# *Latency, duration and codes for objects in inferior temporal cortex*

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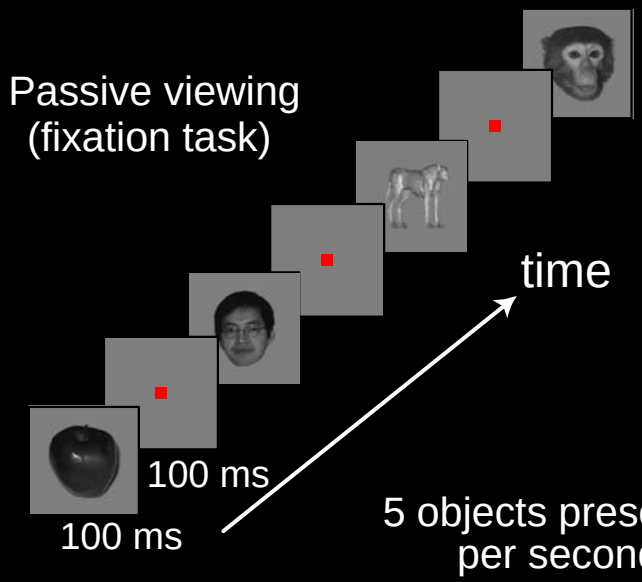
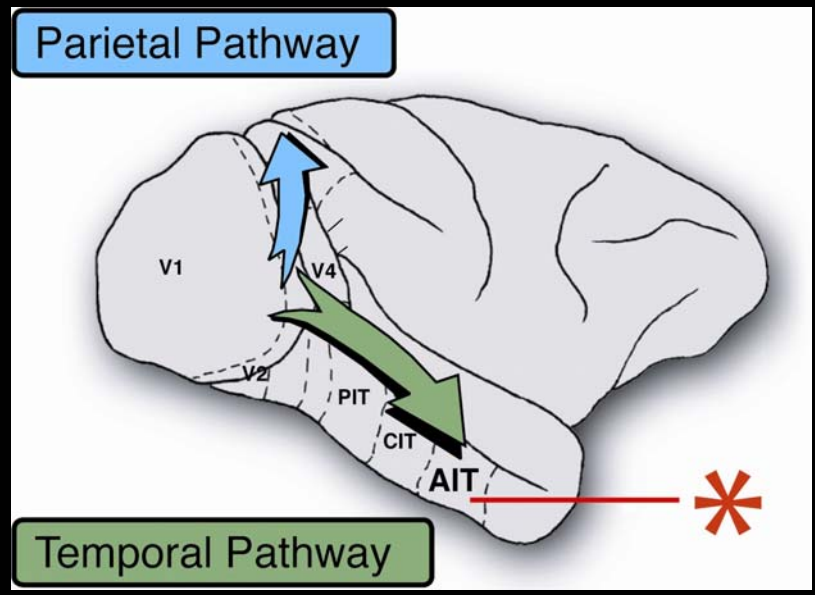
# Recognition can be very fast

# Stimulus presentation

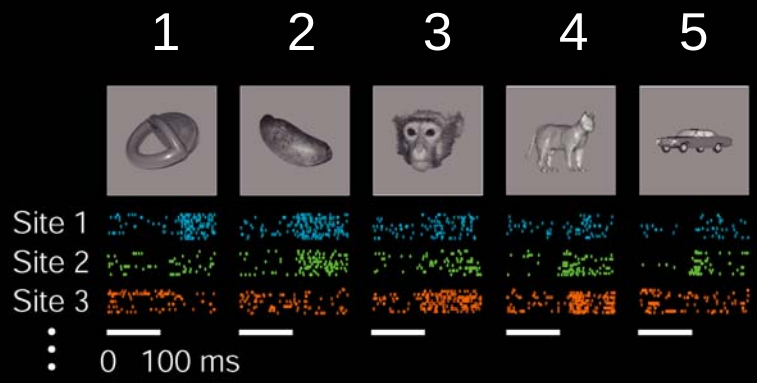



- Recordings of spiking activity from macaque monkeys
- Recordings in an area involved in object recognition (inferior temporal cortex)
- 10-20 repetitions per stimulus
- Presentation order randomized
- 77 stimuli drawn from 8 pre-defined categories

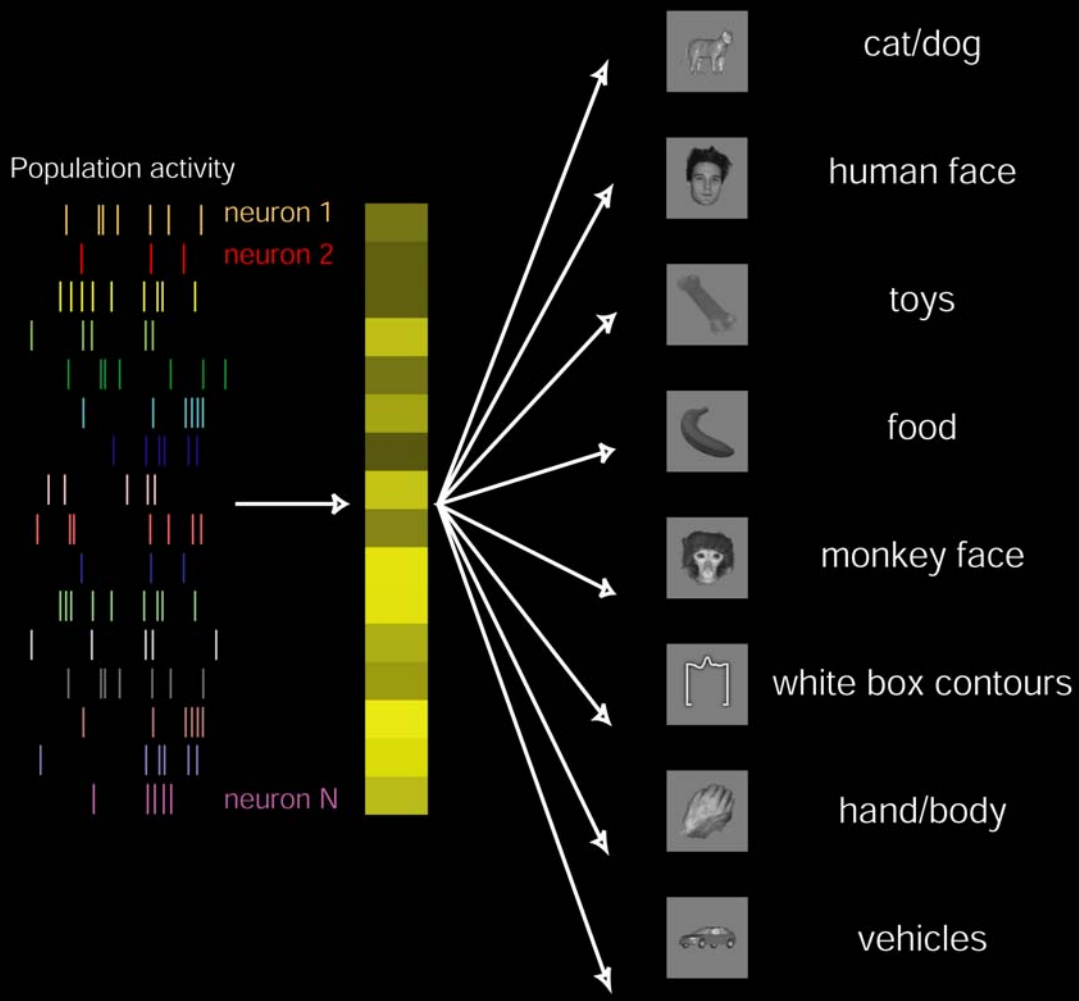
Recordings made by Chou Hung and James DiCarlo

# Reading the neuronal code




| Neuron 1 | Neuron 2 | Neuron 3 | Object |
|---|---|---|---|
| Yes | No | No | 1 |
| Yes | Yes | No | 2 |
| Yes | Yes | Yes | |

Mind reading → Neuronal reading
Can we read out what the monkey is seeing?

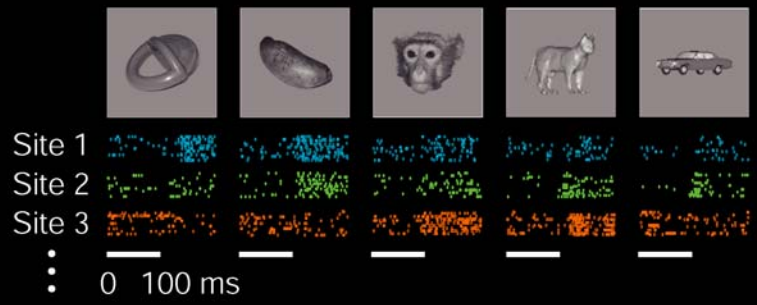


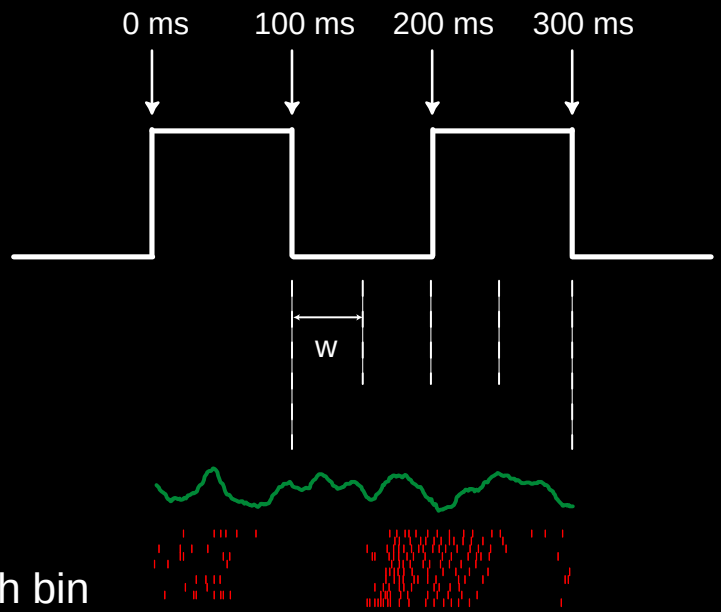

Learning from (**x**,y) pairs

x

$y \in \{1,\ldots,8\}$

# Input to the classifier



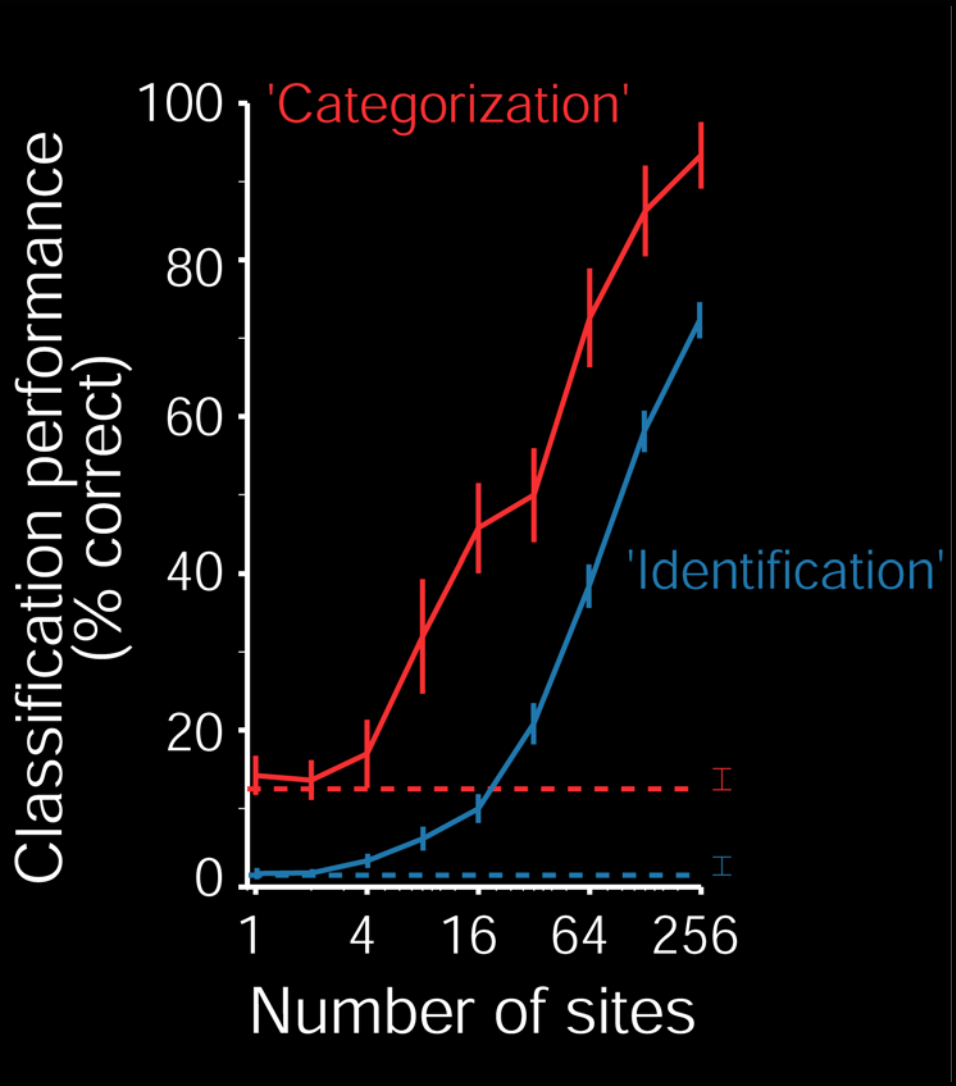




MUA: spike counts in each bin

LFP: power in each bin

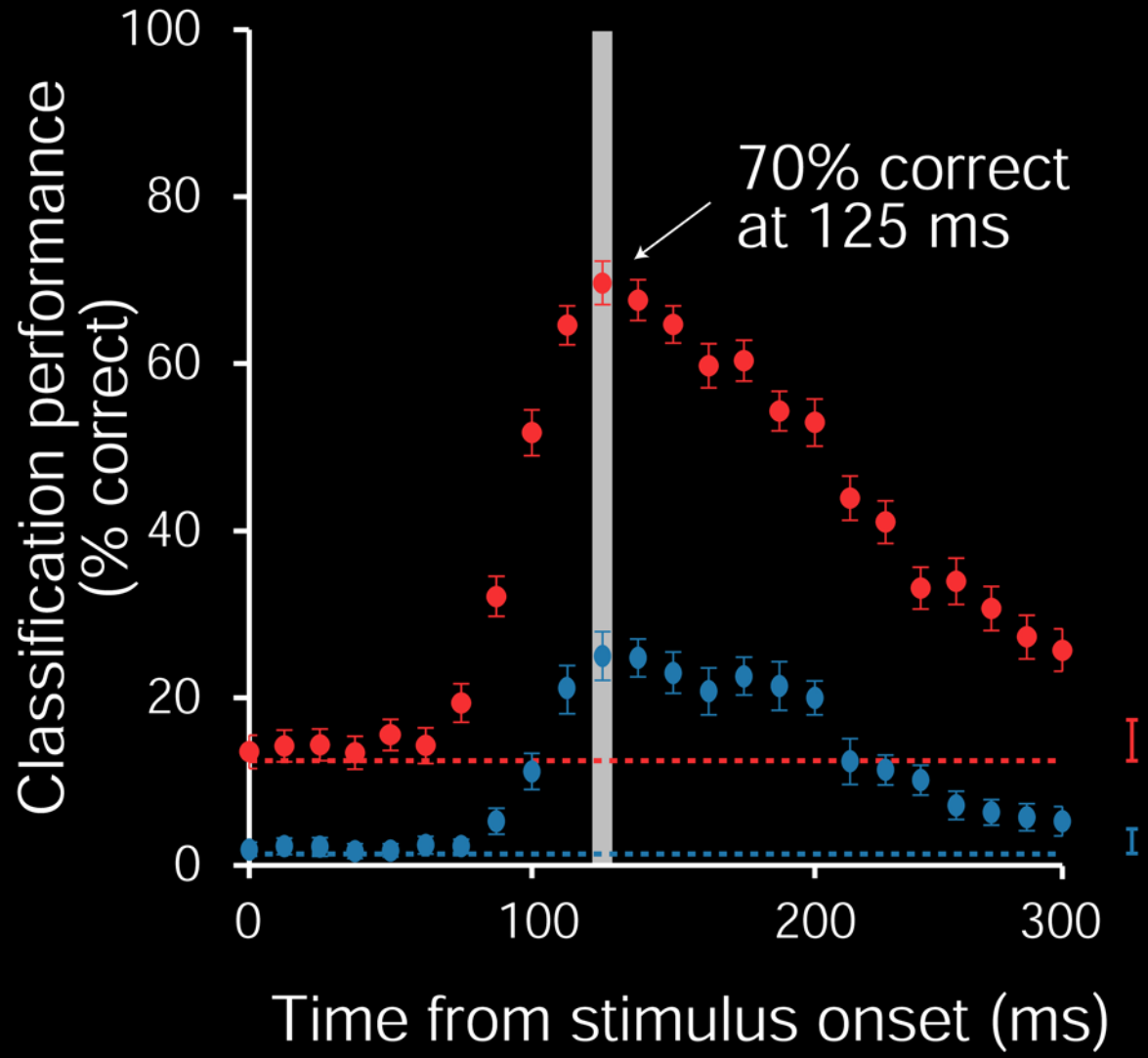
MUA+LFP: concatenation of MUA and LFP

# Accurate read-out of object category and identity from a small population




Hung*, Kreiman*, Poggio, DiCarlo. *Science* 2005

# Decoding requires very few spikes




Hung*, Kreiman*, Poggio, DiCarlo. *Science* 2005

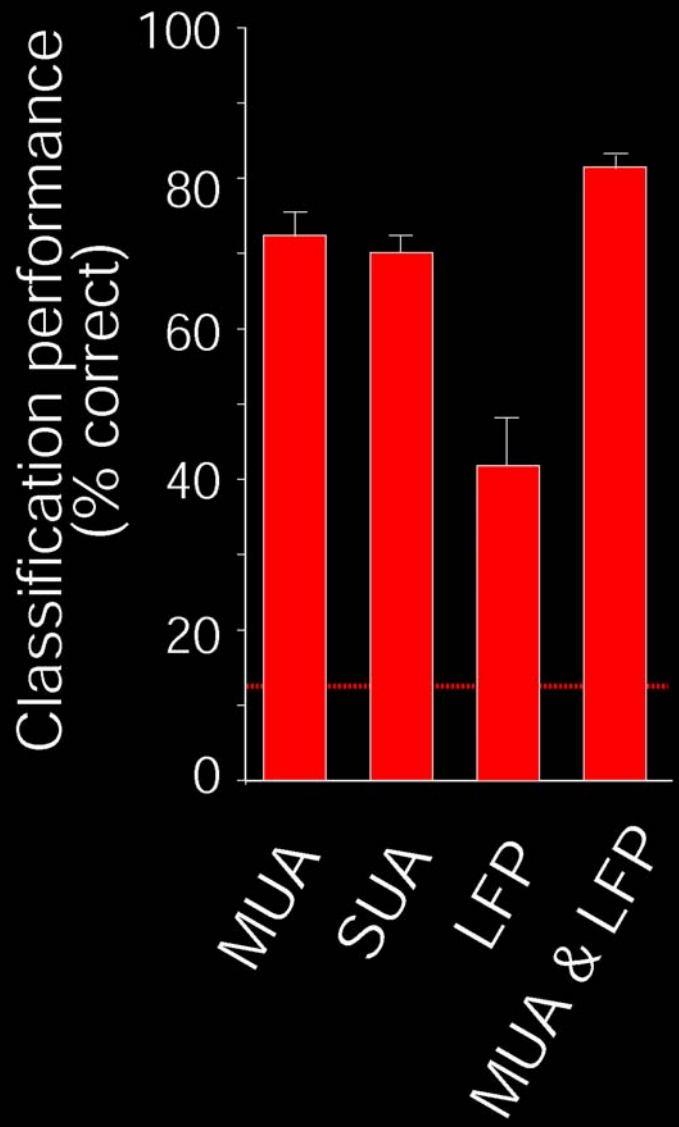
# Local field potentials (the “input”) also show selectivity

MUA: multi-unit spiking activity

SUA: single-unit spiking activity

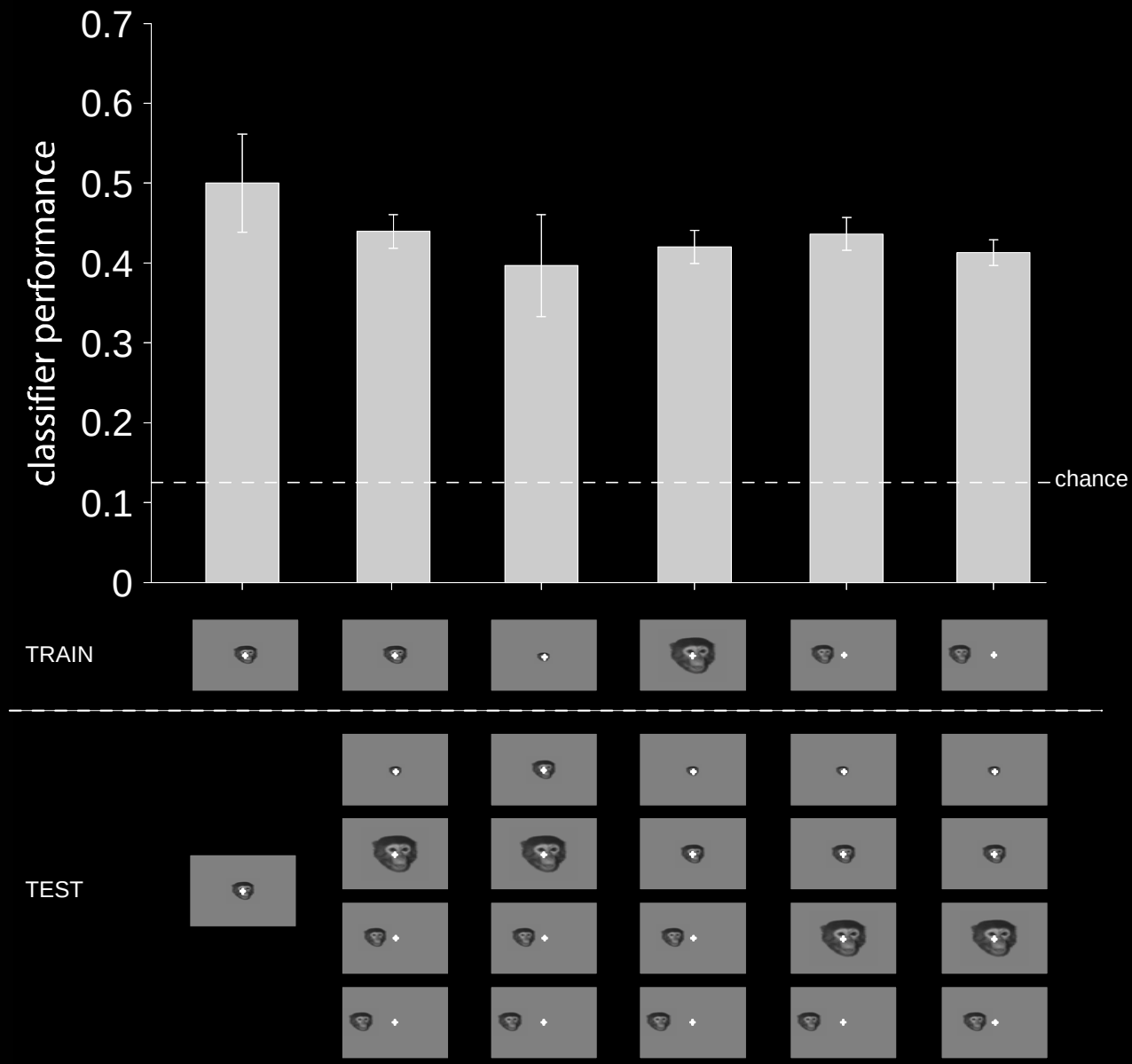
LFP: local field potentials

MUA & LFP: MUA combined with LFP




Kreiman*, Hung*, Kraskov, Quiroga, Poggio, DiCarlo. *Neuron* 2006

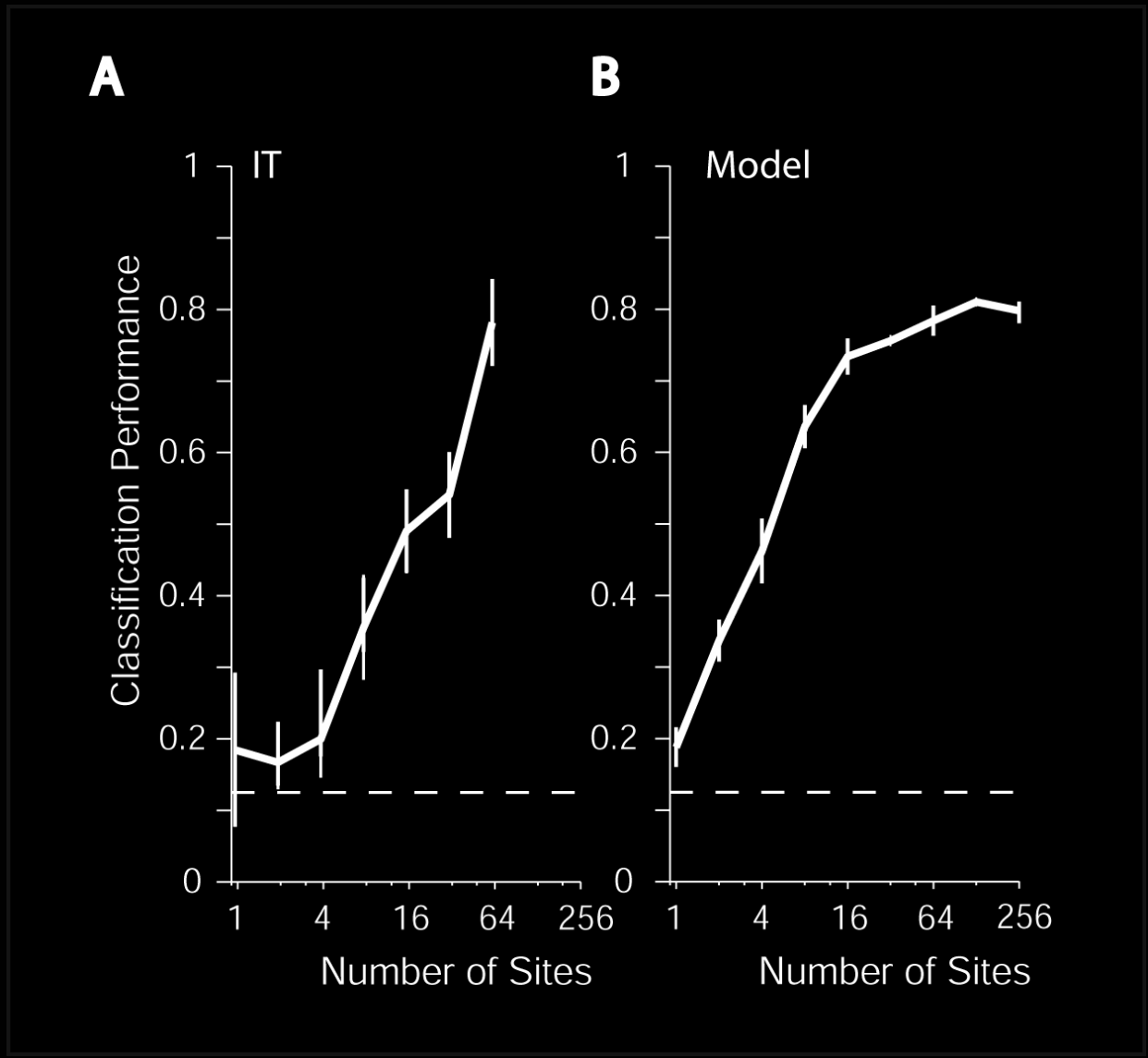
# The classifier extrapolates to new scales and positions



# Other observations

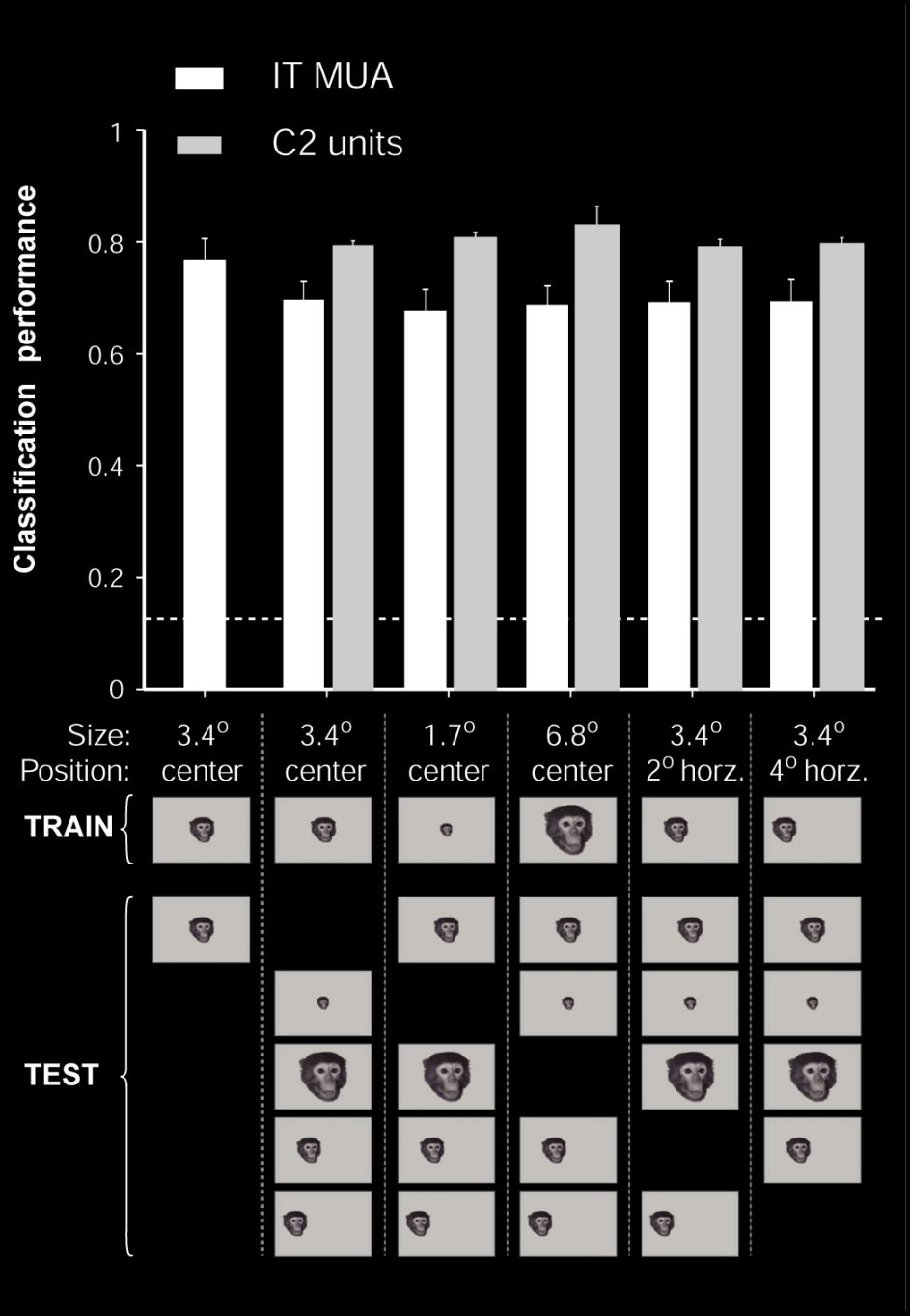
- We can decode information from local field potentials. MUA+LFP > MUA > LFP
- Feature selection significantly improves performance. Choosing the “best” neurons >> randomly selecting neurons
- We can decode the time of stimulus onset
- We can also read out coarse “where” information
- Decoding is robust to internal and external perturbations
- The population can extrapolate to novel pictures within known categories

# We can decode object information from the model units




Serre, Kouh, Cadieu, Knoblich, Kreiman, Poggio. *MIT AI Memo* 2005

# The model shows scale and position invariance



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