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First impression bias in the development of perceptual priors

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Bayesian and predictive coding theories of cognition view perception as the combination of sensory inputs with prior knowledge of the environment. On average, this process results in more accurate and faster perceptual judgements, as long as this knowledge is accurate. To be optimal, priors should update in the face of new information. Past studies have shown that this is indeed the case for simple cue association priors, but research of more complicated priors is lacking.

We here used a moving dots task to investigate the statistical learning and updating of a continuous prior distribution. Participants were asked to estimate the direction of motion of low-contrast dots, which follow a particular distribution. In previous studies participants developed a prior similar to the bimodal stimulus distribution within 200 trials, as evidenced by their biased estimates, lower reaction times, and false alarms. In the current implementation of the task, stimuli were initially drawn from a trimodal distribution, which was switched to a complementary bimodal one after half the trials, without notifying the participants.

Our results show that, as expected, participants learned the initial distribution within the first 200 trials. However, they failed to update their priors, even after 300 trials of the complementary distribution. Instead, they continued exhibiting biases in accordance with a trimodal prior. Bayesian modelling of the participant estimations verified our findings. These results provide evidence for a 'first impressions'bias in prior acquisition, where models of the environment are resistant to change in the face of contradicting information.

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