

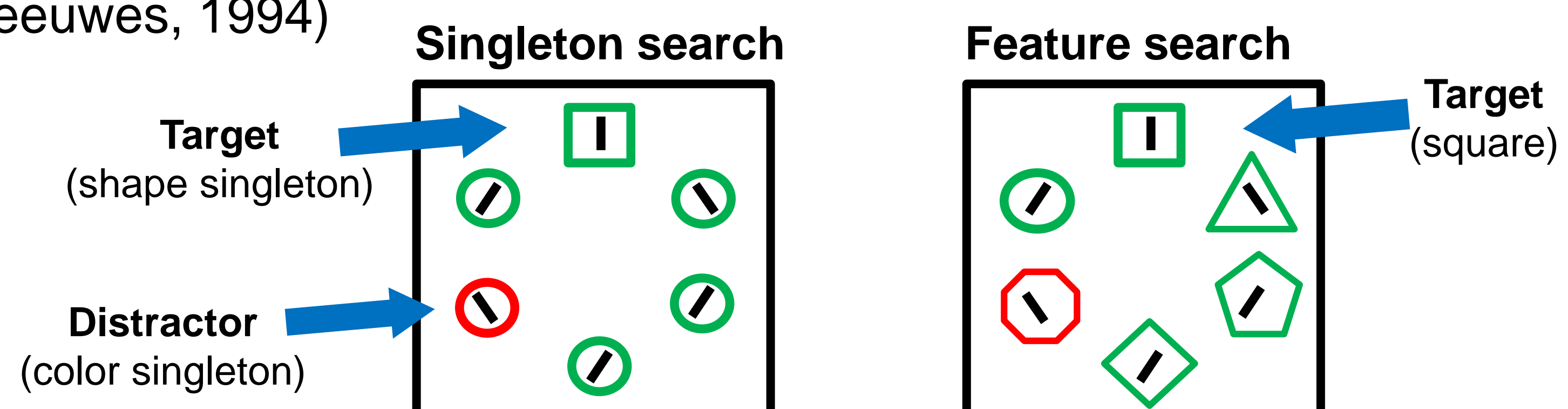


RAGNAROC: A computational model to describe why attentional capture only occurs sometimes

Chloe Callahan-Flintoft¹, Brad Wyble², Gabriella Larkin¹, Michael Geuss¹, Alfred Yu¹, Chou Hung¹
¹ US Army Research Lab, ² Pennsylvania State University

A problem to solve

- Classic attentional capture studies show that in a singleton search, a salient distractor's is able to pull attention away from a less salient target (Theeuwes, 1994)



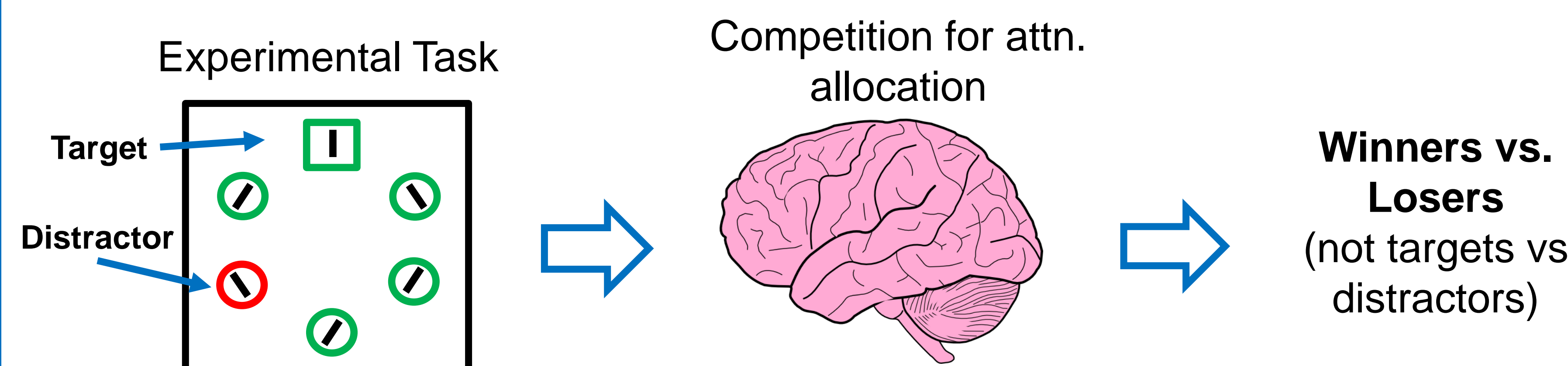
- However other studies show the visual system's ability to suppress the salient distractor and successfully allocate attention to the target (Gaspelin, Leonard, & Luck, 2015)

Why does attentional capture only seem to occur sometime?

- It is essential to understand how attention is allocated across the visual field in order to understand the consequences of technologically advance displays on task completion (e.g. augmented reality used to aid soldiers' missions)



What are 'targets' and 'distractors'?



How is this competition decided?

$$\text{Attentional Priority} = \text{Visual Saliency} * \text{Task Relevancy}$$

Attentional priority scale:



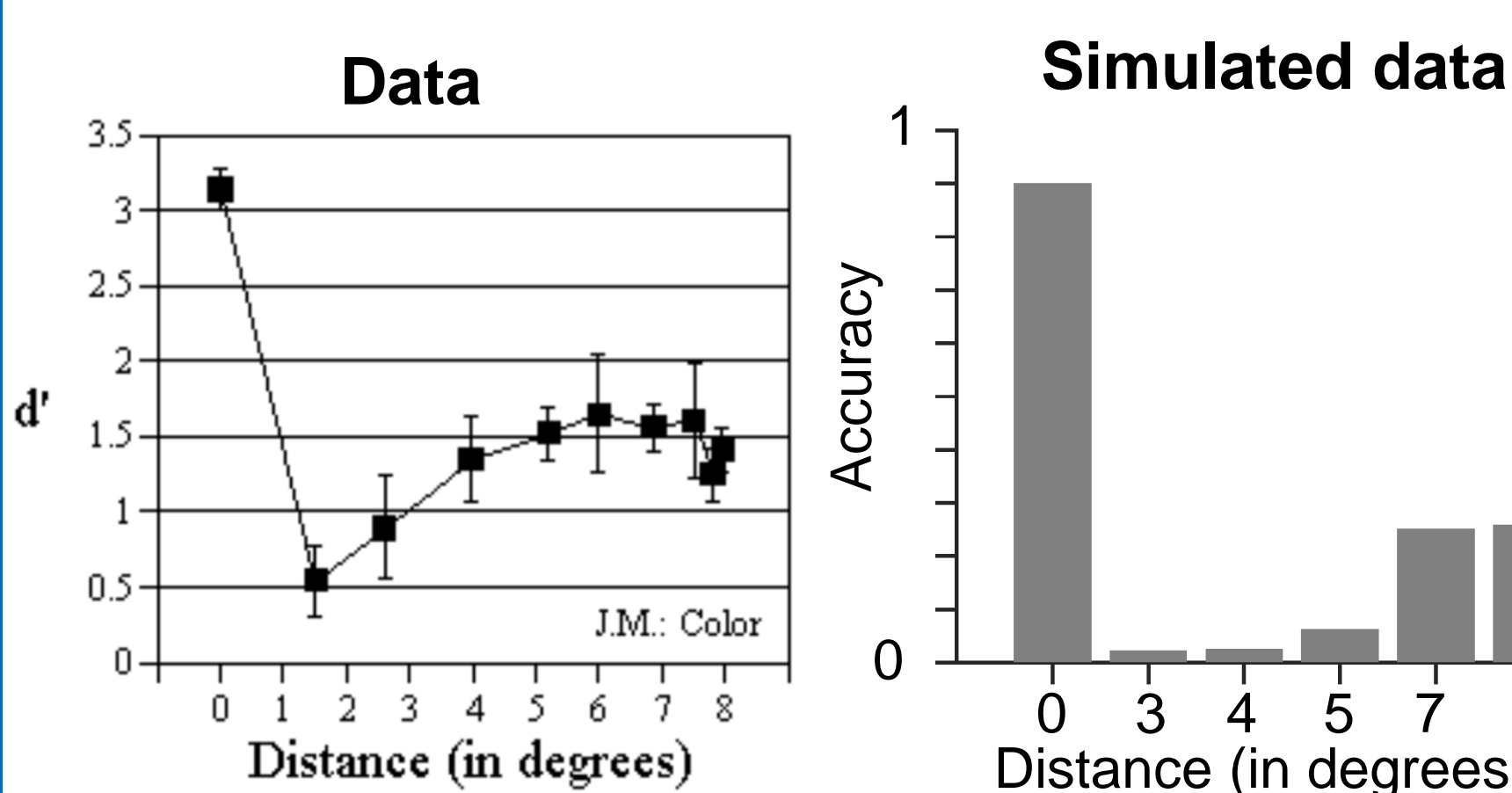
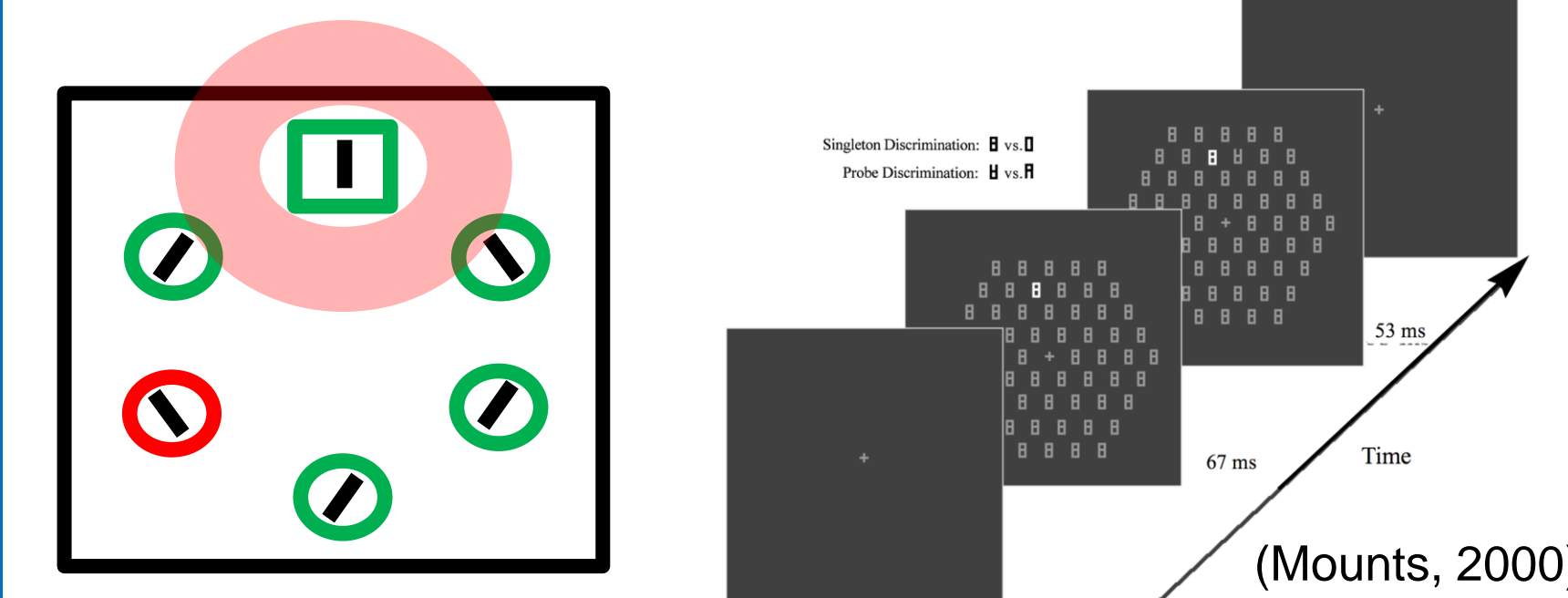
- This moves attention out of the laboratory dichotomy of targets & distractors and into a more flexible, real-world spectrum where stimuli vary in both saliency and task relevancy

How is attention allocated?

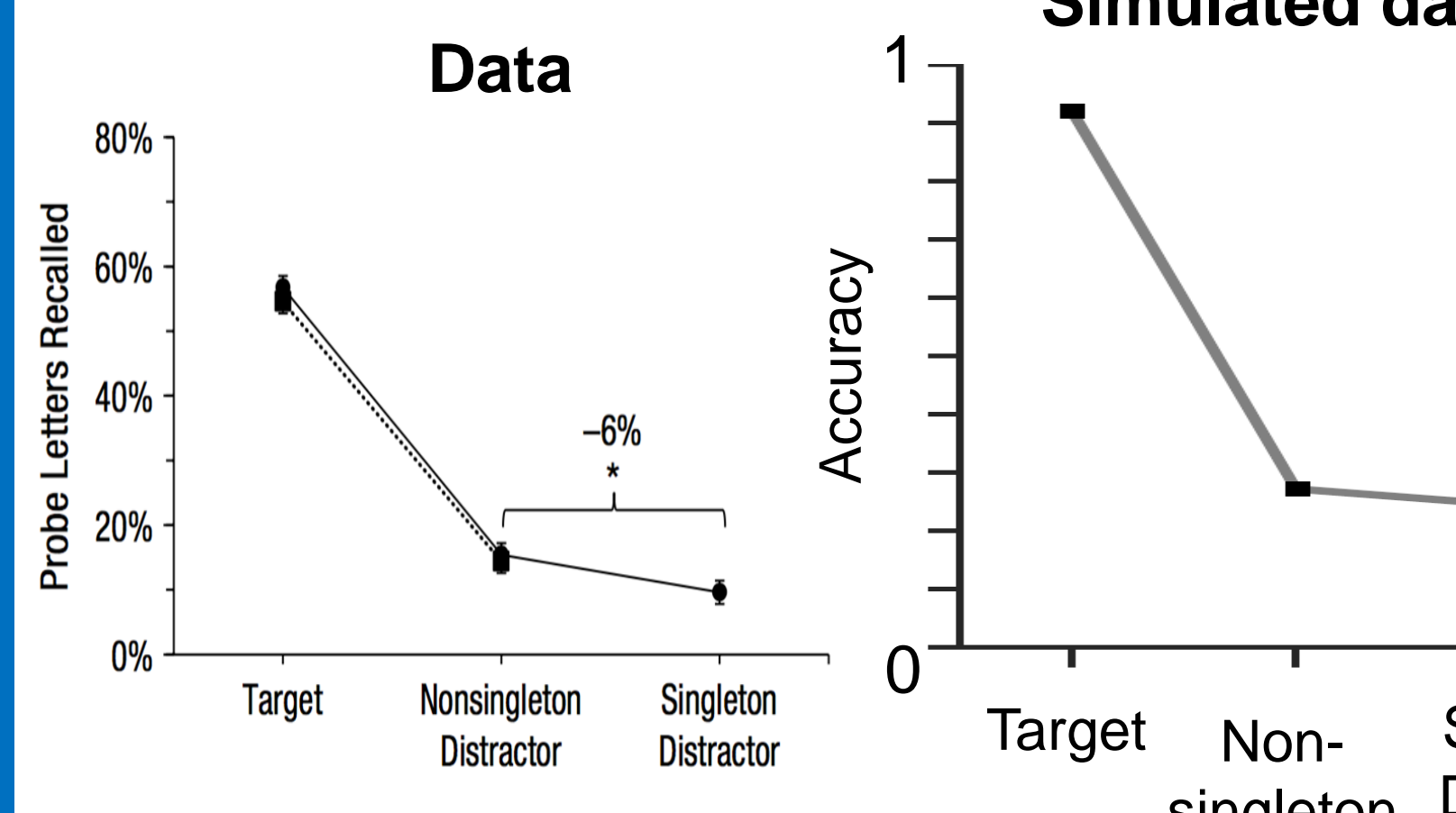
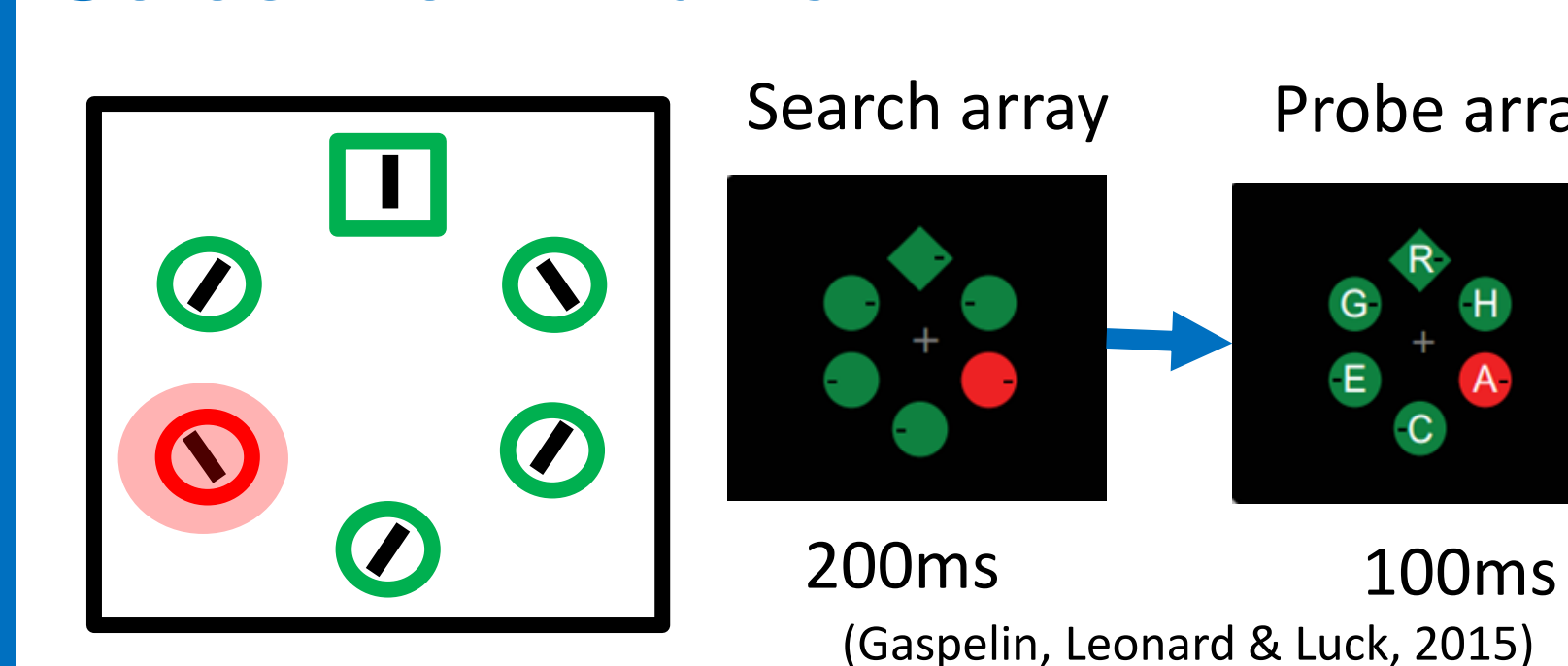
- In RAGNAROC all maps are spatiotopically organized
- Attention enhances processing at a certain **location** rather than of certain stimulus

How does attention inhibit processing?

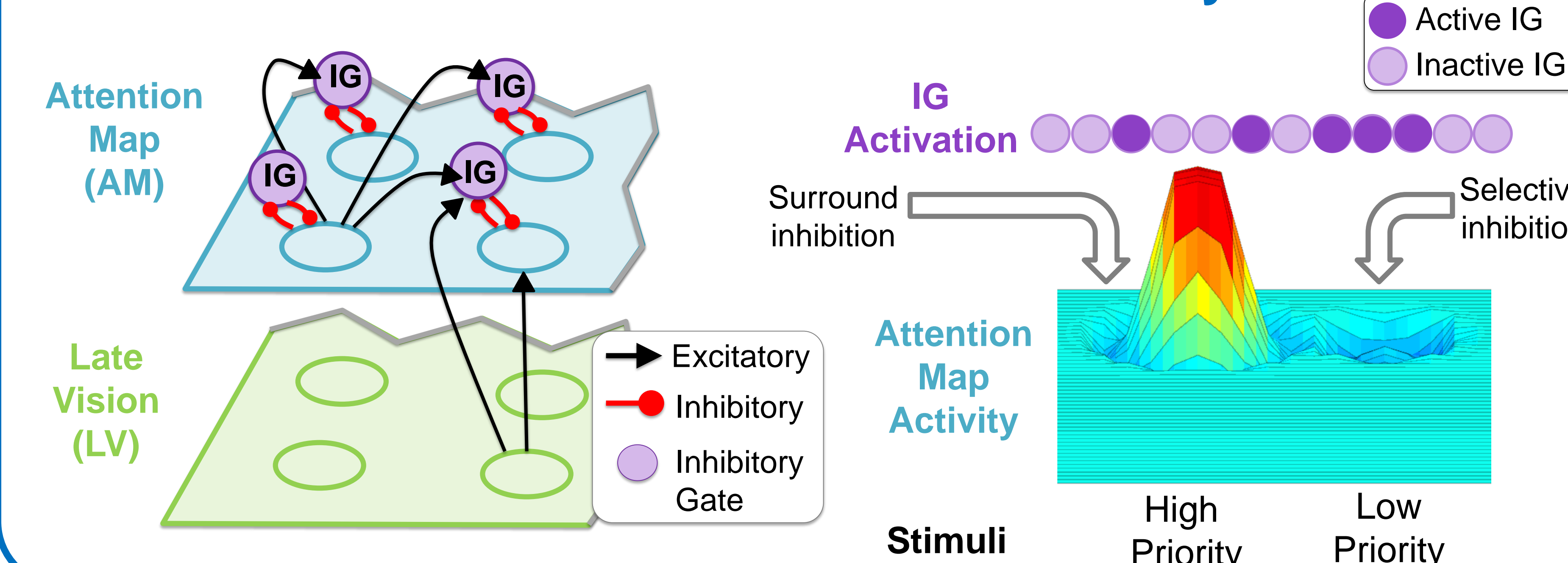
Surround inhibition:



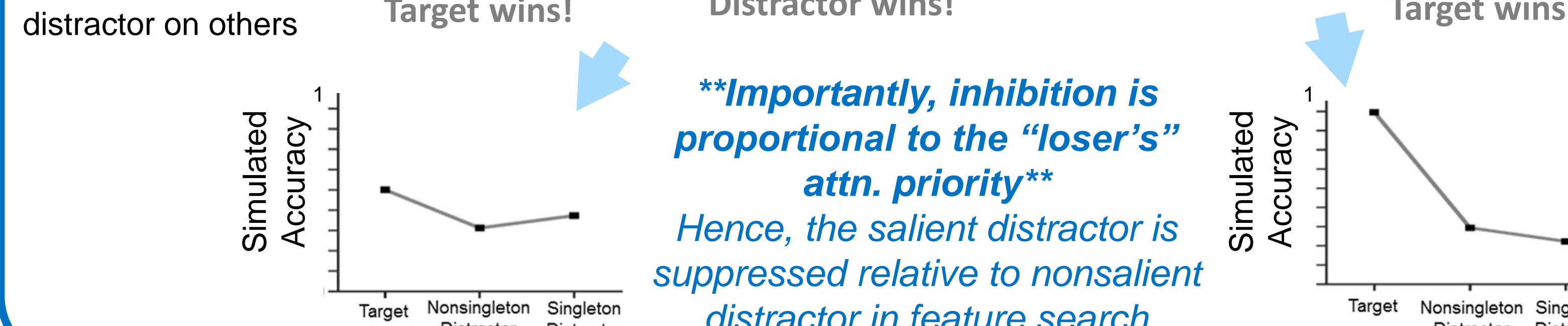
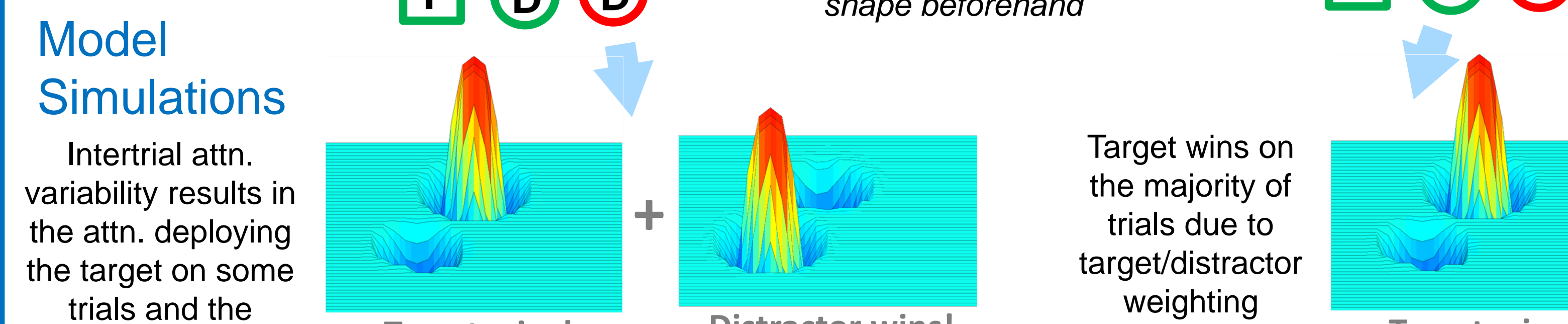
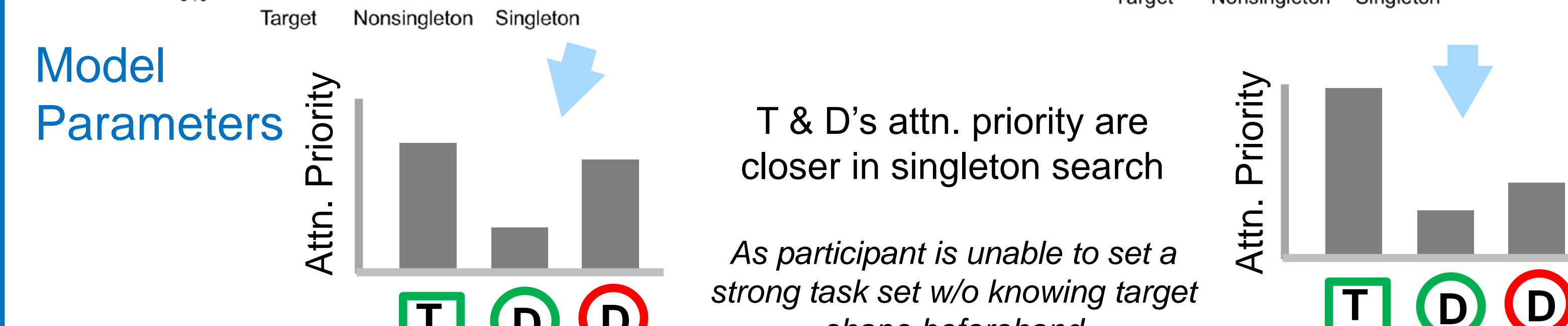
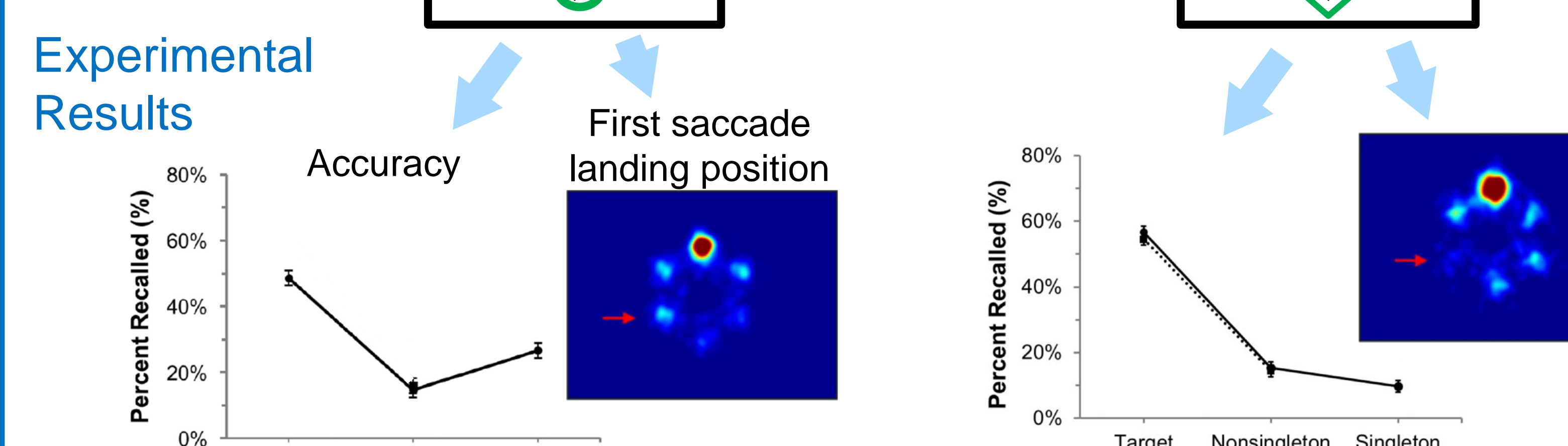
Selective inhibition:



Two forms of inhibition with one set of circuitry:

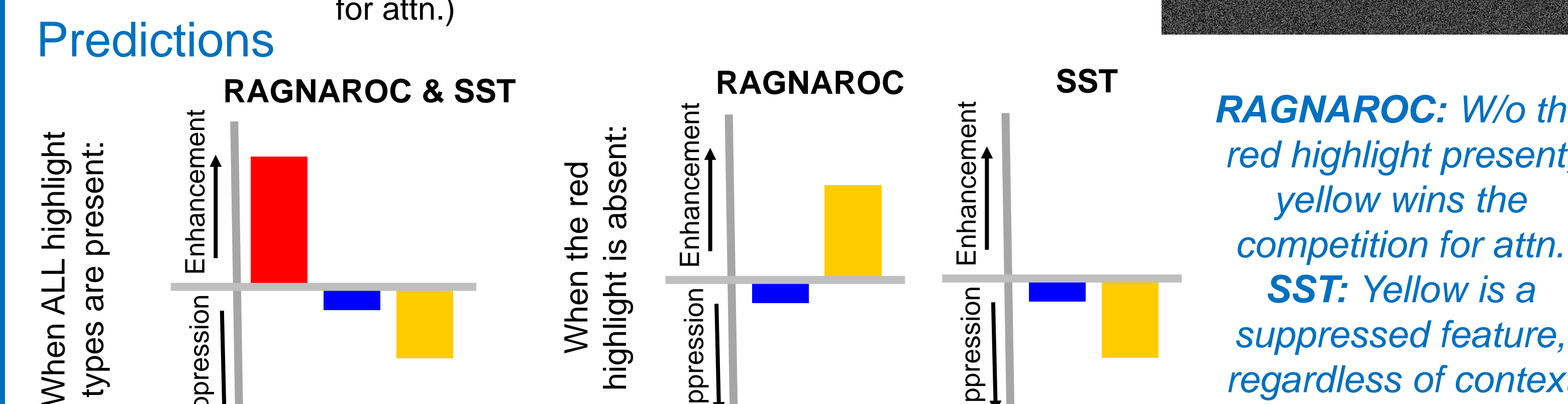
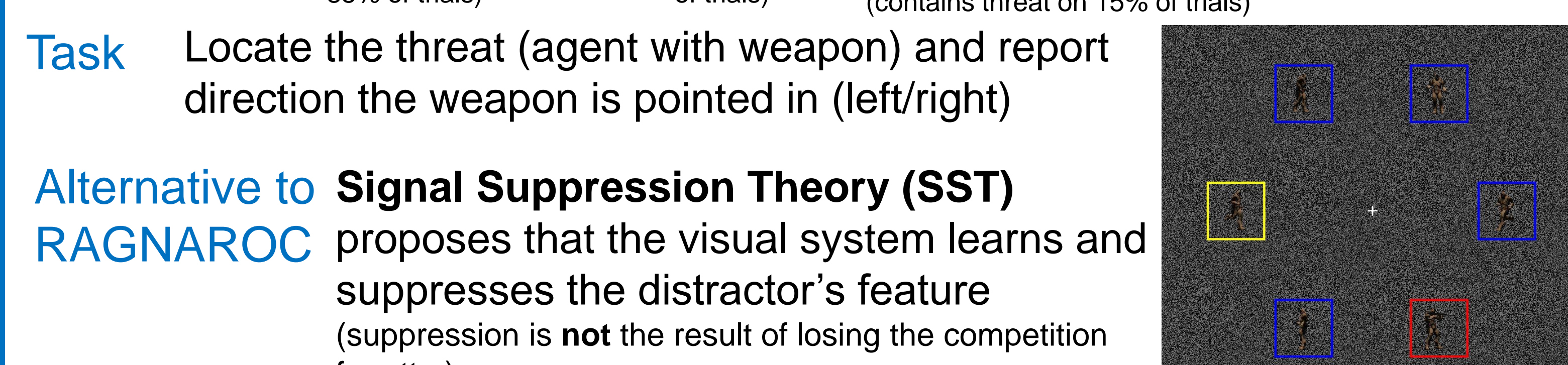


Attn. control settings' effect on capture



Model predictions & applications

- Augmented Target Recognition (ATR) could aid soldiers in the field by highlighting potential threats
- ATR systems must guide attn. resources while maintaining user autonomy and situational awareness (i.e. avoid capture or effective blindspots due to attn. suppression)



RAGNAROC

- The Reflexive Attention Gradient through Neural AttRactOr Competition model is a rate coded neural network using O'Reilly & Munakata (2001) equations to simulate membrane potential

$$MP_{i,j,t} = MP_{i,j,t-1} + dtV M_j \times [(Bias_j + Excite_{i,j,t-1}) \times (EE_j - MP_{i,j,t-1}) + Inhib_{i,j,t-1} \times (EI_j - MP_{i,j,t-1}) + Leak_j \times (EL_j - MP_{i,j,t-1})]$$

Attention Map:

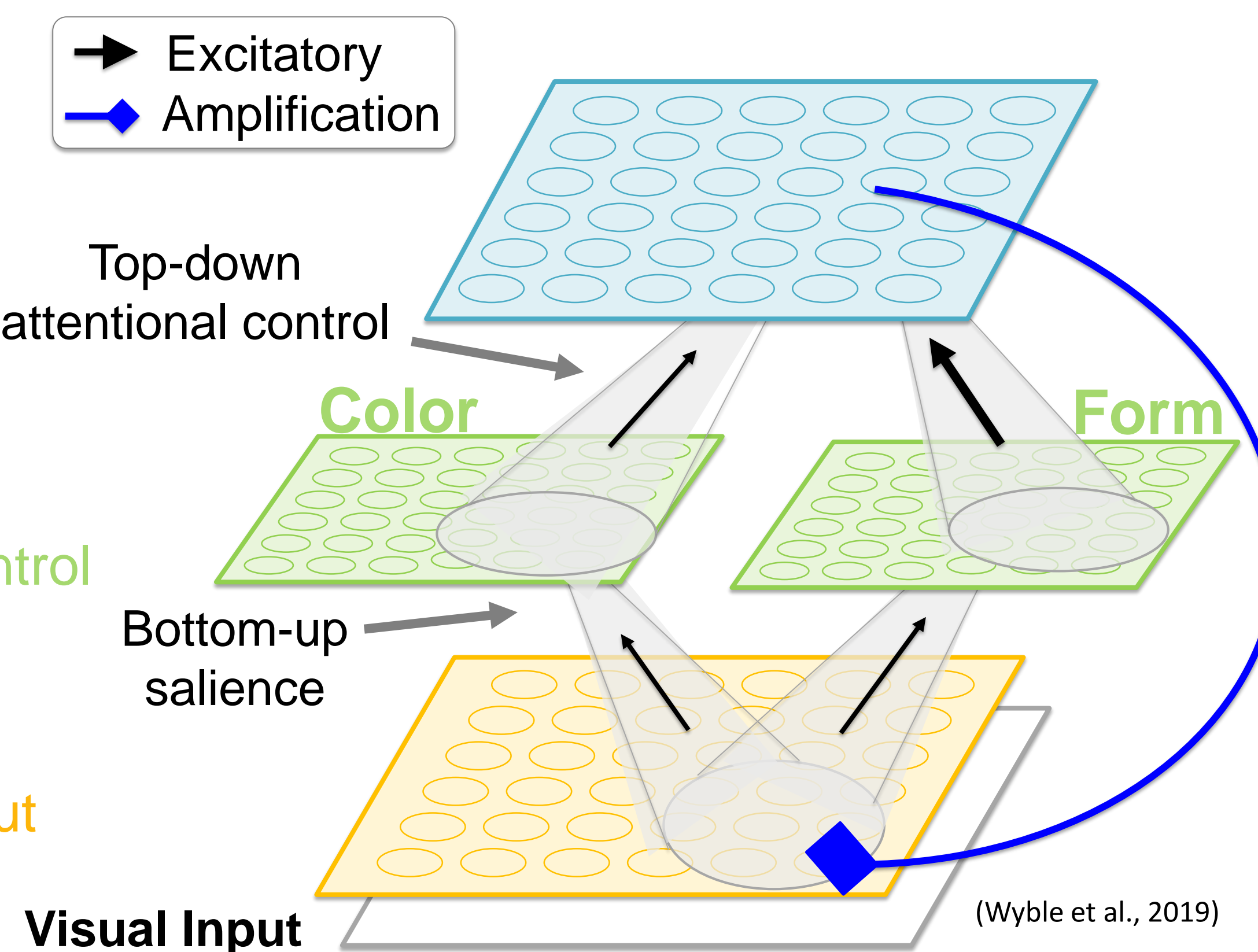
- Aggregates input
- Mediates competition

Late Visual:

- Differentiates stimuli
- Permits top-down control

Early Visual:

- Represents initial input



How does the model simulate data?

