125-Perception & imagery #15

Effects of expectations and sensory unreliability on illusory auditory agency detection – a preregistered study

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BACKGROUND

- Agency detection is the capacity to detect intentional agents in one's surroundings, which has been said to underlie religious beliefs and experiences (e.g., Barrett & Lanman, 2008)
- In the predictive processing model of agency detection, we detect illusory agents where the prior probability is high and sensory reliability is low (Andersen, 2019).
- In a previous study, Andersen et al. (2019) found that expectations and sensory unreliability drive detection of illusory agents in virtual reality.
- We conducted a preregistered follow-up experiment in a purely auditory setting to test if expectations & sensory unreliability drive response bias in voice detection.
- We manipulated expectations (high vs. low) and noise (white noise vs. no noise) in a signal detection task.

QR code to OSF preregistration

Hypotheses:

- Participants with high exp. will exhibit a stronger bias towards „signal present" resp. than participants with low expectations.
- Participants with high exp. will exhibit a stronger bias towards "signal present" resp. in noise stimuli as compared to no noise stimuli.
- Participants with low exp. will exhibit a stronger bias towards "signal not present" resp. in noise stimuli as compared to no noise stimuli.

METHOD

Participants: *N* = 122 (77 F, age M = 25.2), 3 part. excluded.

Study design: B-S (high vs low exp.), W-S (noise vs no noise)

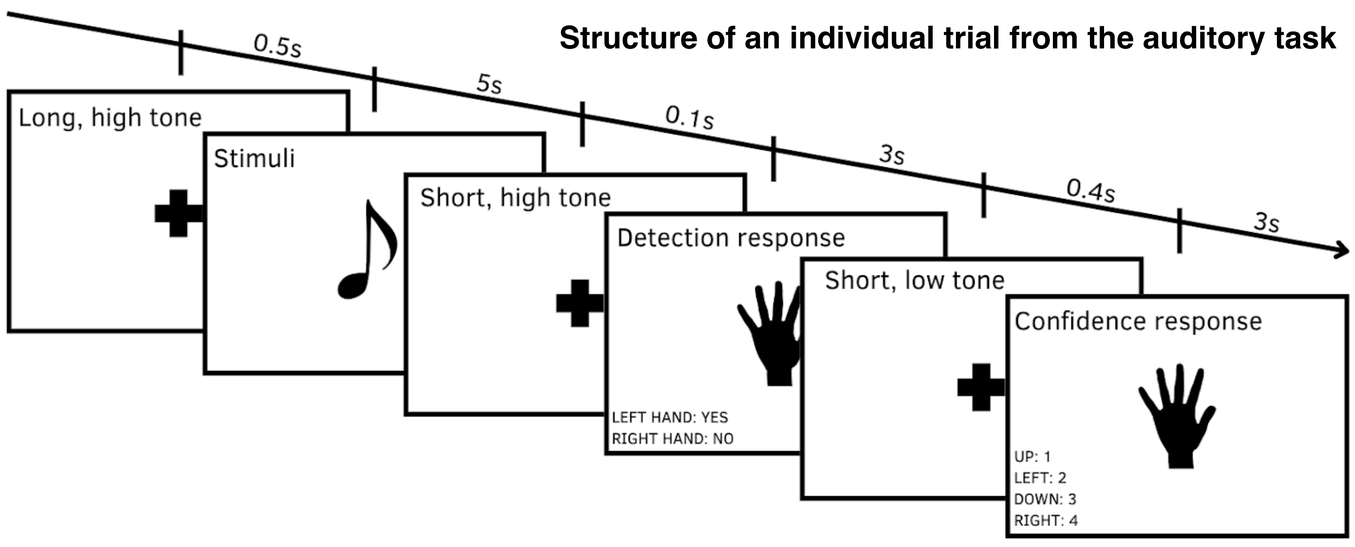
Auditory task: general instructions, training, manipulation, proper task

Stimuli: 120 sounds (60 with voice, 60 with noise, counterbalanced)

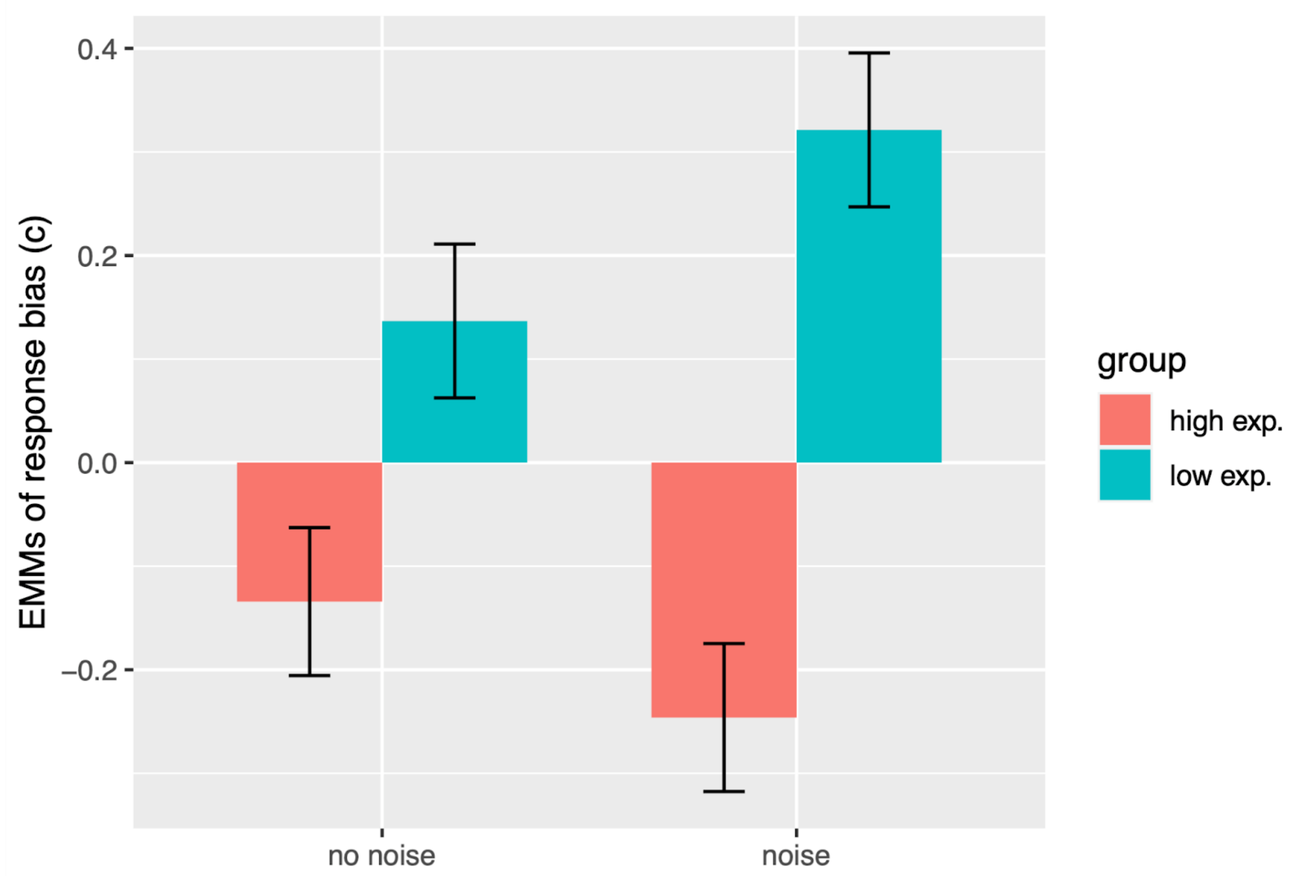
Questionnaires: Paranormal and Sup. Belief Scale (Dean et. al, 2021), Absorption Scale (see Luhrmann et al., 2021)

Data preprocessing: z-scores for Hits, FAs, Misses and CRs; we computed sensitivity (*d'*) and response bias (*c*). Higher *c* = more conservative strategy.

Structure of an individual trial from the auditory task



RESULTS



Main analysis (N = 104): linear mixed effects model (R^2=0.72)

Effect of group (β = -0.27, p = .009) and an interaction (β = -0.30, p < .001)

- EMMs pairwise comparison:
  - Low exp. group: no noise - noise (t = -3.05, p = 0.015, d = -0.62, 95% CIs = [-0.34; -0.03])
  - High exp. group: no noise - noise (t = 1.92, p = .225, d = 0.37 , 95% CIs = [-0.04; 0.26])
  - No noise condition: low exp. - high exp. (t = 2.63, p = 0.046, d = 0.9, 95% CIs = [0.01; 0.54])
  - Noise condition: low exp. - high exp. (t = 5.50, p < .001, d = 1.89; 95% CIs = [0.30; 0.84])

Additional analyses:

- Noise decreased *d'* (V = 1716, p = .002), group had no effect on *d'* (W = 5168, p = .593)
- No significant effects of PSBS or absorption.
- Confidence was boosted in trials congruent with expectations and decreased by noise.

DISCUSSION

- In our study, we found that expecting to hear a lower or higher number of voices than actually present leads to a more conservative or liberal response bias, respectively. This effect was enhanced when a white noise was present in the stimuli.
- It is hard to explain our findings with a mere drop in performance caused by noise, as noise affected each group differently.
- The data aligns with predictive processing account of agency detection, where prior beliefs and sensory unreliability leads to illusory agency detection. This mechanism might be a building block of auditory religious experiences: hearing religiously meaningful voices might result from high relevant expectations and conditions of sensory unreliability.
- As we were obliged to exclude many participants that suspected the true purpose of the study, we recommend enhancing the believability of instructions in future studies.