# Holistic Processing of Unfamiliar Faces and Novel Objects in Autism

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## Background

Autism Spectrum Disorder (ASD) is a pervasive disorder characterized by impaired social communication and atypical sensory processing, among other symtoms.

Difficulty with face perception is a common finding in ASD.

When perceiving faces, typically-developed (TD) individuals use holistic, or conjunctive processing, which we will operationally define here as "perceiving a combination of features as an integrated whole."

**Are face-processing deficits in ASD specific to faces, or do they represent a broad holistic-processing deficit?**

## Methods

*Participants:*
  8 autistic  (2 females, M age = 10 yrs.)
  27 TD participants (14 females, M age = 12 yrs.)

*Stimuli*:
  Novel objects - Objects consisted of 3 features, an outer shape, inner shape, and fill. High-ambiguity (HA) object pairs shared two features, low-ambiguity object pairs shared one.

  Computer-generated faces - HA face pairs included morphed faces that were 90% similar, LA face pairs were 50% morphs. Morphs were piloted to match novel object difficulty levels.

*Task:* Participants were shown pairs of stimuli (objects or faces) and performed a same or different judgment task.

DV: The ratio of within:between item saccades (W:B) was recorded. High W:B is indicative of holistic processing, low W:B of a feature-based strategy[1].
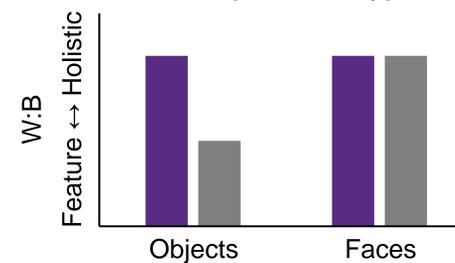
### High Ambiguity     Low Ambiguity



  = High W:B          = Low W:B
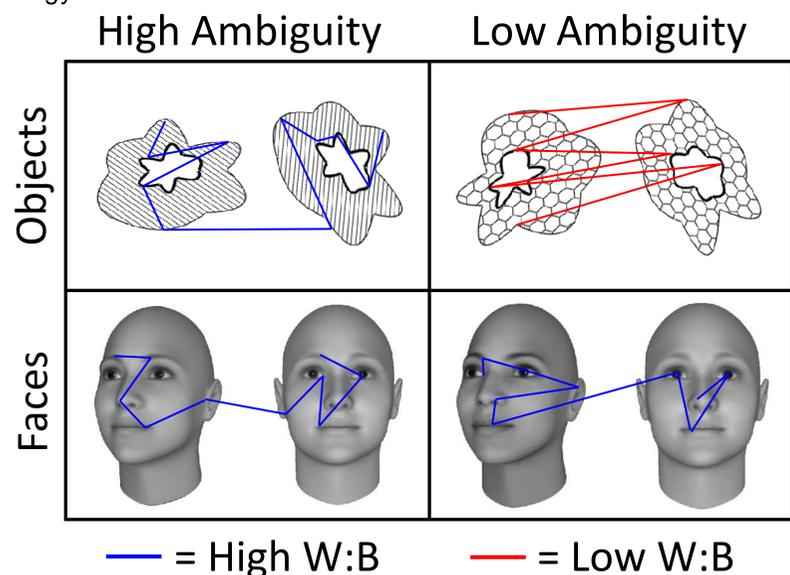
## Hypotheses

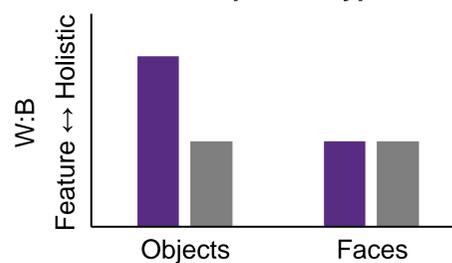*TD / ASD: No Impairment:* HA objects and all faces will be processed holistically.

*ASD: Face-specific*: Objects will not differ from TD, but faces only will be processed less holistically.

*ASD: Holistic-processing:* All stimuli will be processed in a feature-based manner.
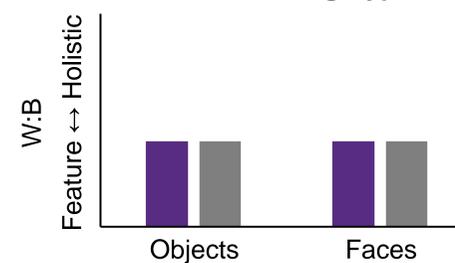


**TD / ASD: No Impairment Hypothesis**

**ASD: Face-specific Hypothesis**

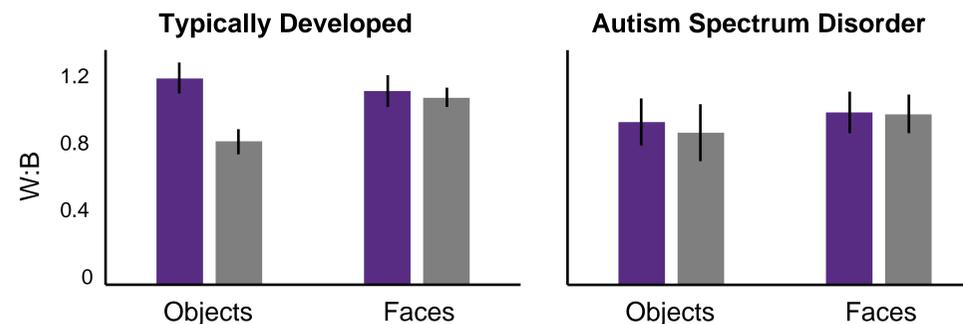**ASD: Holistic Processing Hypothesis**

■ High Ambiguity     ■ Low Ambiguity

## Results

A 3-way, mixed-model, repeated measures ANOVA was conducted.

A 3-way interaction was found ($\eta_p^2 = 0.08$) in addition to main effects of stimulus type ($\eta_p^2 = 0.06$) and ambiguity ($\eta_p^2 = 0.10$), as well as a 2-way interaction between stimulus type and ambiguity ($\eta_p^2 = 0.13$).



**Typically Developed**          **Autism Spectrum Disorder**

Follow-up 2-way, repeated measure ANOVAs were conducted for TD and ASD groups.

TD participants showed an extremely strong interaction between stimulus type and ambiguity level ($\eta_p^2 = 0.41$), as well as main effects of stimulus type ($\eta_p^2 = 0.11$) and ambiguity level ($\eta_p^2 = 0.27$).

Autistic participants did not show any interaction ($\eta_p^2 = 0.01$) or main effects of either stimulus type ($\eta_p^2 = 0.04$) or ambiguity level ($\eta_p^2 = 0.03$).

**$\eta_p^2 \geq 0.06$ is a moderate effect size, $\eta_p^2 \geq 0.14$ is a large effect size**

## Results

Ratios were log transformed to test for differences from chance patterns of looking (1:1).

A 3-way mixed-model, repeated measures ANOVA was conducted.

A 3-way interaction was found ($\eta_p^2 = 0.10$), main effects of stimulus type ($\eta_p^2 = 0.09$) and ambiguity ($\eta_p^2 = 0.17$), and 2-way interactions between stimulus type and ambiguity ($\eta_p^2 = 0.19$) and diagnosis and amiguity ($\eta_p^2 = 0.09$).



**Typically Developed**          **Autism Spectrum Disorder**
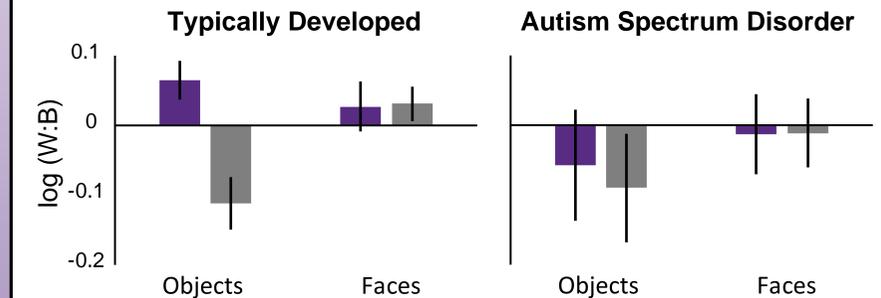
Follow-up 2-way, repeated measures ANOVAS were conducted for TD and autistic groups.

TD participants showed an extremely strong interaction between stimulus type and ambiguity level ($\eta_p^2 = 0.49$), as well as main effects of stimulus type ($\eta_p^2 = 0.14$) and ambiguity level ($\eta_p^2 = 0.42$).

Autistic participants did not show an interaction ($\eta_p^2 = 0.03$) or a main efect of ambiguity level ($\eta_p^2 = 0.05$), but did exhibit a main effect of stimulus type ($\eta_p^2 = 0.07$).

## Discussion

TD participants showed holistic processing with HA objects as well as with faces, regardless of ambiguity level.

Autistic children did not exhibit holistic processing of any stimuli, and showed no trend towards an effect of ambiguity level.

*These data support the holistic-processing hypothesis, suggesting that underlying difficulties with holistic processing contribute to face processing issues in autism.*

Log transformed data revealed a trend towards differential processing of faces and objects in autism, where objects were processed relatively less holistically than faces, suggesting that face processing issues cannot be completely explained by decreases in holistic processing.

1. Barense et al., (2012). *Neuron*, 75, 157-167.

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