

Introduction to Cognitive Computational Modeling

Debbie Yee
Brown University

SRNDNA Modeling Workshop
July 27, 2024



Thank you to our organizers and sponsors!



Kendra Seaman
UT Dallas
SRNDNA Co-Director



Israel Smitherman
UT Dallas
SRNDNA Fellow



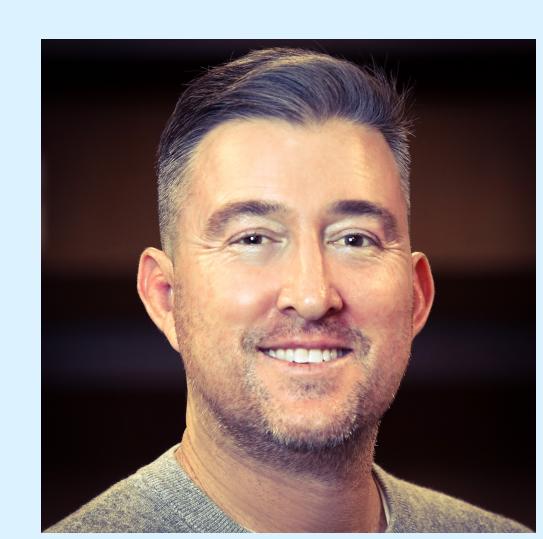
Joe Kable
Penn
Advisory Board



Karolina Lempert
Penn
Advisory Board



Heather Calvert
Penn
MindCORE Exec Director



Luke Stockel
NIA
Program Officer



Computational Modeling Workshop 2024

Saturday, July 27

Before the Alzheimer's Association International Conference
University of Pennsylvania

A free, one-day workshop on computational modeling of decision making focused on reinforcement learning and drift diffusion modeling techniques, with application to aging populations.

Theoretical lectures and hands-on tutorials:

9:00 – 9:30am: **Introduction to Computational Cognitive Modeling** by Debbie Yee (PhD) , *Brown University*

9:45 – 10:30am: **Introduction to Reinforcement Learning** by Angela Radulescu (PhD), *Mt. Sinai Center for Computational Psychiatry*; and Alana Jaski, *Brown University*

10:30 – 10:45am: Coffee Break

10:45 – 11:30am: **Introduction to Drift Diffusion Models** by Bob Wilson (PhD), *University of Arizona*

11:30 – 1:00pm: Lunch Break

1:00 – 1:45pm **The Promise of Computational Models to Decision Neuroscience of Aging** by Gregory Samanez-Larkin (PhD), *Duke*

2:00 – 4:30pm: *Hands on Tutorials (Parallel Tracks)* – **Drift Diffusion Models (HSSM)** by Debbie Yee, Krishn Bera, and Alex Fengler; and **Reinforcement Learning** by Angela Radulescu, Alana Jaskir, and Bob Wilson

4:30 – 6:00pm: Reception

Why this workshop?

Computational Models are powerful because:

- They provide a theoretical framework to decompose decision processes into constituent cognitive components
- They can simultaneously account for choice and response time, and estimate parameters that map onto latent psychological processes
- They are powerful tools for analyzing variability between and within individuals (e.g., age, clinical disorder)

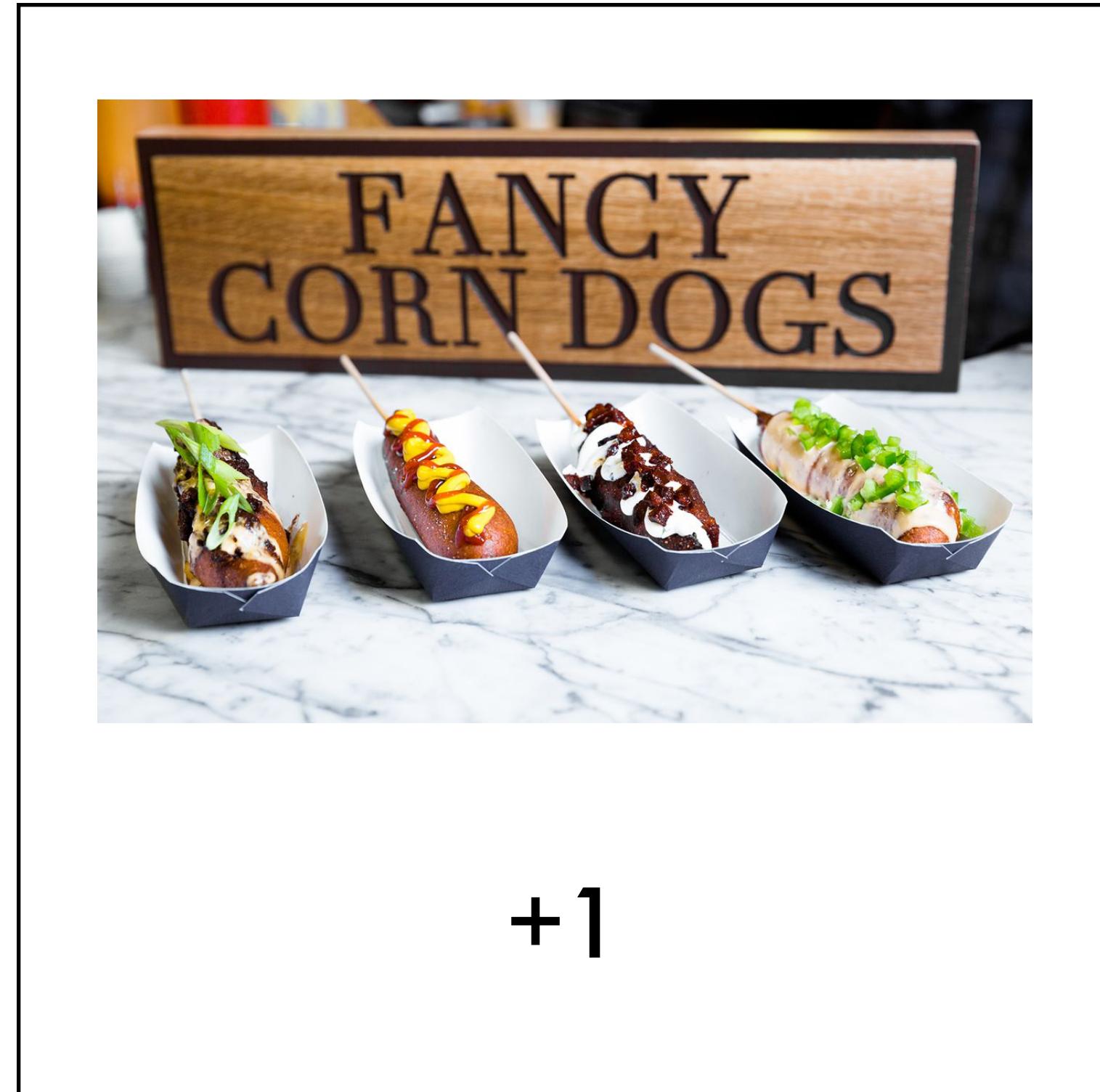
Reading Terminal Market



Goal:
decide what to eat for lunch

Two strategies for decision-making

Strategy 1:
Learn from feedback



Two strategies for decision-making

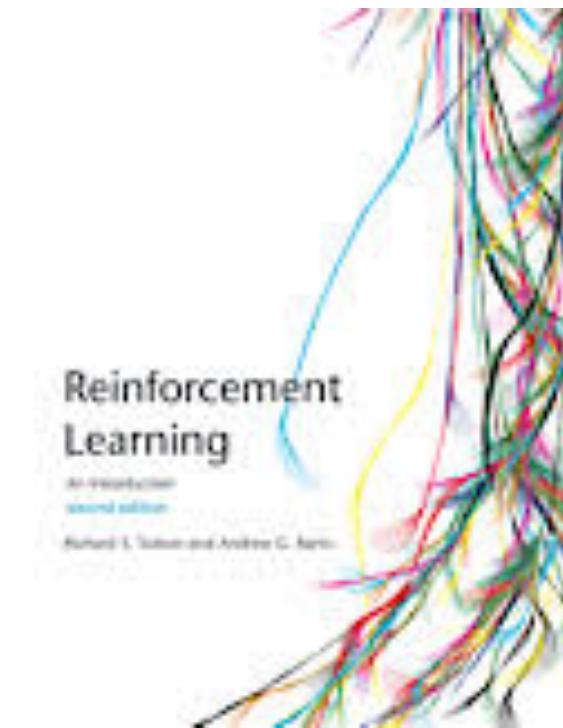
Strategy 1:
Learn from feedback



Angela Radulescu
Mt. Sinai



Alana Jaskir
Brown



Reinforcement Learning

Reward,
State



Environment



Agent

Sutton & Barto, 2018

Two strategies for decision-making

Strategy 1:
Learn from feedback



Strategy 2:
**Accumulate Evidence Until
Decision Threshold**

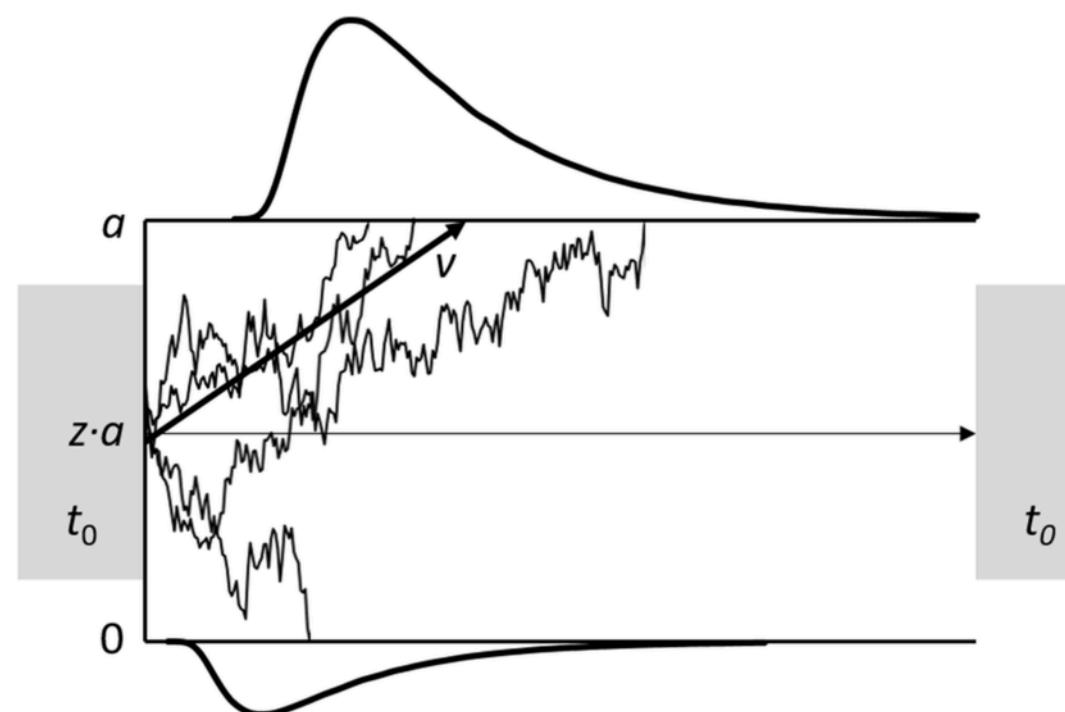


Two strategies for decision-making

Strategy 2:
**Accumulate Evidence Until
Decision Threshold**



Sequential Sampling Models



Ratcliff et al., 2016; Wiecki, Sofer, & Frank 2013

Two strategies for decision-making

Strategy 2:
**Accumulate Evidence Until
Decision Threshold**



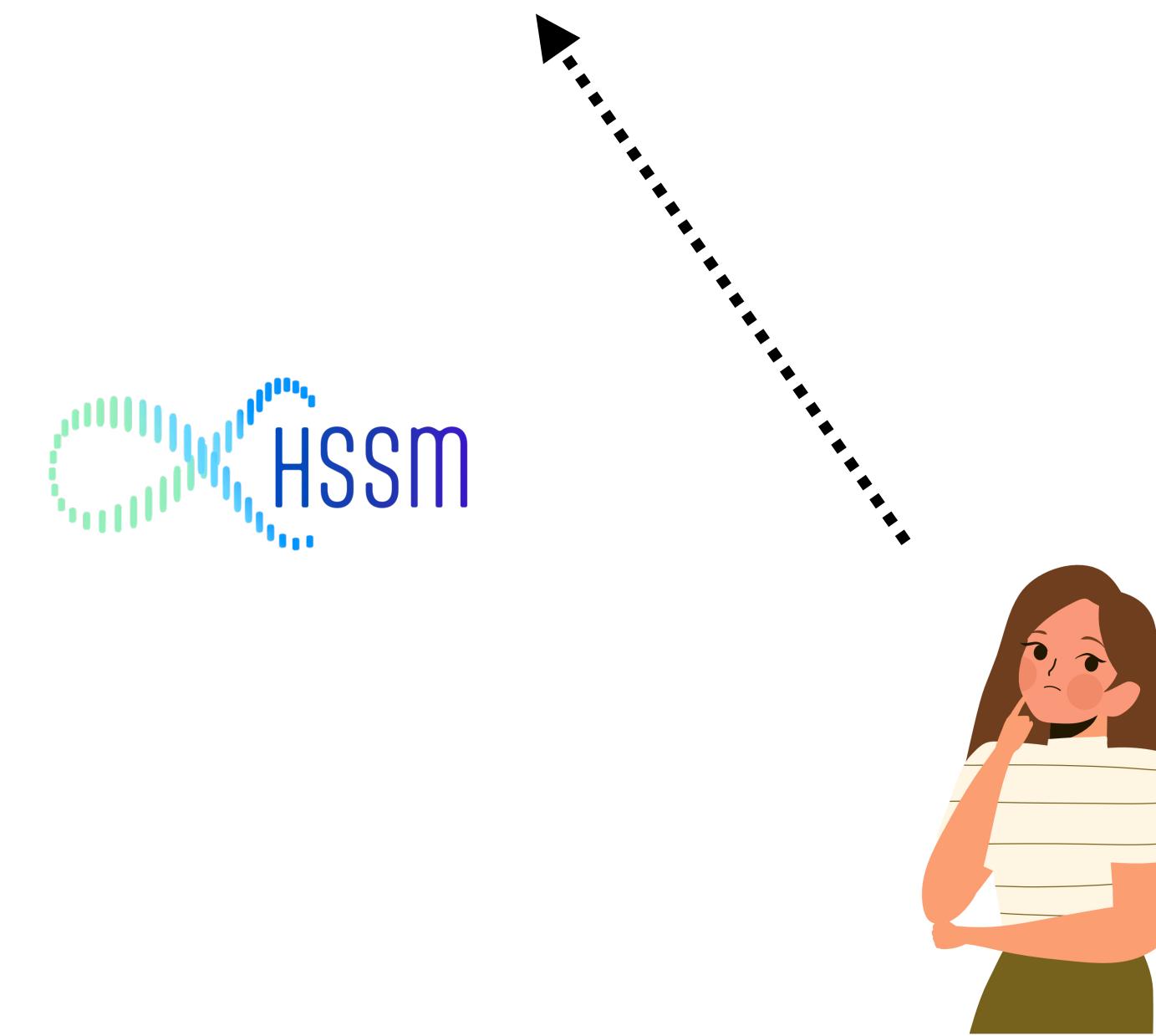
Bob Wilson
U Arizona



Alex Fengler
Brown

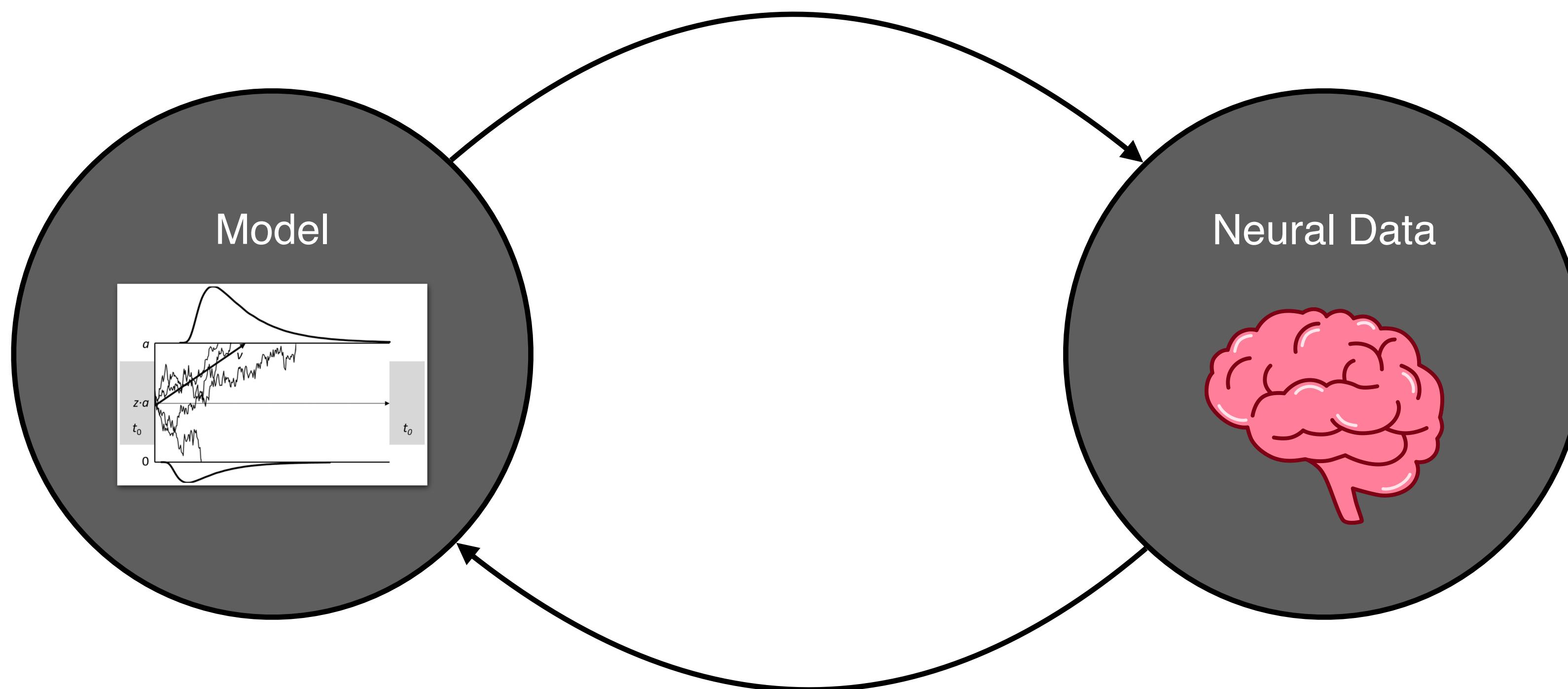


Krishn Bera
Brown



Model-Based Approaches in Cognitive Neuroscience

Include model parameters in as regressors in
neuroscience analyses (e.g., fMRI, EEG, neuronal firing, etc)



Include neural data (e.g., fMRI BOLD, EEG Power, drugs, etc)
as regressors in drift diffusion model



Ten simple rules for the computational modeling of behavioral data

Robert C Wilson^{1,2†*}, Anne GE Collins^{3,4†*}

¹Department of Psychology, University of Arizona, Tucson, United States;

²Cognitive Science Program, University of Arizona, Tucson, United States;

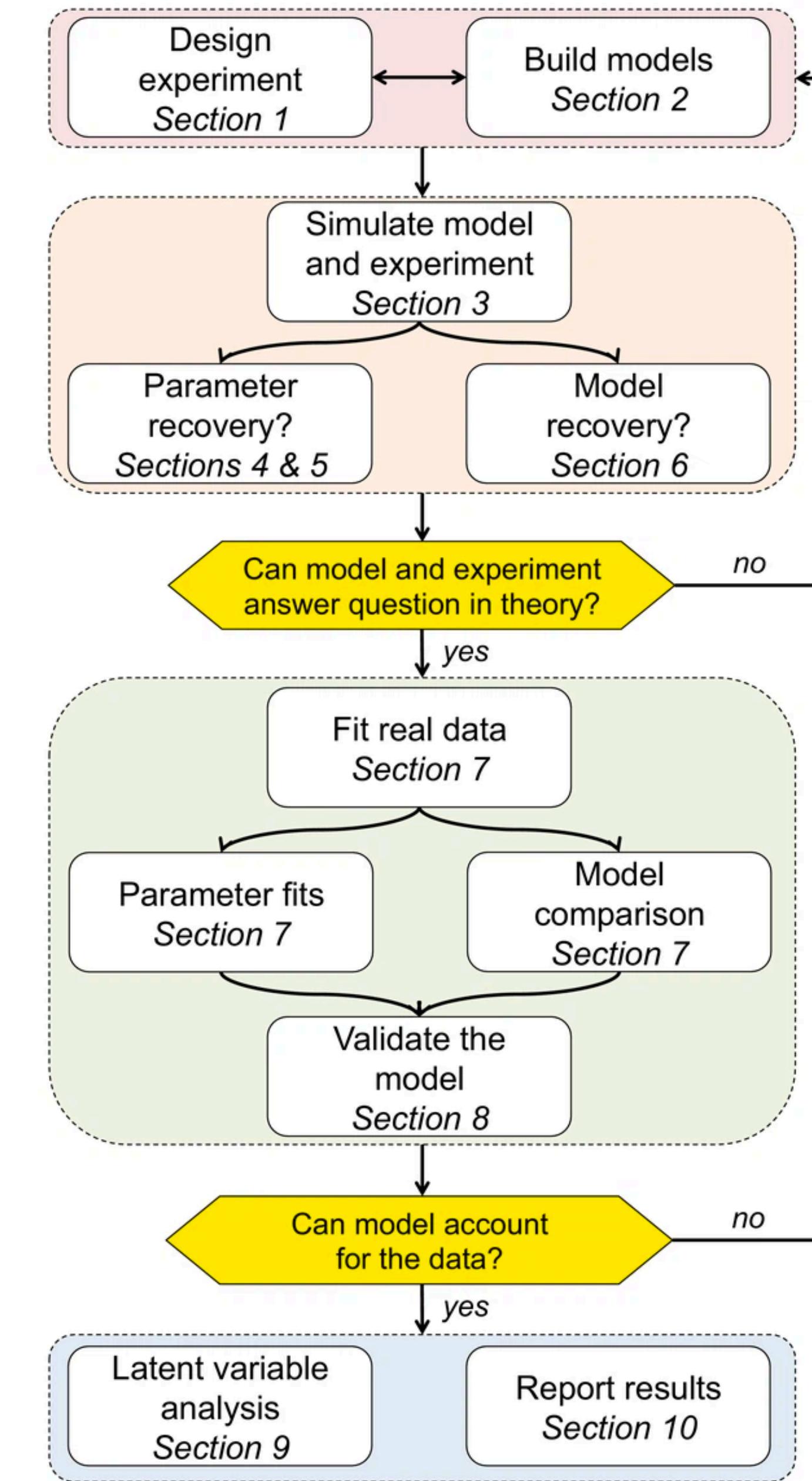
³Department of Psychology, University of California, Berkeley, Berkeley, United States; ⁴Helen Wills Neuroscience Institute, University of California, Berkeley, Berkeley, United States

Model-Based fMRI and Its Application to Reward Learning and Decision Making

JOHN P. O'DOHERTY,^{a,b} ALAN HAMPTON,^a AND HACKJIN KIM^b

^aComputation and Neural Systems Program, California Institute of Technology, Pasadena, California, USA

^bDivision of Humanities and Social Sciences, California Institute of Technology, Pasadena, California, USA



Applications for Aging & ADRD



***“The Promise of Computational Models
to Decision Neuroscience of Aging”***

Greg Samanez Larkin

Duke

Thanks for your attention!

Any questions?

Github Repo

<https://github.com/debyee/SRNDNA-ModelingWorkshop-2024>

