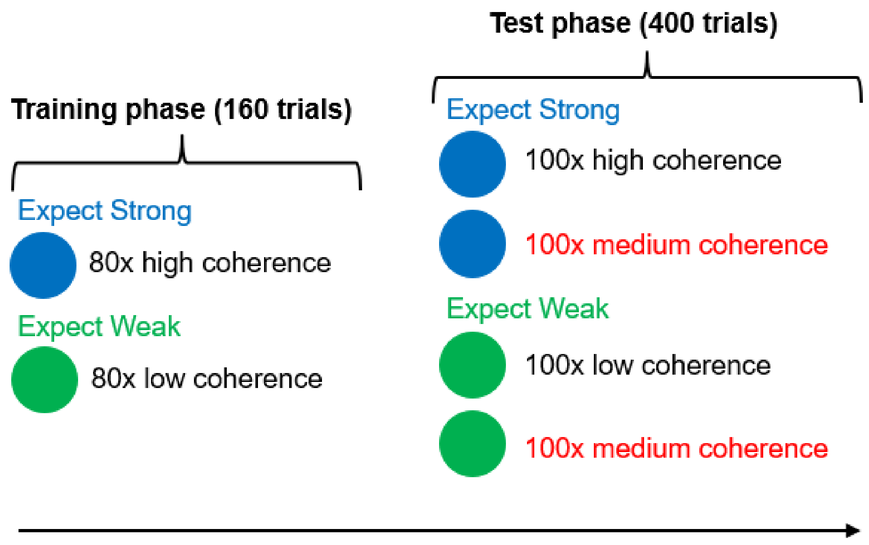

Fig. 3: The training phase aimed to familiarise Ps with the colour mapping of the probabilistic cues. Medium coherence stimuli were added in the test phase. On these trials objective motion strength is matched but subjective expectations differ due to cues.

Experiment 1: Results

Ps reported **significantly higher subjective confidence on expected strong trials** (*t(33)= 3.015, p=0.005, dz= 0.517*). There was **no difference in objective accuracy** between expect strong and expect weak trials (*t(33)= 0.913, p=0.368, dz= 0.156*).

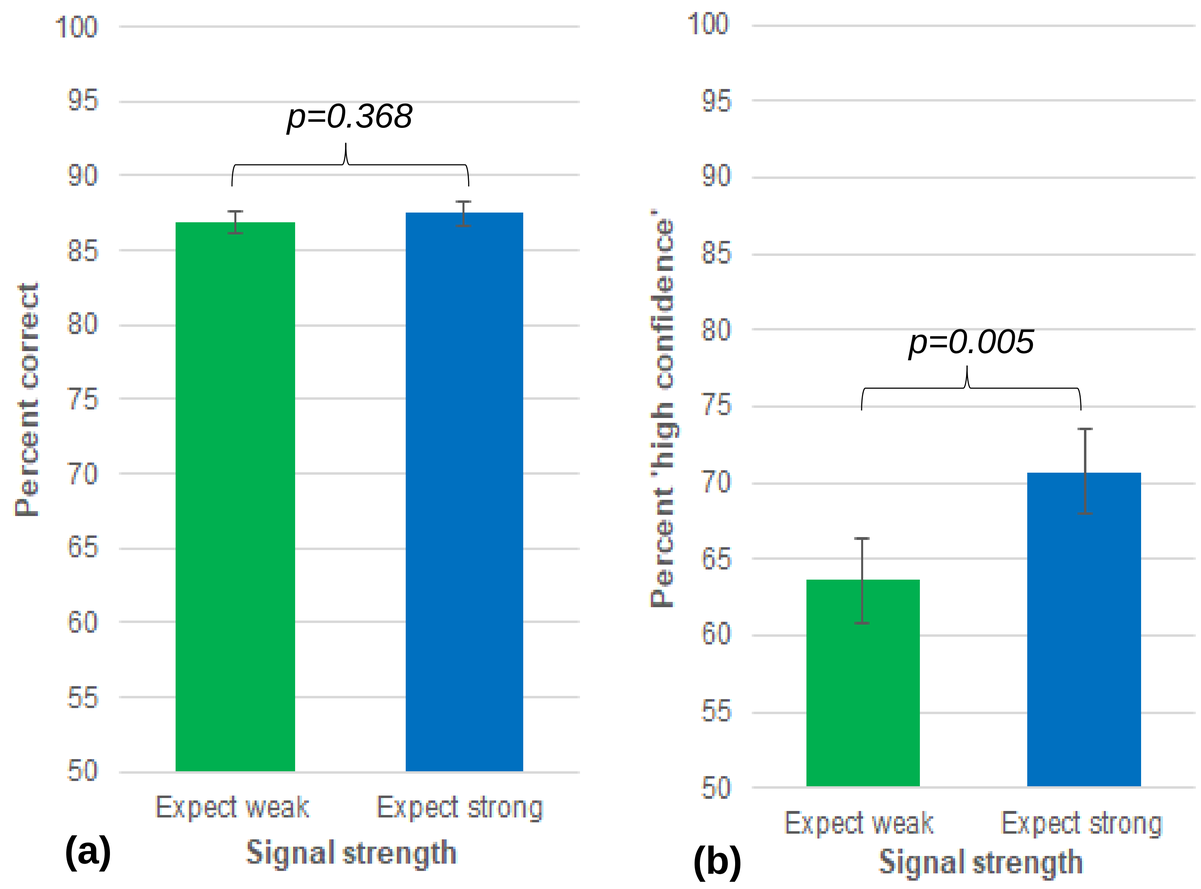

Fig. 4: (a) Ps showed no significant difference in accuracy between 'expect weak' and 'expect strong' trials. (b) Ps reported significantly higher confidence on 'expect strong; trials.

Conclusion and future directions

These results suggest we can condition confidence. **This supports Bayesian models which hypothesise that expectations should bias metacognition**.

A proportion of Ps were at ceiling in accuracy (and confidence) on the medium strength test trials. Adjusting this feature of the task may allow us to see more variance in subjective confidence – and possibly an even larger effect.