

Does the cortex make a decision?

Readings for today

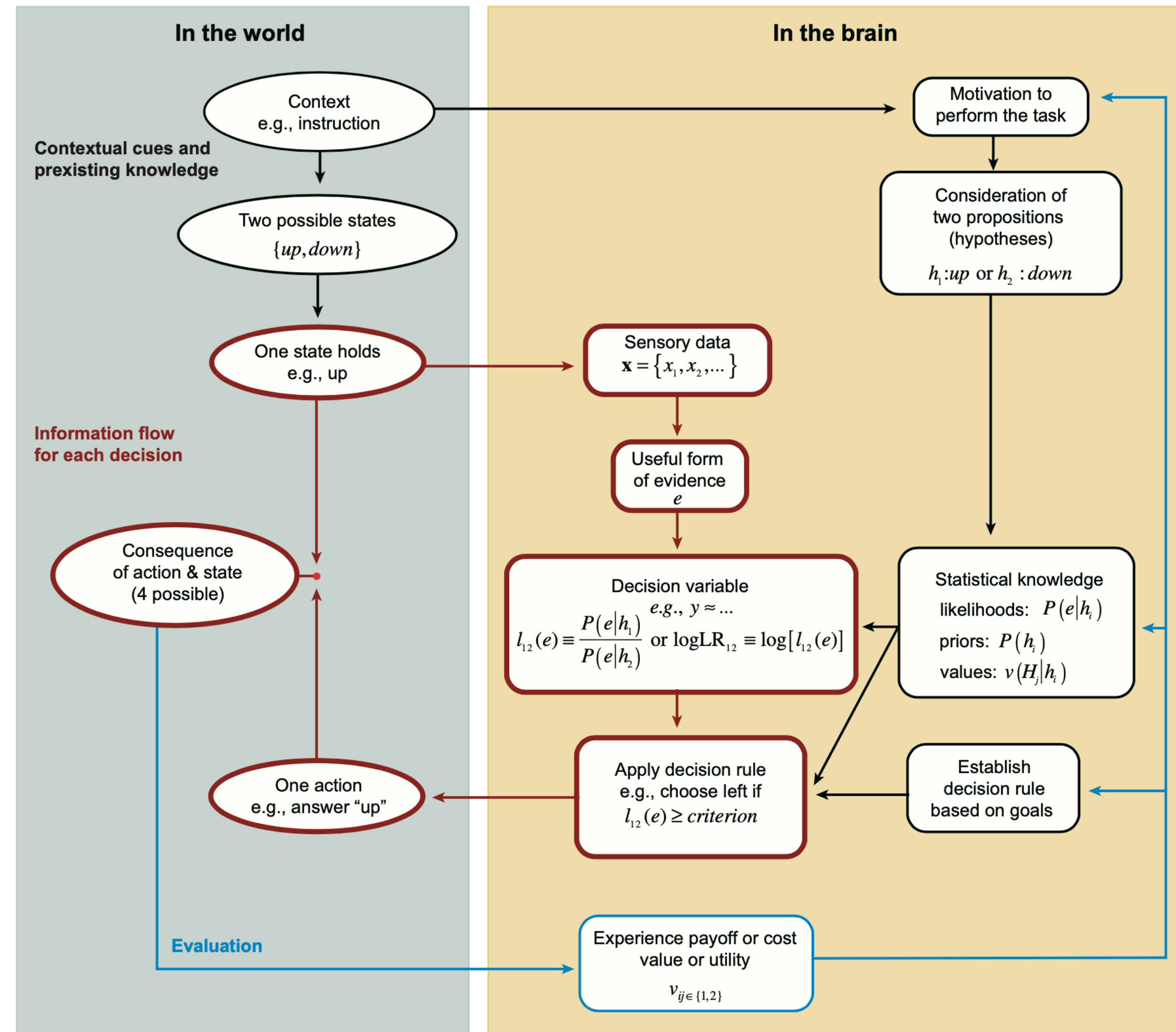
- Latimer, K. W., Yates, J. L., Meister, M. L., Huk, A. C., & Pillow, J. W. (2015). Single-trial spike trains in parietal cortex reveal discrete steps during decision-making. *Science*, 349(6244), 184-187.

Topics

- Accumulators in the cortex
- Is it really accumulation?

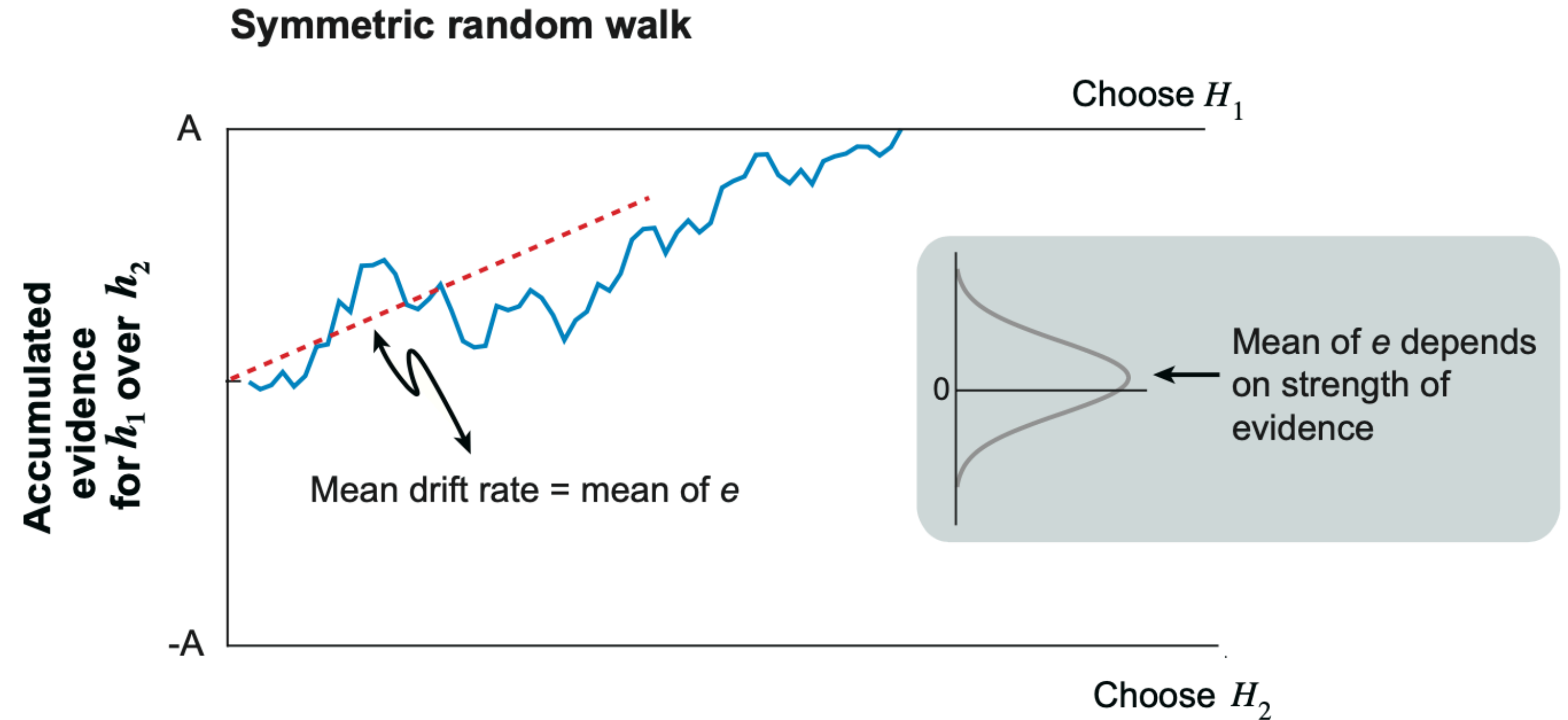
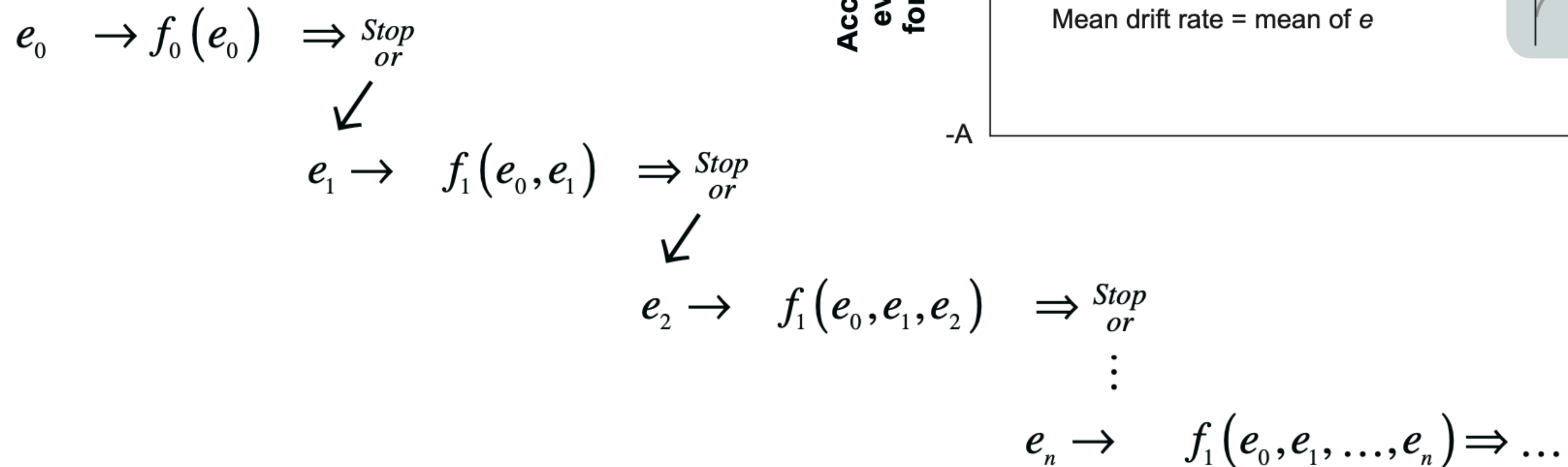
Accumulators in the cortex

Elements of making a decision

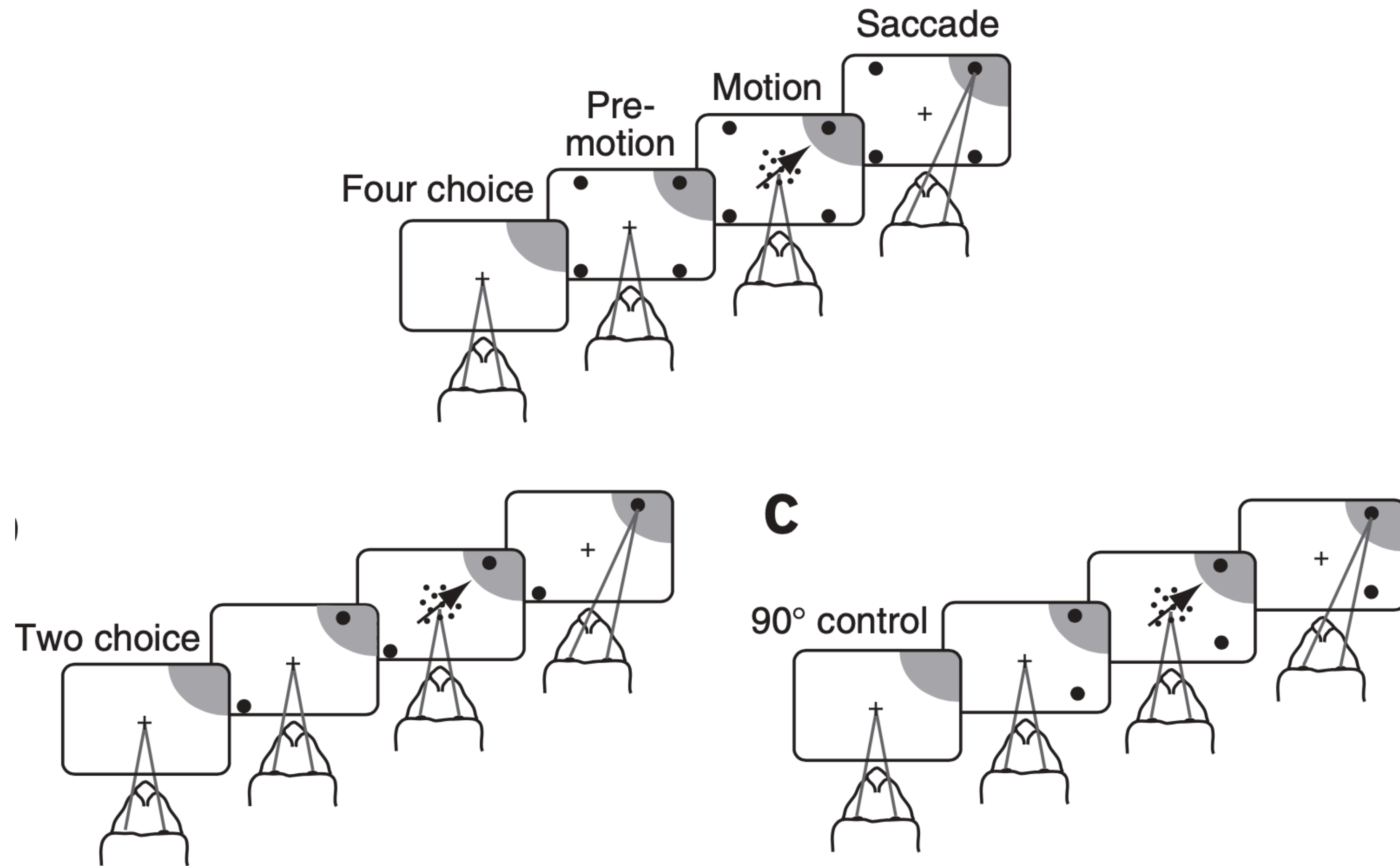


Serial evaluation of evidence

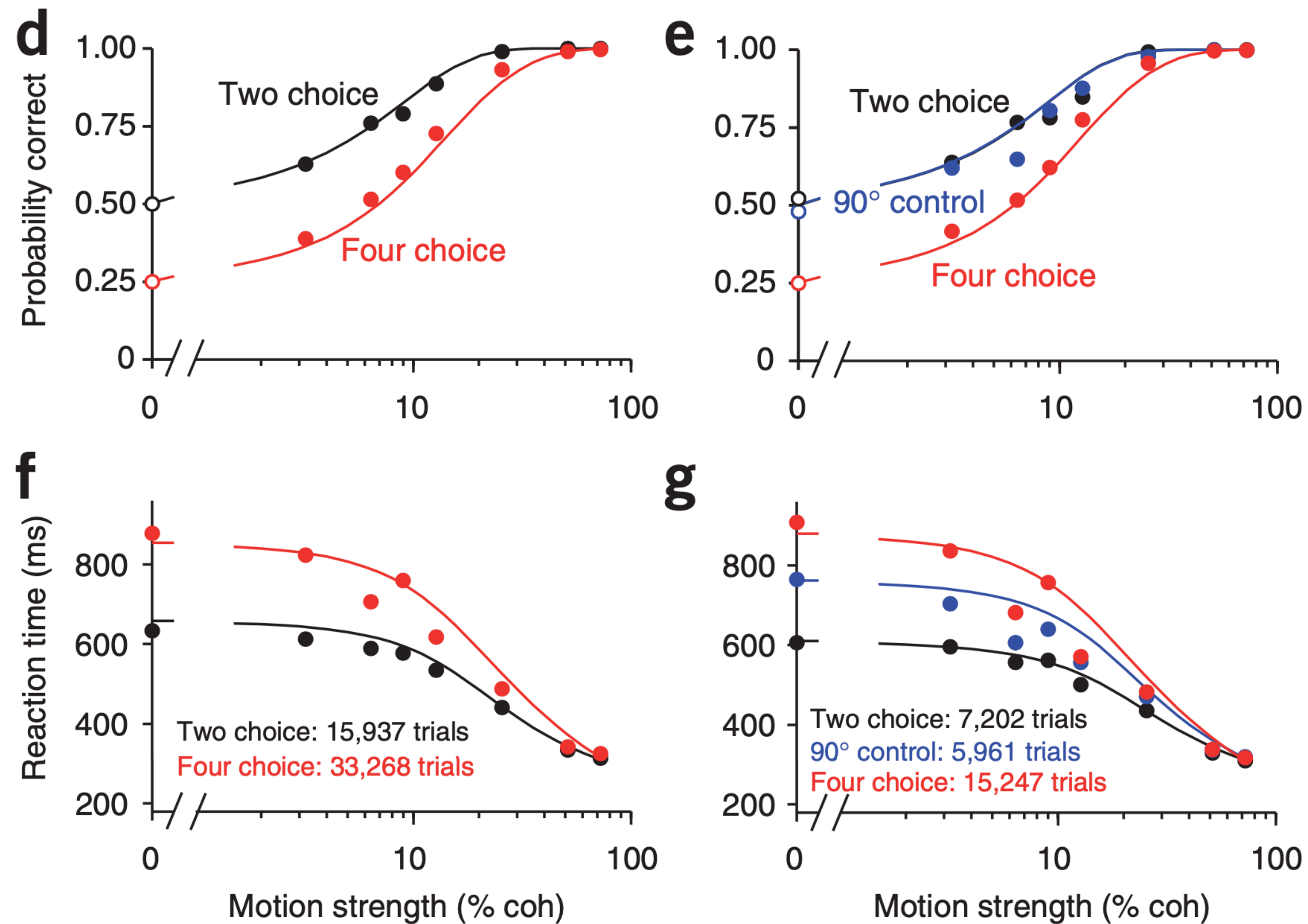
Sequential analysis framework



Multi-choice dot motion task



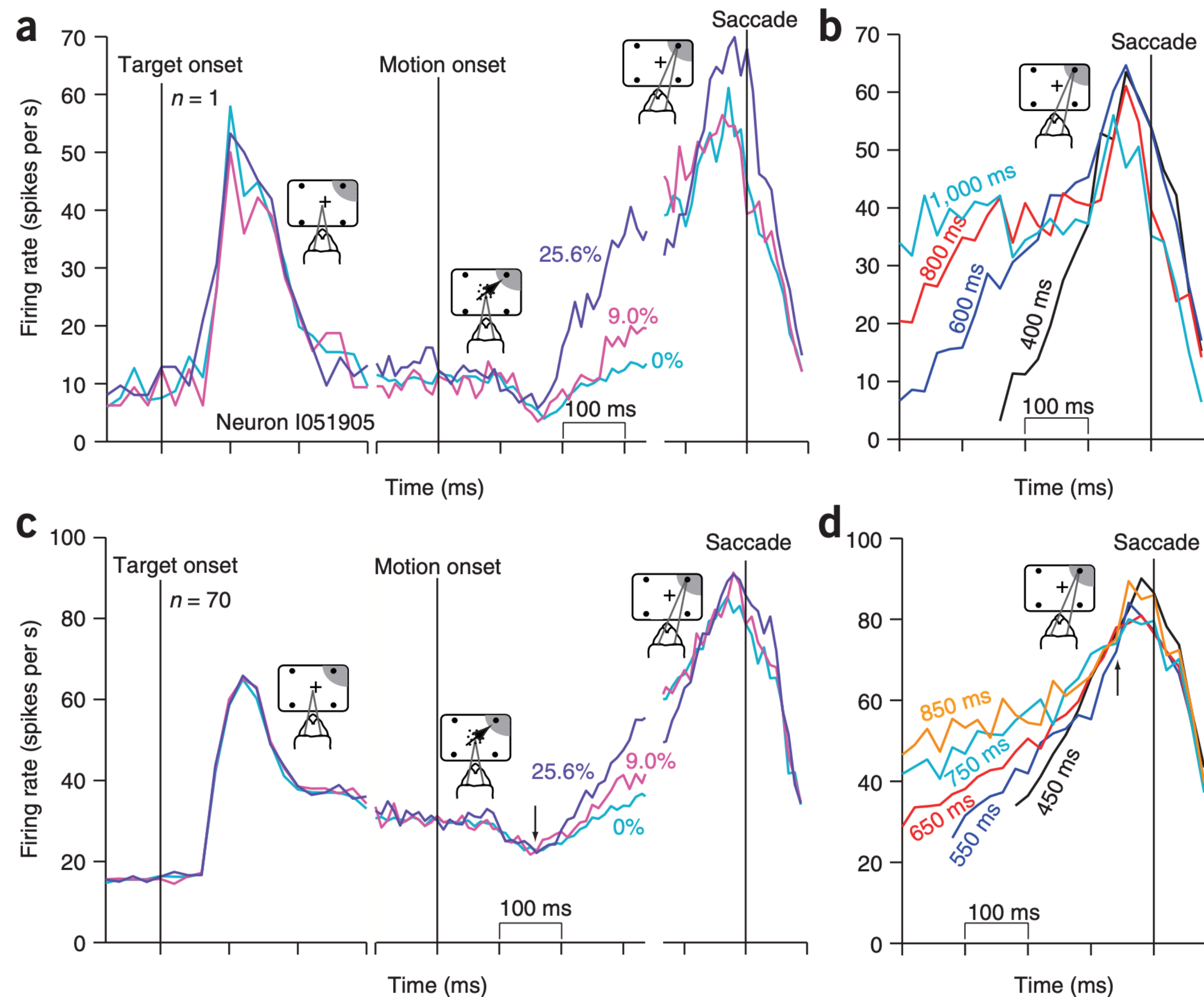
Speed & accuracy



Decisions got faster and more accurate with:

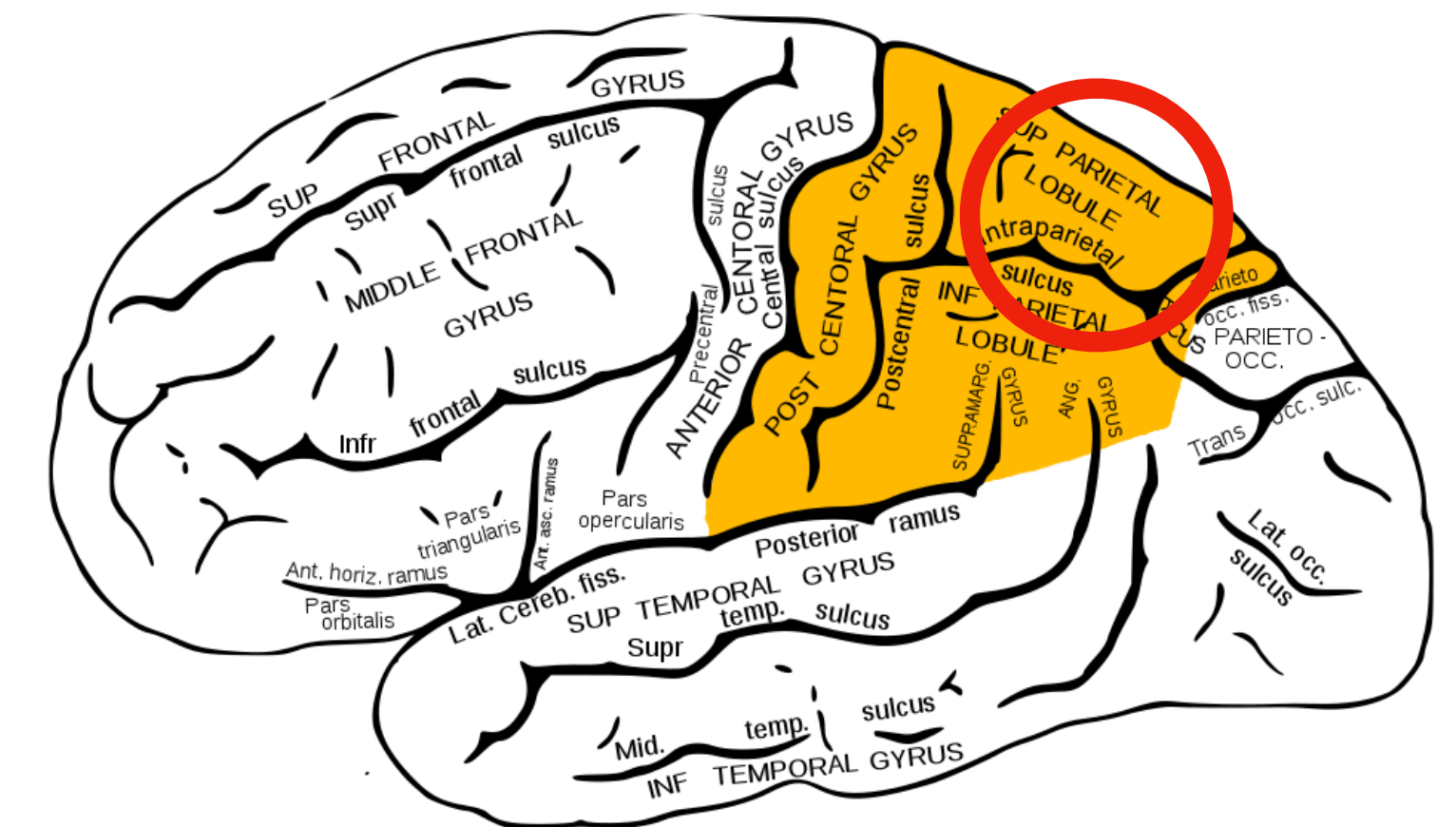
1. Fewer options
2. More coherent evidence

Ramping in the cortex



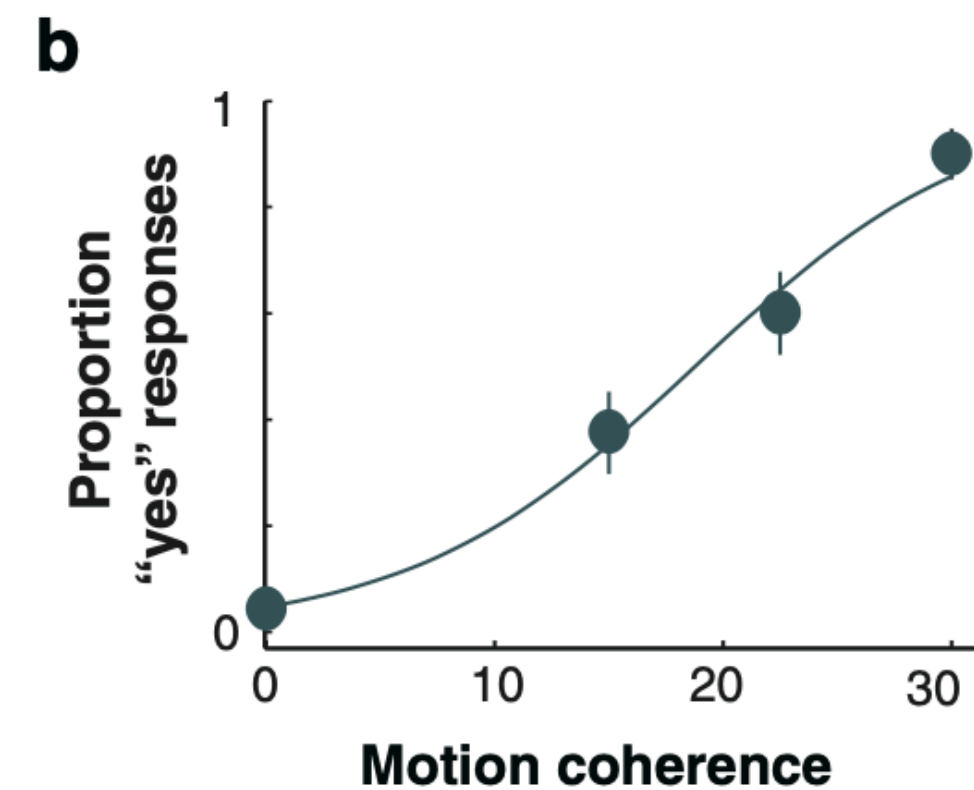
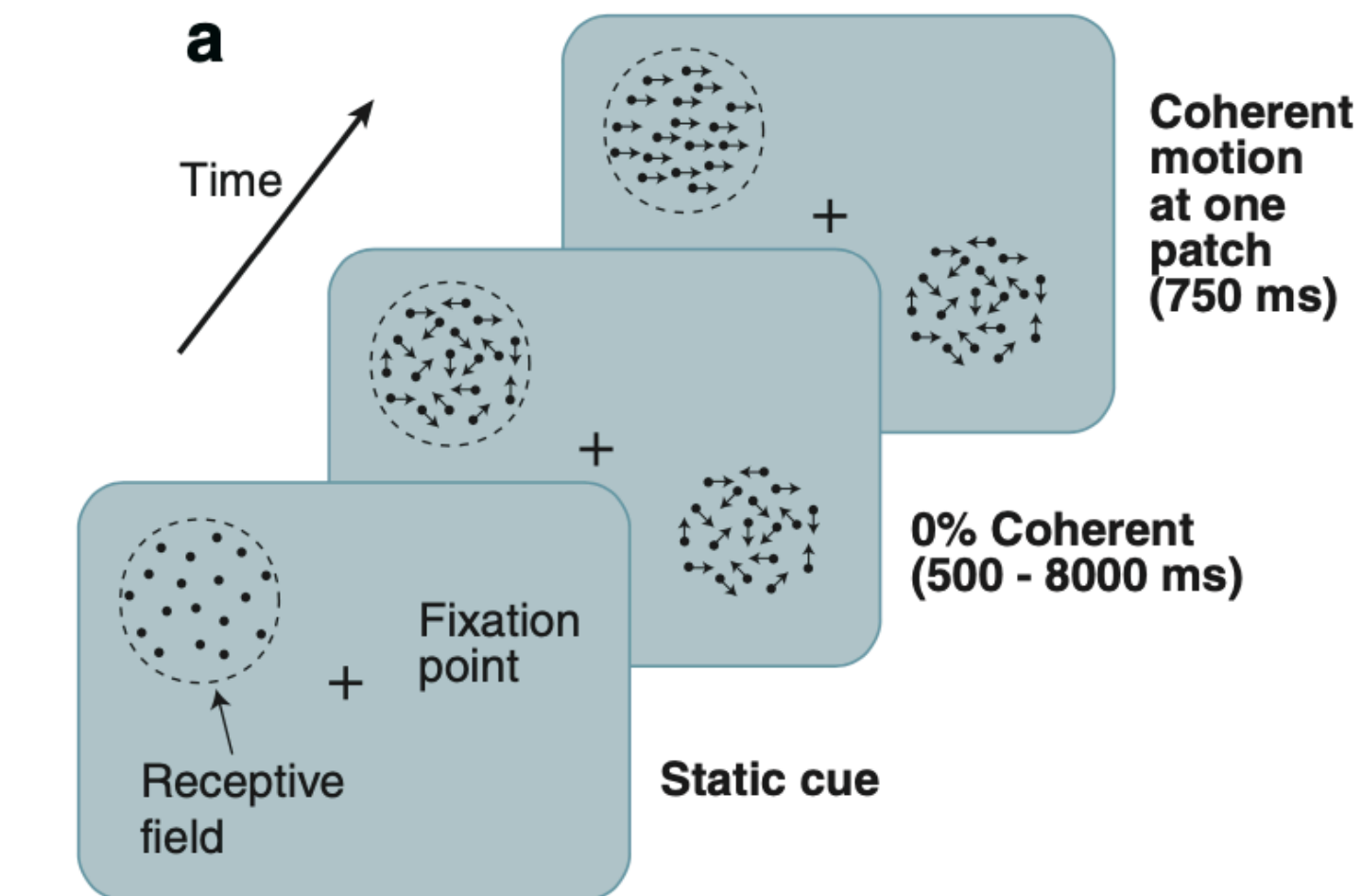
Single neuron

Firing rates of neurons in LIP respond like bounded accumulators.

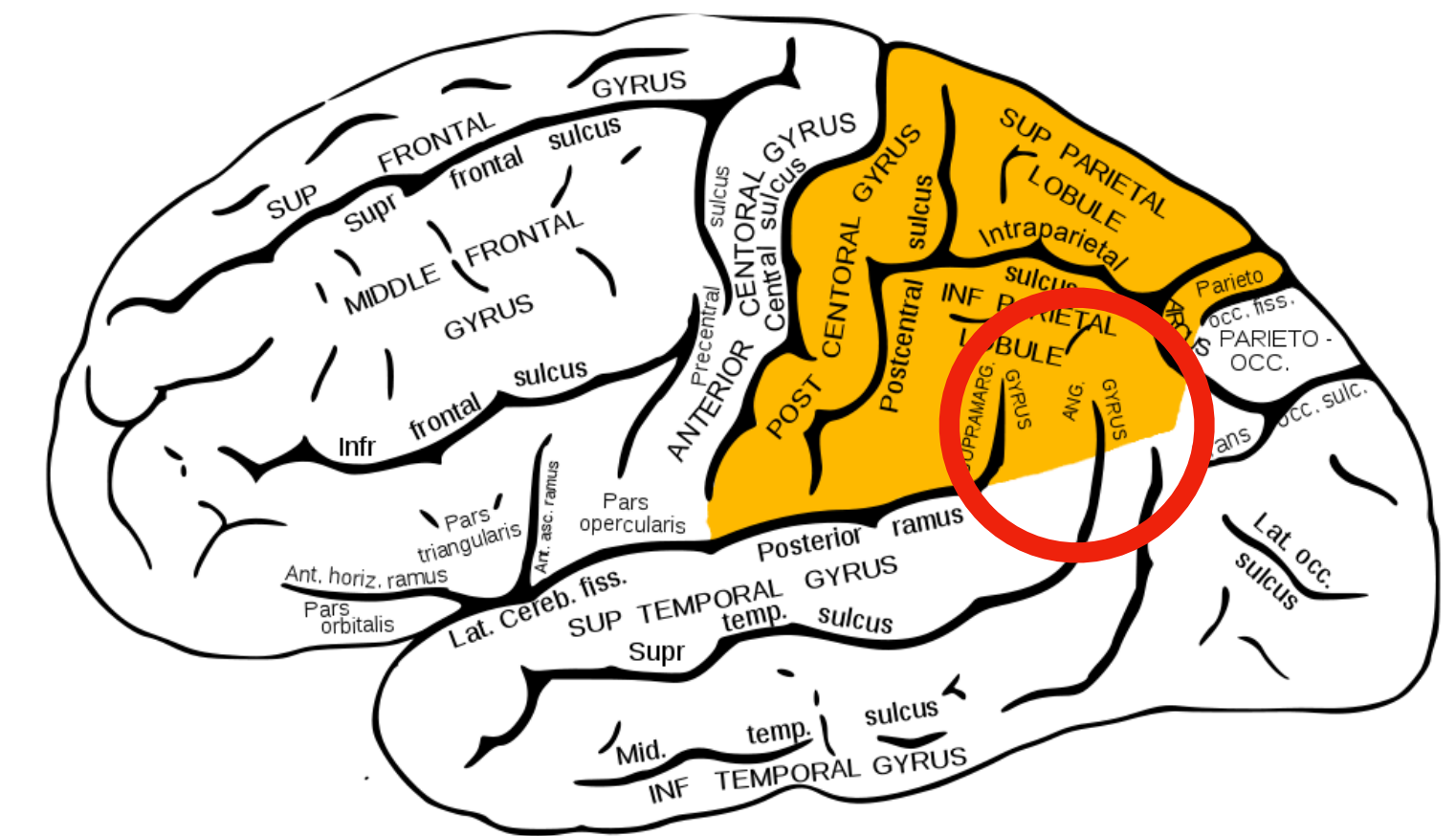
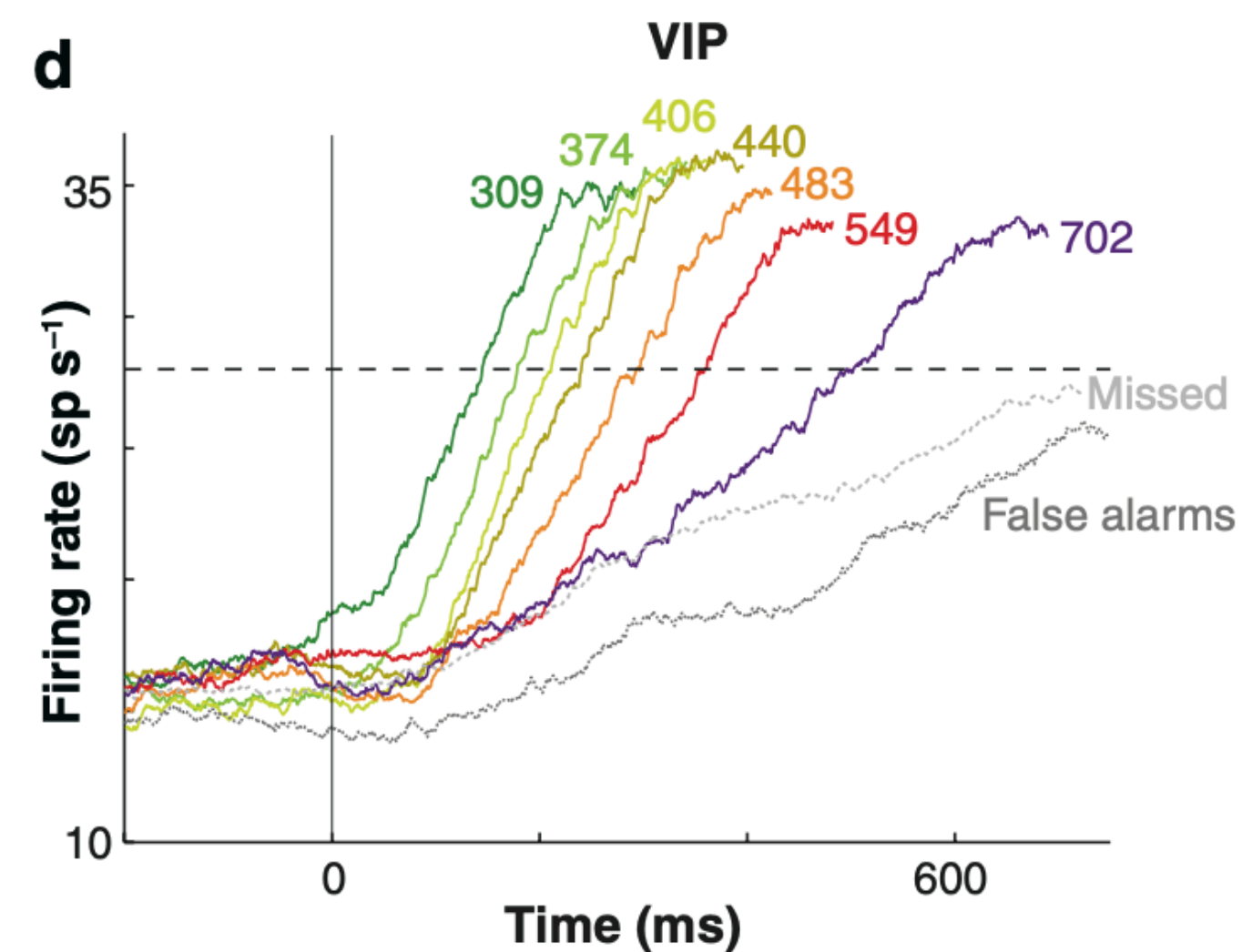
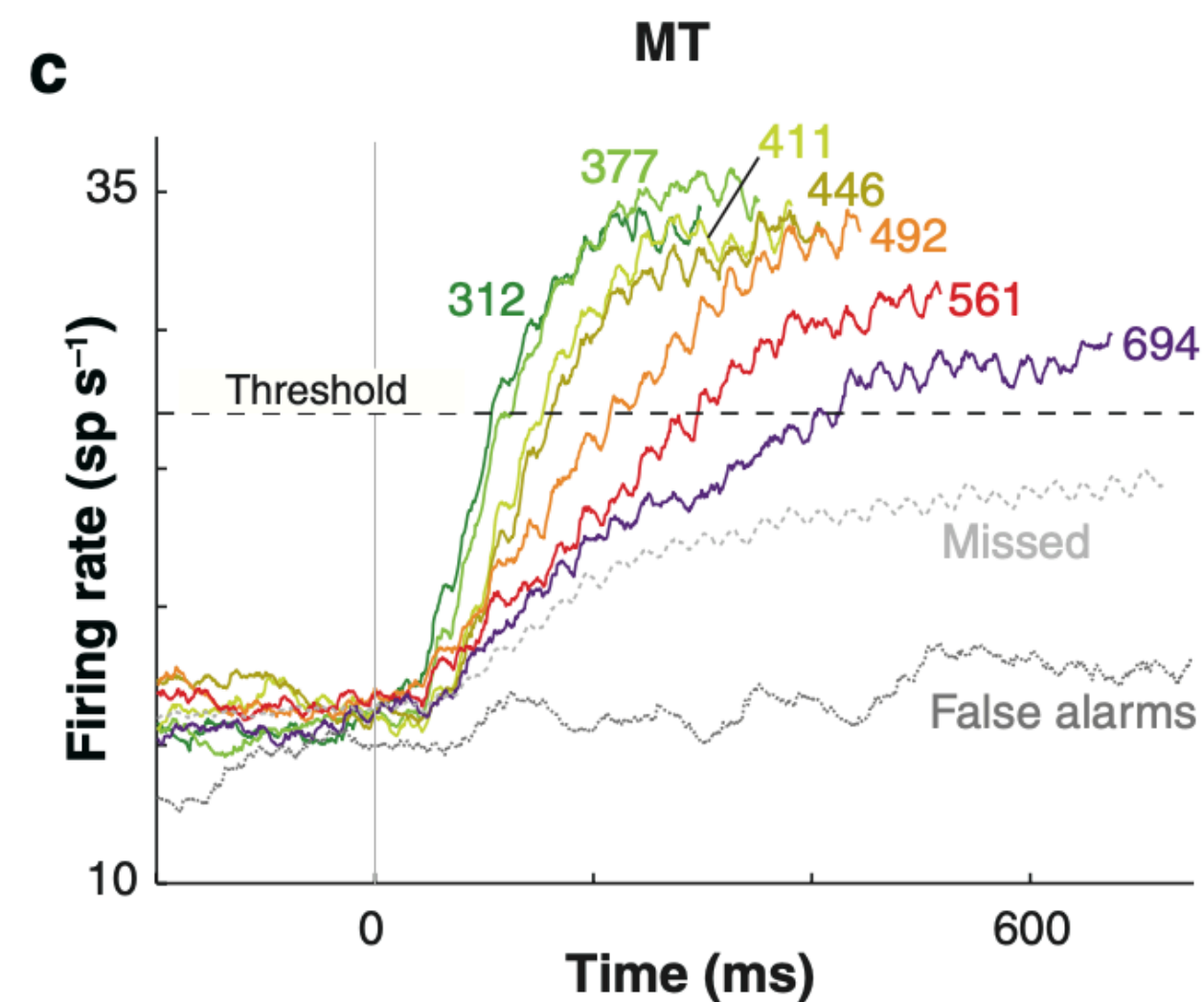


Population avg

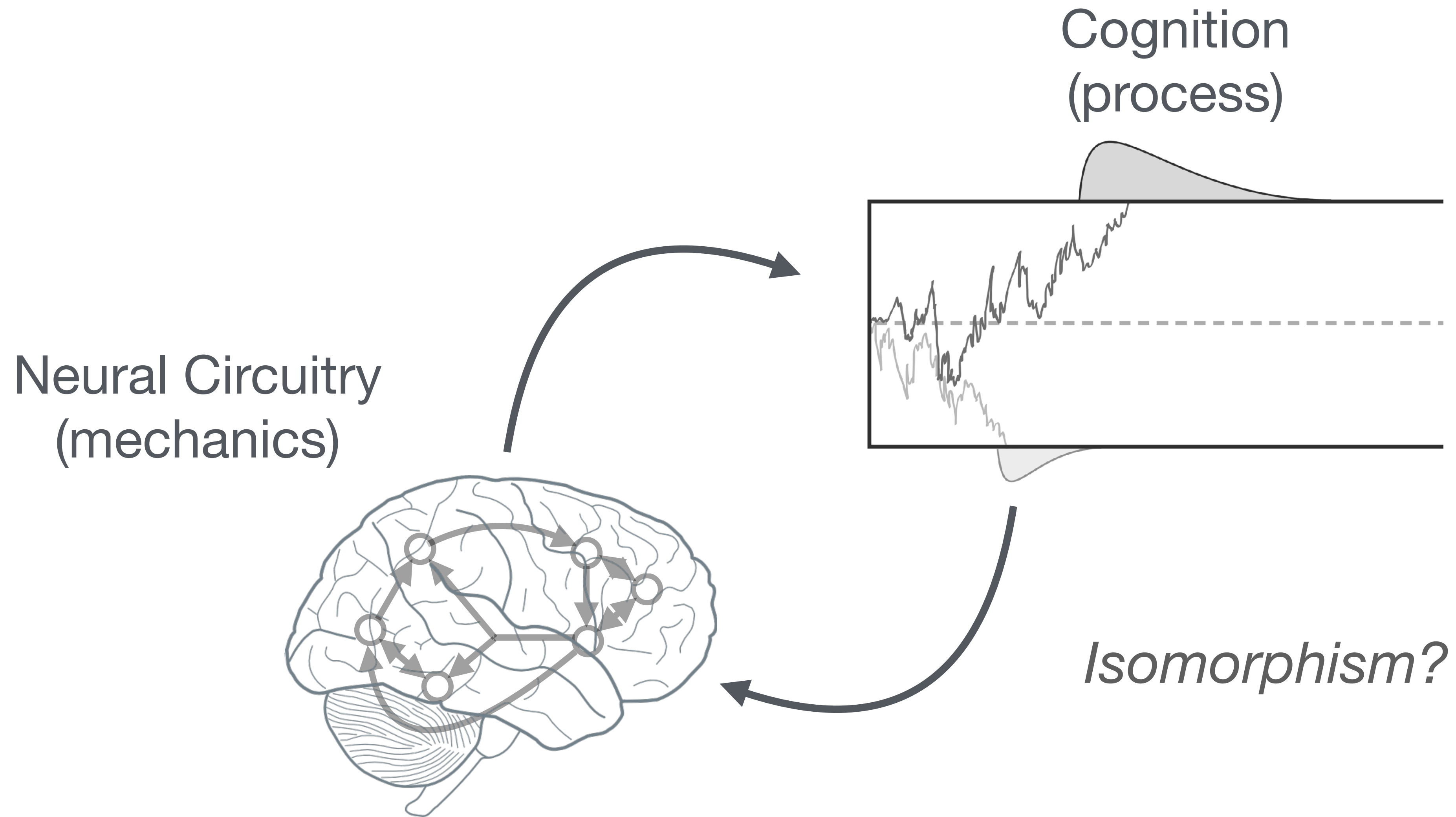
Other accumulators



Areas that process visual motion also show accumulator-like dynamics.



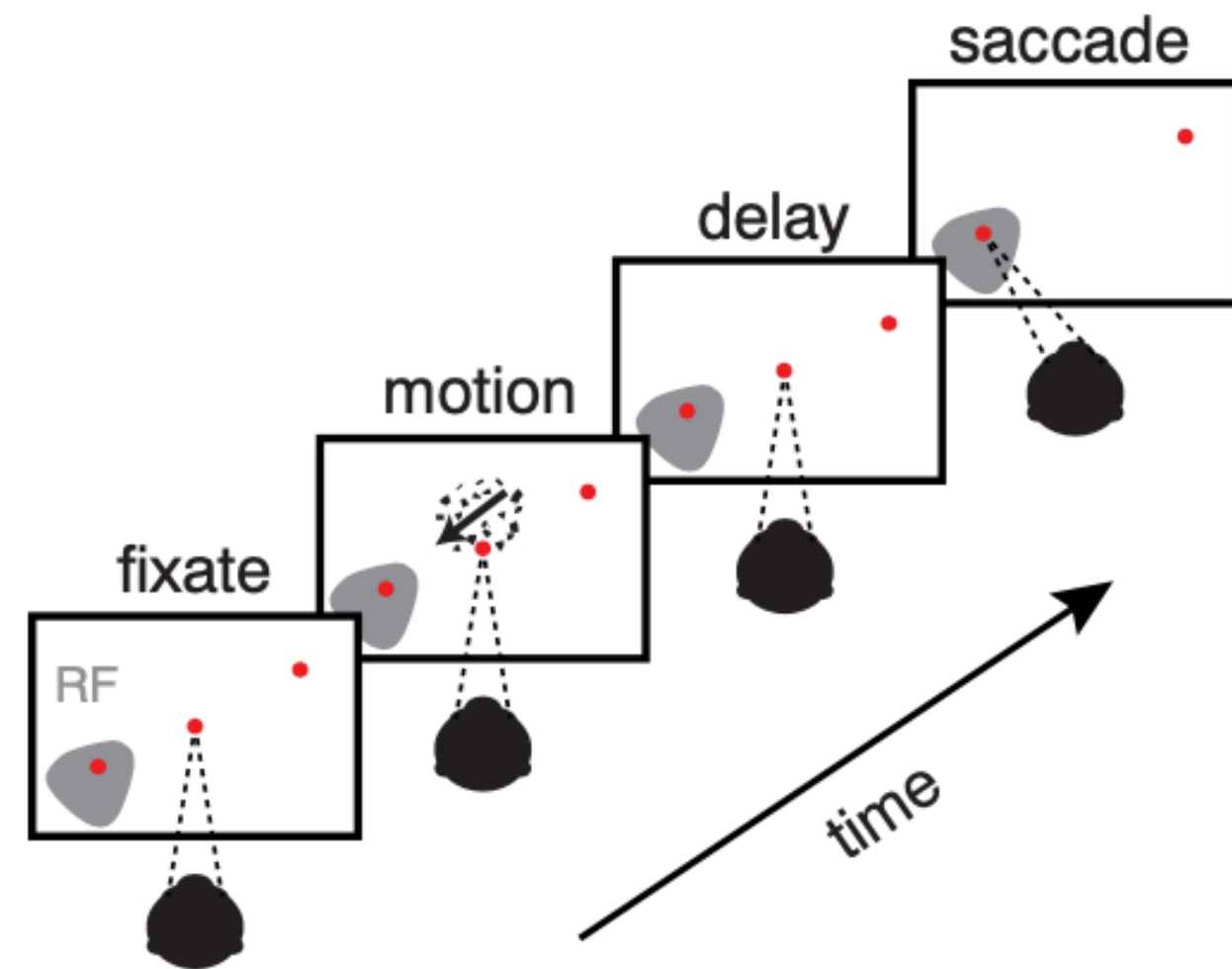
Assumptions?



Is it really accumulation?

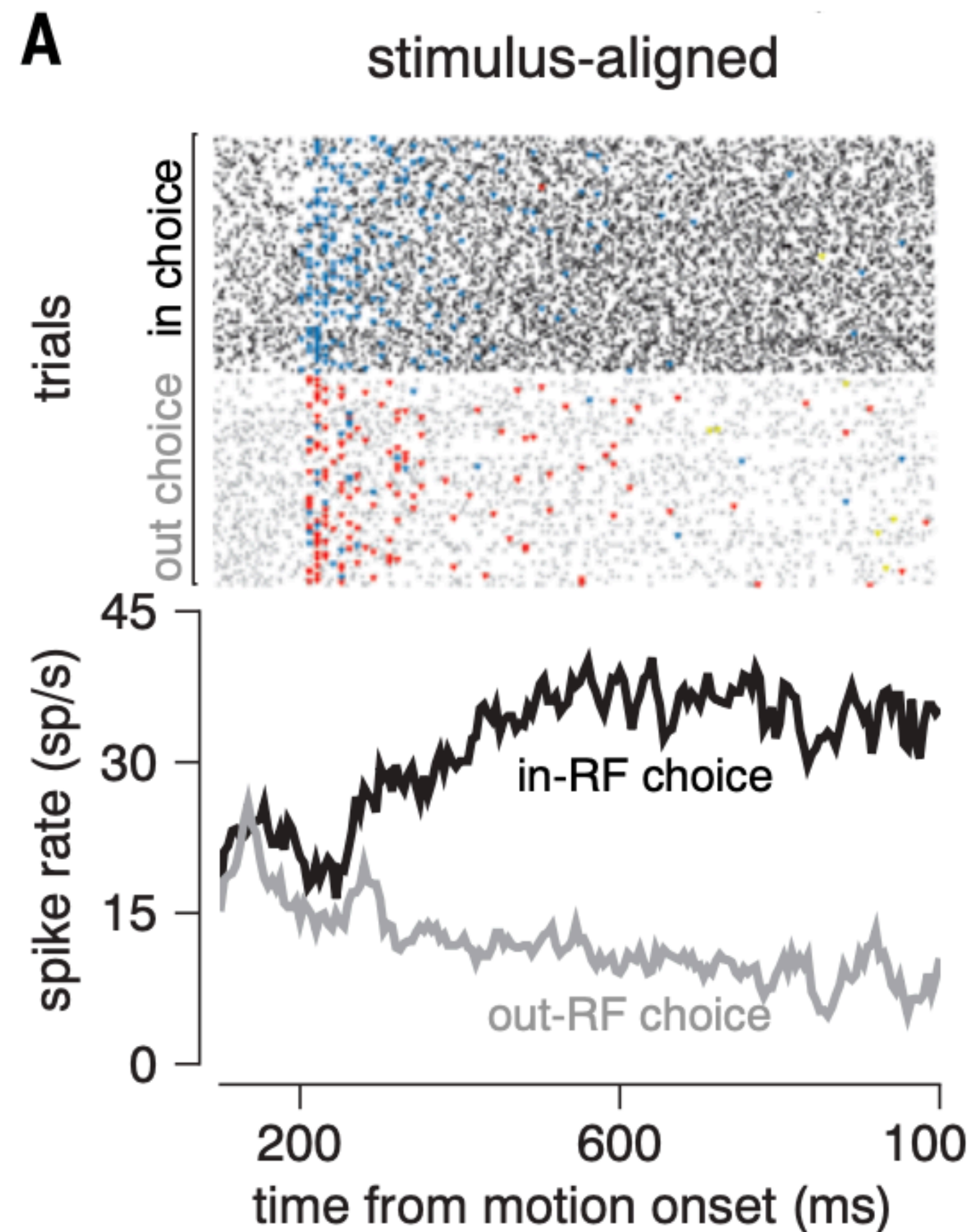
Rethinking accumulators

A motion discrimination task



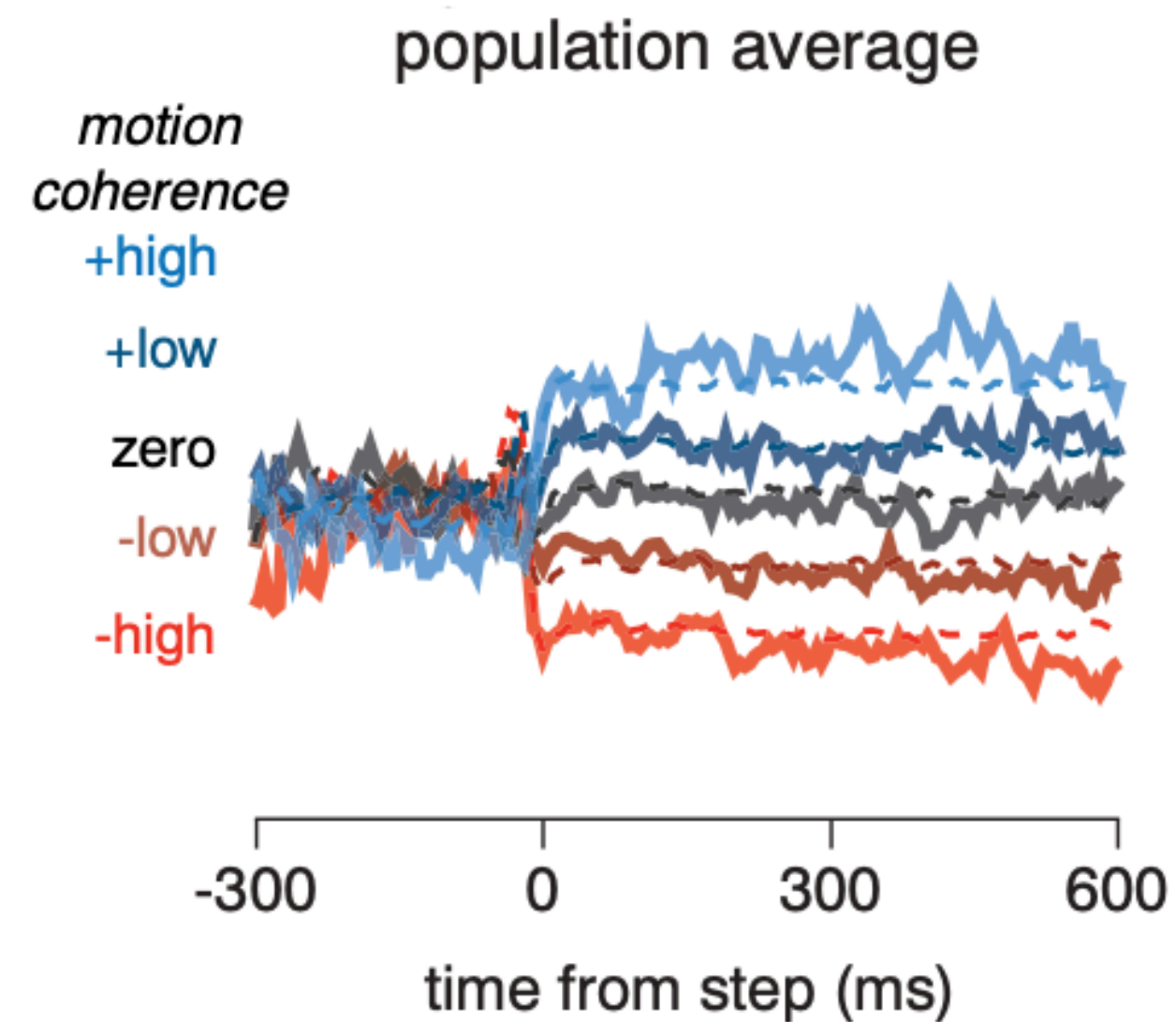
The ramping and stepping behavior will look identical when aligned to stimulus onset

Same data, different analysis



Search routine to find “steps” in firing rates of neurons during the deliberation time.

Accumulators vs steppers



Most neurons in LIP showed patterns largely consistent with the step model, though some showed ramping (accumulator effects) and some showed responses inconsistent with either model.

Timeline of a controversy

TECHNICAL COMMENT

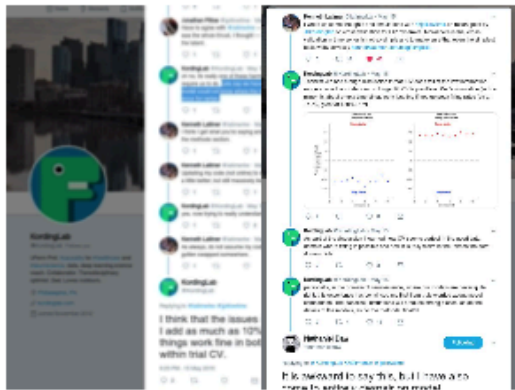
NEURONAL MODELING

“OVER OUR DEAD CAREERS,
IT RAMPS SO HARD!”

Michael N. Shadlen,^{1*} Roozbeh Kiani,² William T. Newsome,³ Joshua I. Gold,⁴
Daniel M. Wolpert,⁵ Ariel Zylberberg,⁶ Jochen Ditterich,⁷ Victor de Lafuente,⁸
Tianming Yang,⁹ Jamie Roitman¹⁰

“EVERYBODY SUCKS AT STATISTICS
...also LIP totally ramps”

Xuelong Zhao, Konrad P. Kording
May 4, 2018



TECHNICAL RESPONSE

NEURONAL MODELING

“LIP DOESN’T EVEN RAMP!”

● Kenneth W. Latimer,^{1,2} Jacob L. Yates,^{1,2} Miriam L. R. Meister,^{2,3}
Alexander C. Huk,^{1,2,4,5} Jonathan W. Pillow^{1,2,5,6*}

“Super whack arguments
you guys. Please retire”

Kenneth W. Latimer,^{1,2,3} Jacob L. Yates,^{1,2} Miriam L. R. Meister,³
Alexander C. Huk,^{1,2,4,5} Jonathan W. Pillow^{1,2,5,6*}

“JK EVERYONE! ...sort of...”

● Kenneth W. Latimer¹, Alexander C. Huk², Jonathan W. Pillow^{3,*}



Take home message

- Churchland et al. show that averaged firing rates of cells tracks with the certainty of the evidence in making a decision.
- Latimer et al. show that, at the single neuron level, a subset of cells appear to show step-like properties instead of ramping.

Debate time!

Prompt: Given the mixture of results in the LIP (and other areas) as to whether cortical neurons express accumulator-like properties, should we abandon accumulator models for explaining how the cortex makes decisions?

Group A: Defend cortical accumulators

Group B: Reject cortical accumulators

Timeline:

