

Project 02: A Study on Human and Robot Perception and the Architecture Of Perceptual Information Processing

Aravind BATTAJE^{1,3}, Nina M. HANNING^{2,3}, Martin ROLFS^{2,3}, Oliver BROCK^{1,3}

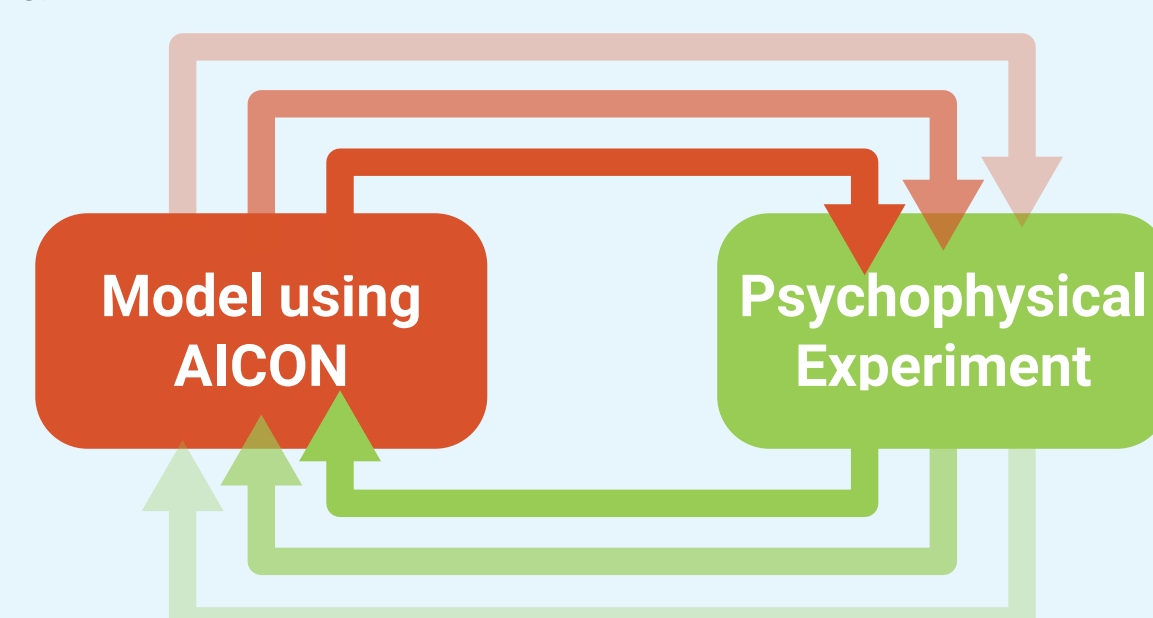
¹ Robotics and Biology Laboratory, Technische Universität Berlin; ² Department of Psychology, Humboldt-Universität zu Berlin; ³ Science of Intelligence, Research Cluster of Excellence, Berlin

We **examine** and **build** visual information processing in order to understand it

How do we do this?

We build models for human vision. We make predictions from those models and test those predictions on humans. Using deviations between model predictions and human responses, we further refine the model and repeat.

Through this loop, models inherit the robust information processing principles underlying human vision.



Active InterCONnect, a framework from robotics, is designed around the principle of **weak decomposability**—an intelligent system that consists of many, strongly interacting parts.

Human vision is also weakly decomposable. This makes **AICON** a strong candidate framework to create models of human vision.



Take-home

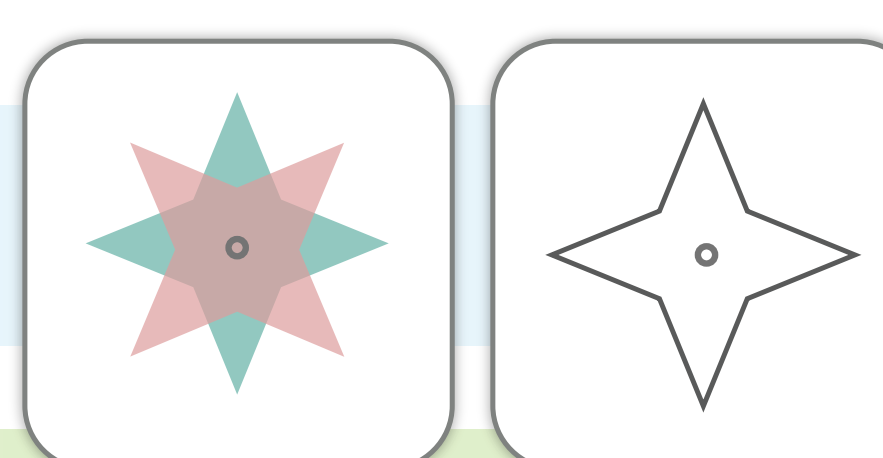
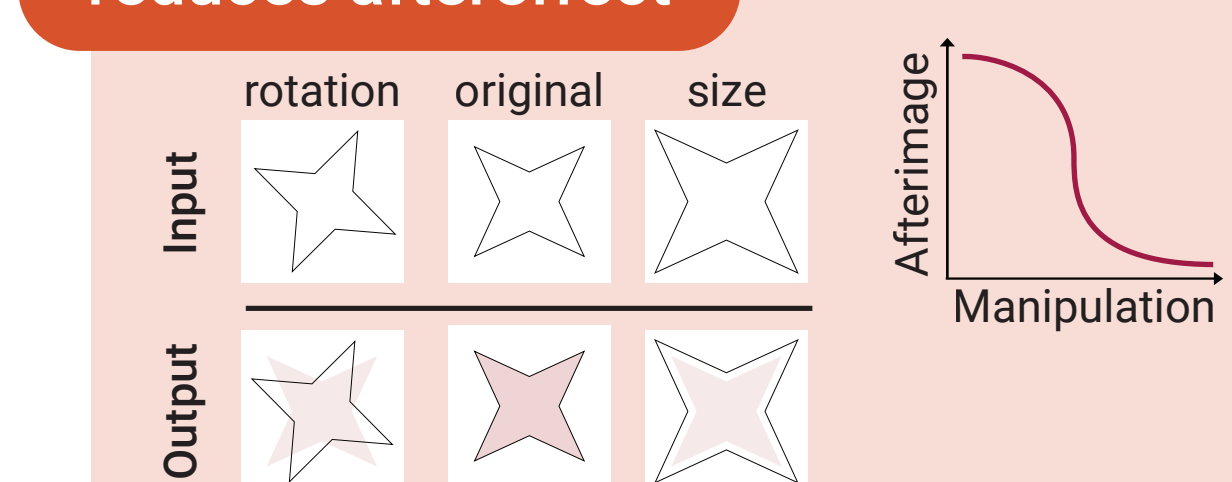
AICON-based models capture crucial aspects of human vision [3]!

They generalize so well that we were able to make predictions that guided future experiments.

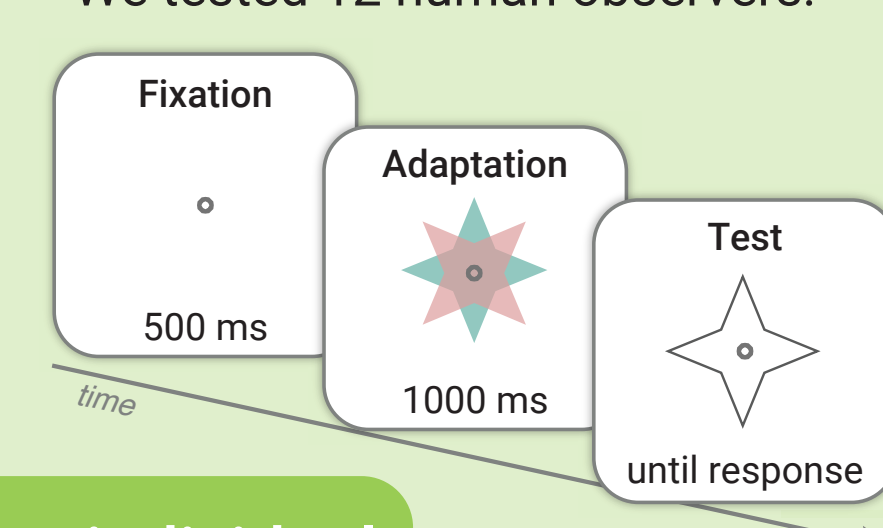
AICON allows us to rapidly study perception and behavior in humans and other biological instances, in a synergistic manner.

Color aftereffect^[1]

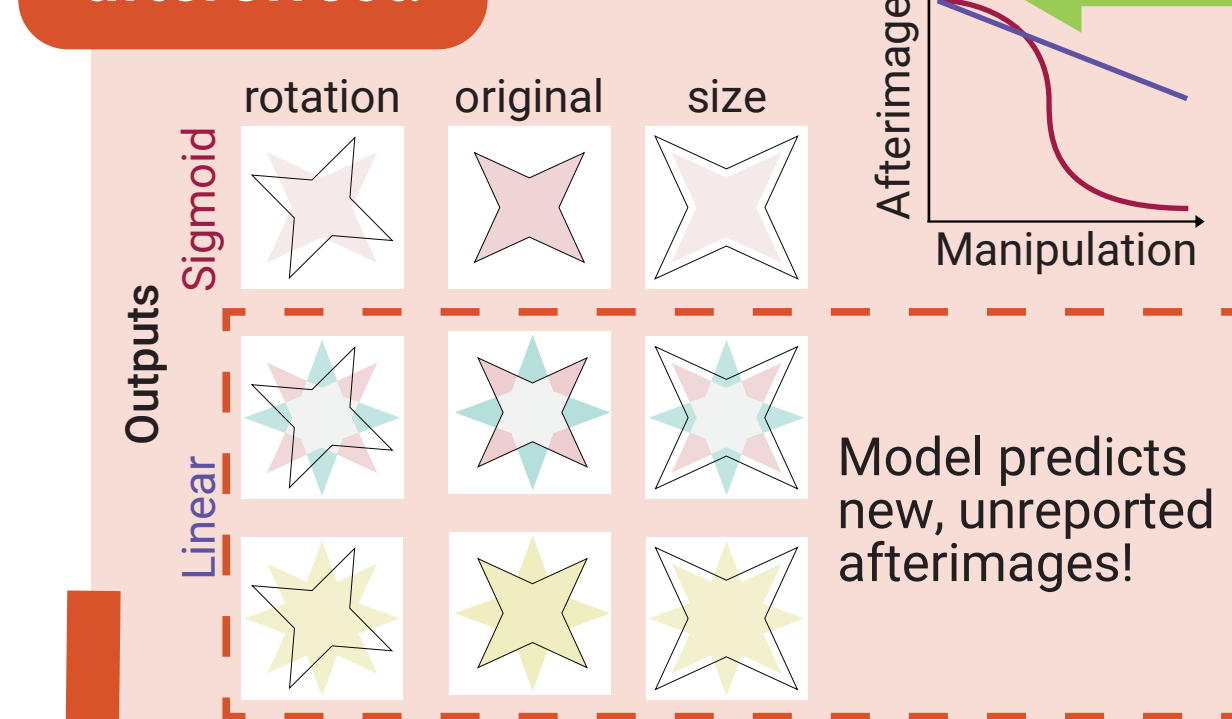
Manipulating outline reduces aftereffect



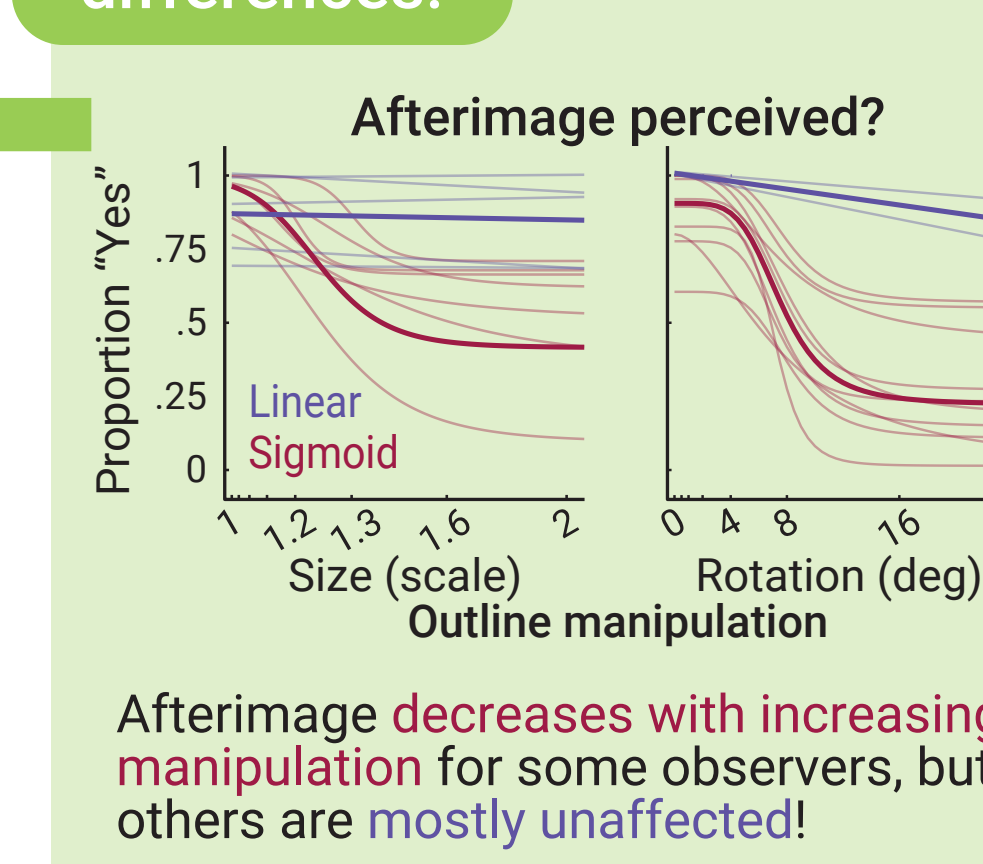
We tested 12 human observers:



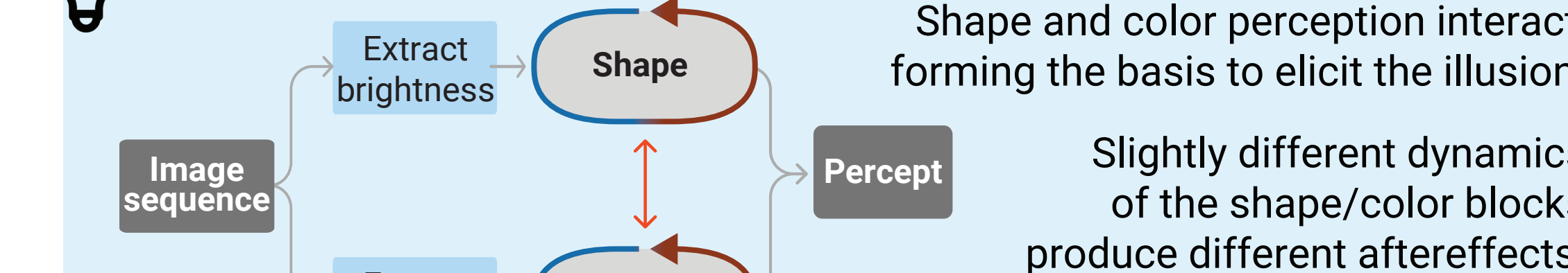
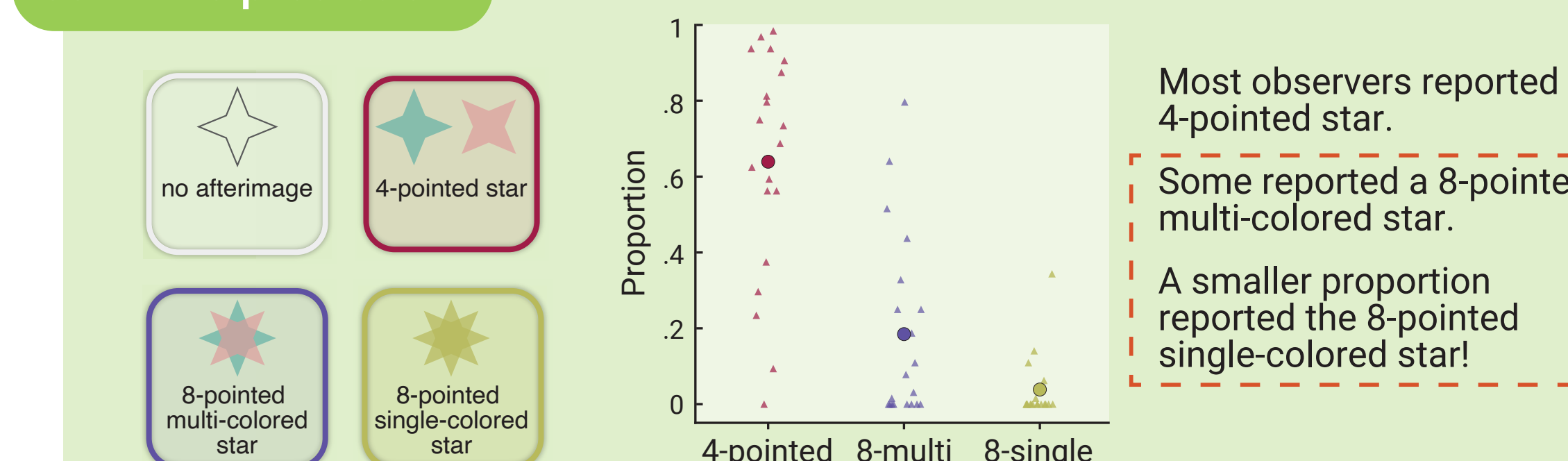
Unreported aftereffect!



Interindividual differences!

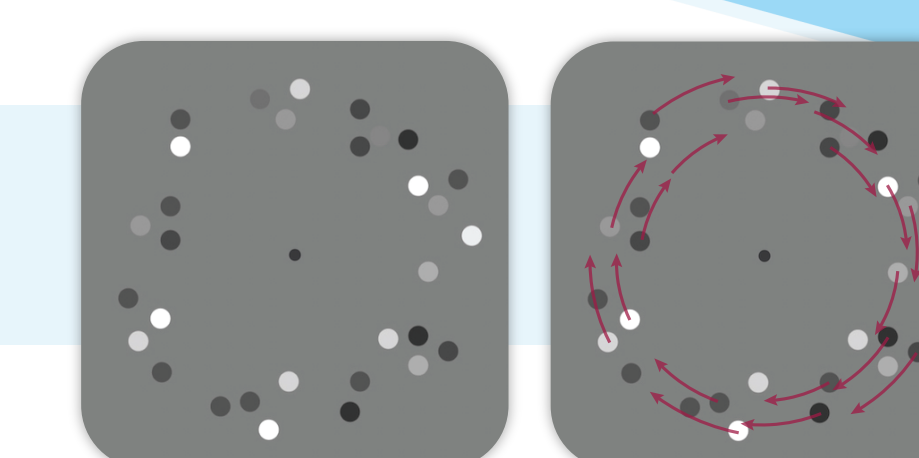


Human perception confirms prediction!

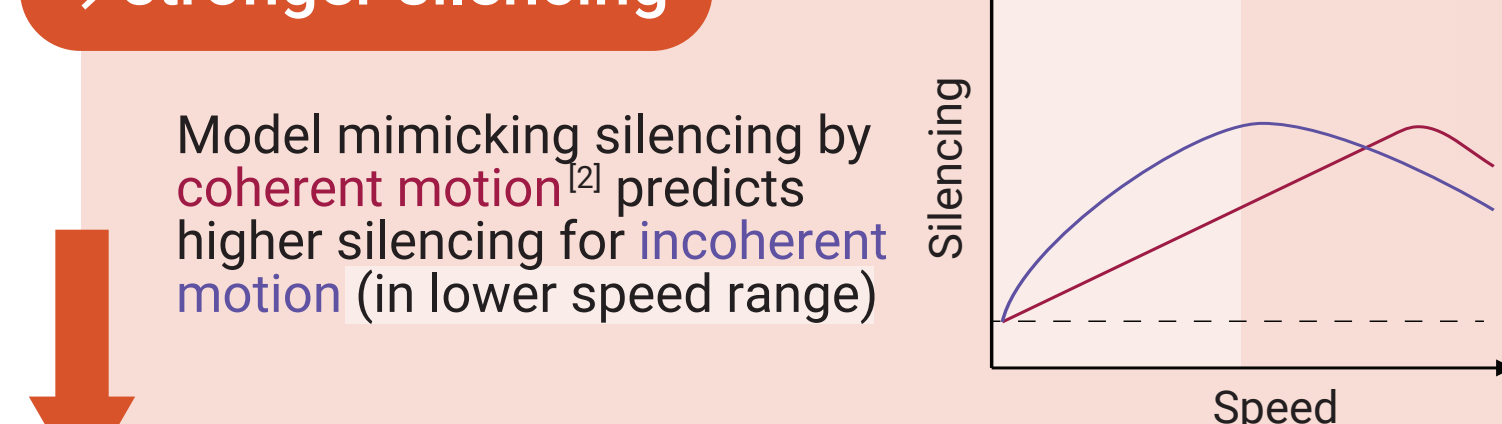


This AICON-based model of interacting shape & color perception captures the essence of the mechanisms underlying this illusion, allowing us to perform multiple iterations & capture interindividual differences.

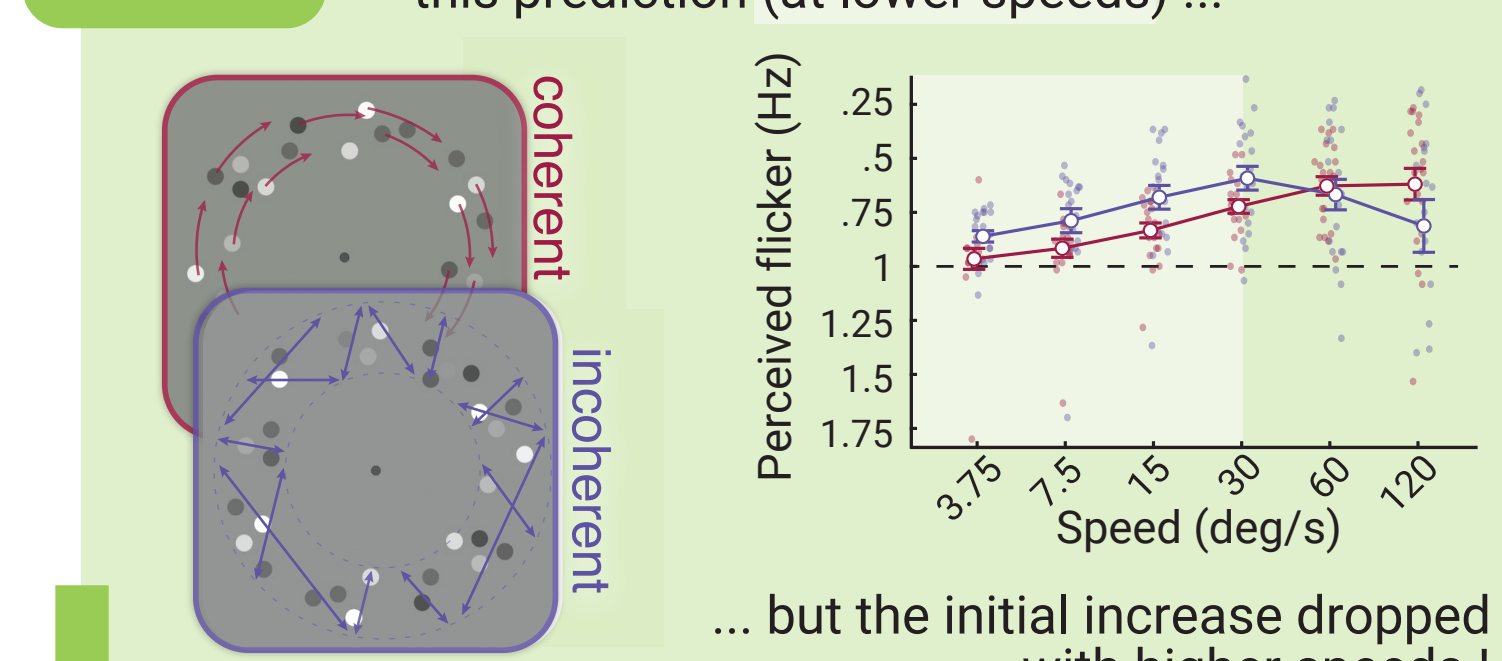
Silencing by motion^[2]



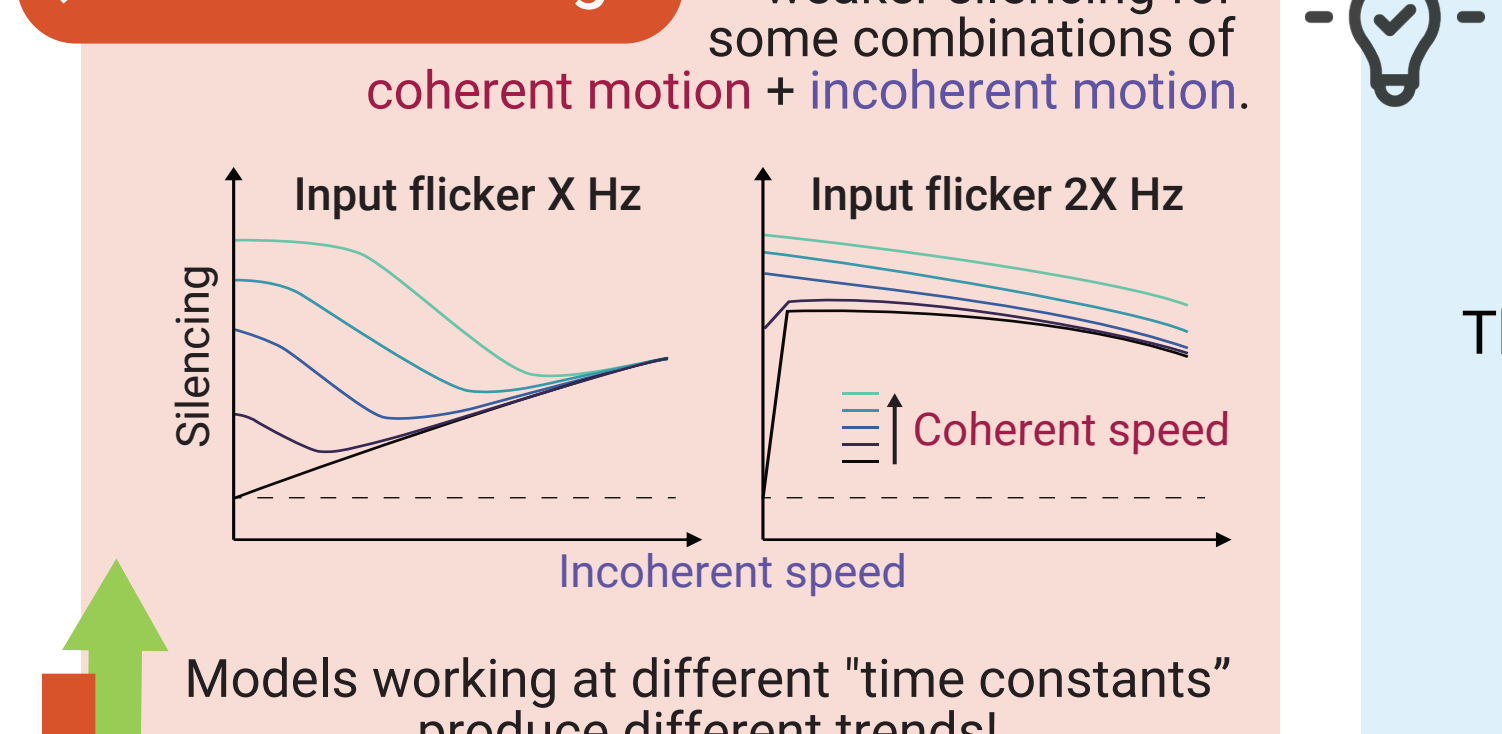
Incoherent motion → stronger silencing



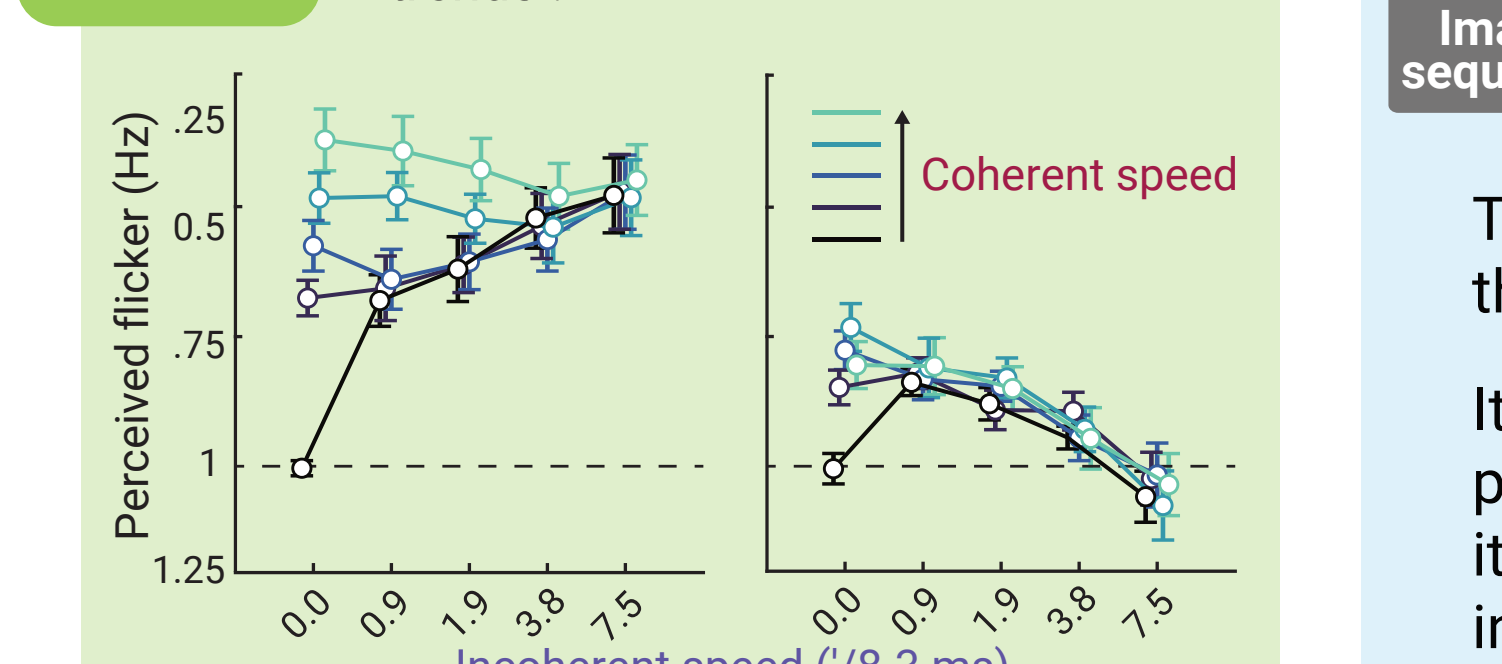
(mostly) true!



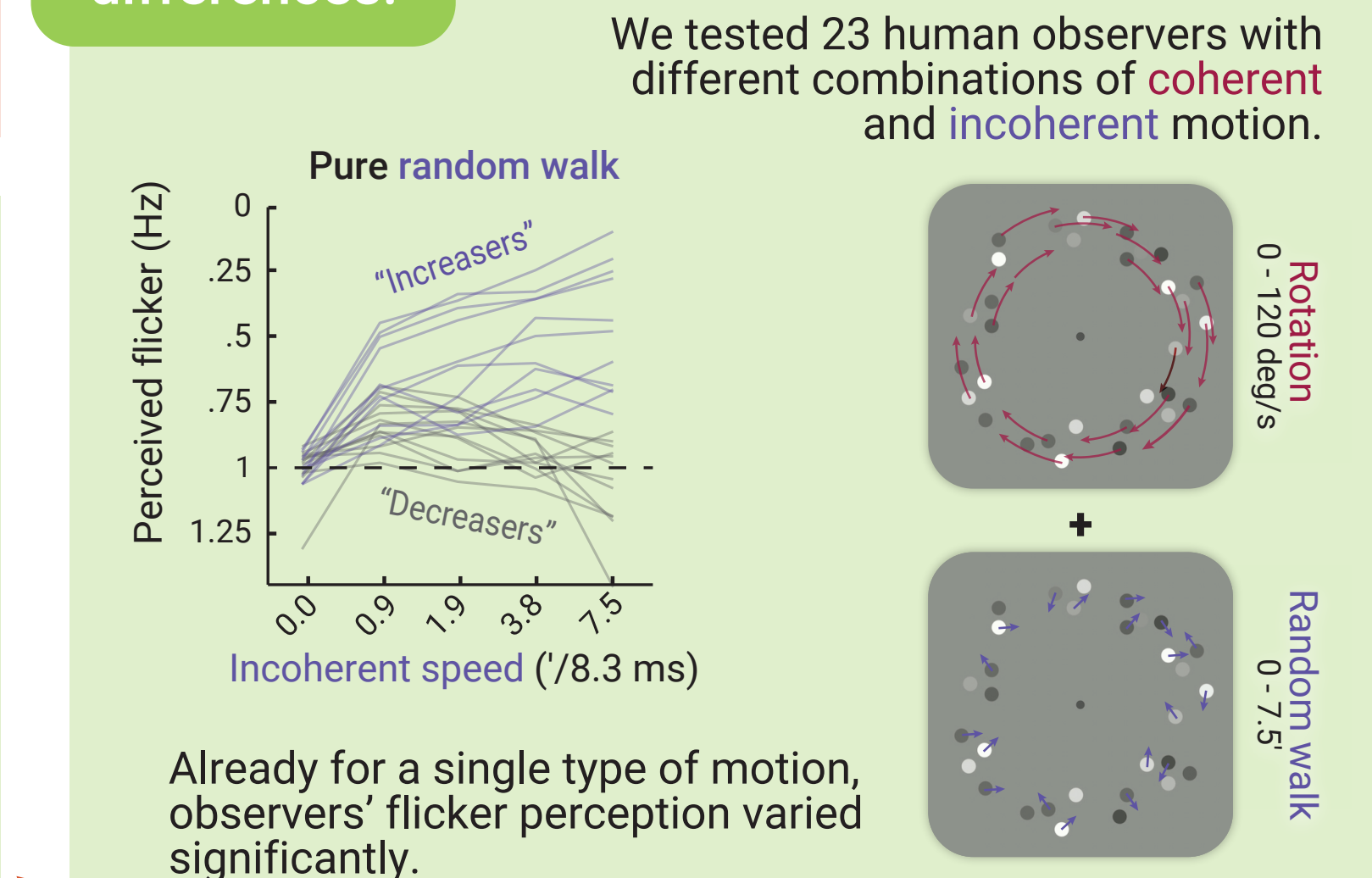
Additional motion → weaker silencing?!



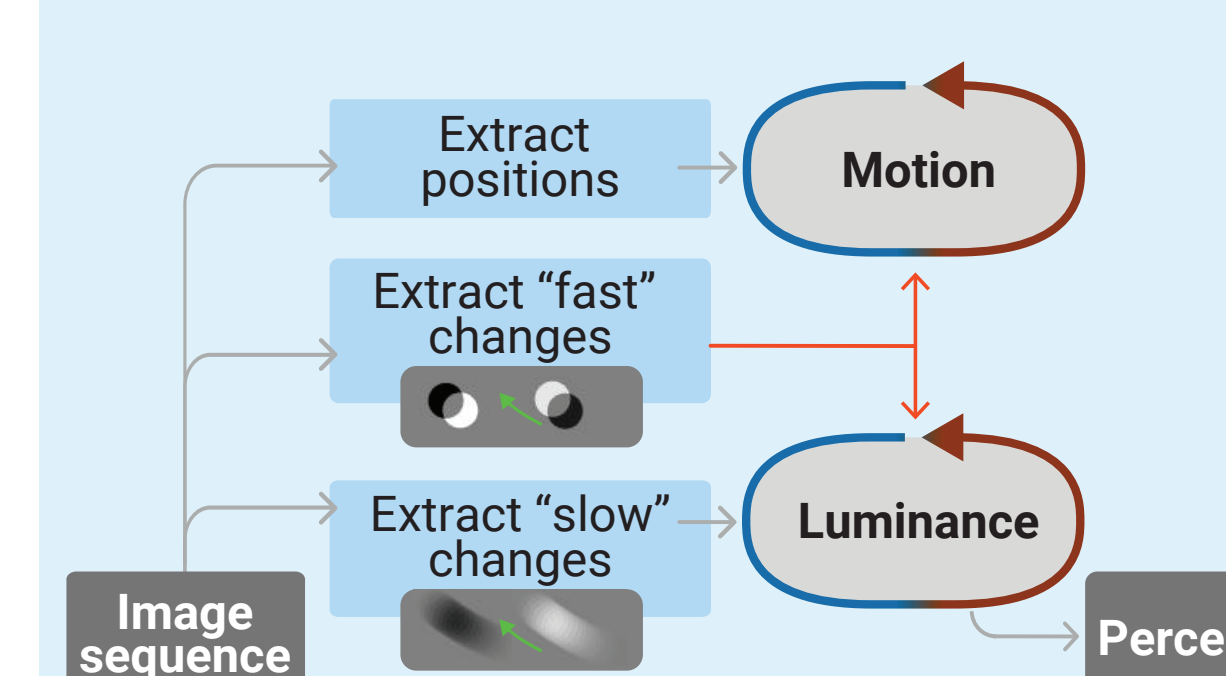
Yes!



Interindividual differences!



Moving objects produce signals whose information content is split between motion and luminance. This can be expressed as an interaction, that bolsters each other's perception.



The AICON-based model fully captures the silencing illusion.

It thus can serve as the foundation to perform multiple analytic-synthetic iterations, while also explaining inter-individual differences.

References

- [1] Van Lier, Vergeer & Anstis (2009), *Current Biology*
- [2] Suchow & Alvarez (2011), *Current Biology*
- [3] Battaje, Godinez, Hanning, Rolfs & Brock (2024), *bioRxiv*