# Altered learning of stimulus distribution in individuals with autism

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## Introduction

Alterations in sensory processing are a core phenotype of Autism, encompasses a range of aspects, including illusions, visual search and face perception.[1]

**Two hypotheses:**

1. Imbalanced integration of priors: Proposed theories of autistic perception suggest a reduced effect of prior knowledge on perception.[1,2]
2. Reduced Learning Accounts: Other studies propose that autistic individuals rely on previous knowledge but are slower to update that knowledge.[2]

**Objectives:**

1. Do autistic individuals show changes in how prior experiences affect visual search?
2. Do they demonstrate different learning patterns when searching for features in different target distributions?

**To these aims, we examined how visual search history influences search accuracy and pupil size.**

## Method

Participants searched for a color singleton target and discriminated its orientation (left or right)

**Colors:**

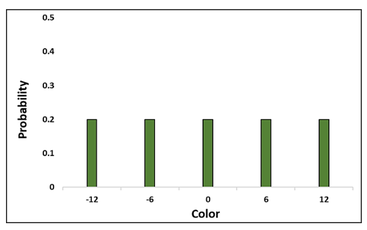
- DKL color space
- Target color: Randomly drawn from either Uniform (Experiment 1) or Gaussian (Experiment 2) distributions
- Distractor-target color distance was fixed
- Search colors and background color were all equilluminant.

The search display was masked.

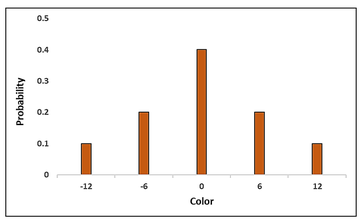
Stimulus–mask SOA was set at a threshold

- Quest staircase procedure

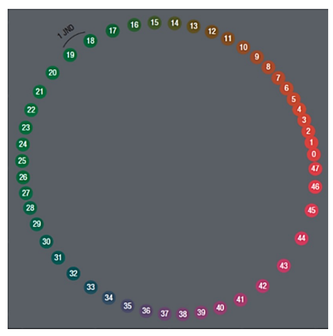
**Dependent variables:** Accuracy and pupil size.




**Exp.1**
Uniform distribution




**Exp.2**
Gaussian distribution



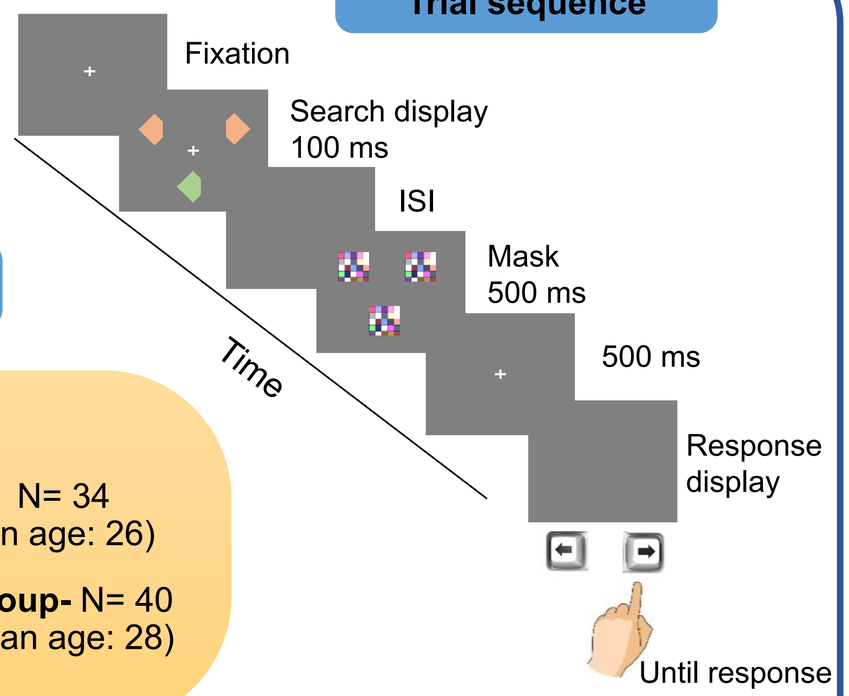
**DKL color space** [3]

**Participants:**

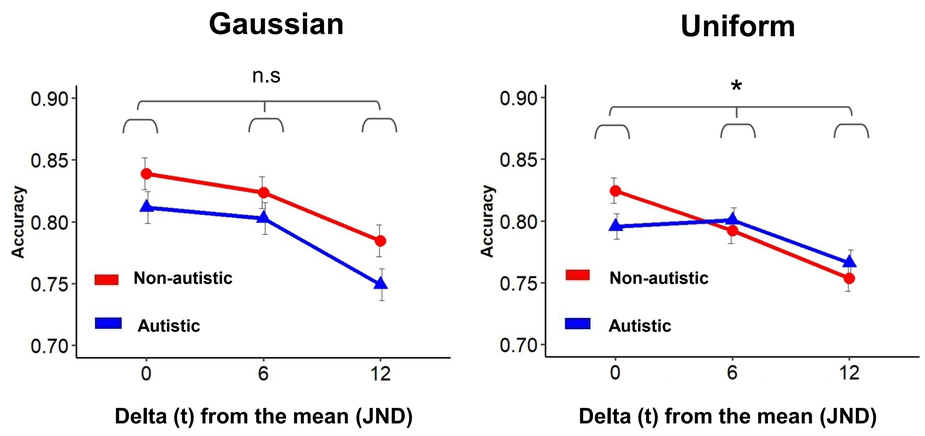
**Autistic group-** N= 34
(8 females, mean age: 26)

**Non-autistic group-** N= 40
(29 females, mean age: 28)

**Trial sequence**

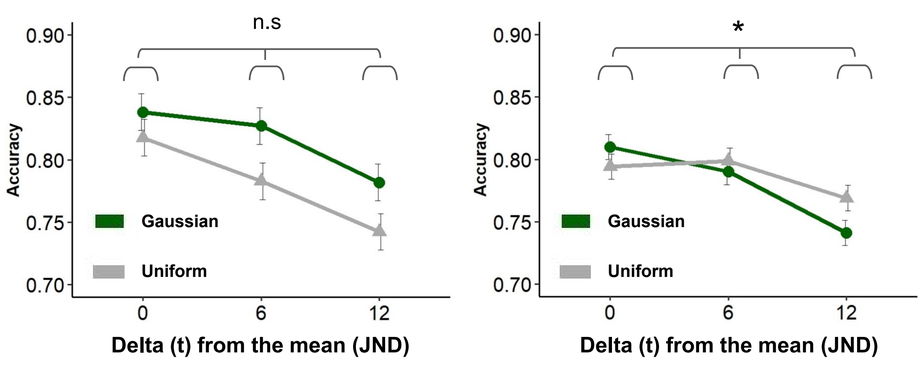



## Results













**Non-autistic:**

Target-mean bias: Accuracy and pupil size varied as a function of target color distance from the mean.

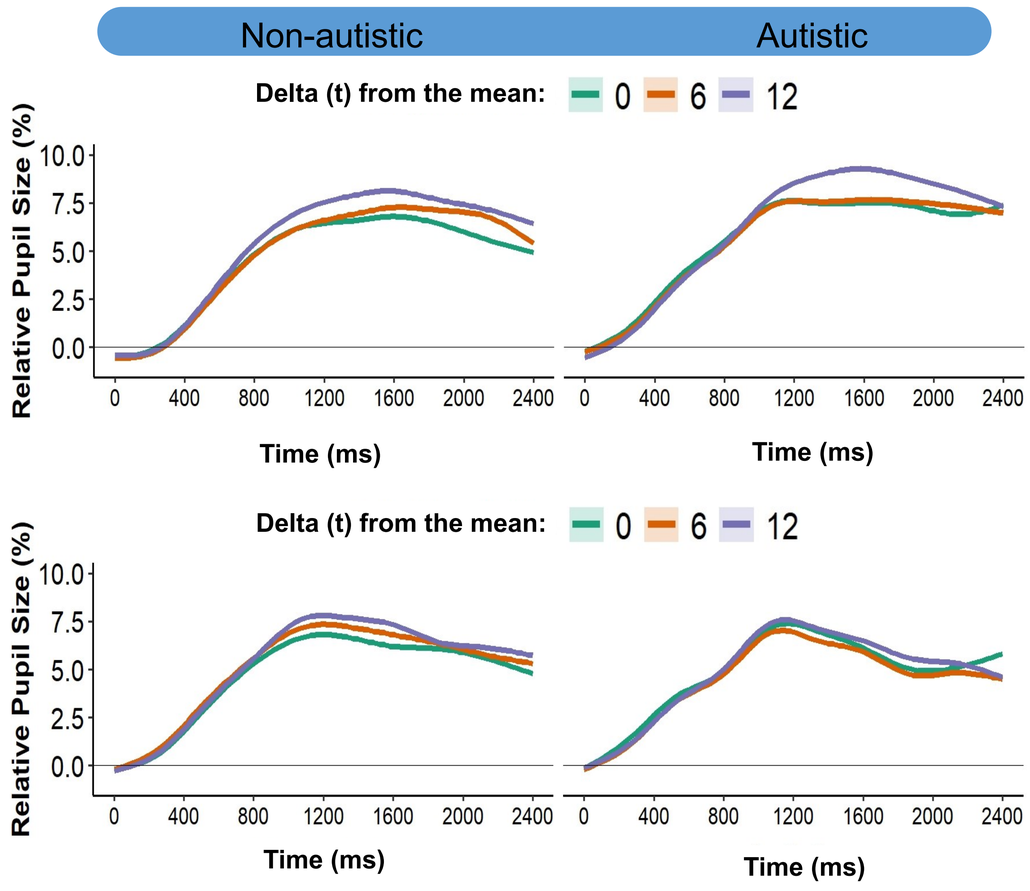
**No interaction with distribution type.**

**Autistic:**

Target-mean bias in Gaussian but not Uniform distribution.

**An interaction with distribution type.**

**Pupil size results**




- Sig. interaction found between Time, Delta (t) from the mean, Group, and Distribution ($p < .001$) based on the Linear Mixed Effect Model (LMEM).

## Conclusion

- When searching for a color singleton, both non-autistic and autistic individuals can learn the statistical regularities over trials.
- Non-autistic individuals extract the mean of previously presented colors, regardless of the color distribution.
- Autistic individuals, however, are sensitive to the shape of the stimulus distribution:
  - They extract the mean only for Gaussian distributions but not Uniform distributions.
- These findings suggest alterations in the processes of forming implicit priors based on search history.

**References**

1. Hadad, B. S., & Yashar, A. (2022). Sensory perception in autism: What can we learn? Annual review of vision science, 8, 239-264.
2. Lieder, I., Adam, V., Frenkel, O., Jaffe-Dax, S., Sahani, M., & Ahissar, M. (2019). Perceptual bias reveals slow-updating in autism and fast-forgetting in dyslexia. Nature neuroscience, 22(2), 256-264.
3. Chetverikov, A., Campana, G., & Kristjánsson, Á. (2017a). Representing colour ensembles. Psychological Science, 28(10), 1510-1517. https://doi.org/10.1177/0956797617713787.2.

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