Characterising spatial noise to understand performance limitations in Multiple Object Tracking

Shanmukha “Adi” Upadhyayula & Jonathan I. Flombaum

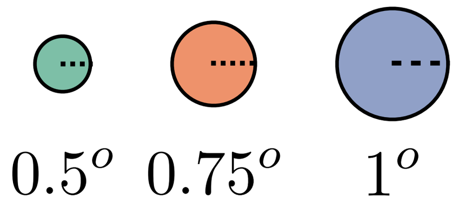
JOHNS HOPKINS KRIEGER SCHOOL of ARTS & SCIENCES

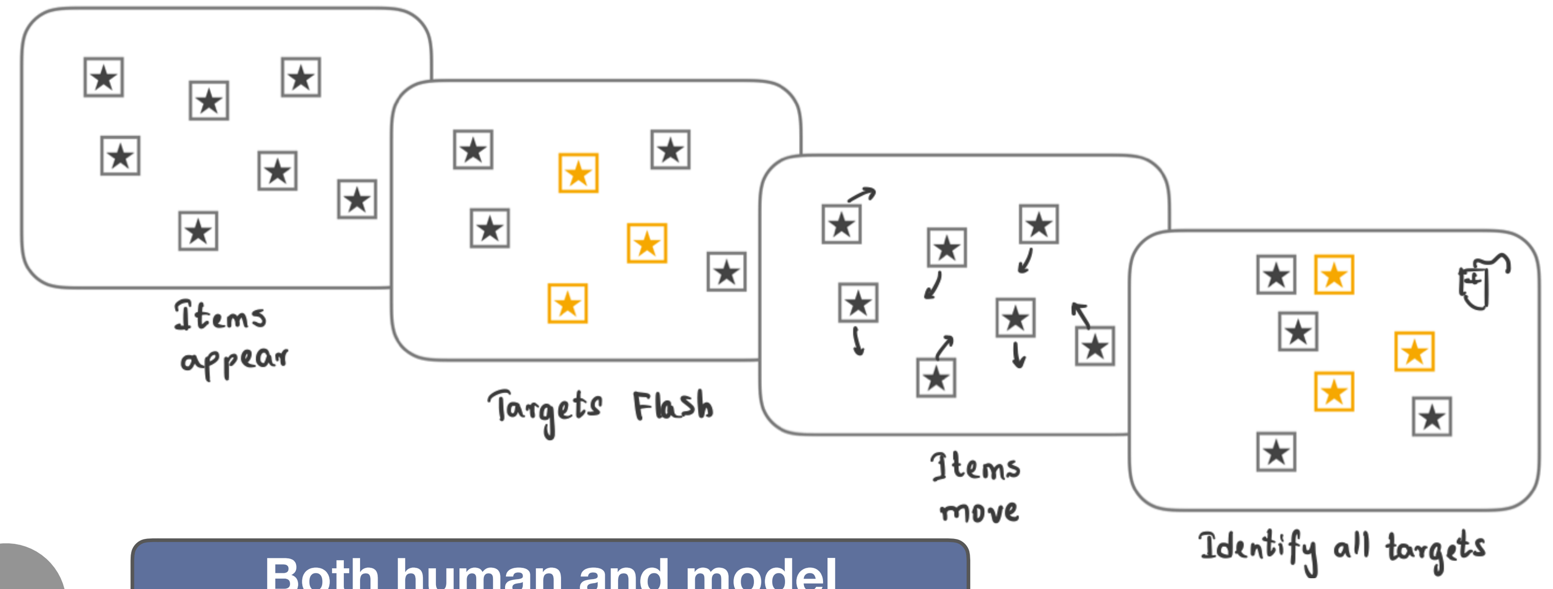
The Vision Sciences Group

Experiment 1: Manipulate Object size in MOT

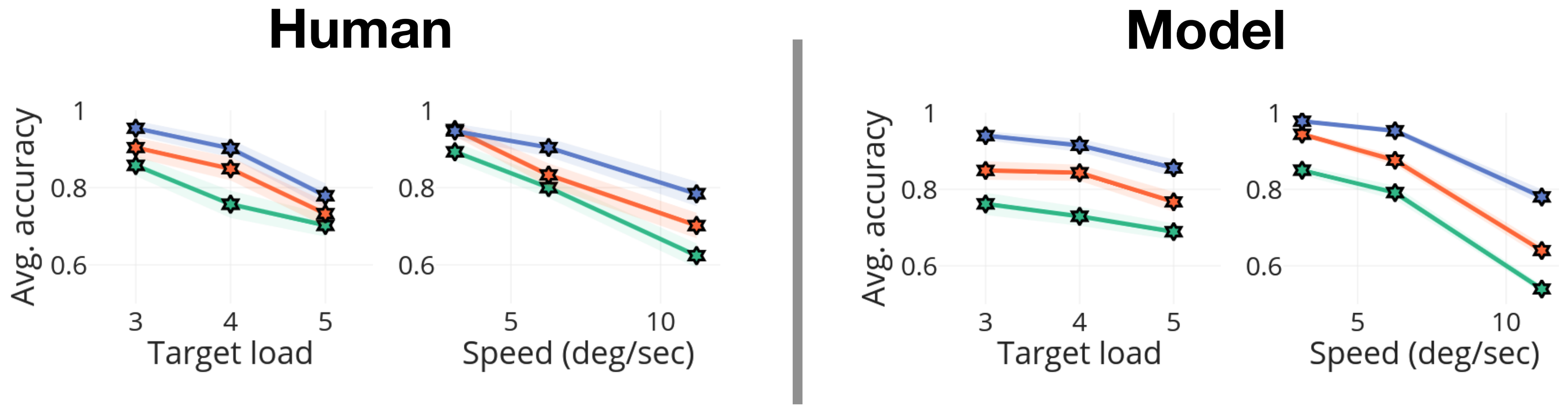
Logic

Manipulate object size because it should interact with eccentricity, and it’s not usually manipulated.

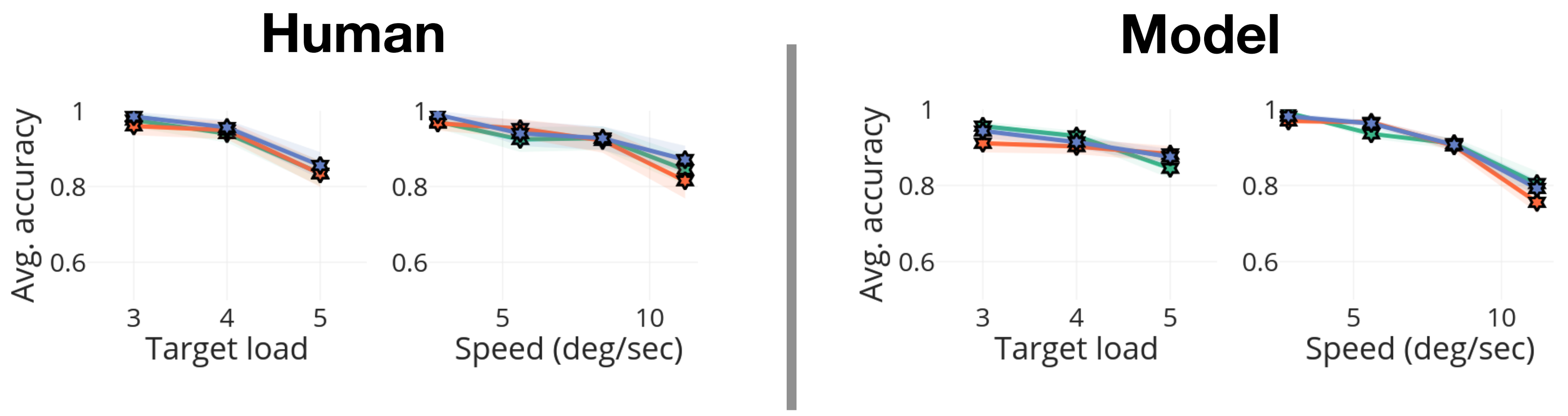




1a Both human and model performance are affected by size



1b But not when we control for center to center distances. (by making trajectories for the largest objects, and then using those for all sizes)

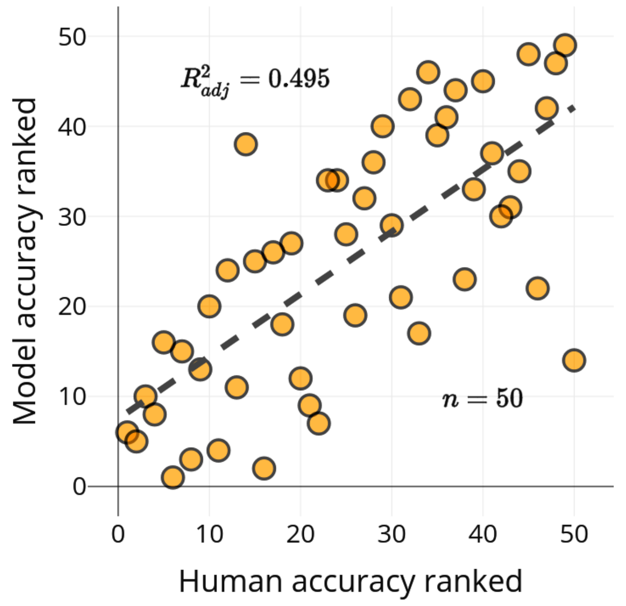


A long term goal

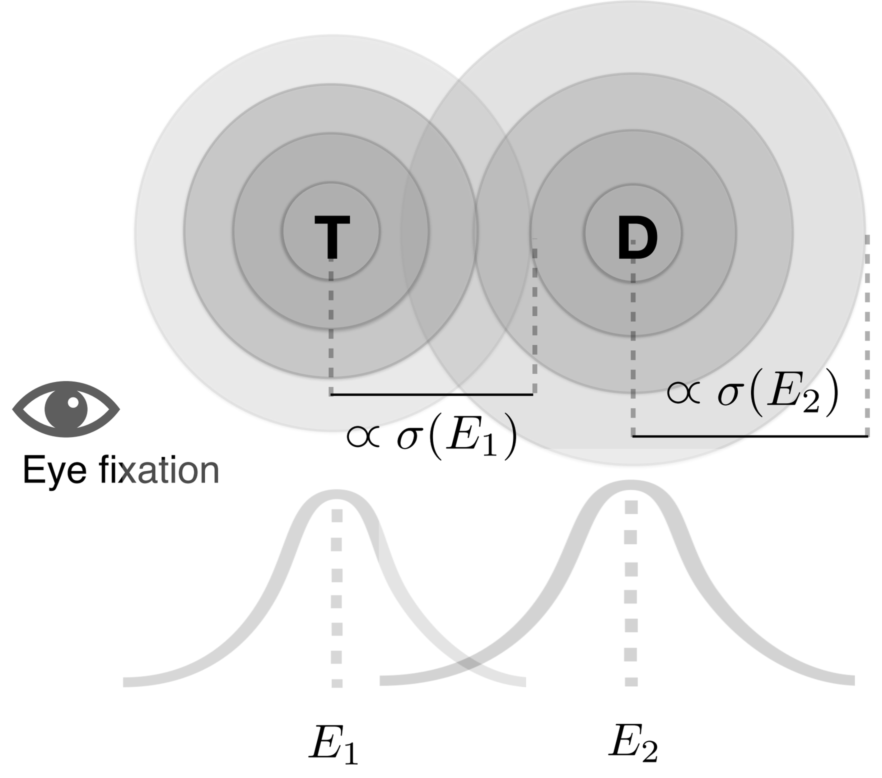
To model Multiple Object Tracking (MOT) in a way that accounts for individual observer *eye movements*

Why bother with eye movements?

Because where you look during MOT determines how well you do in this task, and we were able to show this using a computational model that differed only in eye movements across the individuals



The Strategy



Given noisy unlabelled samples from the Ts and Ds in the display, decide which samples came from the Ts.

variance of the distribution depends on the observer’s current fixation.

The Problem

So far, we’ve just been guessing about how the *variance depends on fixation*

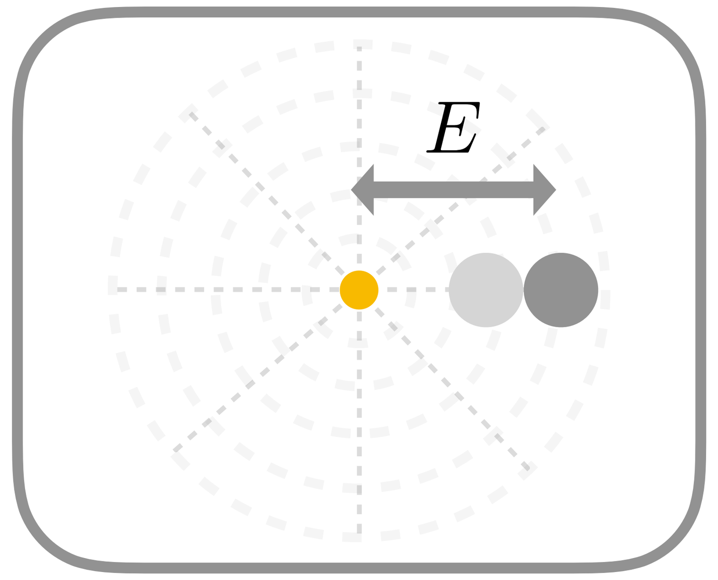
$$\sim \mathcal{N}(E, \sigma = 0.08 * (1 + 0.42 * E))$$

Is the effect of E independent? **So** Can we measure it?

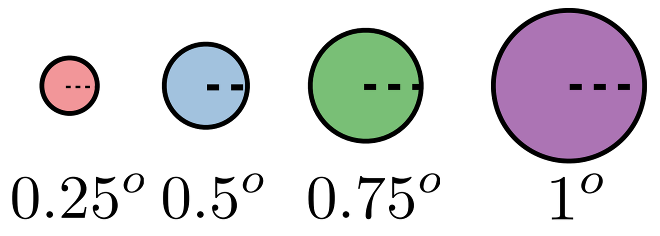
yes ***we think so***

Experiment 2 : Measure the spatial noise equation

2AFC task : Two discs appear side by side (L/R, U/D).
Say which is the brighter one while fixating in the center



Varied size and eccentricity

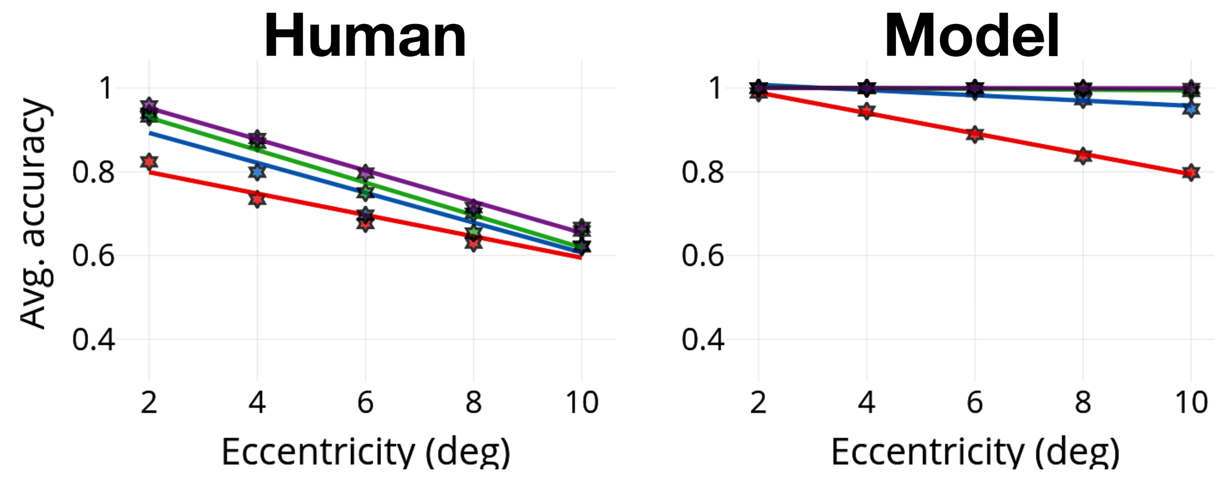


$$\{2^o, 4^o, 6^o, 8^o, 10^o\}$$

E

Logic

This simple task should reveal the effects of eccentricity on the position confusability of two items.



Old model way out performs humans in this task

New eccentricity equation fit using signal detection theory for the 2AFC task

$$\sim \mathcal{N}(0, \sigma = 0.04 + 0.23 * E)$$

Ongoing work : Trying to characterise an equation that best explains the human behaviour in both the paradigms!

supadhy6@jhu.edu