Ignorance or awareness of changes measured in a probabilistic inference task

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/ BACKGROUND

A cognitive bias often reported for schizophrenia is the tendency to make decisions based on little evidence, namely the *jumping to conclusions* (JTC) bias. The beads task (Huq et al., 1988) is the most commonly used task to investigate the JTC and different attempts were made to explain the JTC. One proposition is that patients might miscomprehend the task and assume volatility, i.e. a change of the task environment, where there is none (Balzan et al., 2012).

In our task we explicitly stated volatility, i.e. the environment may change.
We tested patients with schizophrenia, autism diagnosis disorder and healthy controls.

It has been demonstrated that when making decisions in volatile environments humans follow Bayesian rules (Nassar et al., 2010).
We thus base our analysis on a Bayesian approach to identify the contribution of ***expected*** *and* ***unexpected uncertainty*** on an agent's behaviour.

/ METHODS

This project is part of a larger ongoing study on cognitive biases.

Here, we administered a version of the beads task that requests the participants to indicate the probability of the bead coming from bag A or B.
We induced ***volatility*** by informing the participants that the jars can change in ca. 50% of all trials.
We developed two mathematical models of an ***Ideal Bayesian observer*** (IBO) – one that incorporated this as a fixed probability value of the volatility, and one that let this probability vary freely (Pfuhl et al., 2015) – and compared them with the participants' responses.

SAMPLE

Participants tested so far:
N = 26 patients diagnosed with schizophrenia (SCZ),
N = 16 persons diagnosed with autism spectrum disorders (ASD), and
N = 42 healthy controls

BEADS TASK

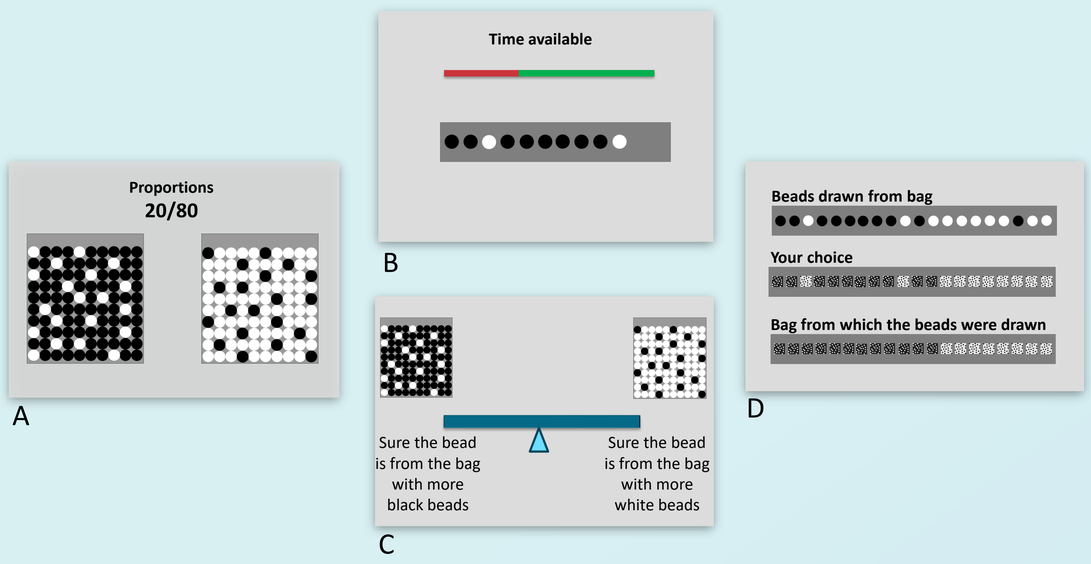


Fig. 1 Beads task
A) Shown are two bags which contain either 80 black and 20 white beads, or the reverse. Beads are drawn sequentially with replacement.
B) & *C)* Each of the 5 trials has 20 draws, and the result of each draw, i.e. the color of the bead is shown. The bag of origin is unbeknownst to the participants. The participants' task is, within 10 seconds, to estimate a probability for the beads being drawn from either the bag with more black or more white beads. They do so by dragging the marker on a visual scale either to the left or the right side.
D) At the end of each trial feedback on the actual bag of origin of the beads is provided.

QUESTIONNAIRE

We mapped the participants' "need for closure" (NFC), or "*a motivated need for certainty*" (McKay et al., 2006) with the Short Need for Closure scale (SNFC; Roets & Van Hiel, 2011).

/ RESULTS

JUMPING TO CONCLUSIONS (JTC)

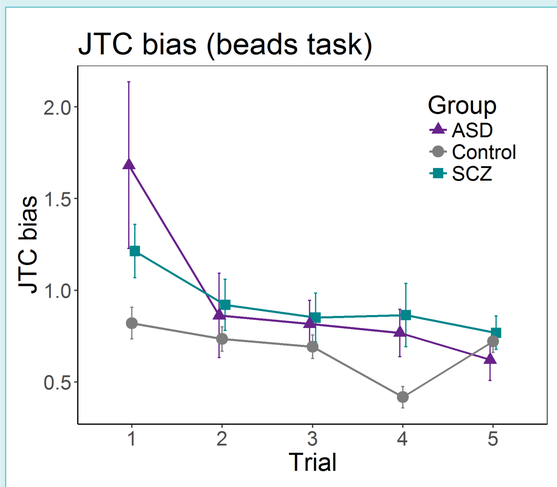


Fig. 2 JTC bias is the ratio of "jumps" (crossing the 0.5 mark on the visual scale in favor of one bag to the other after seeing a change in color between current and prior bead) to color changes per trial. Group means are displayed with standard errors.

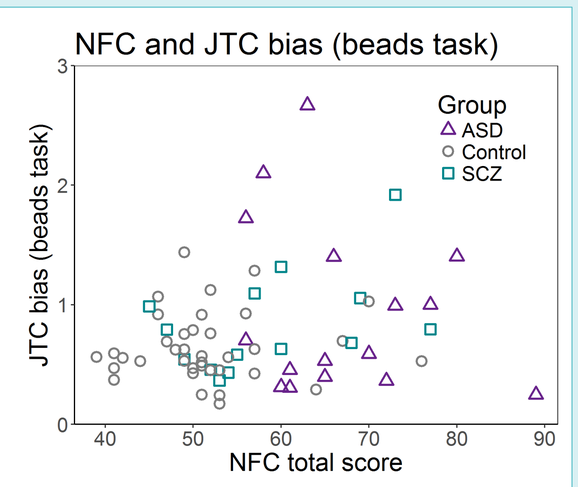


Fig. 3 JTC bias plotted against the Need for Closure (NFC) total score per group.

DEVIATION FROM THE IDEAL BAYESIAN OBSERVER (IBO)

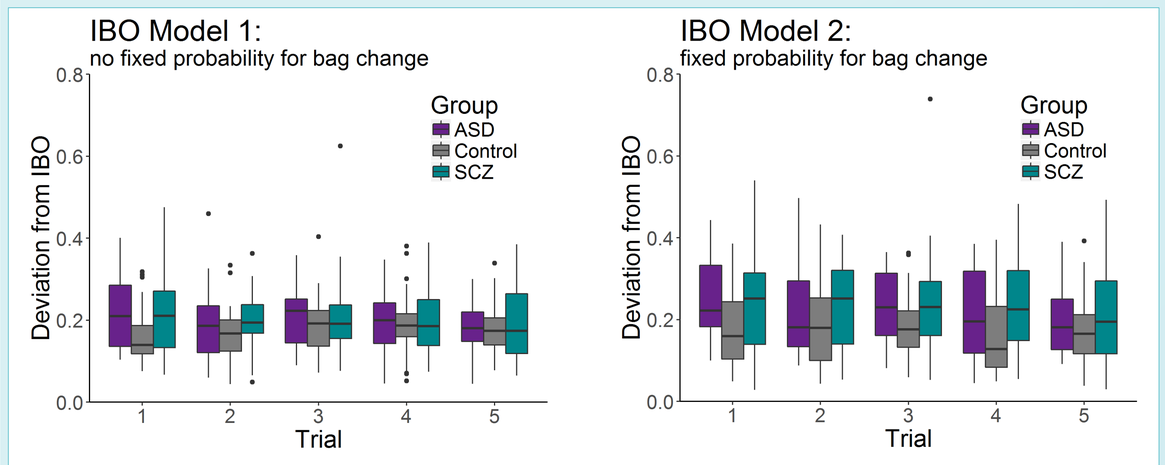
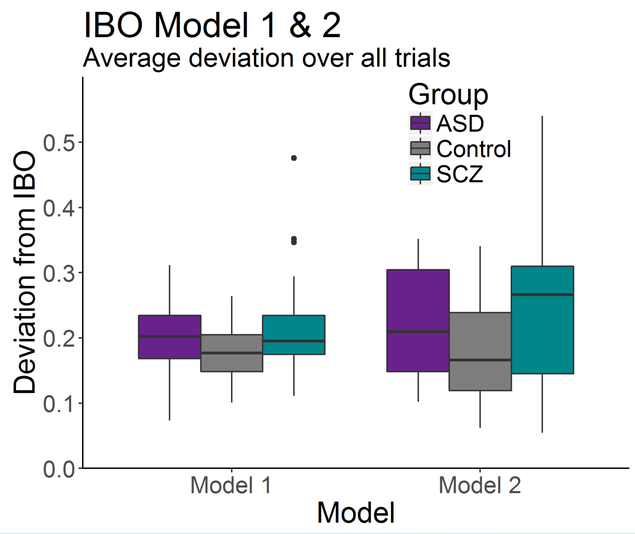


Fig. 4 & 5 Absolute differences between the participants' and the IBO's probability ratings per bead, averaged over number of beads for each trial. Results are displayed for both IBO models.

Fig. 6 Overall deviation from the two IBO models

Model 1: probability value for the bags to change can vary (i.e. bigger or smaller than described in the instruction).
Model 2: incorporates the stated probability value for the bag to change (i.e. bag change in 50% of all trials).



/ CONCLUSIONS & FUTURE PLANS

Patients with schizophrenia and persons with an ASD show a higher JTC bias than the healthy control group, especially in the first trial and with a notably larger variance. This JTC bias is mostly due to overweighting the current evidence and might be influenced by an overestimation of the stated volatility. The bias decreases over the five trials - suggesting learning through feedback.

A high JTC bias seems to be related to a high need for closure (NFC) in patients with schizophrenia, potentially explaining the JTC as a result of coping with averse uncertainty.

The IBO analysis suggests that patients overestimate the stated volatility, i.e. the probability for the environment to change. Our data indicates thus a too strong awareness rather than ignorance of volatility in patients. Further analysis, including the Hierachical Gaussian Filter (HGF; Mathys et al., 2011) is carried out to specify this.

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