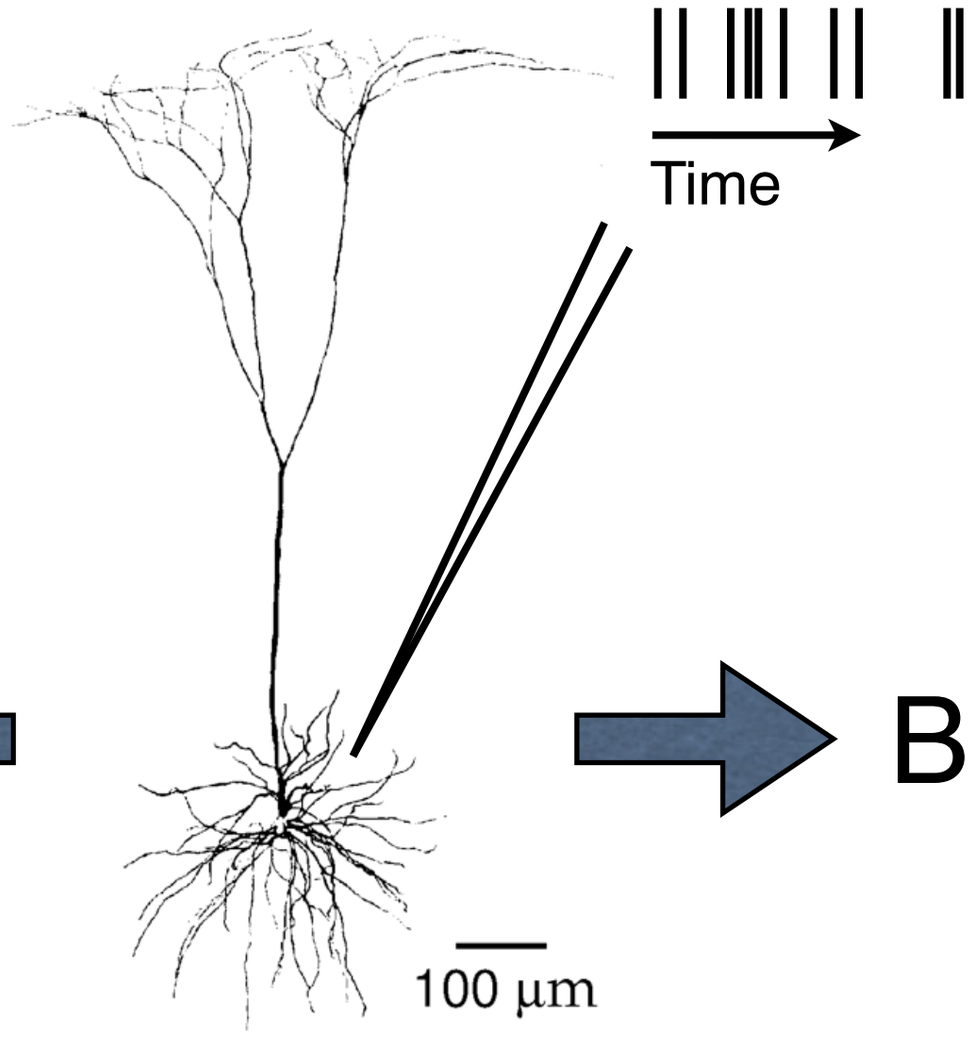
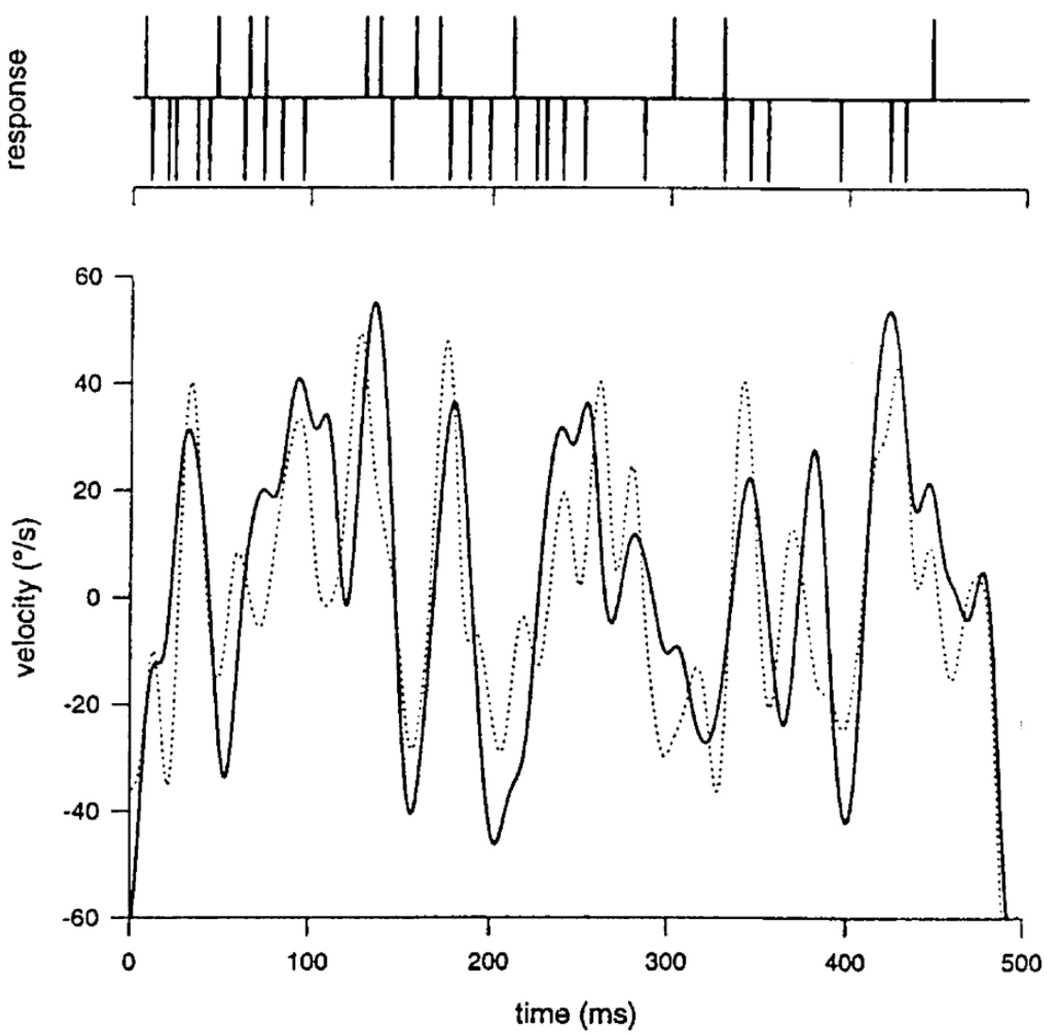
Decoding

External stimuli

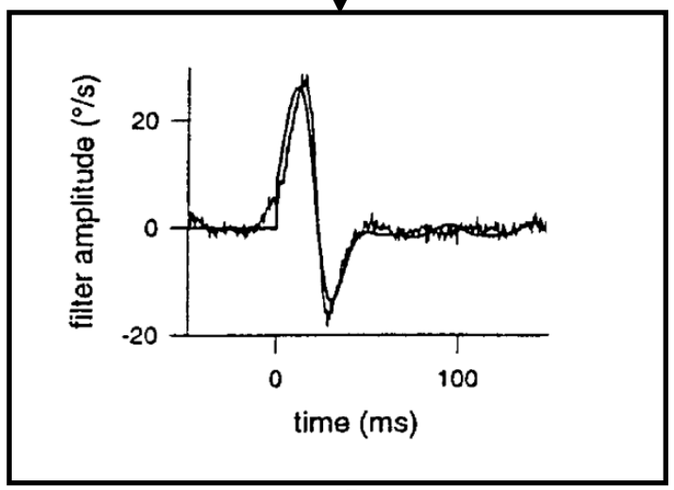


Behavior

Decoding a stimulus



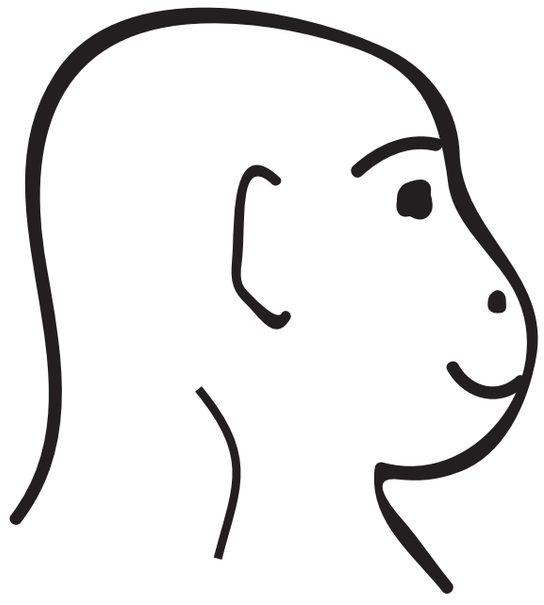
Linear



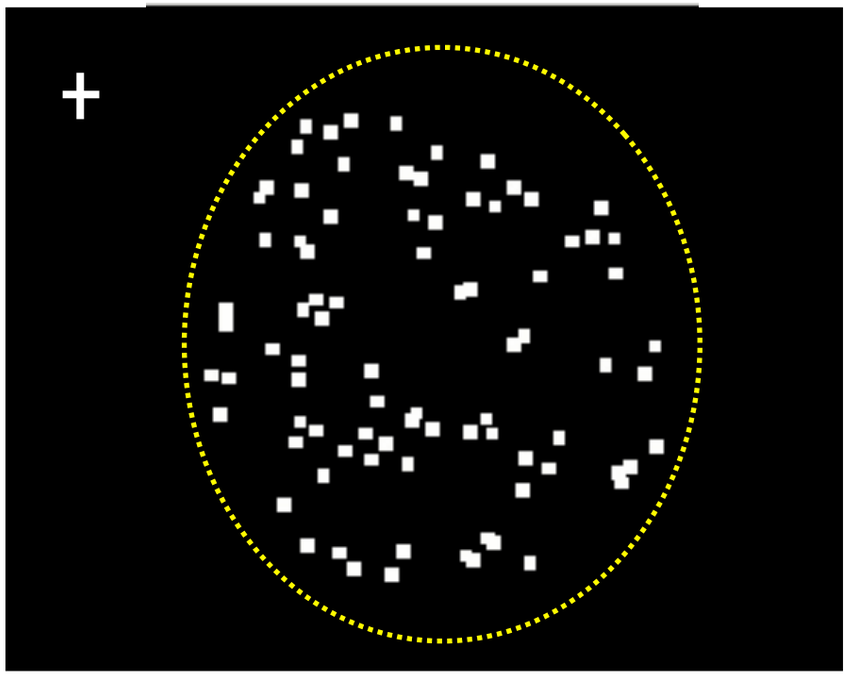
Nonlinear

Information theory provides upper bounds

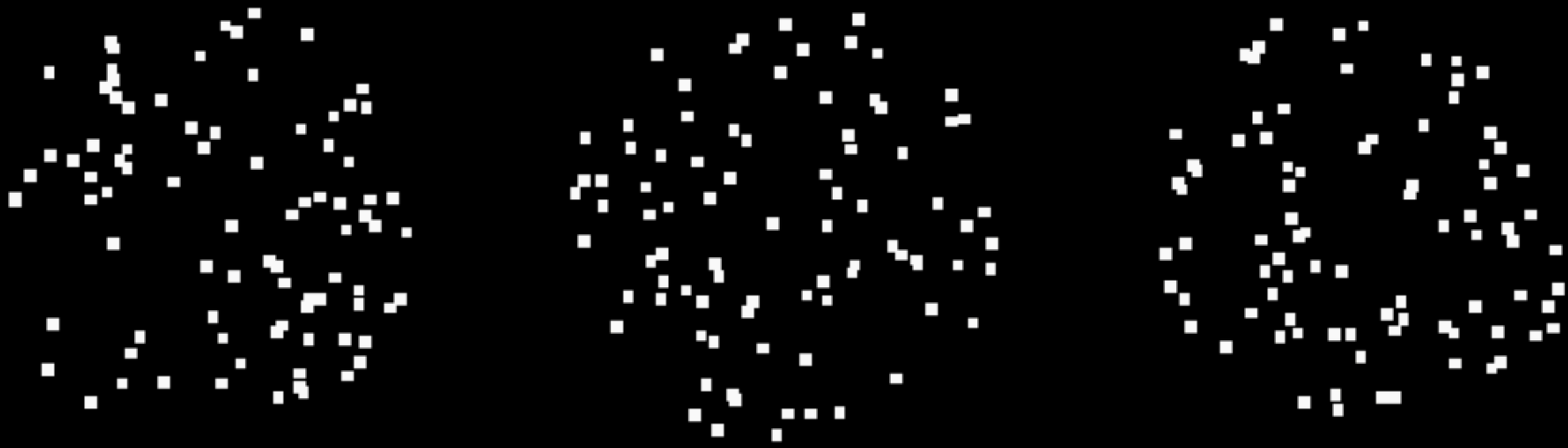
Motion discrimination



Null ⟷ Preferred



Britten et al., 1996



0%

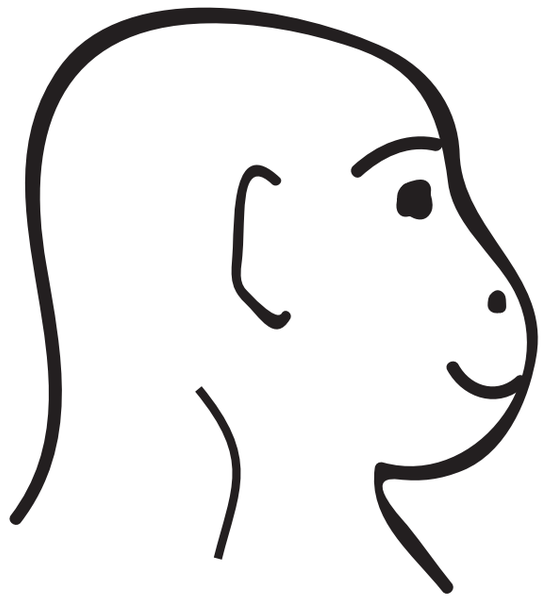
No Net Motion

50%

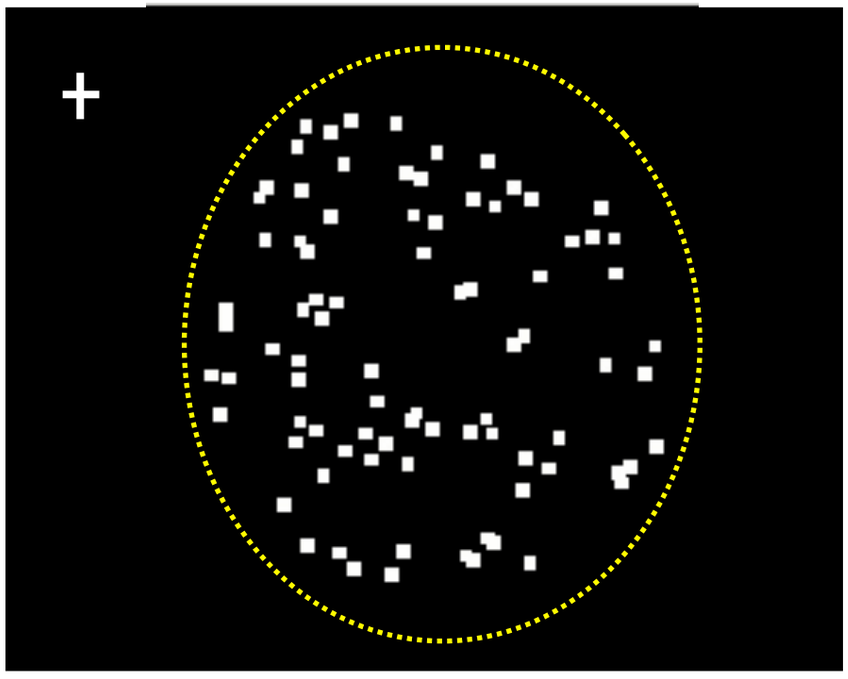
100%

Strongest Motion

Motion discrimination

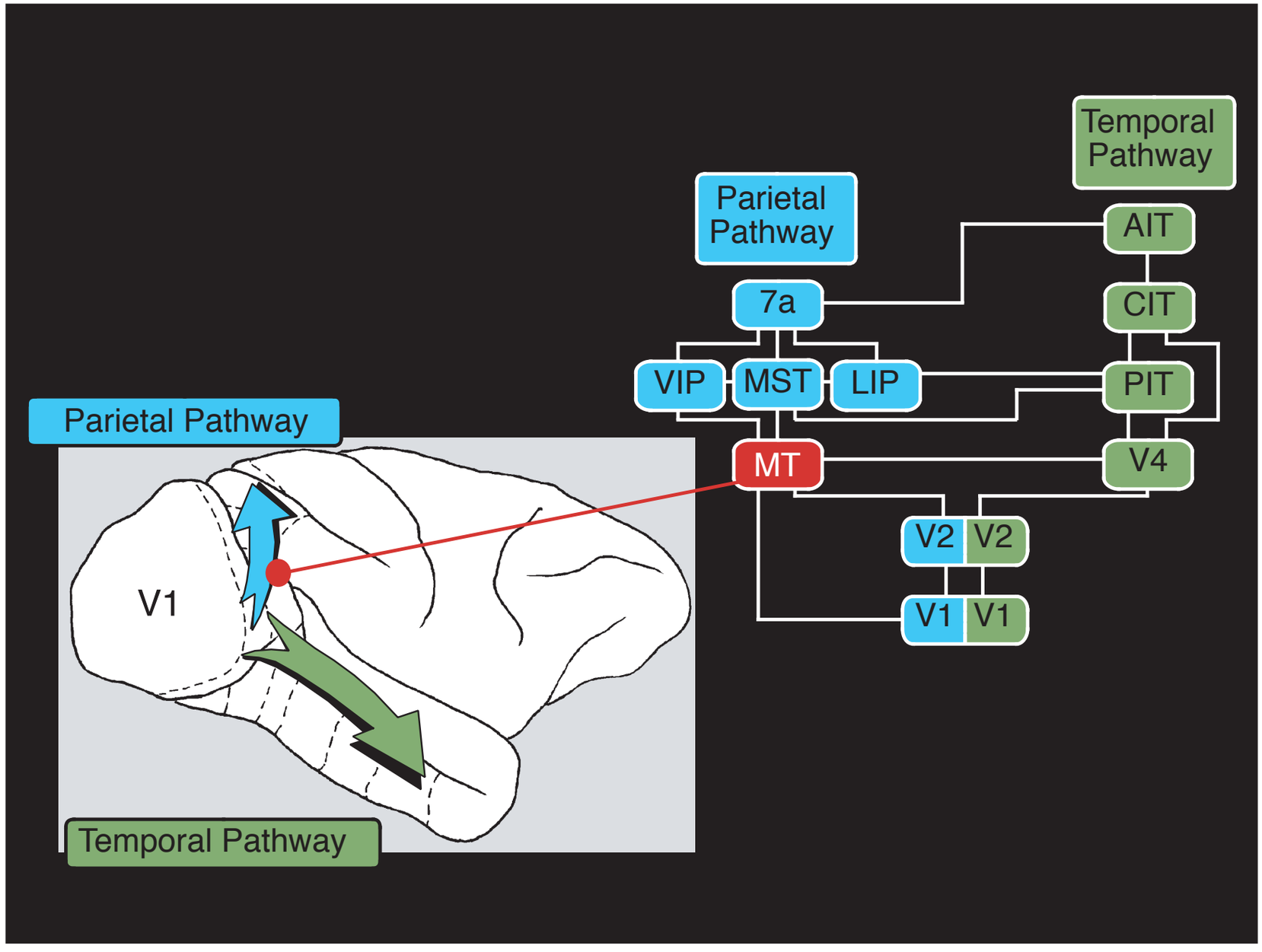


Null ⟷ Preferred

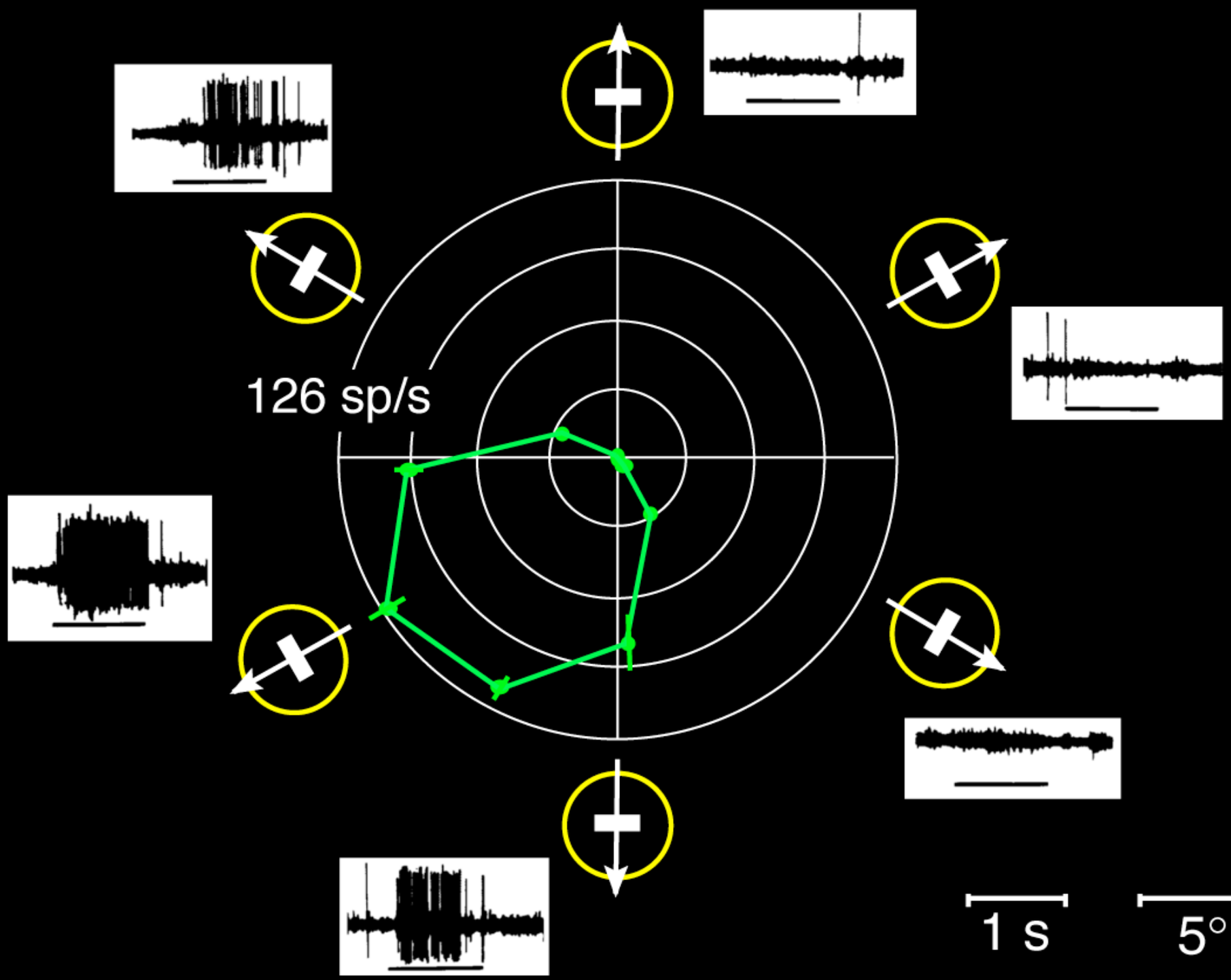


Britten et al., 1996

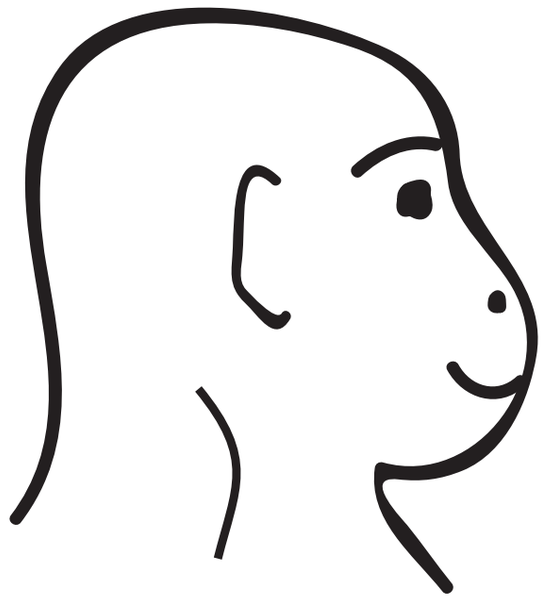
Recording in area MT of visual cortex



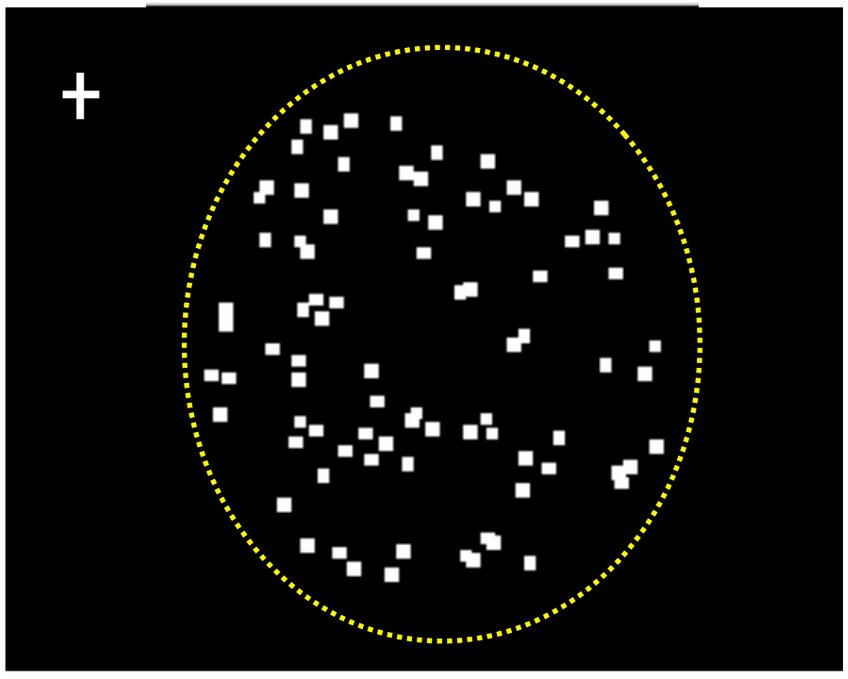
Directional selectivity in MT



Motion discrimination

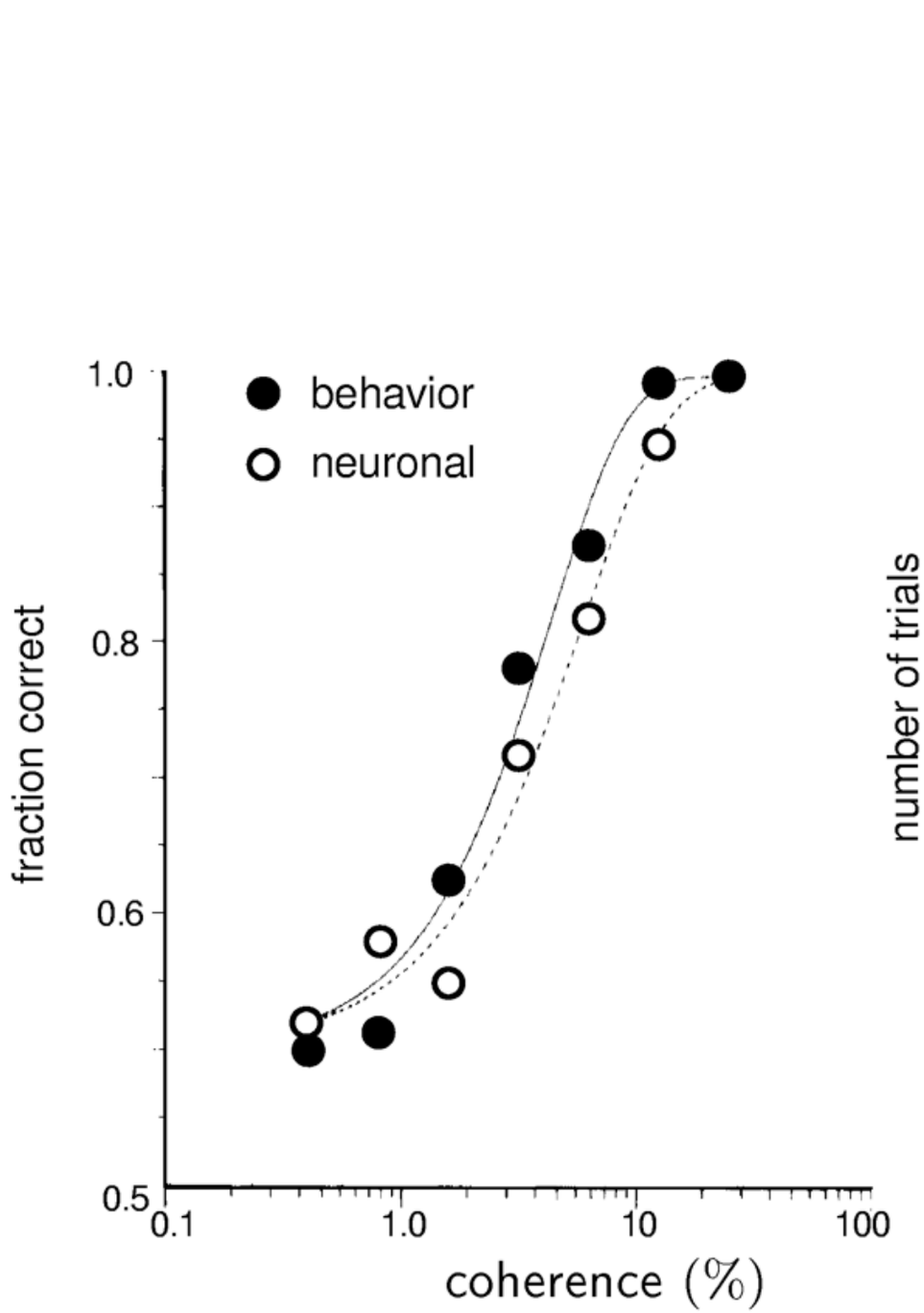


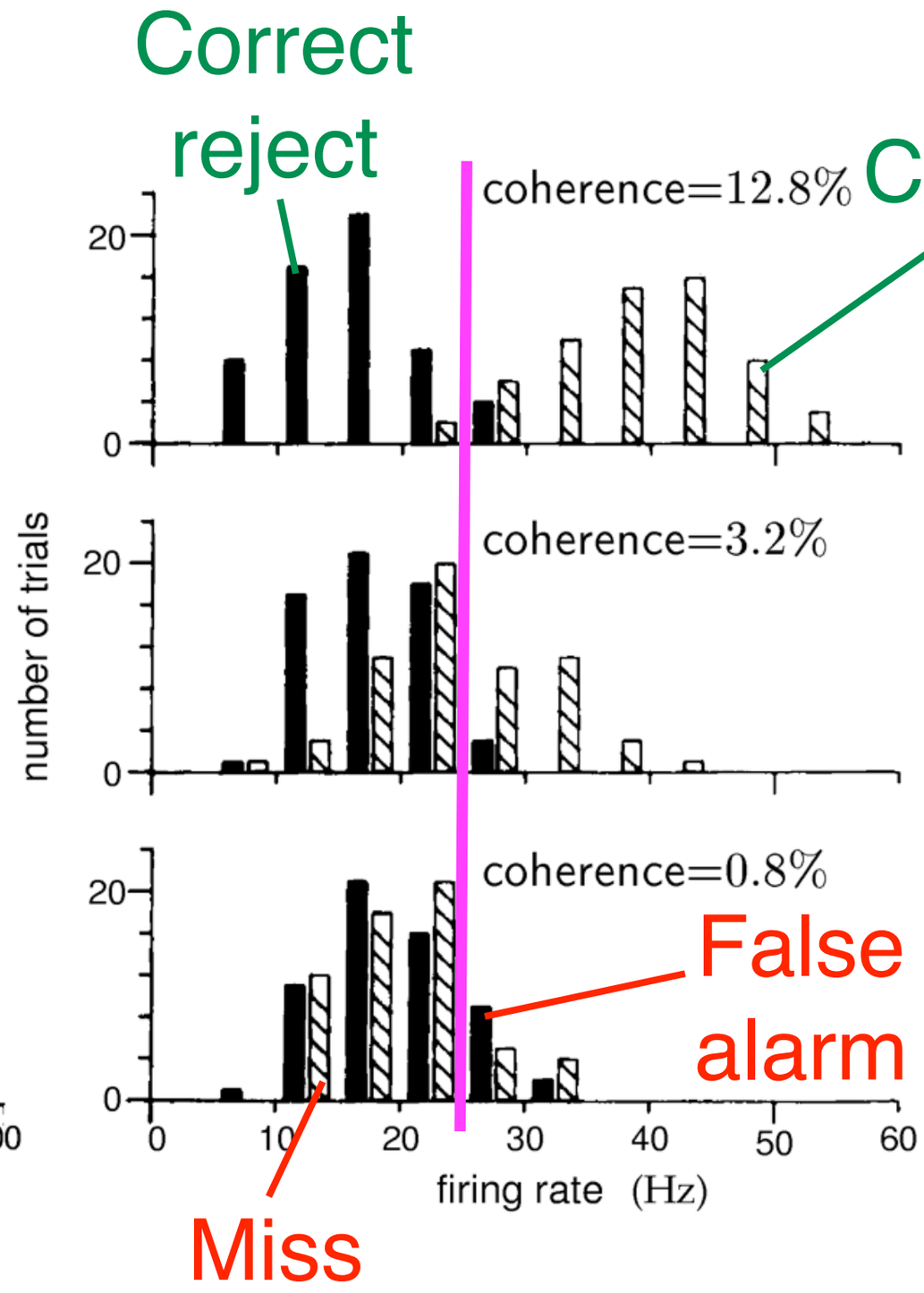
Null ⟷ Preferred



Britten et al., 1996

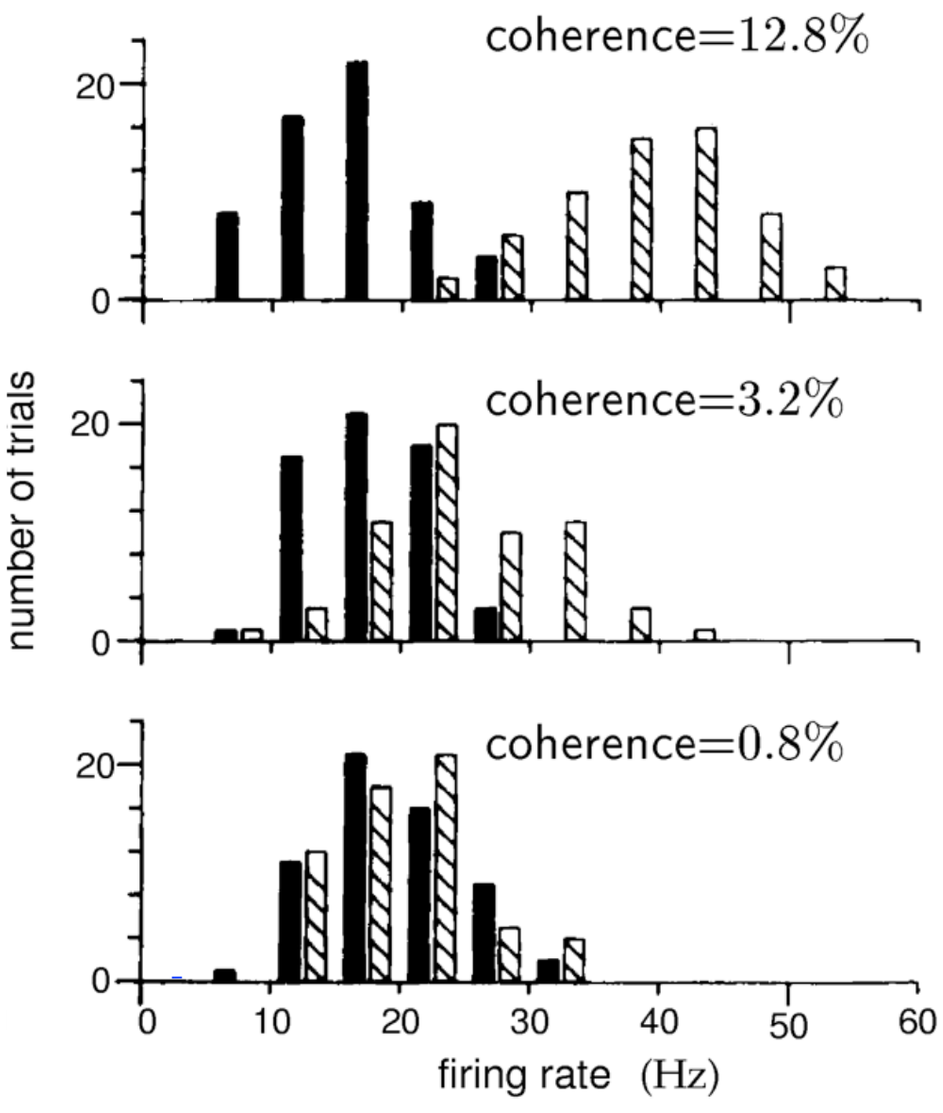
Motion discrimination

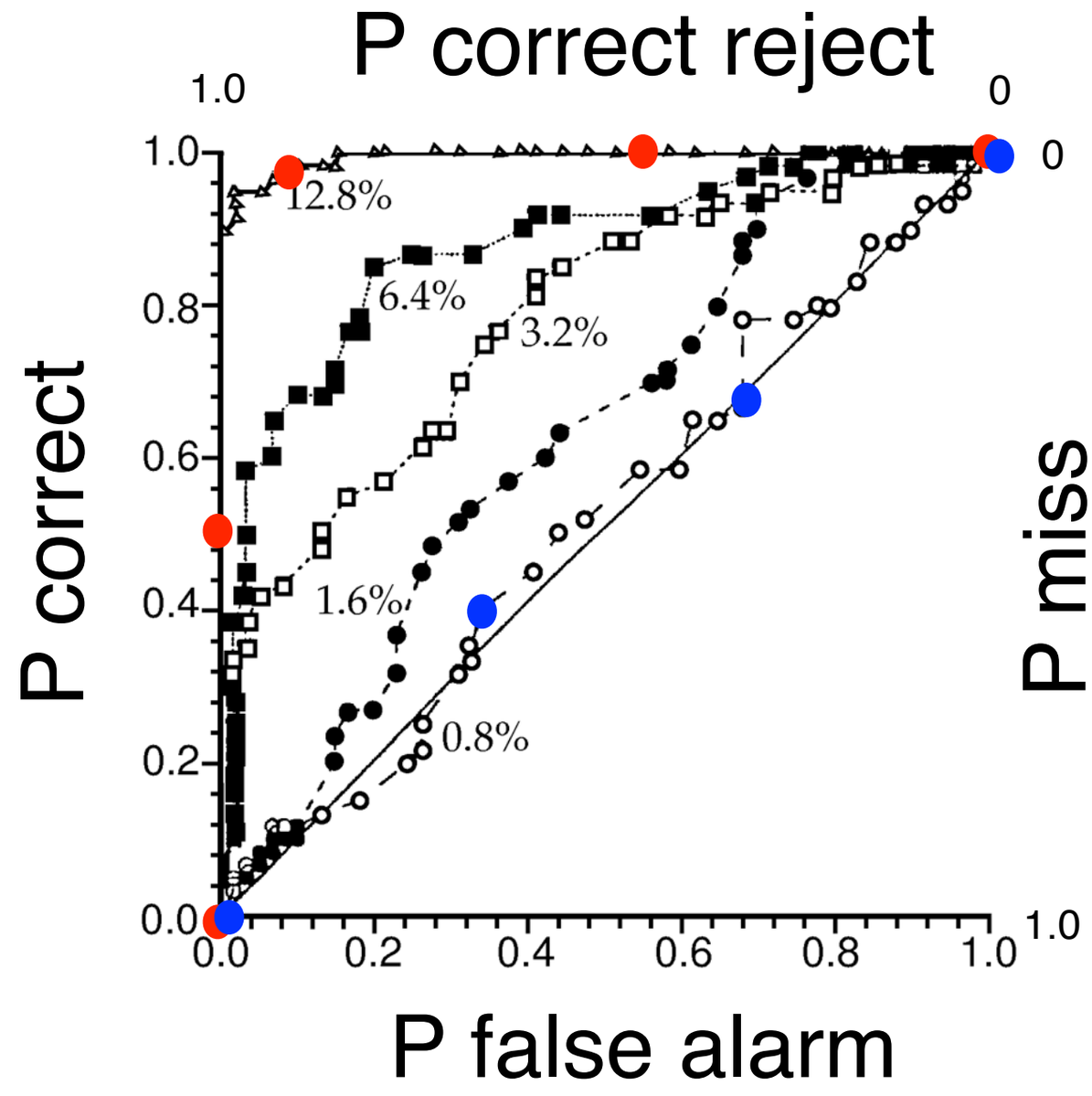




ROC analysis

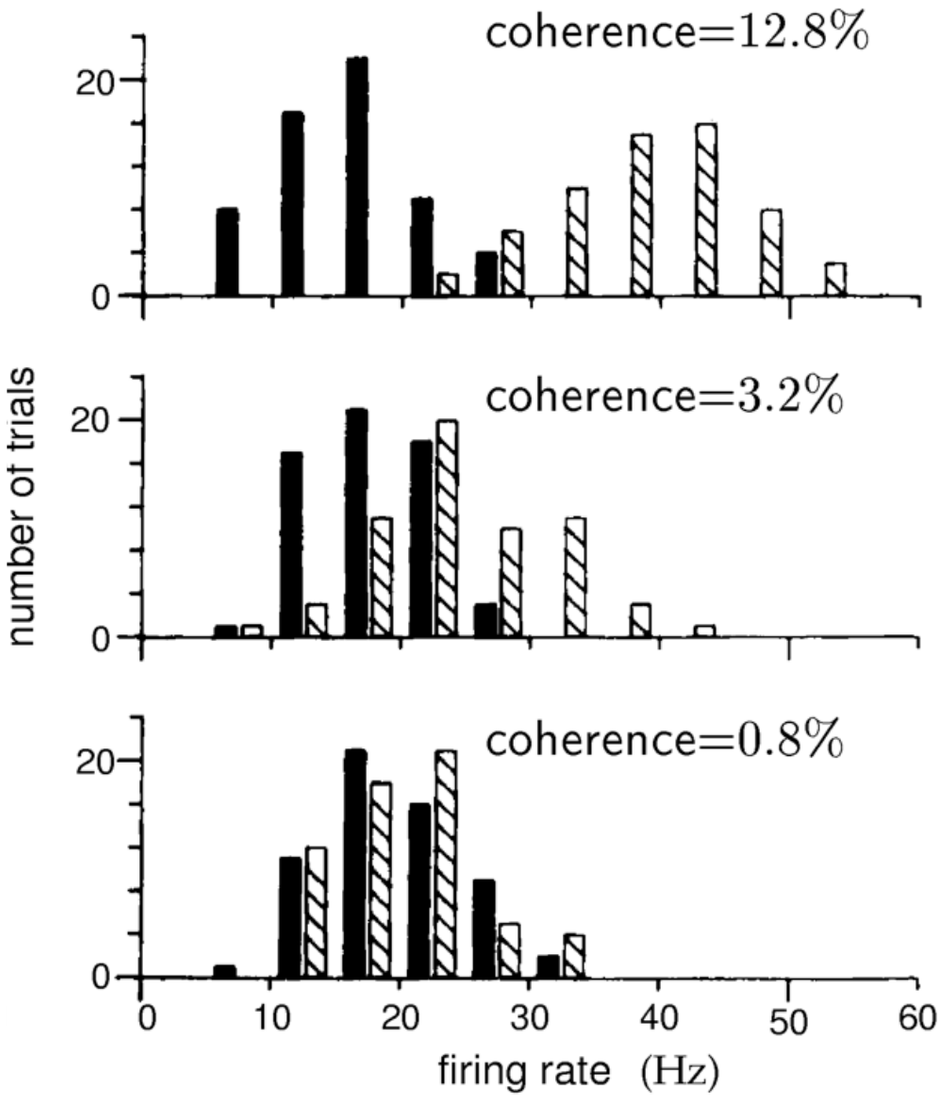
Criterion (or threshold) dependent

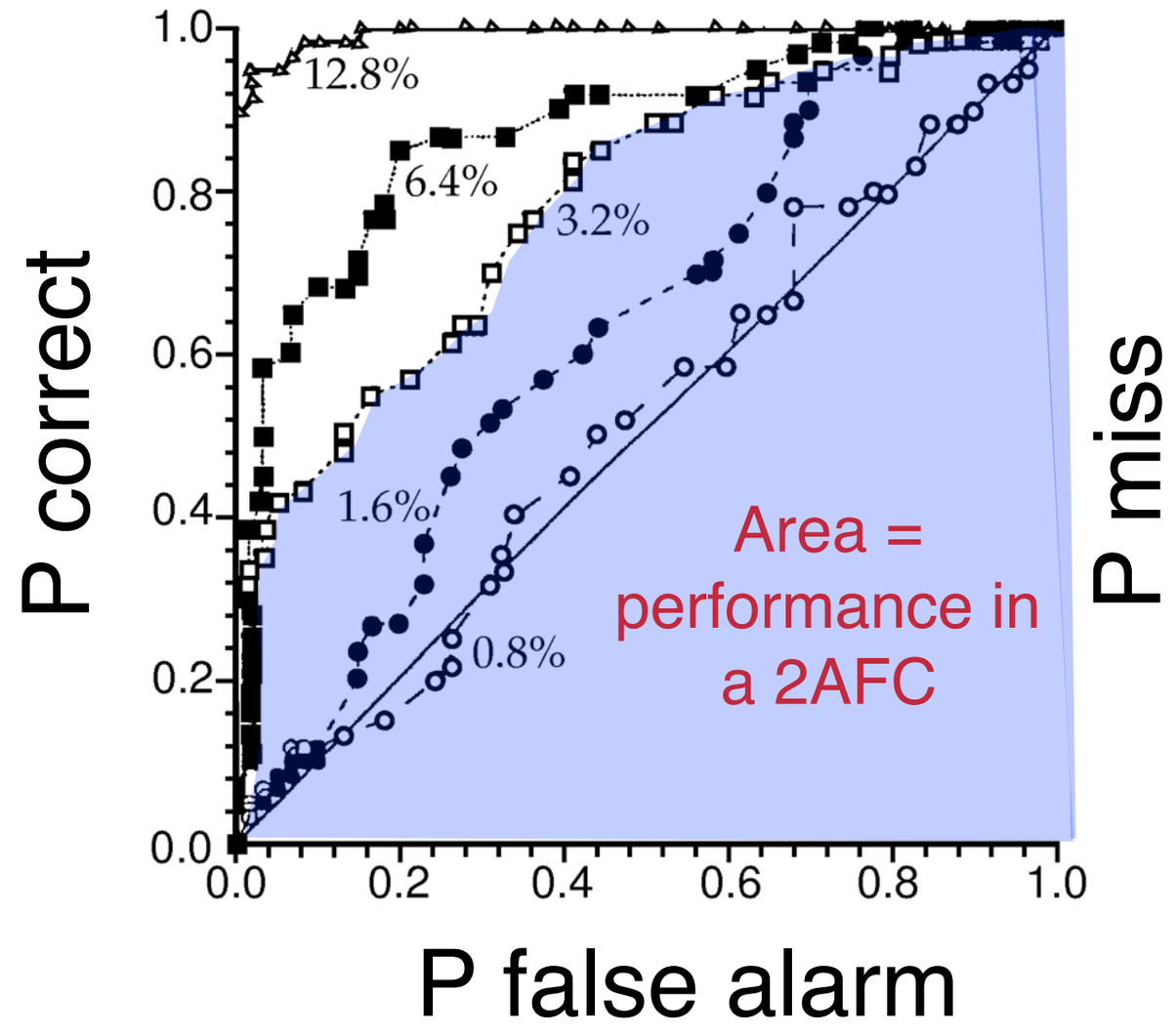




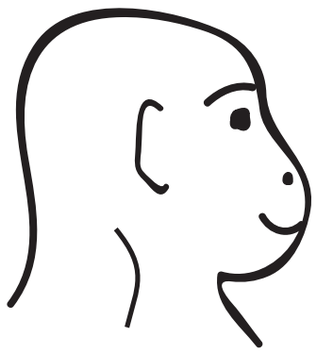
ROC analysis

Criterion free (area under the ROC curve)

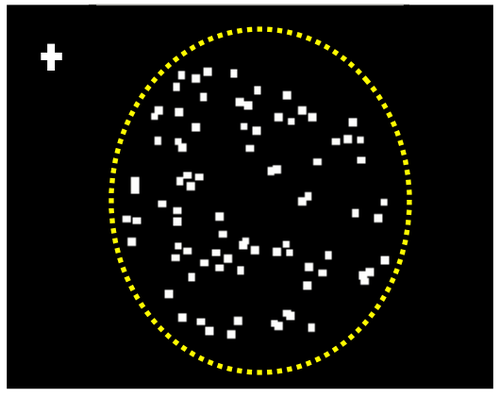




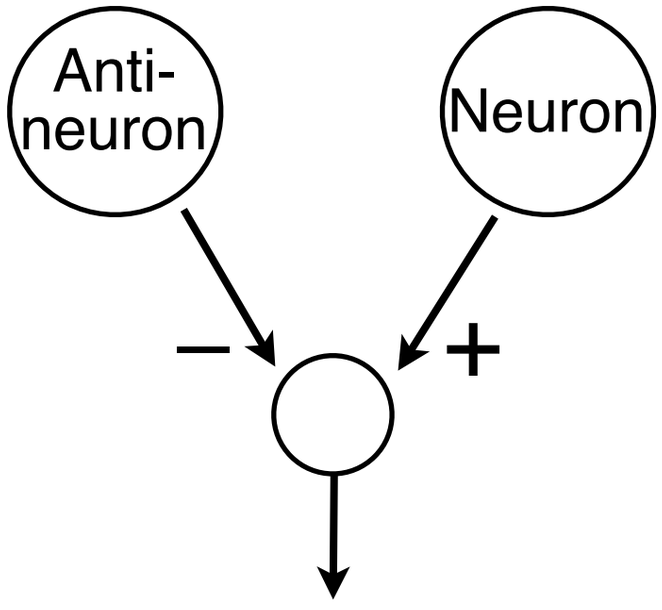
Motion discrimination



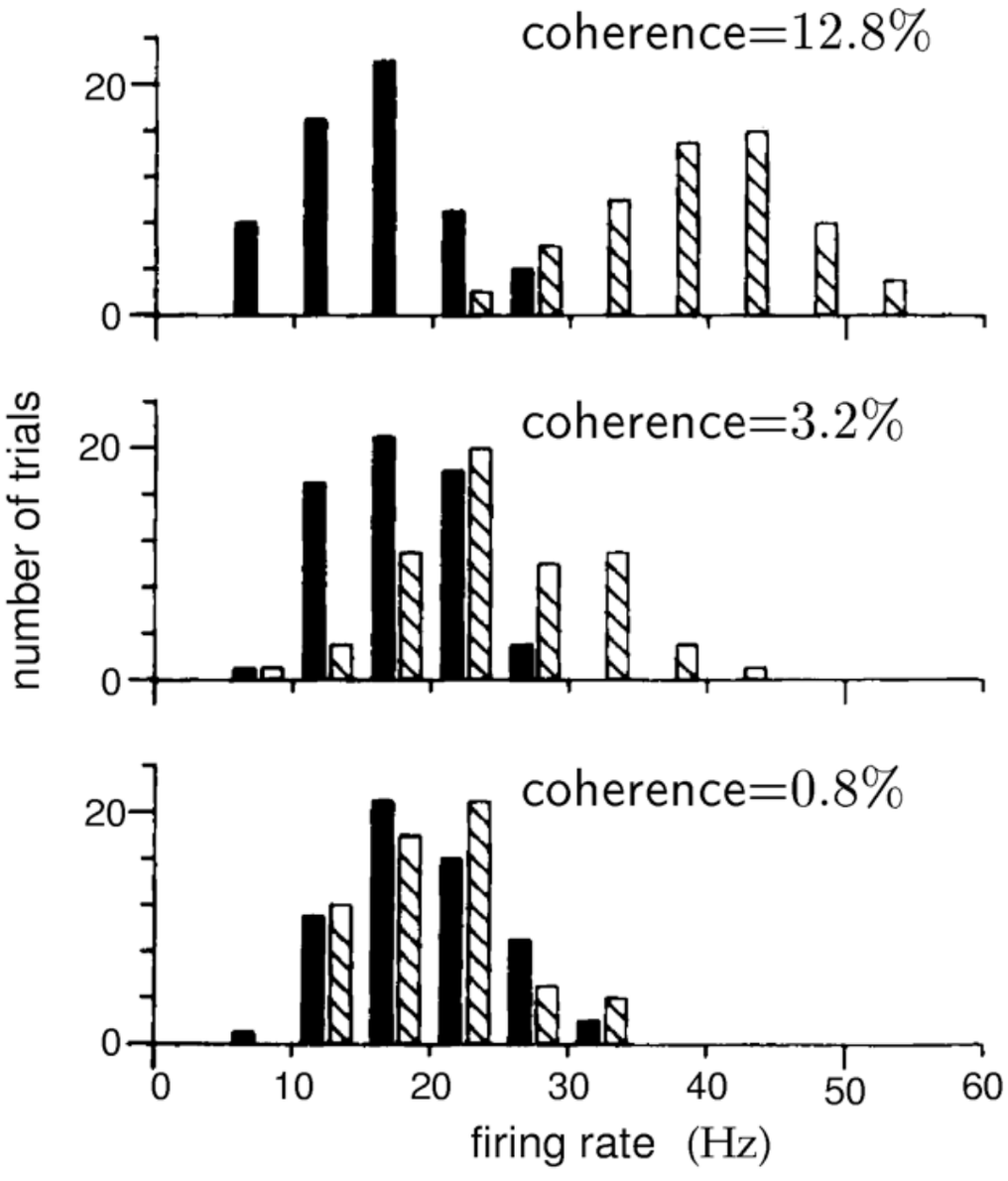
Null ⟷ Preferred



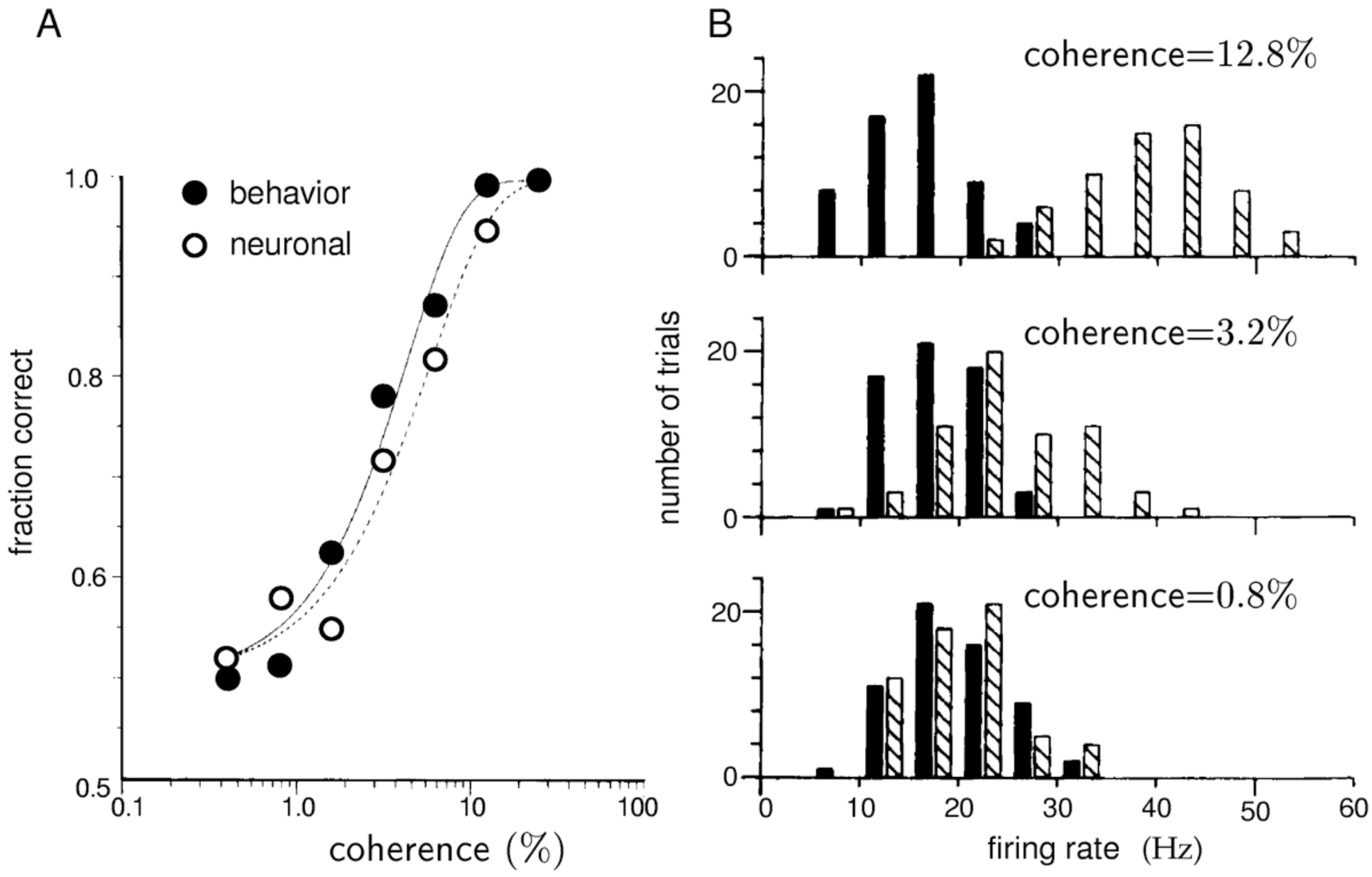
Text



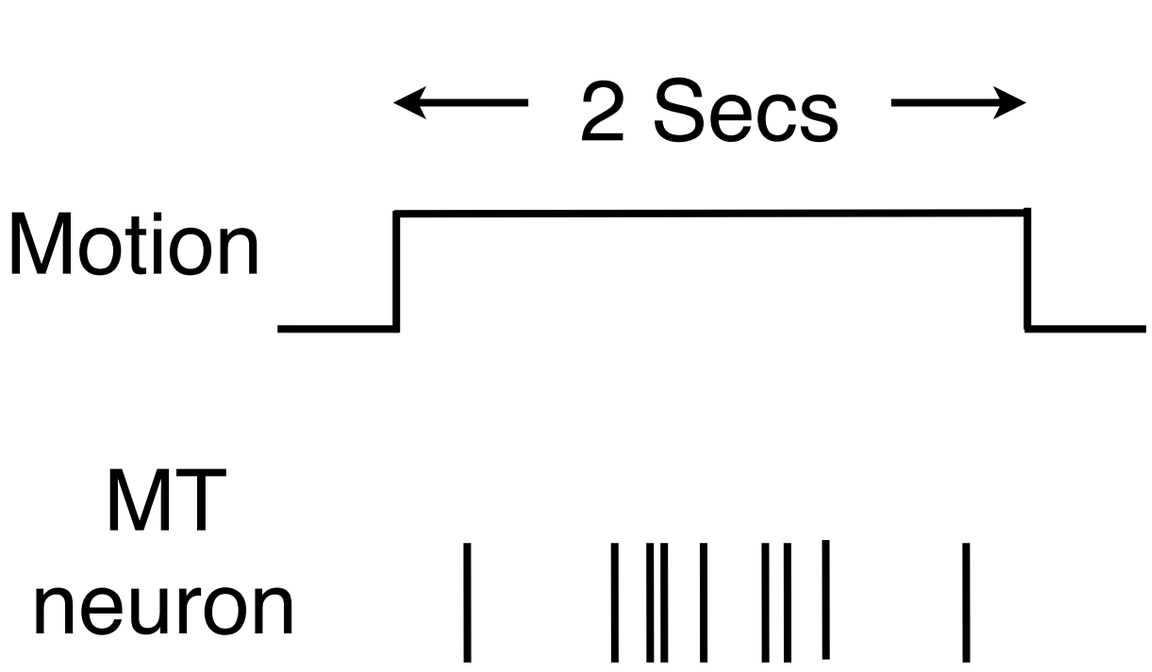
> 0 is Preferred
< 0 is Null

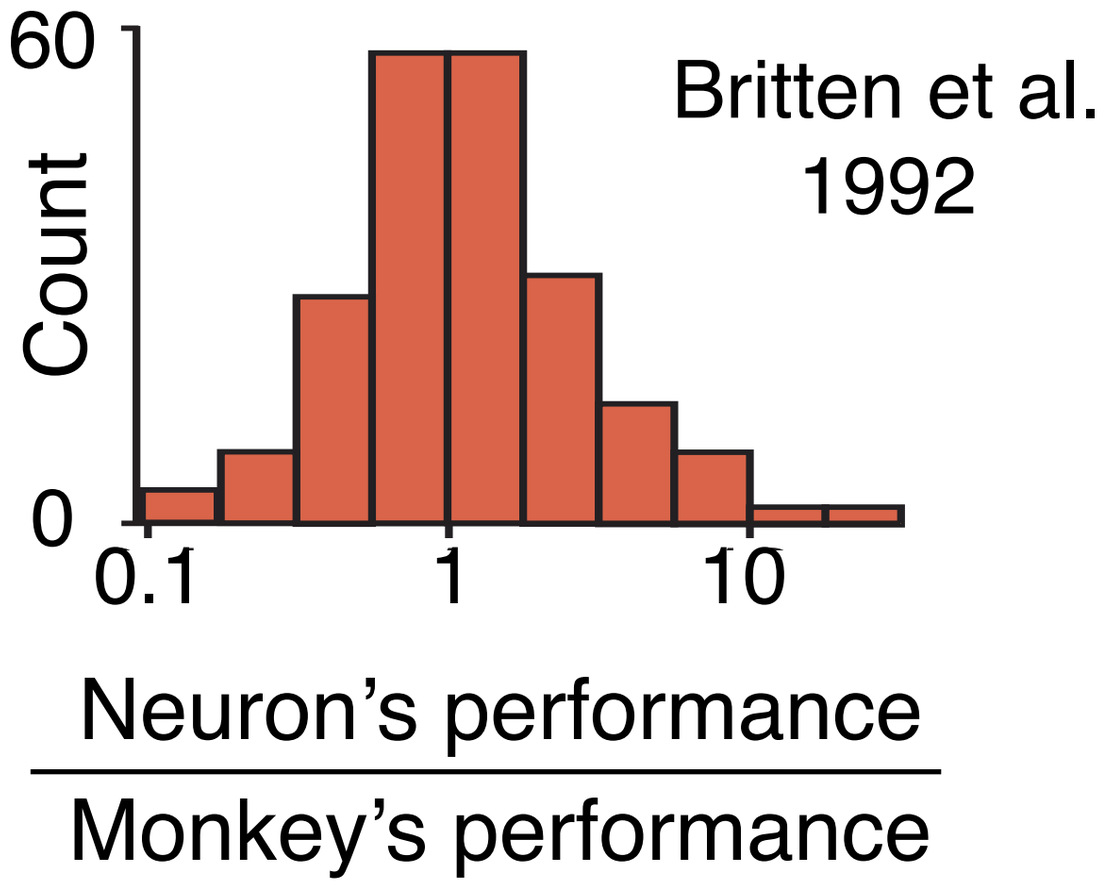


Motion discrimination



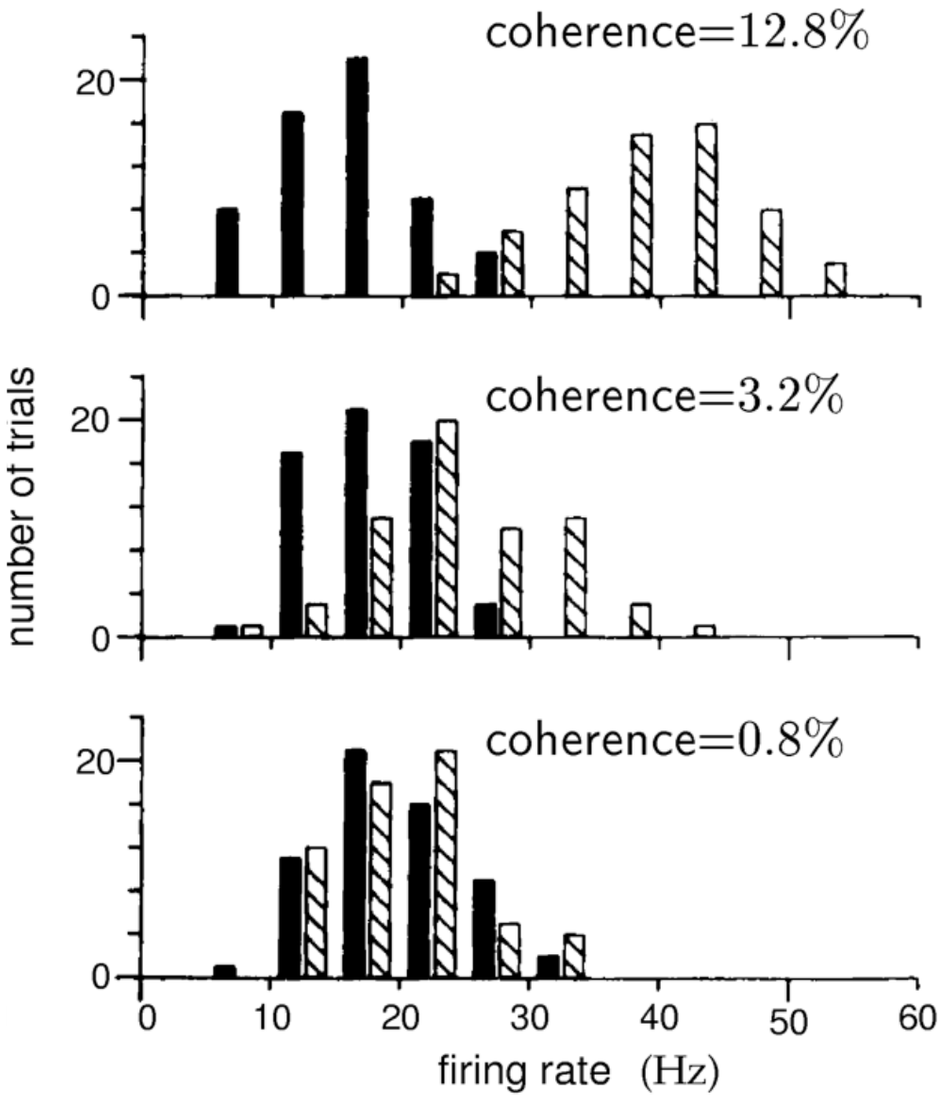
Behavioral versus neuronal performance

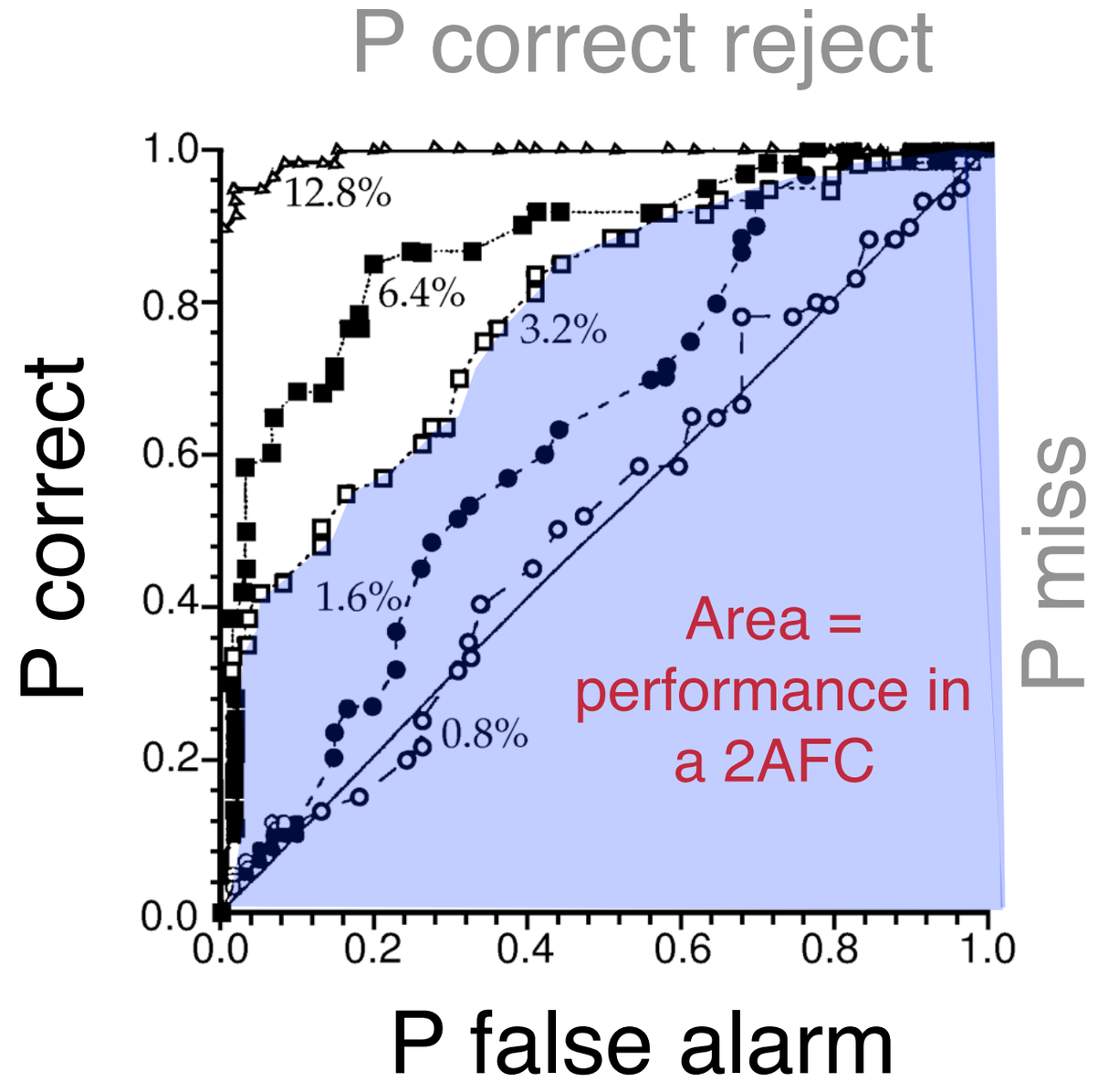




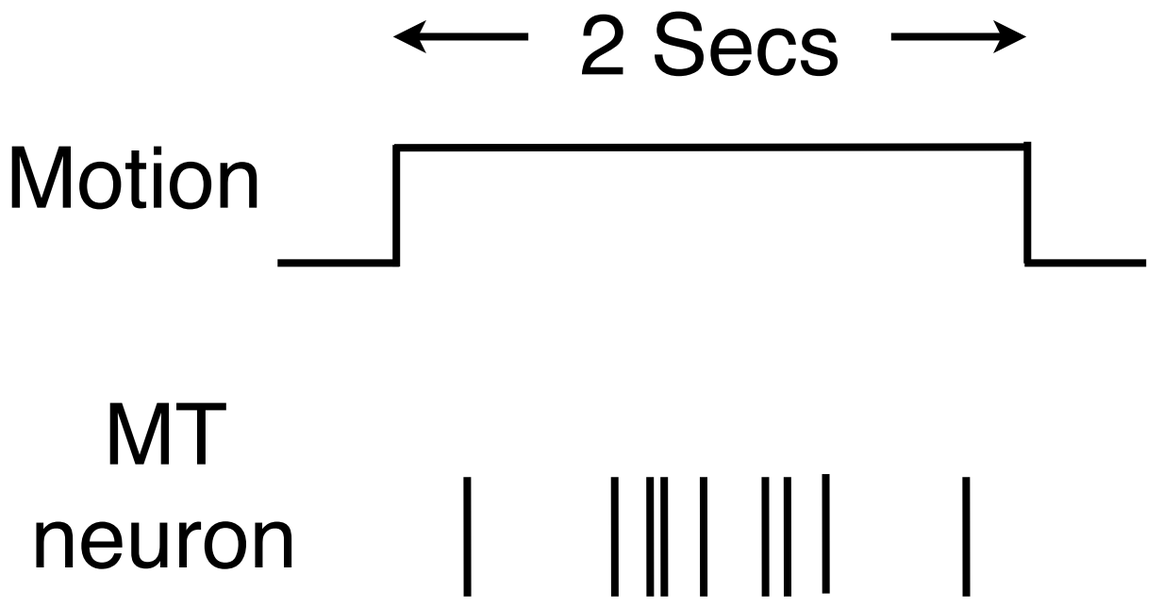
ROC analysis

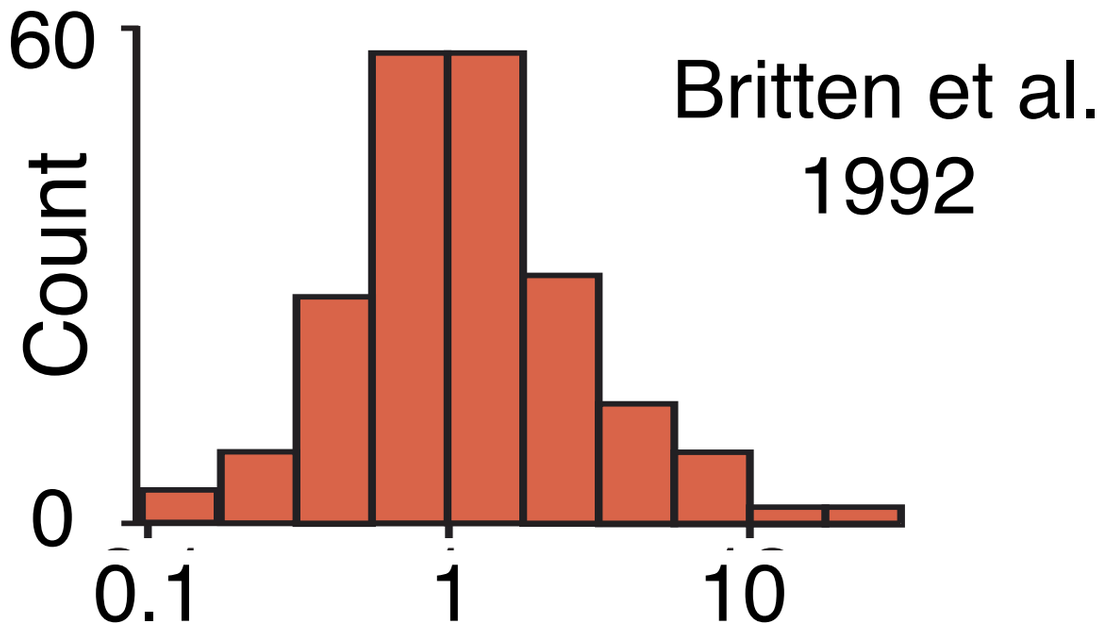
Criterion free (area under the ROC curve)



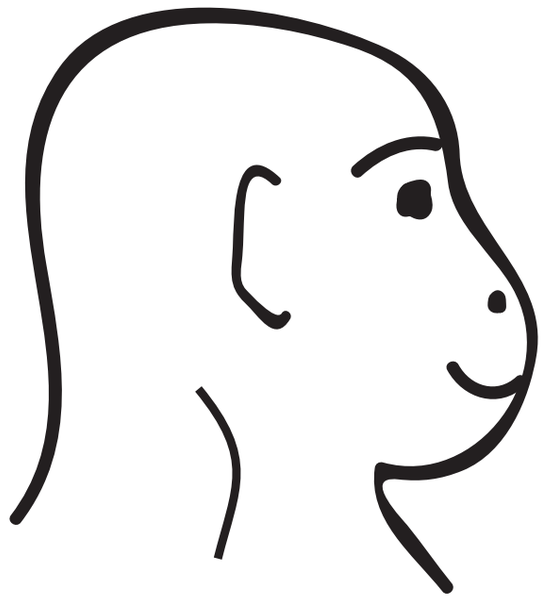


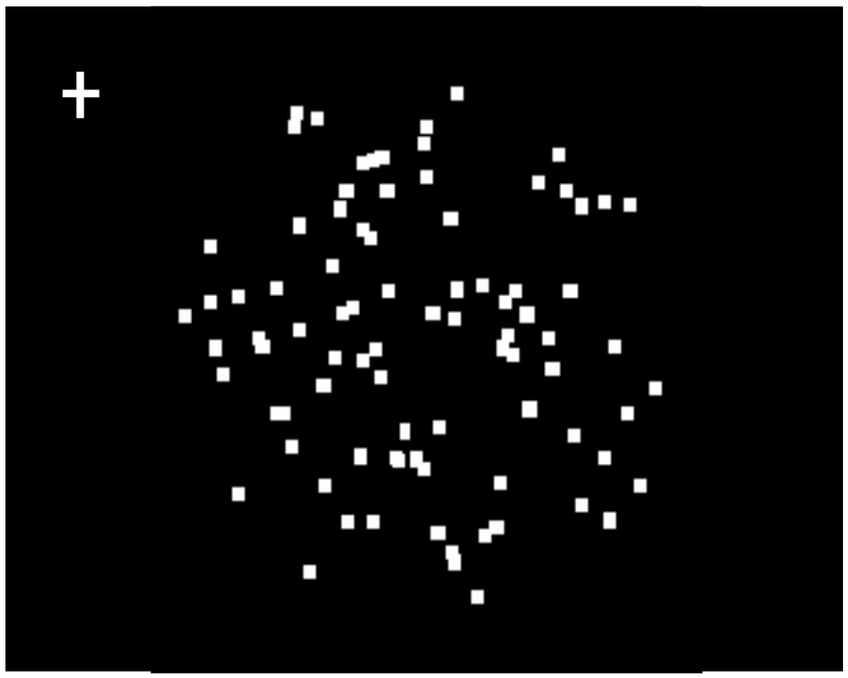
Behavioral versus neuronal performance





Motion detection





Reaction time task

Motion

Example MT Neuron

0%

Coherent Motion

High (50%)

= Lever Release

Motion Strength

Med (35%)

Low (24%)

Missed Trials

Correct Trials

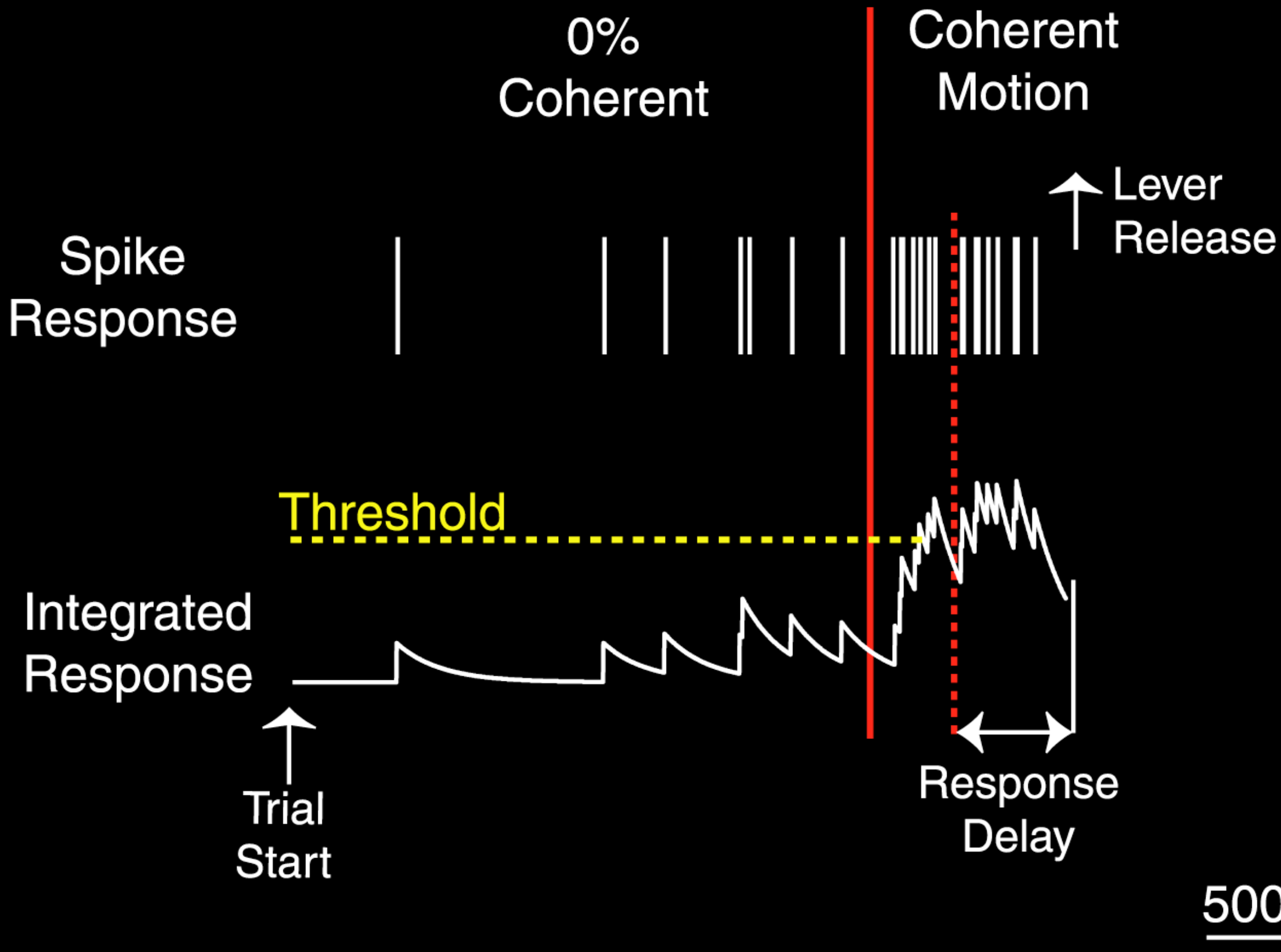
-500

0

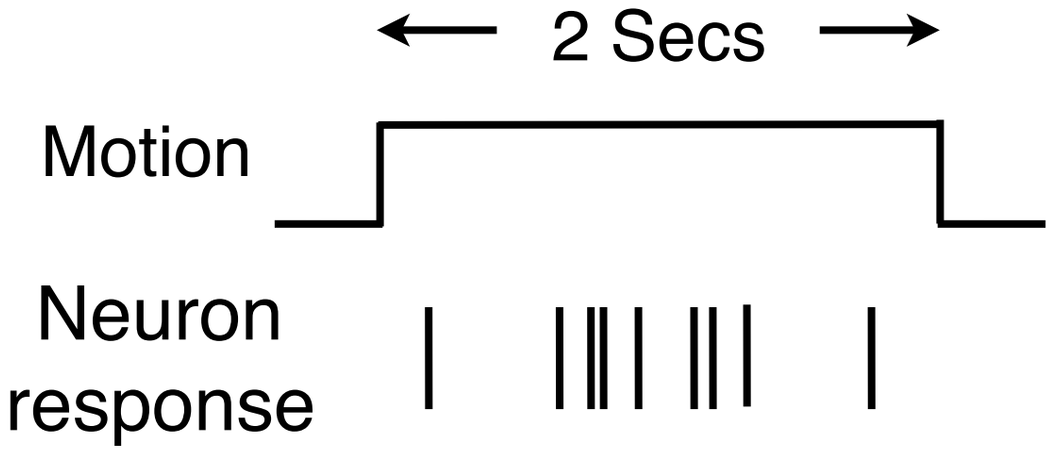
500

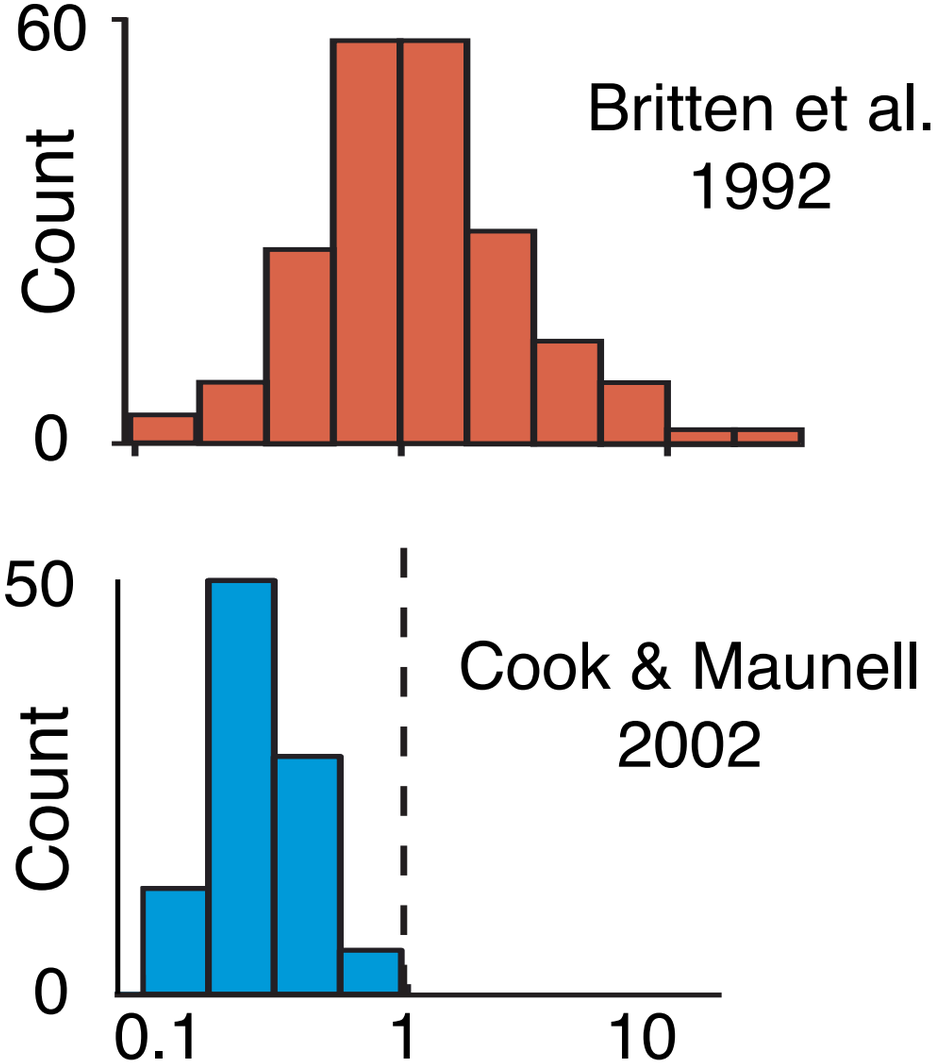
Time (ms)

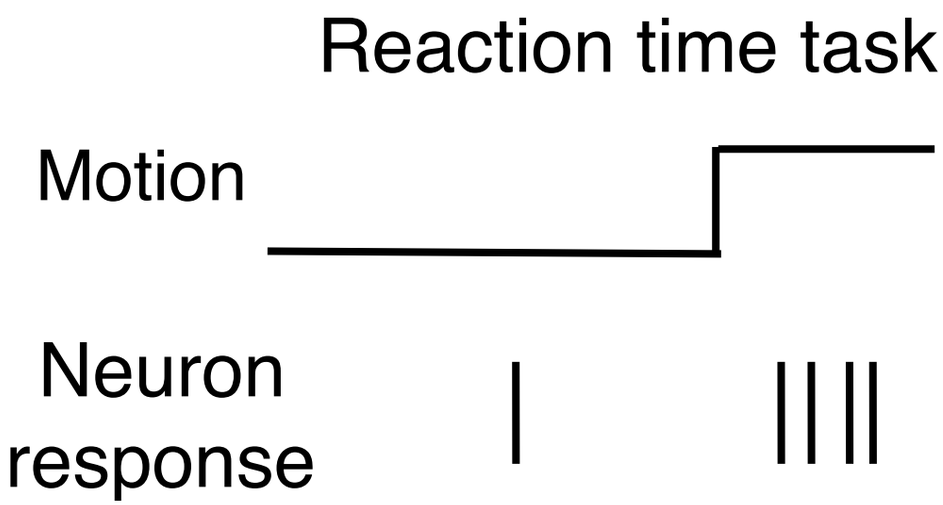
Threshold detection model



MT performance depends on stimulus duration

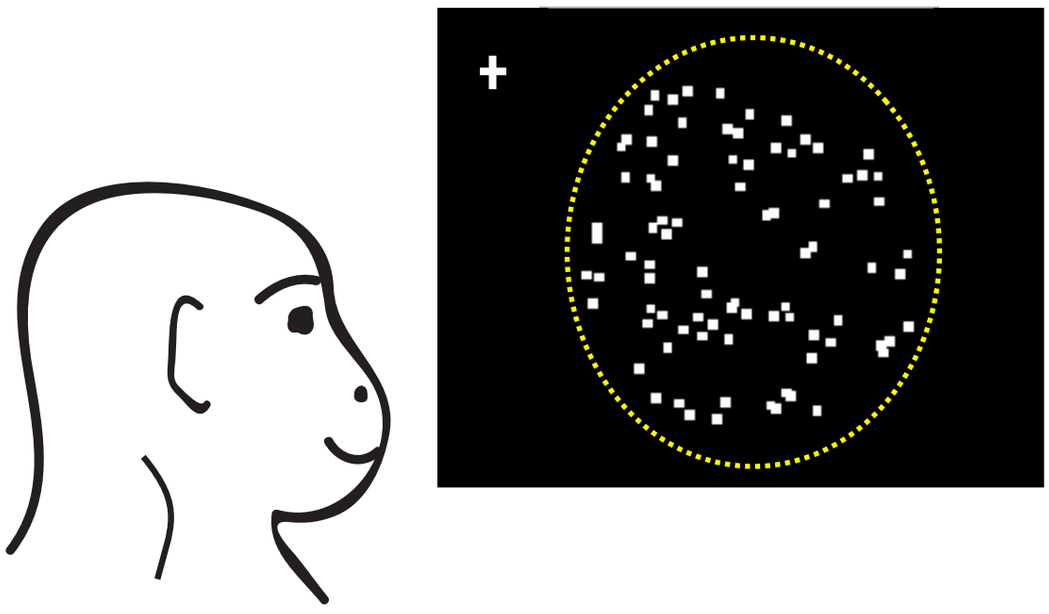


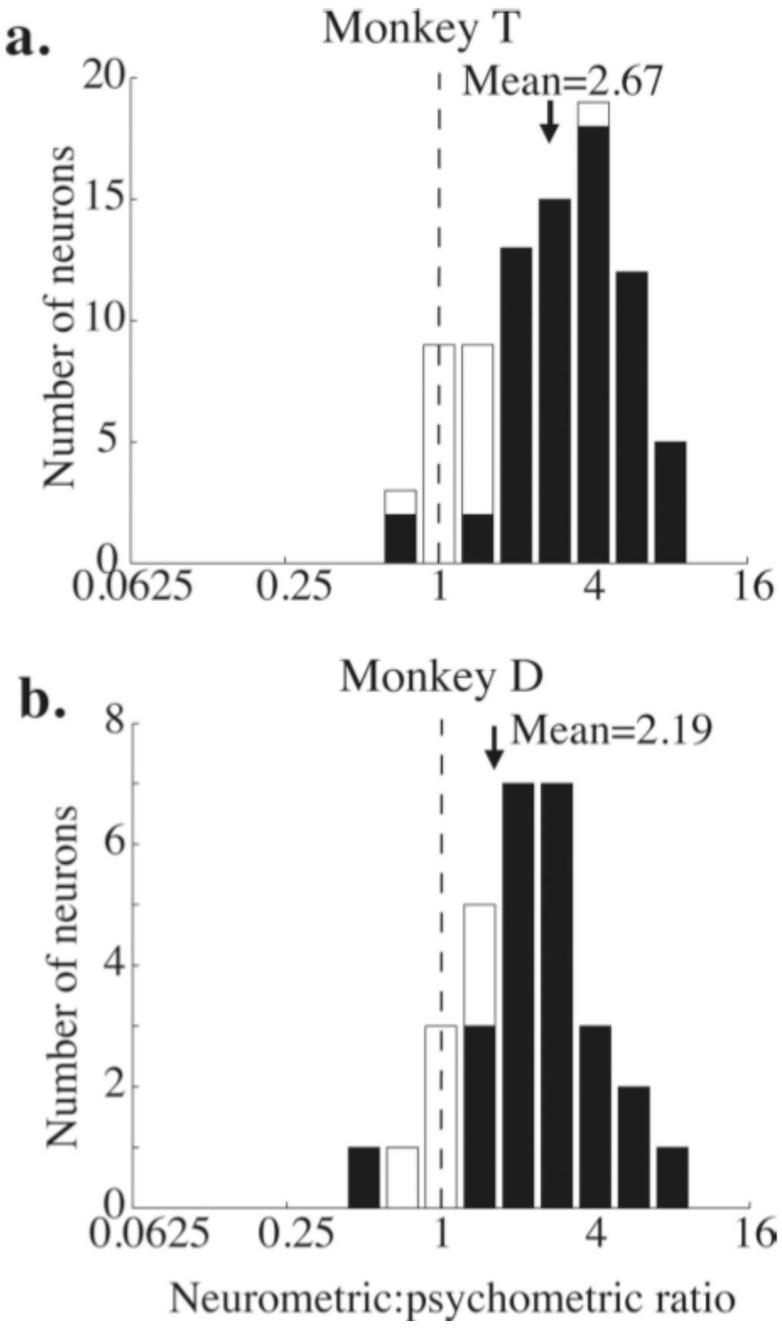




MT performance depends on stimulus duration

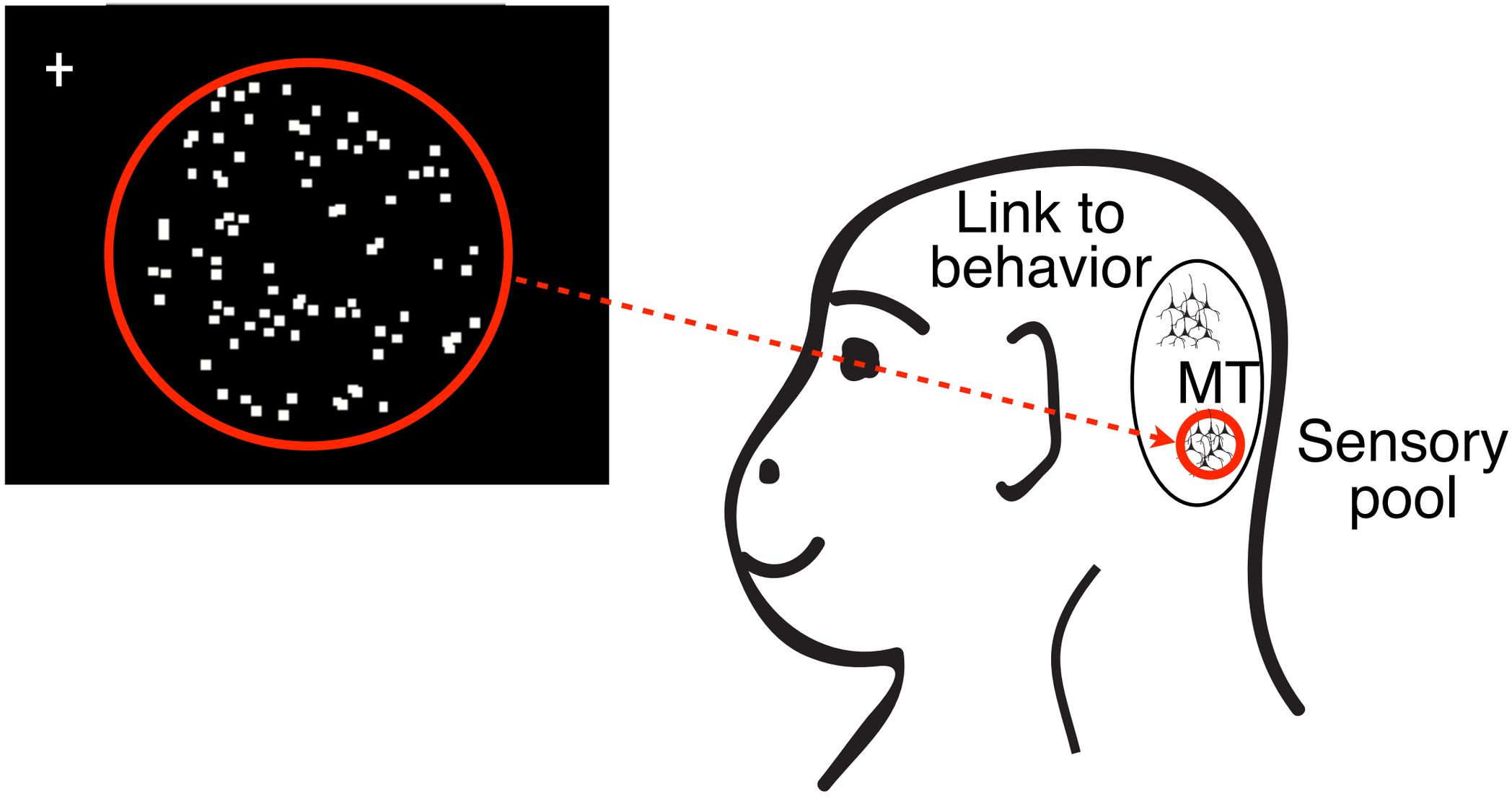
Reaction time





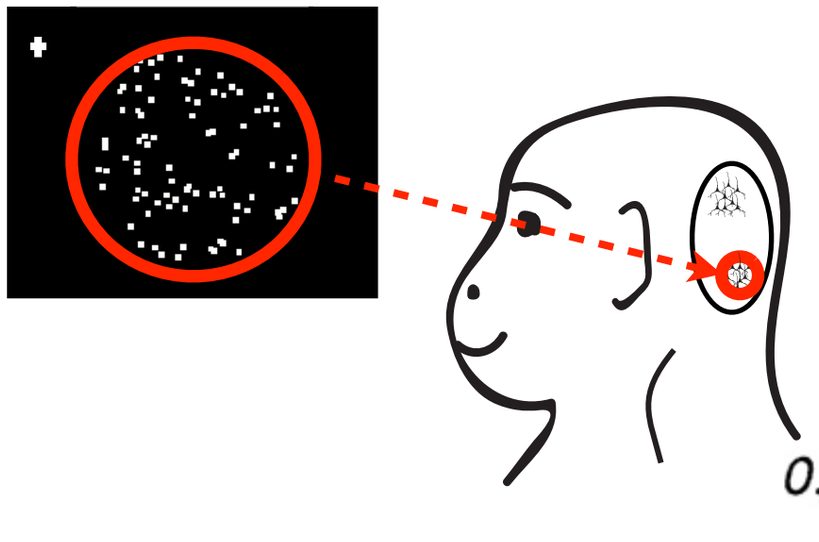
Cohen & Newsome, 2009

Link between neural fluctuations and visually guided behavior



Britten et al., 1996

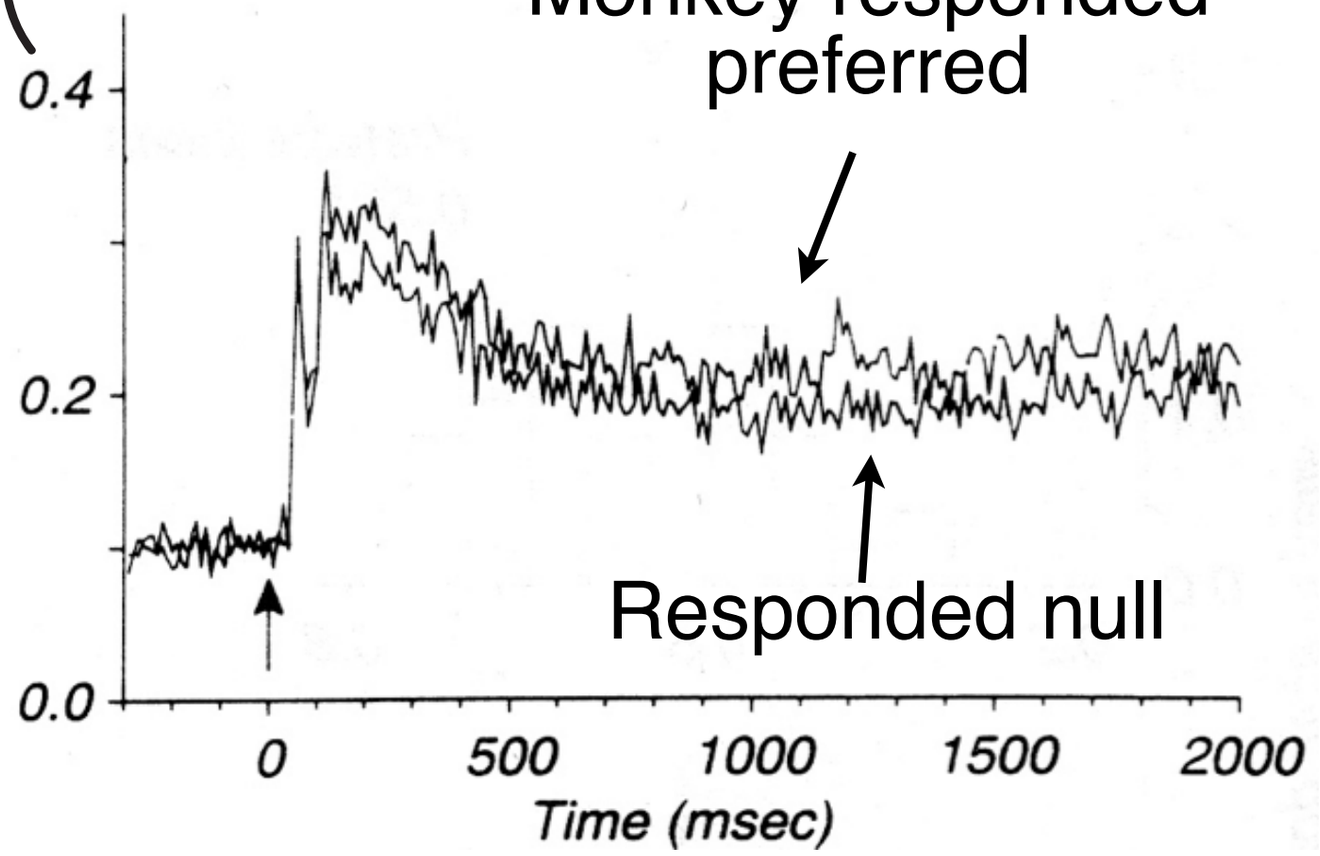
Link between neural fluctuations and visually guided behavior



MT

Monkey responded preferred

Normalized neuronal response



Responded null

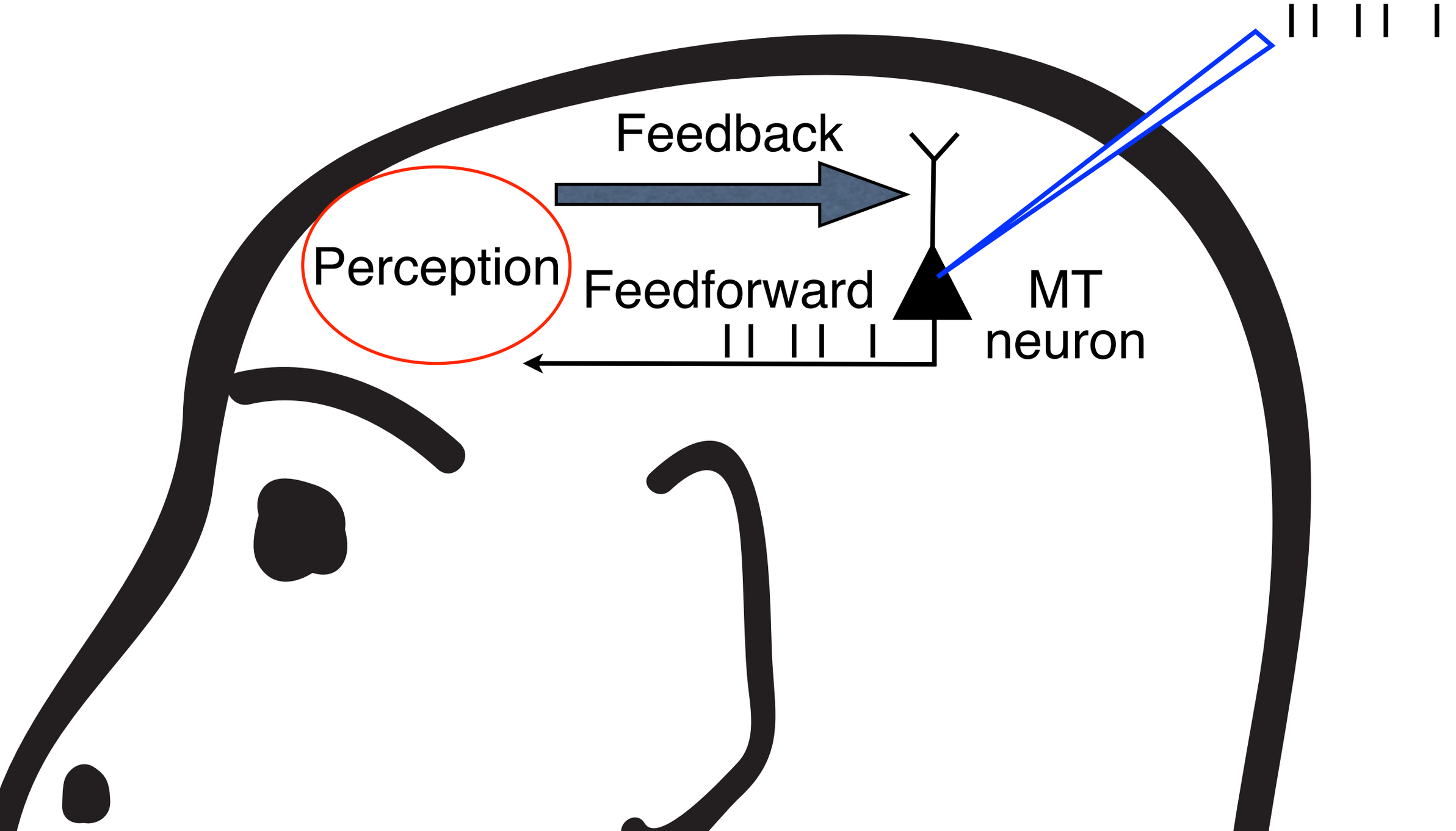
Britten et al., 1996

Or is the link causal?

Nienborg & Cumming, 1996

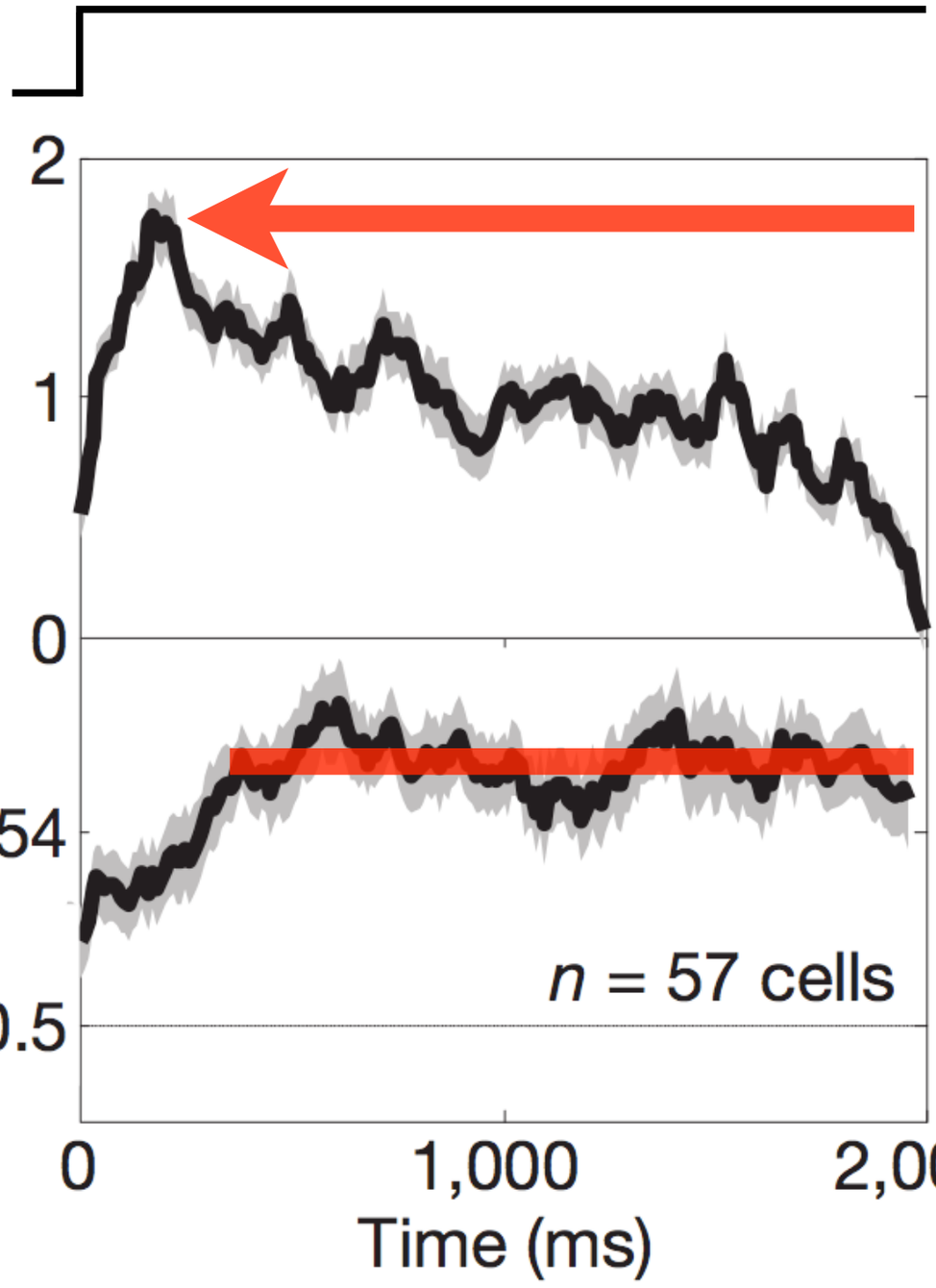
Shadlen & Newsome, 1996

Nienborg & Cumming (2009)



Or is the link non-causal?

Visual stimulus



Correlation between stimulus and behavior

Early stimulus used most

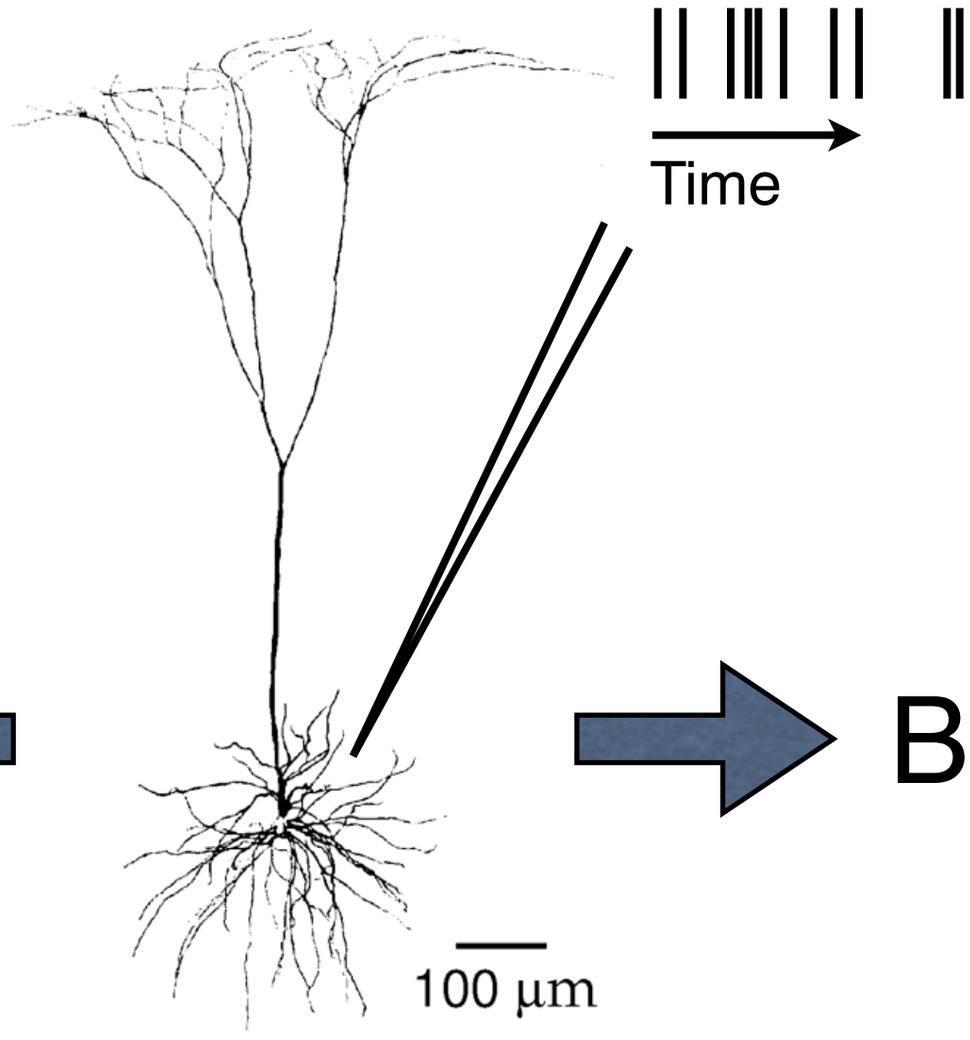
Correlation between neural fluctuations and behavior

Late plateau in neural-behavioral correlations

Nienborg et al., Nature, 2009

Decoding

External stimuli

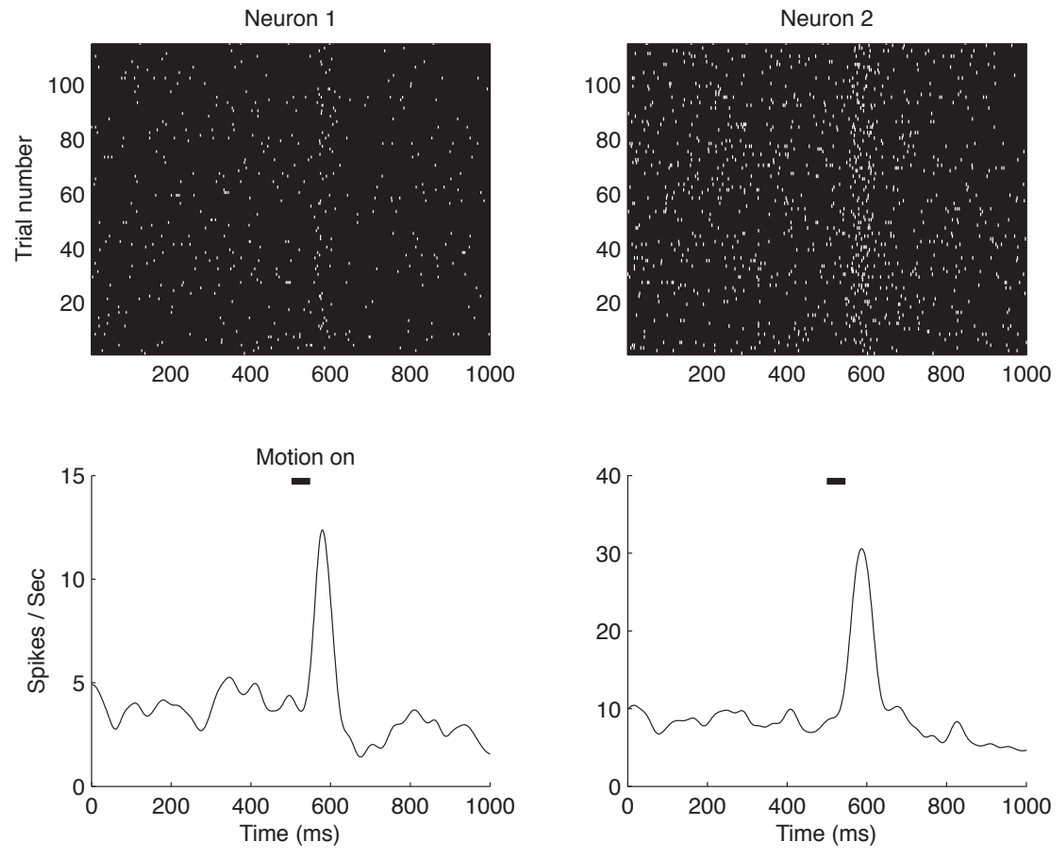


Behavior

Introduction to Computational Neuroscience
Decoding and ROC analysis

In this lab you will analyze the responses of two MT neurons that were simultaneously recorded from a monkey performing a motion detection task. The goal of the lab is to apply ROC analysis to decode the neural response. Specifically, you will perform neurometric and detect probability analyses.

The details of this experiment were presented in class. Briefly, a monkey was trained to release a lever when two random dot stimuli moved coherently, which occurred at a random time. Each patch overlapped one of the neuron's RFs and the coherent motion was always in the neuron's preferred direction.



1) **Load the data.** Loading the file *decodingLabData.mat* creates the variables *neuron1*, *neuron2* and *responseTimes*.