

# Increased internal noise in autism spectrum disorder and associations with response variability and overall symptom severity



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## Introduction

- Emerging theories of autism spectrum disorder (ASD) suggest underlying impairments of higher internal noise<sup>1</sup>, which limit perceptual performance
- Our recent finding showed increased internal additive noise in ASD measured in the context of visual orientation processing<sup>2</sup>
- This elevation in signal-independent, internal additive noise may in part reflect the amount of baseline noise in the system
- Motion prediction requires estimating future object position based on experienced sensory information and is complicated by various internal noise (e.g., sensory estimates, prediction demands)
- Elevated internal noise can be reflected as higher variability in prediction responses

### Study Objectives:

- Does internal additive noise as measured in the visual orientation domain generalize to other domains, such as motion?
- Is internal additive noise related to global symptoms of ASD?

## Methods

### Participants:

	Autism Spectrum Disorder (ASD; n=20)			Typically Developing (TD; n=18)		
	Mean	SD	Range	Mean	SD	Range
Age	13.3	2.0	10-16	13.8	2.2	9-17
IQ	109.5	14.2	84-133	114.9	14.6	92-148
ADOS Severity*	6.6	1.5	4-9	1.5	0.9	1-4

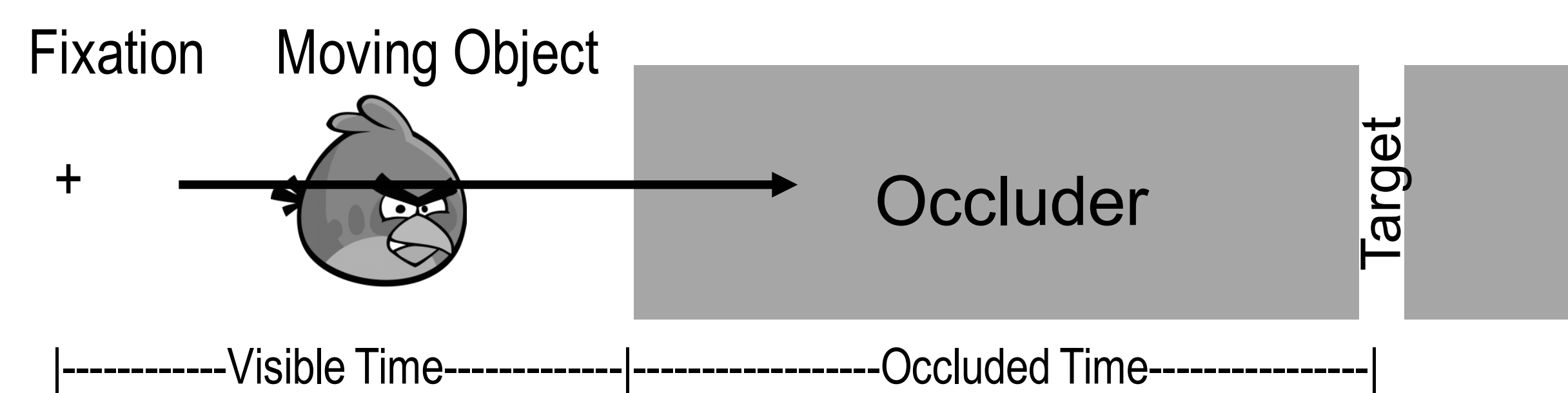
\*ADOS Calibrated Severity Score<sup>3</sup> derived from Autism Diagnostic Observation Schedule (ADOS); 1 (least severe) - 10 (most severe)

### Tasks:

1

- "Is the grating tilted left or right from vertical?"
- 8 external noise levels, 480 trials total
- Measured contrast threshold (%)
- Fit the Perceptual Template Model (PTM)<sup>4</sup> to estimate level of internal additive noise

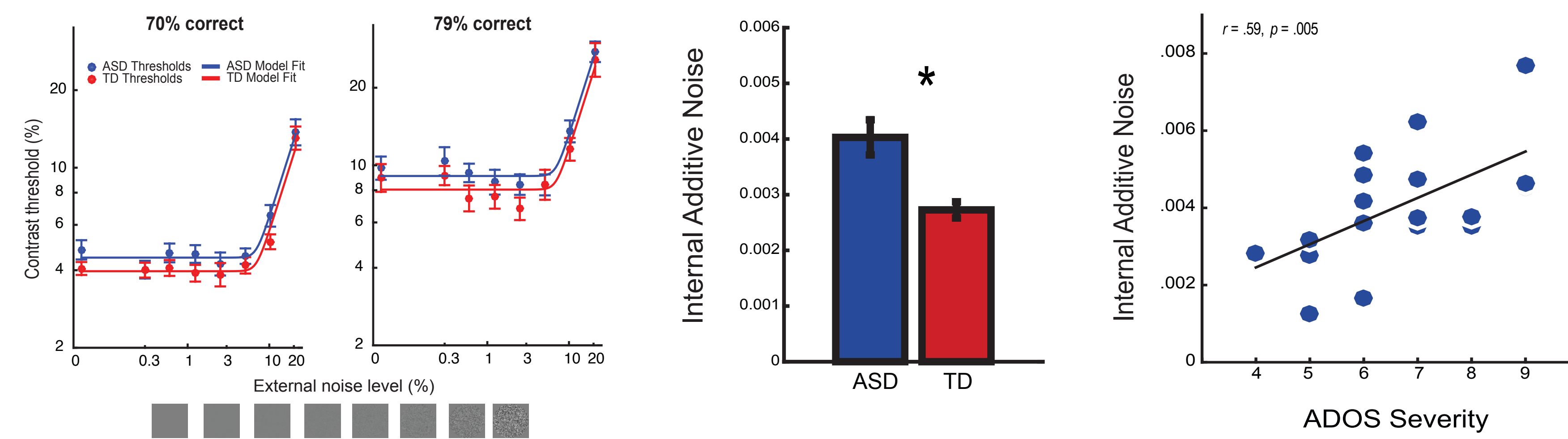
"Press space bar when you think the bird arrives at the white line"



- 400 trials total
- Across trials, object speed and occluder length varied
  - Object speed: 10-20 degrees/second
  - Occluder length: 0.5-20 degrees
- Occlusion Time (seconds) = occluder length/object speed
- Prediction demands during occluded time

## Analysis & Results

### Task 1. Internal Additive Noise in a Visual Orientation Task



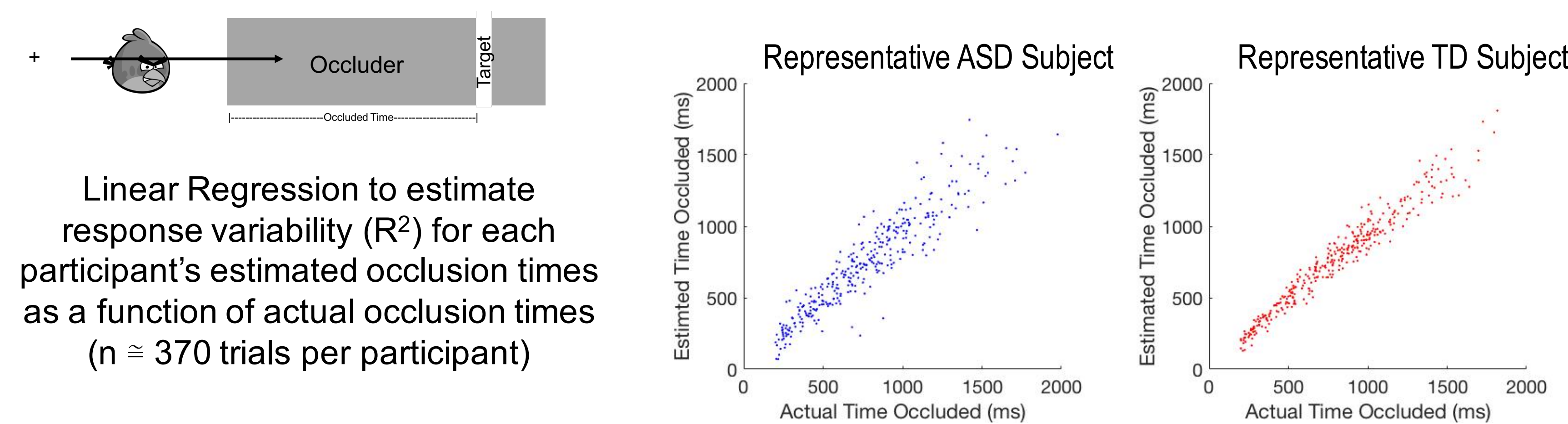
Best explained by:

- 70% increase in internal additive noise in ASD
- 13% worse external noise filtering in ASD

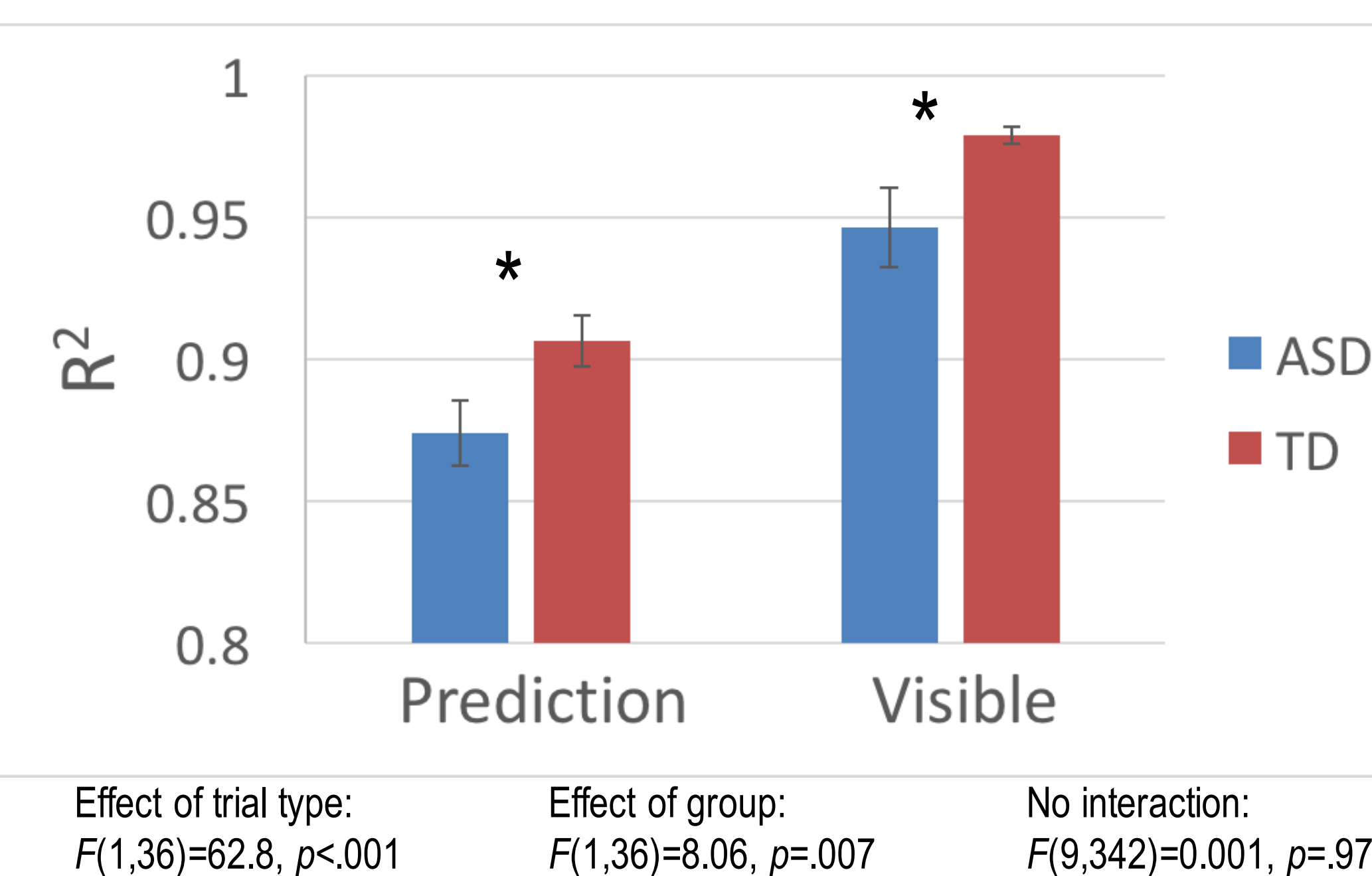
Greater ASD symptom severity is associated with higher internal additive noise

### Task 2. Motion Prediction

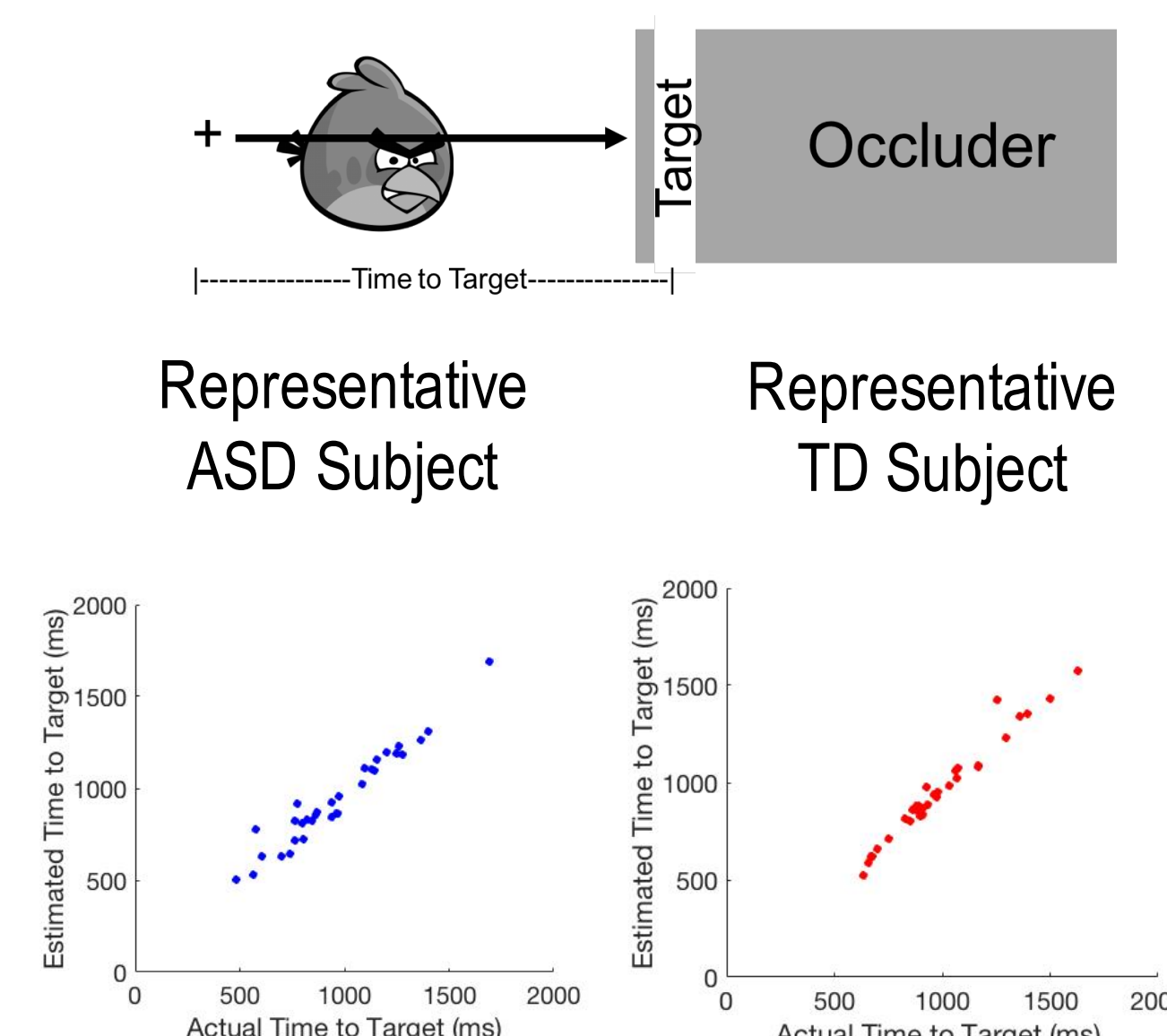
#### Higher Response Variability in ASD



#### Comparison with Trials with No Prediction Demand



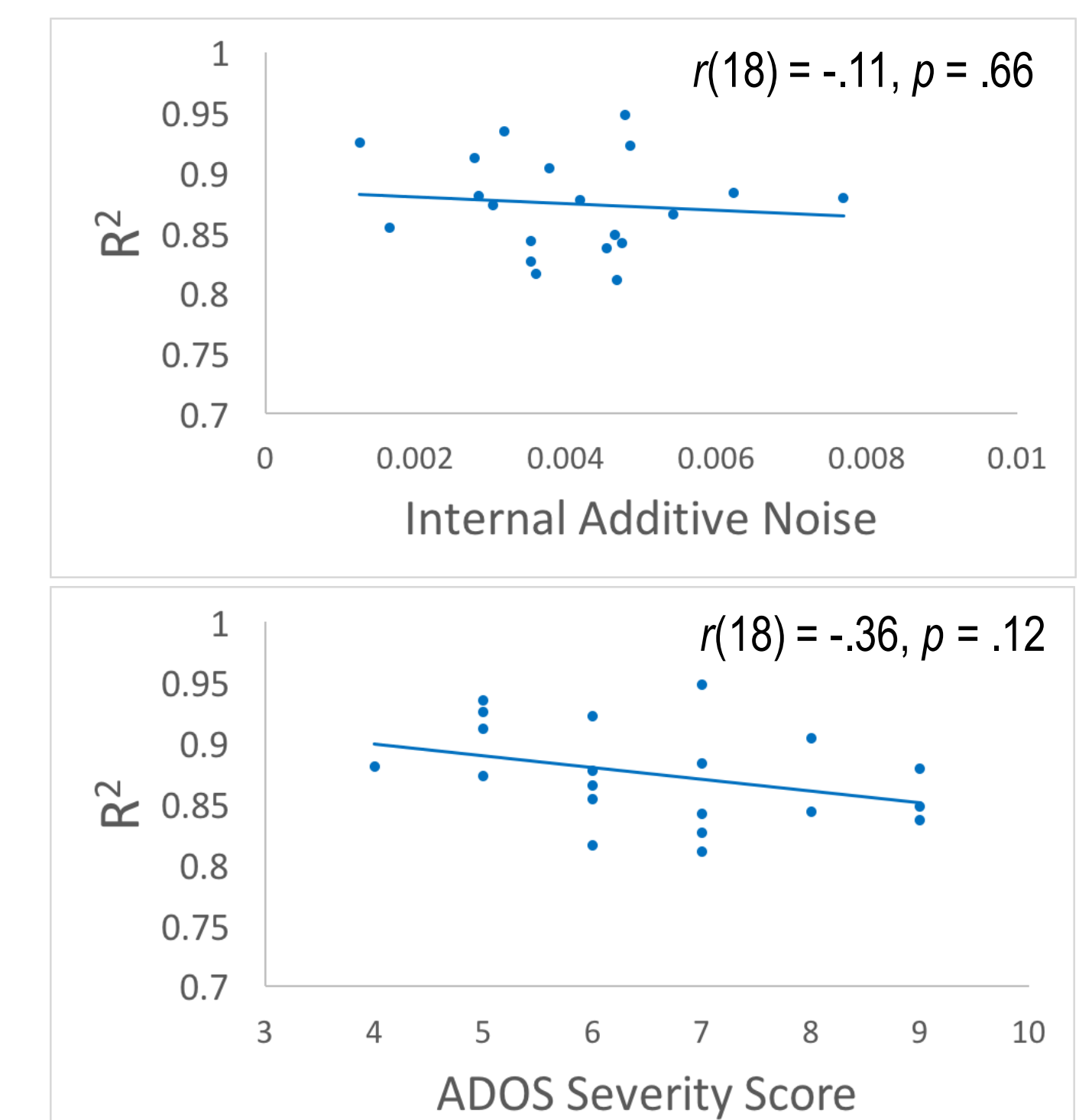
Analysis of trials where stimulus was not fully occluded prior to target (visible trials; n = 30 per participant)



ASD has higher response variability across both trial types  
No interaction between group and trial type

## Results cont.

No relationship between response variability ( $R^2$ ) and internal additive noise (top) or symptom severity (bottom) within ASD group



## Conclusions

- Individuals with ASD have higher internal additive noise
- Higher internal additive noise is associated with greater ASD symptom severity
- Individuals with ASD have higher response variability under prediction demands, which may be due to more general response variability in motion tasks
- Higher response variability is not related to either internal noise or ASD symptom severity

### Future Directions

- More fully characterize response variability without prediction demands
- Investigate how this measure of internal additive noise relates to other perceptual tasks in ASD

## References

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- Gotham et al. (2009). Standardizing ADOS scores for a measure of severity in autism spectrum disorders. *JADD*, 39(5), 693-705
- Lu & Doshier (1998). External noise distinguishes attention mechanisms. *Vis Res*, 38(9), 1183-1198.

## Acknowledgements & Contact

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