Institute of Neuroinformatics
University of Zurich and ETH Zurich

Computation in Neural Systems: Biological Vision

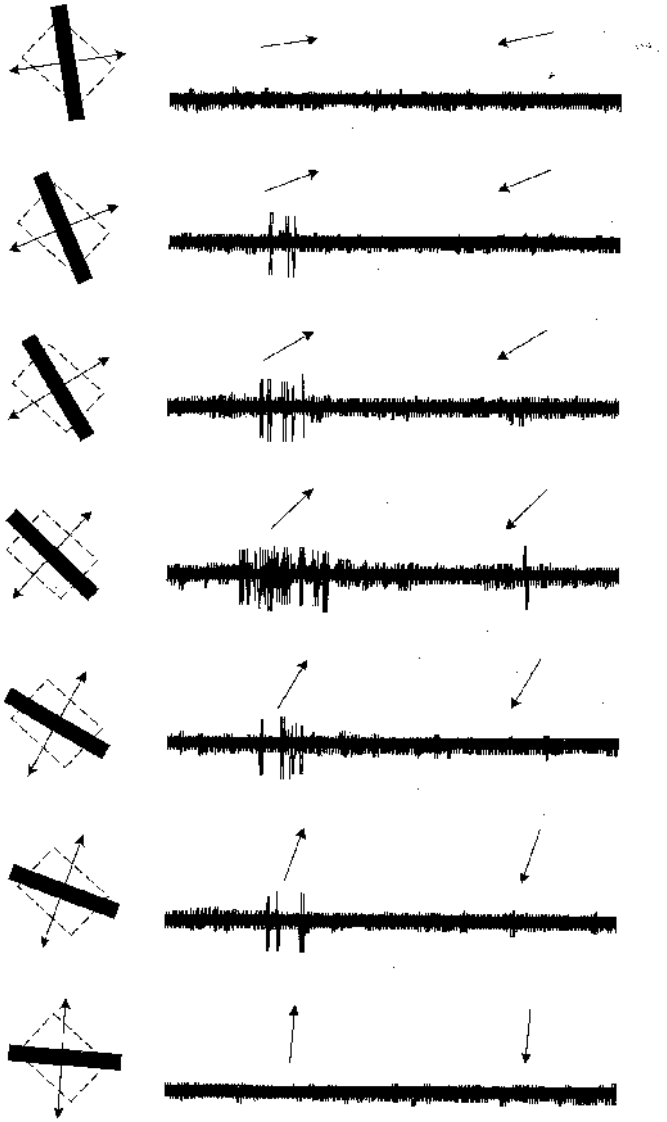
Lecture April 26, 2018

Daniel C. Kiper

www.ini.unizh.ch/~kiper/comp_vis/index.html

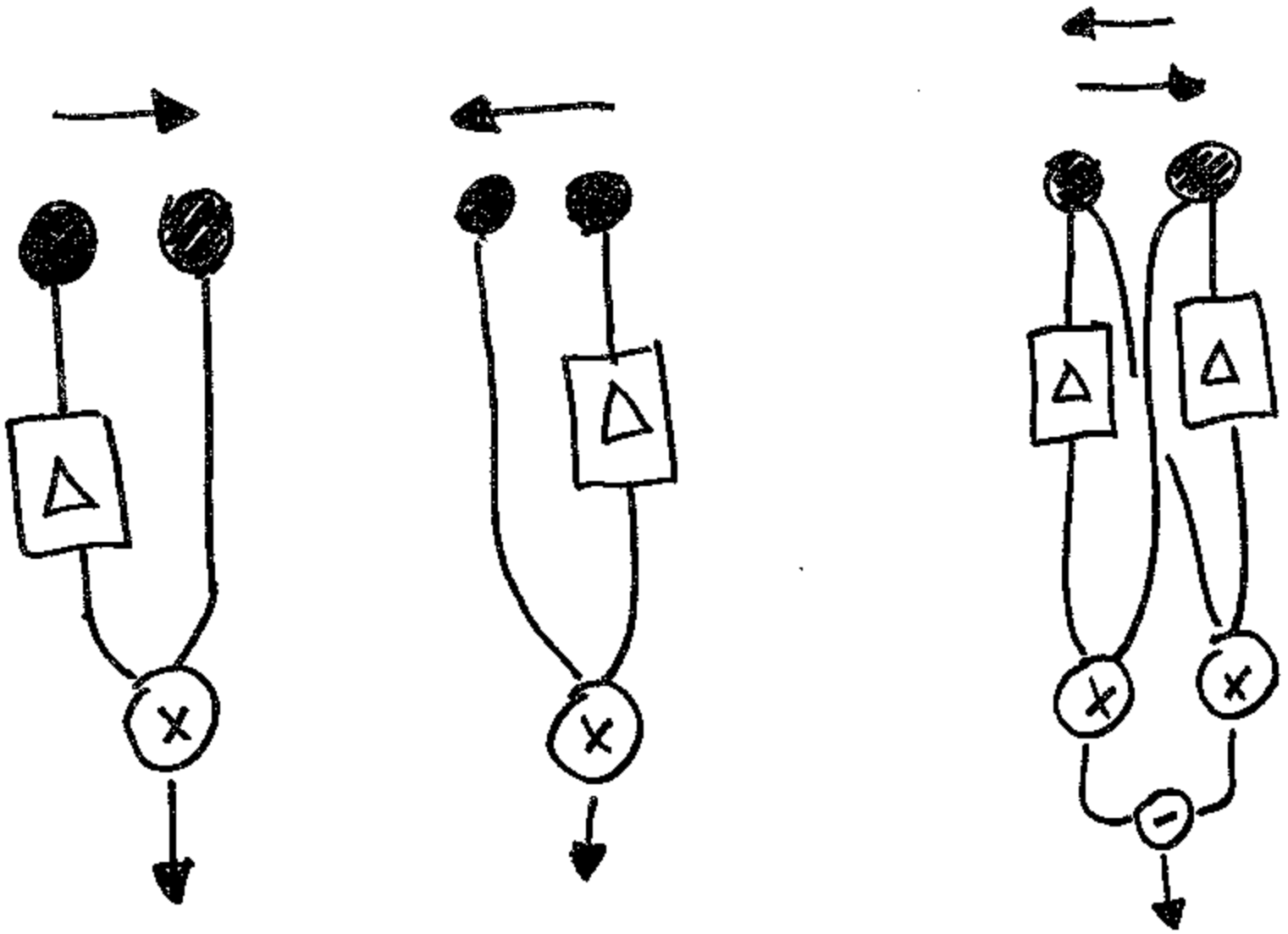
Visual motion: 1D

Selectivity for stimulus orientation and direction

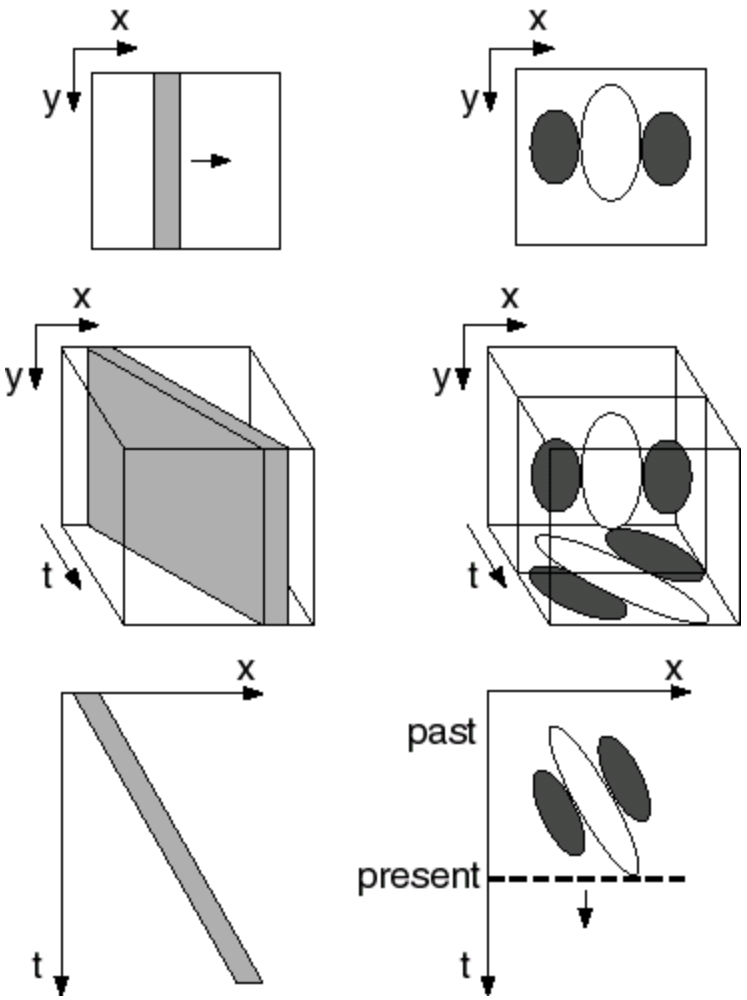


Hubel and Wiesel (1968)
in Wandell (1995)

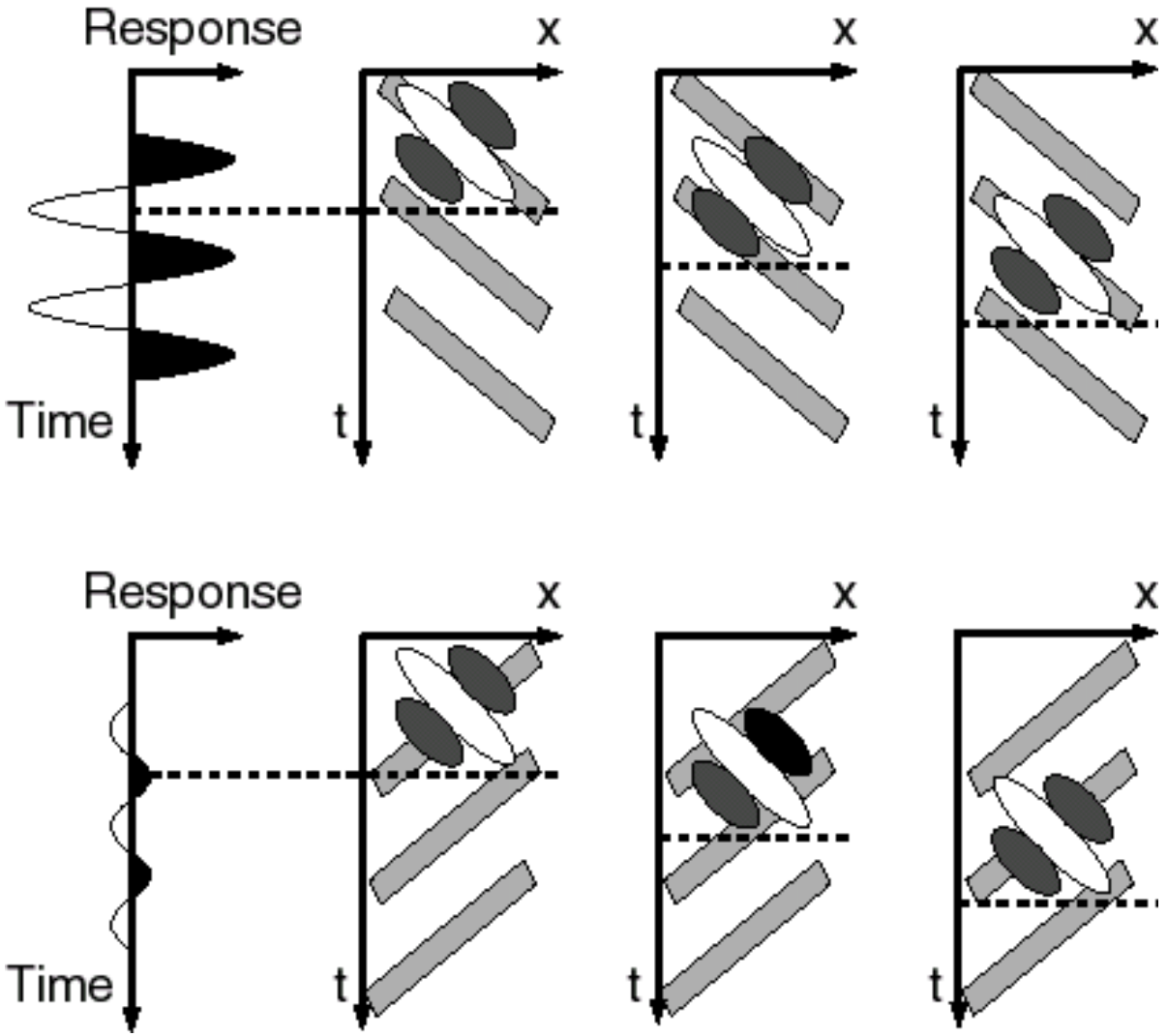
Reichardt detector



Space-time stimuli and receptive fields

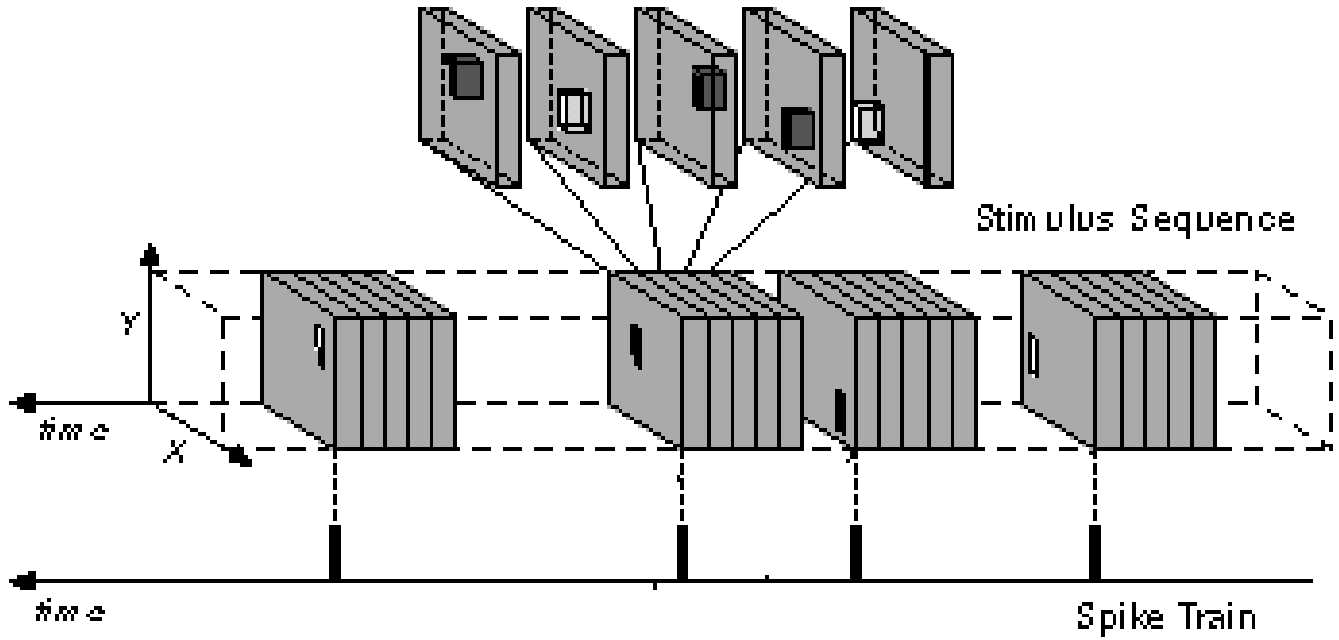


Space-time receptive fields and direction selectivity

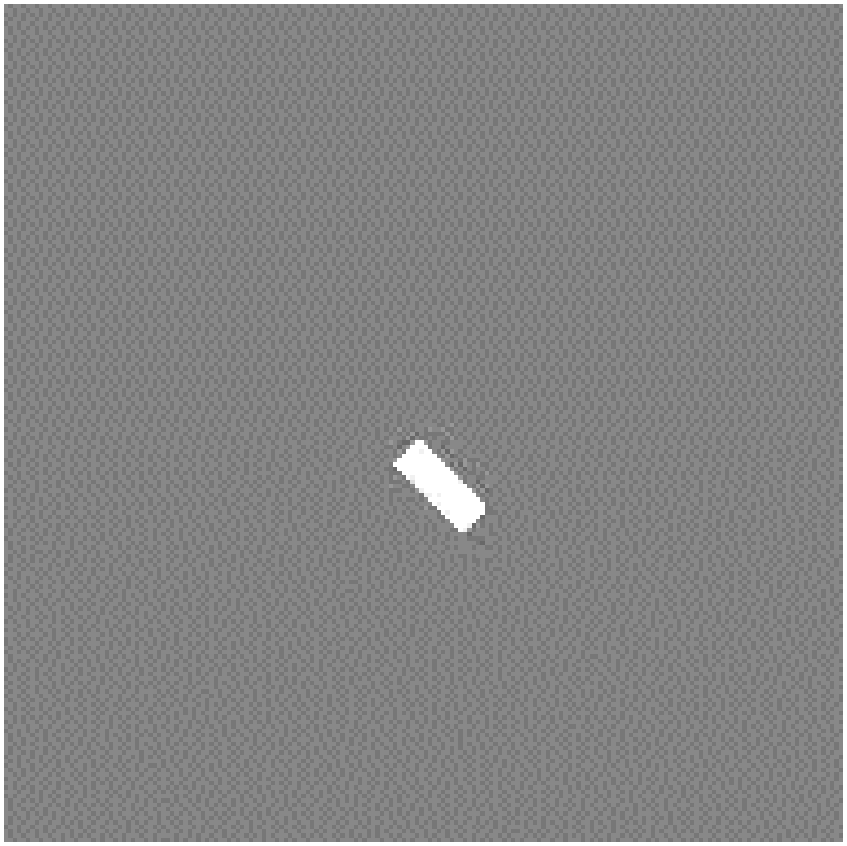


Measuring space-time receptive fields with reverse correlation

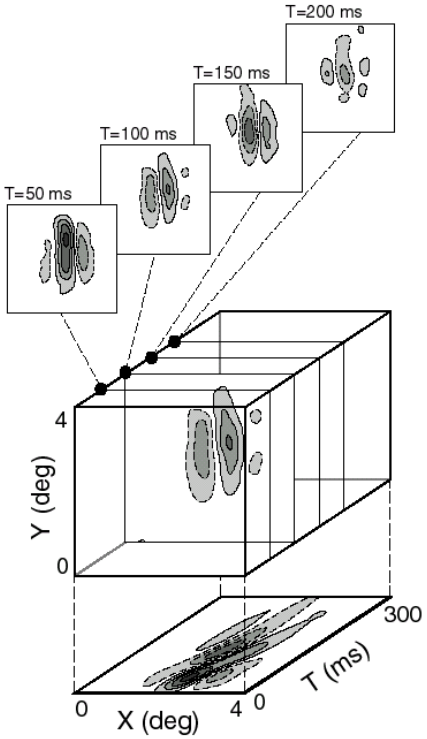
Stimulus for measuring space-time receptive fields

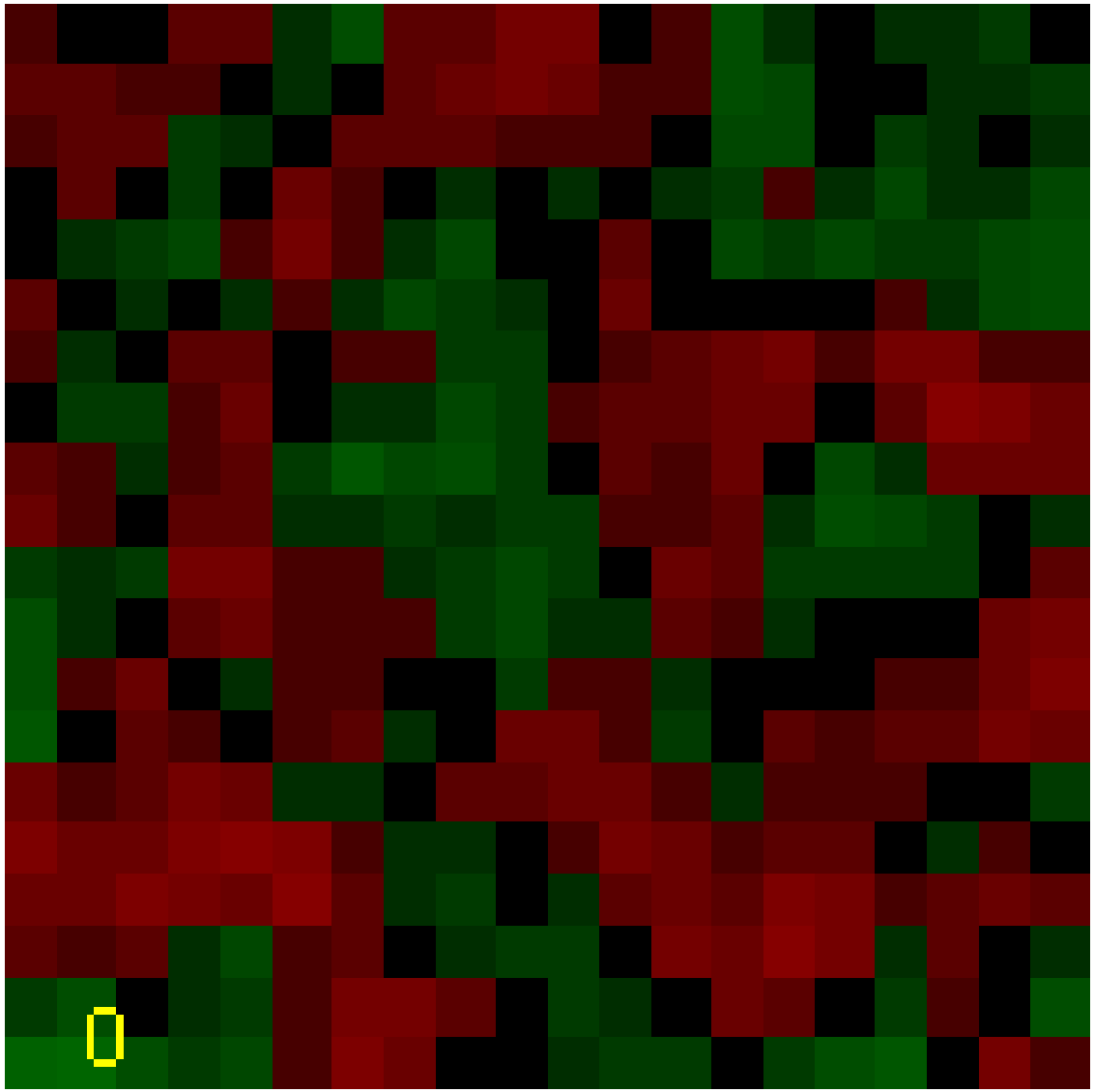


Ohzawa, DeAngelis & Freeman (1996)



Space-time receptive field of a V1 simple cell

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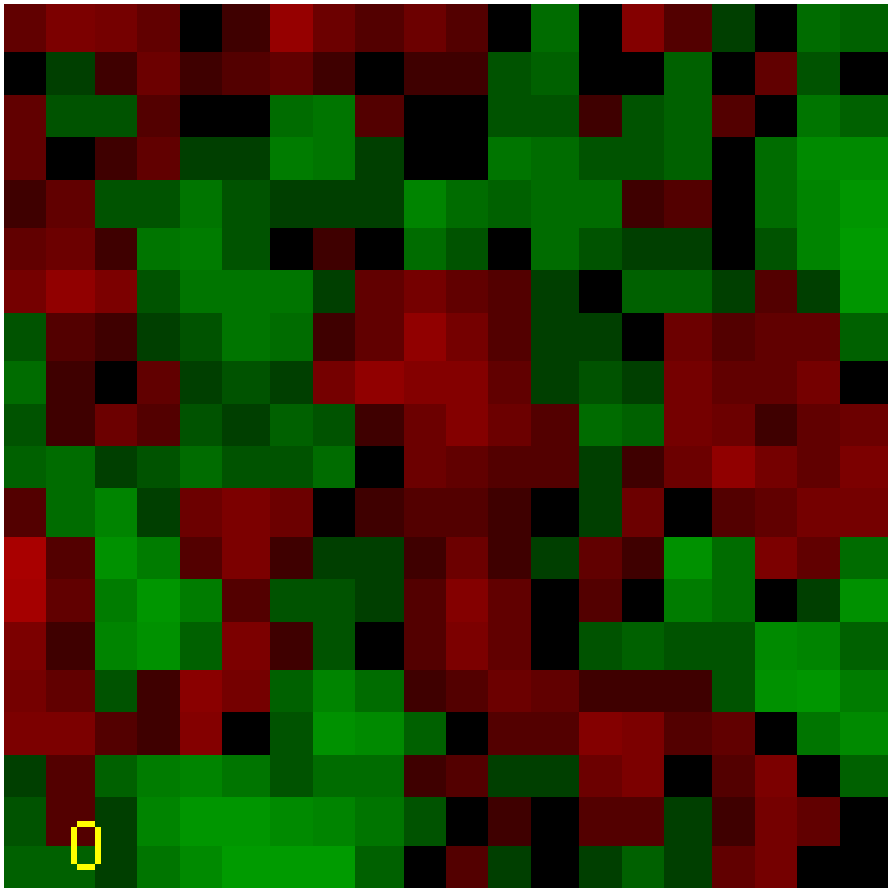

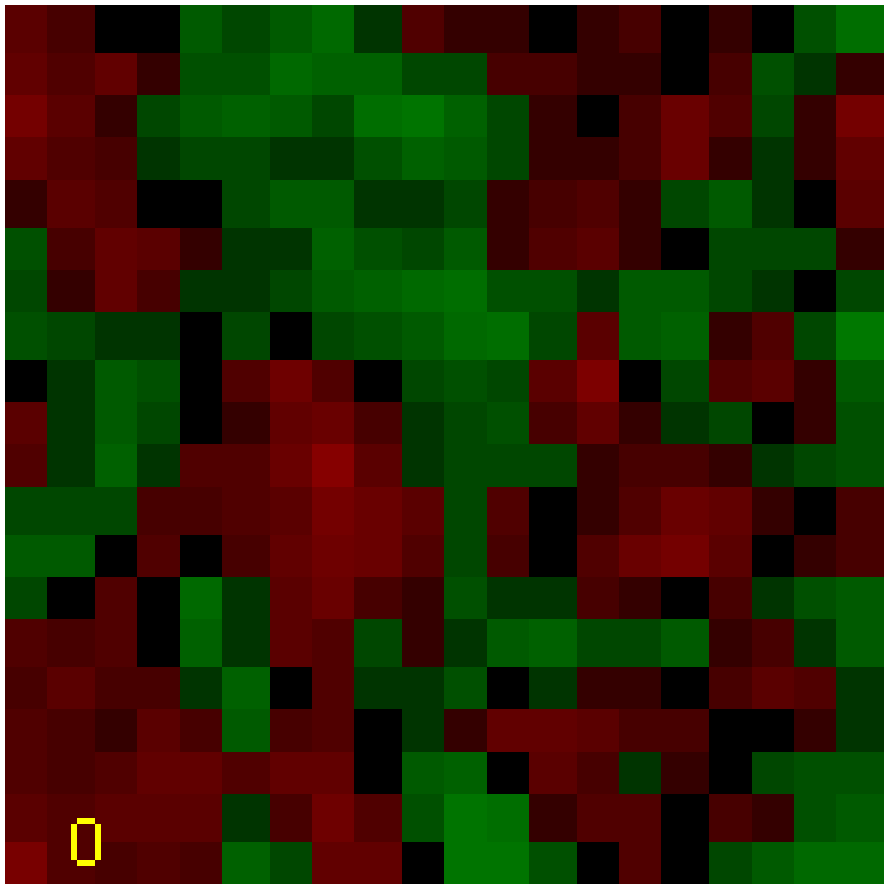
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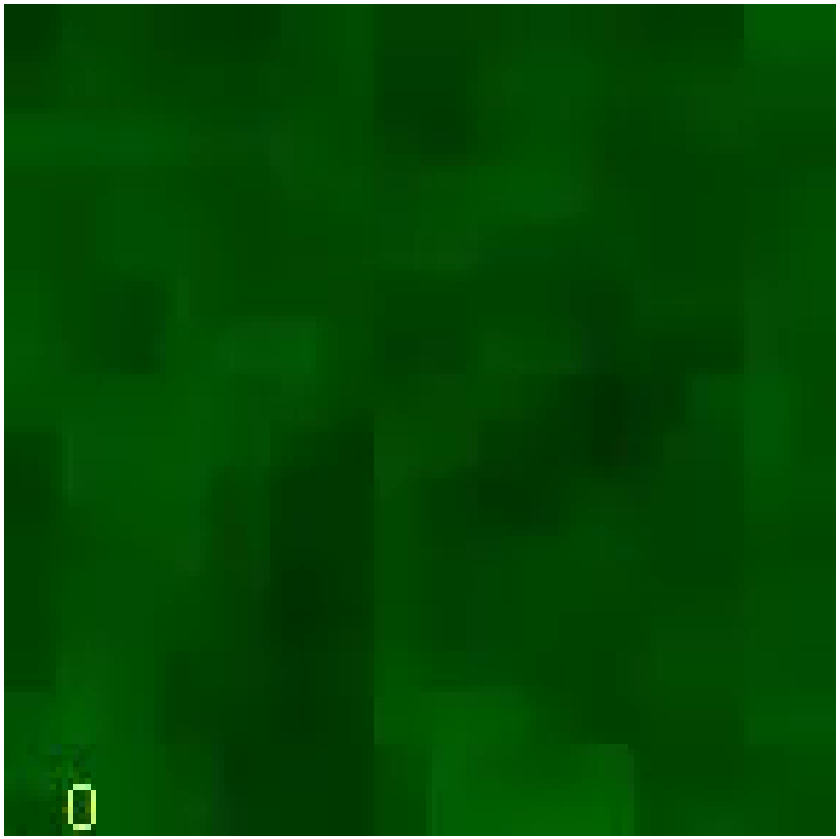
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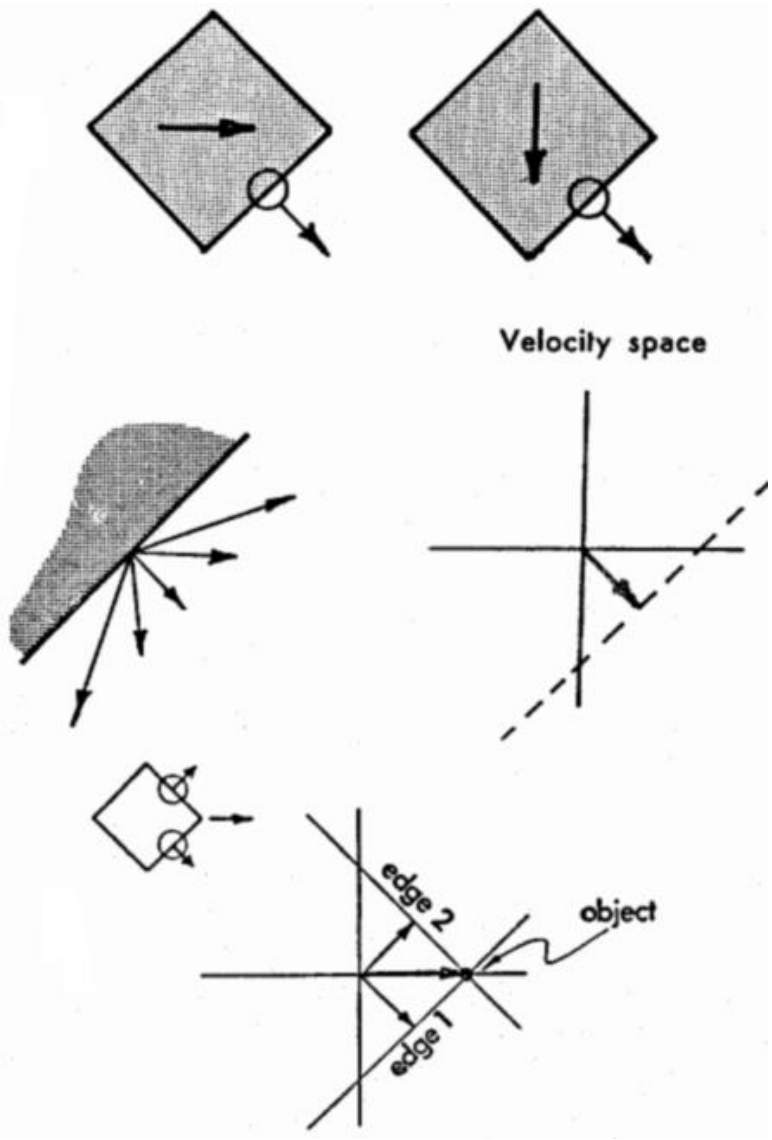
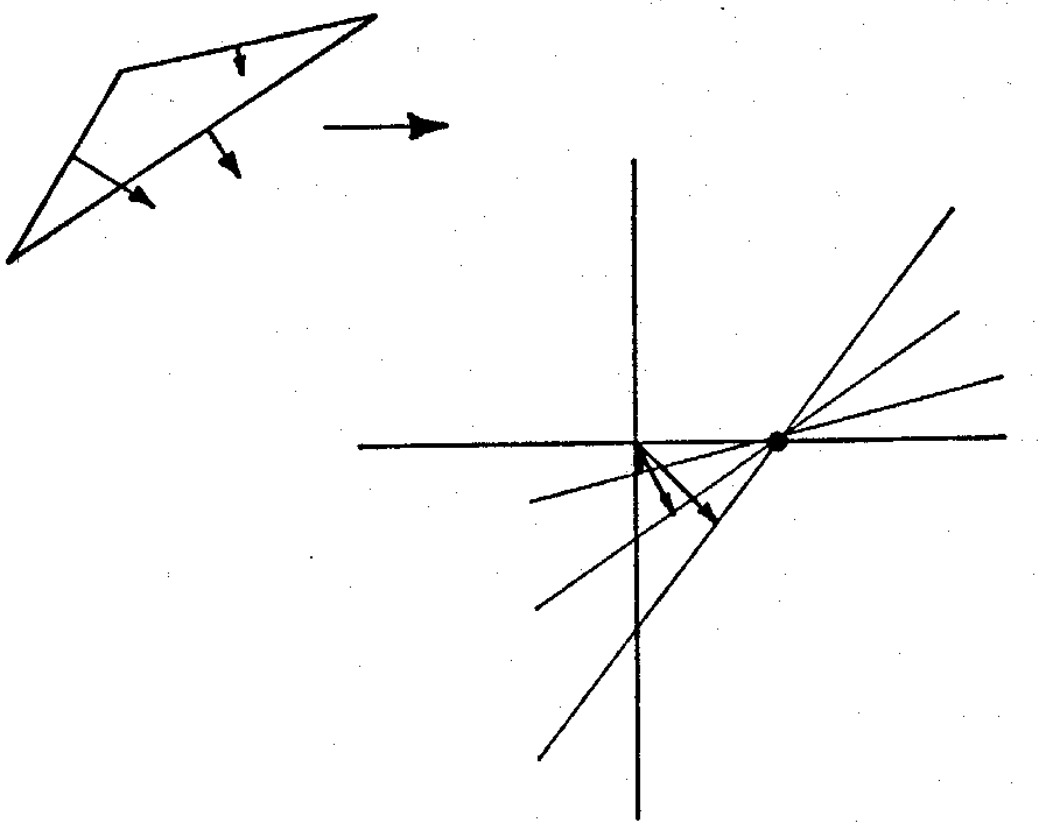
Visual motion: 2D

The “aperture problem”



Movshon, Adelson, Gizzi and Newsome, 1983

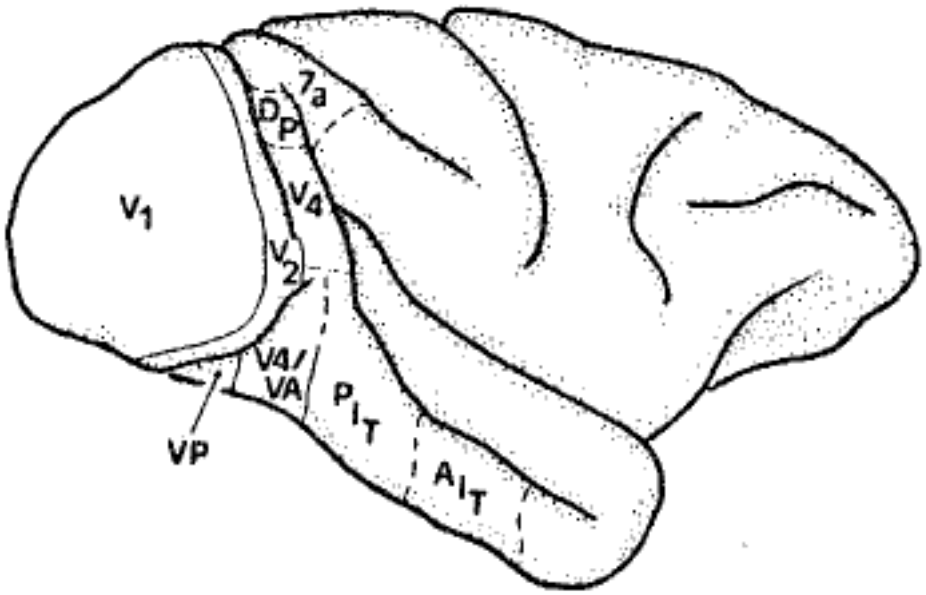
Intersection of constraints

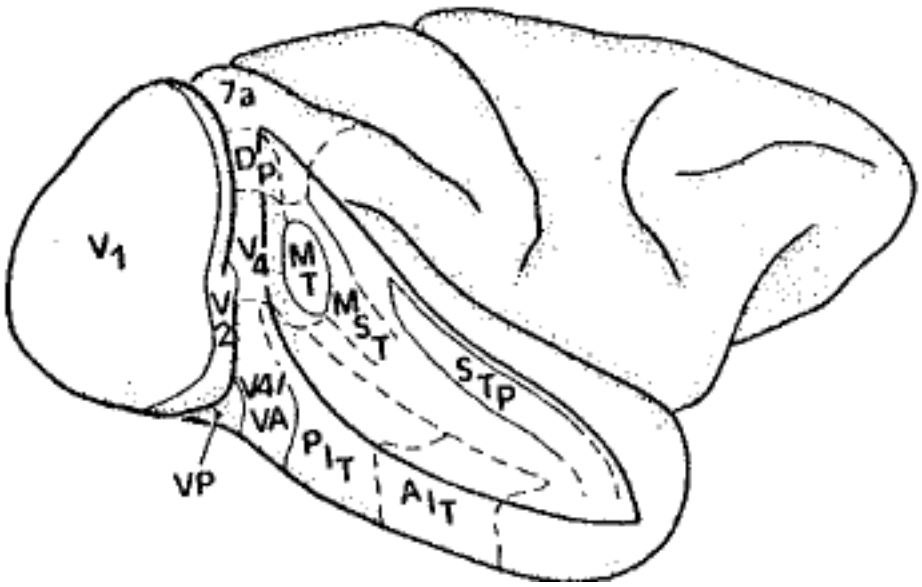


Movshon, Adelson, Gizzi and Newsome, 1983

Area MT
Responses to moving stimuli

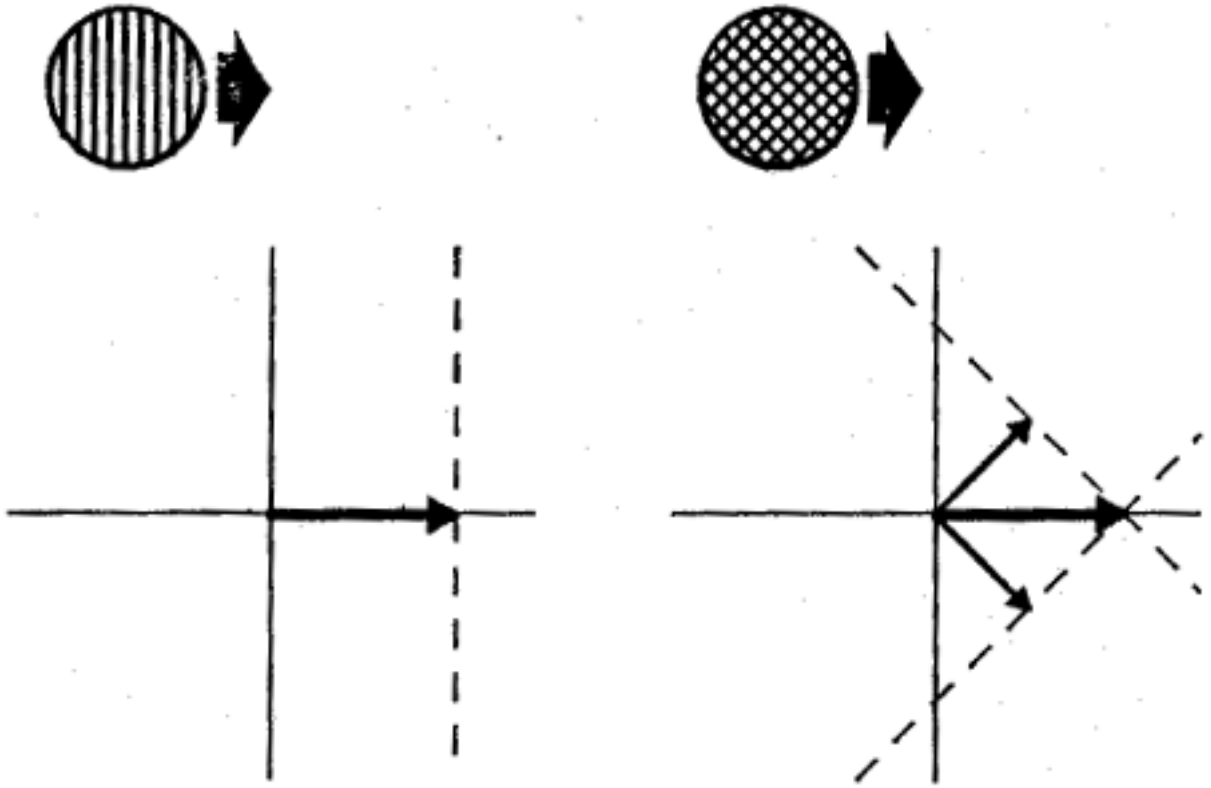
Some visual areas in the macaque brain





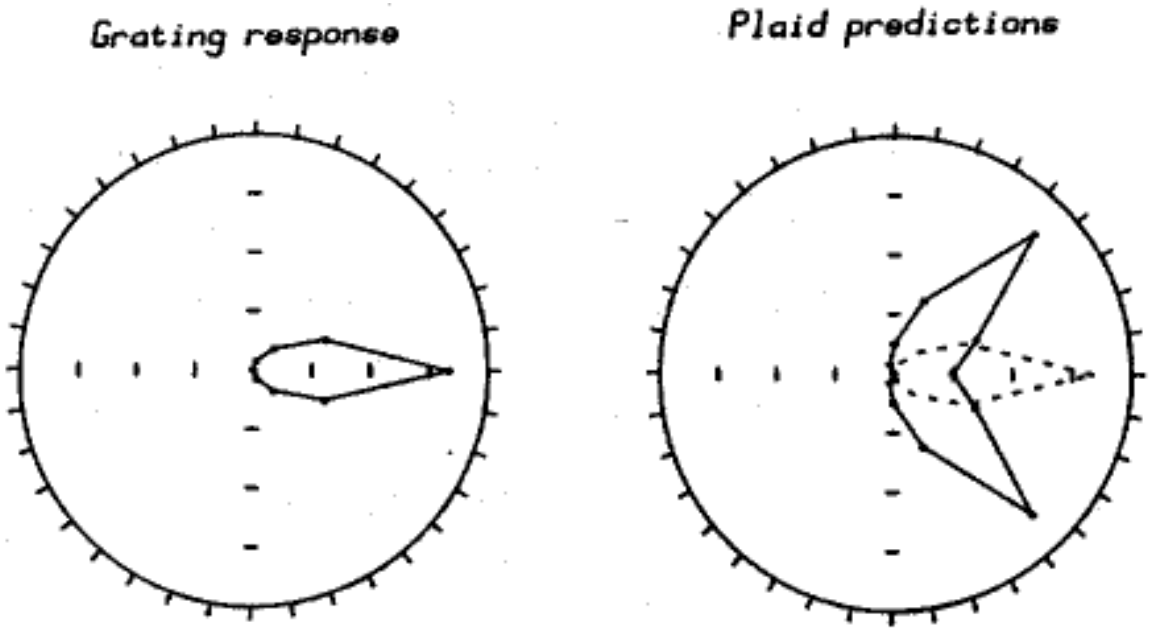
Maunsell and Newsome, 1987

Perceived direction of gratings and plaids



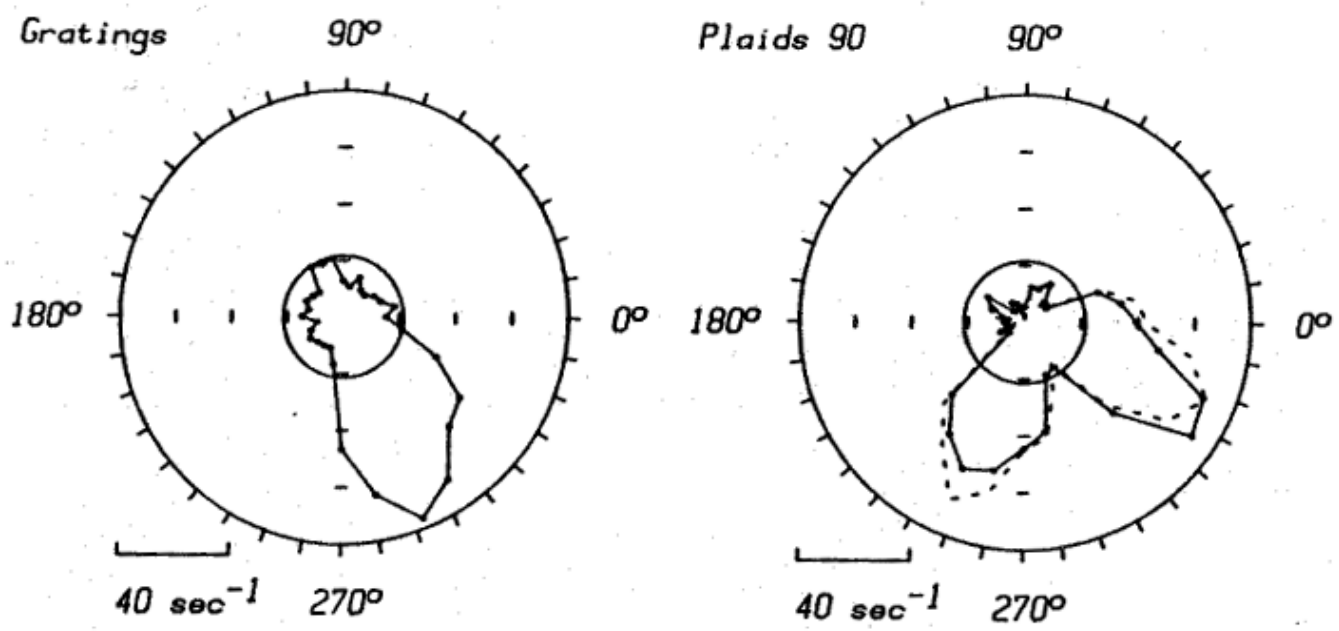
Movshon, Adelson, Gizzi and Newsome, 1983

Component and pattern direction selectivity



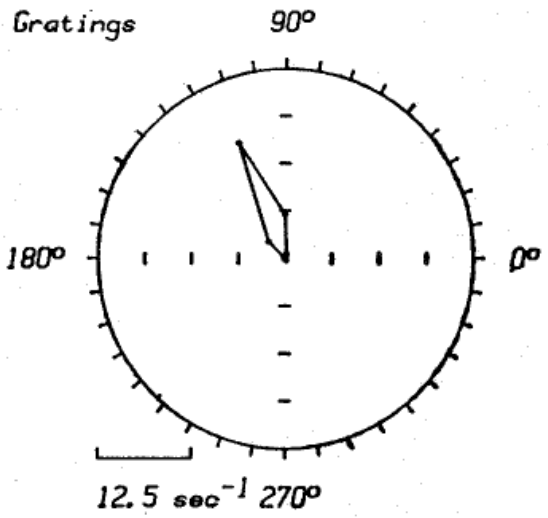
Movshon, Adelson, Gizzi and Newsome, 1983

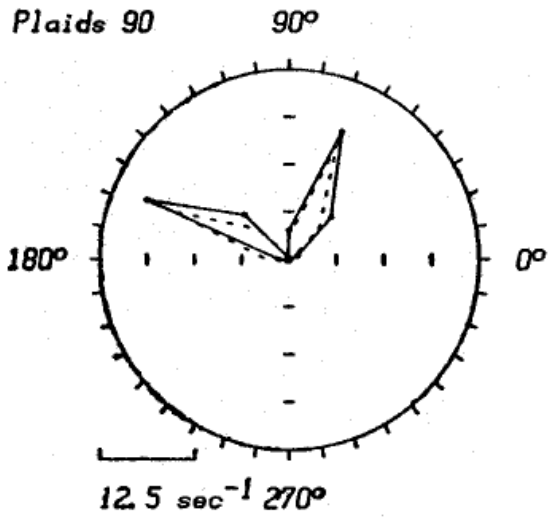
Responses of a V1 cell



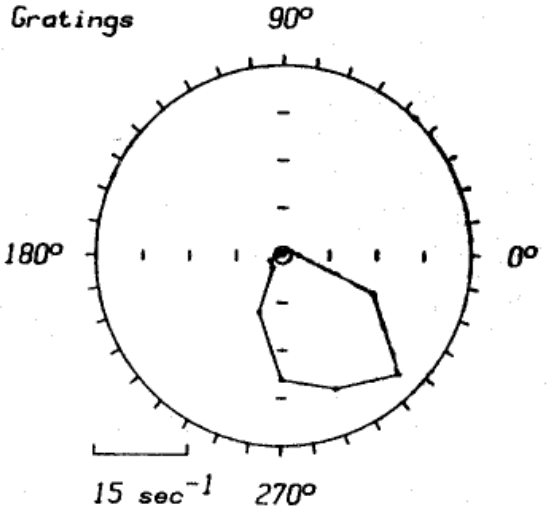
Responses of two MT cells

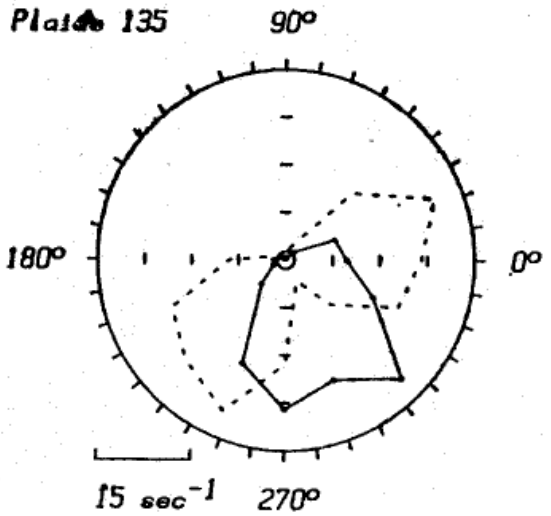
A component selective cell





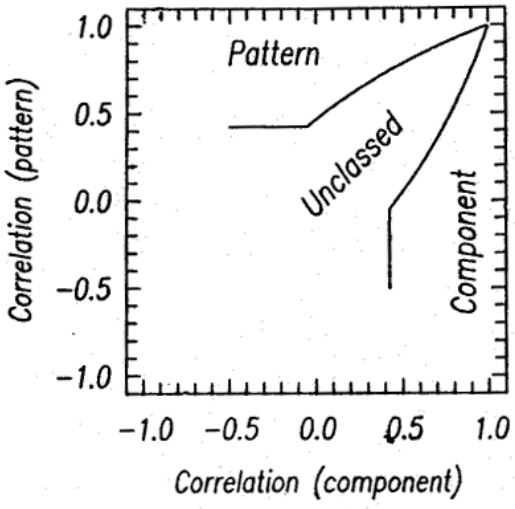
A pattern selective cell



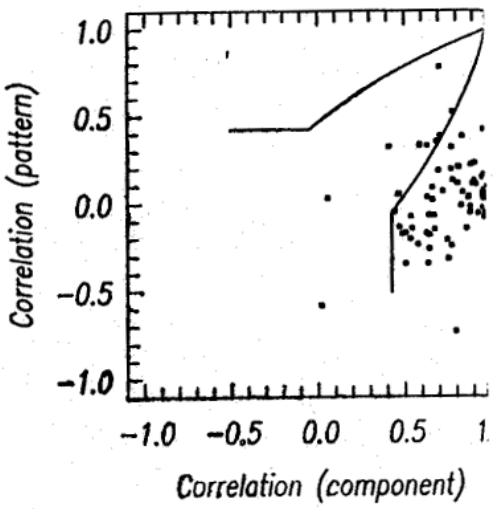


Movshon, Adelson, Gizzi and Newsome, 1983

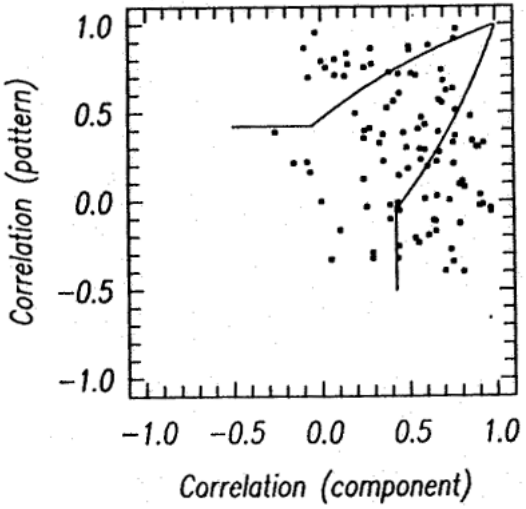
Population analysis



V1



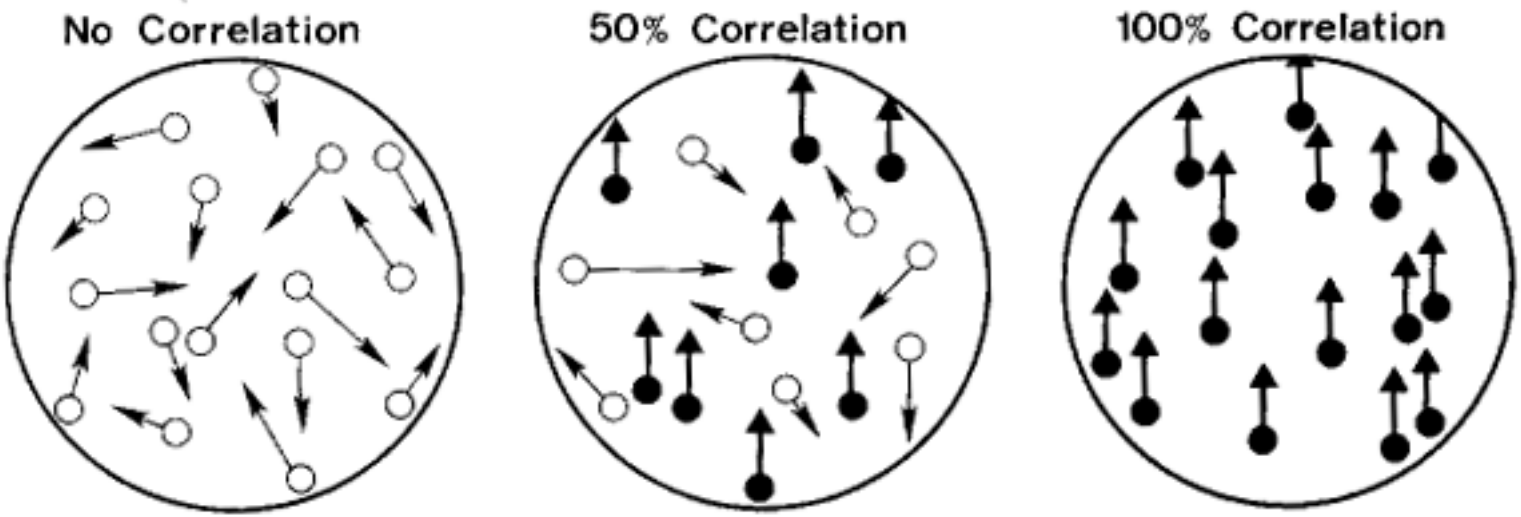
MT



Movshon, Adelson, Gizzi and Newsome, 1983

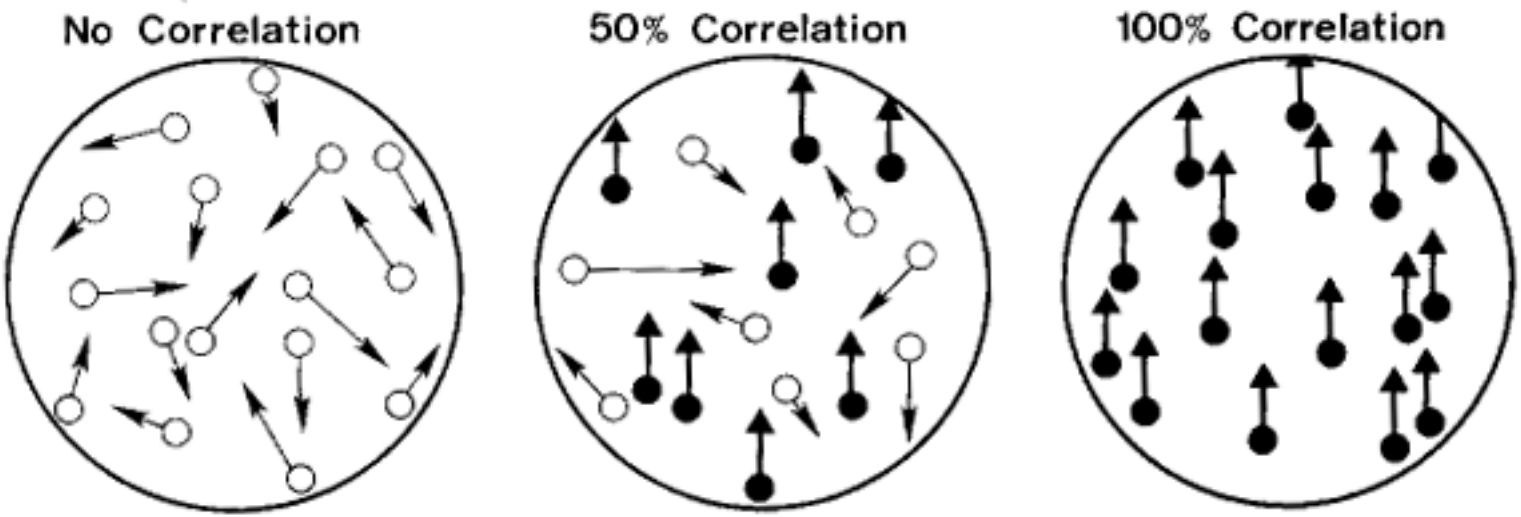
Area MT and the perception of visual motion

Stimulus for measuring motion sensitivity



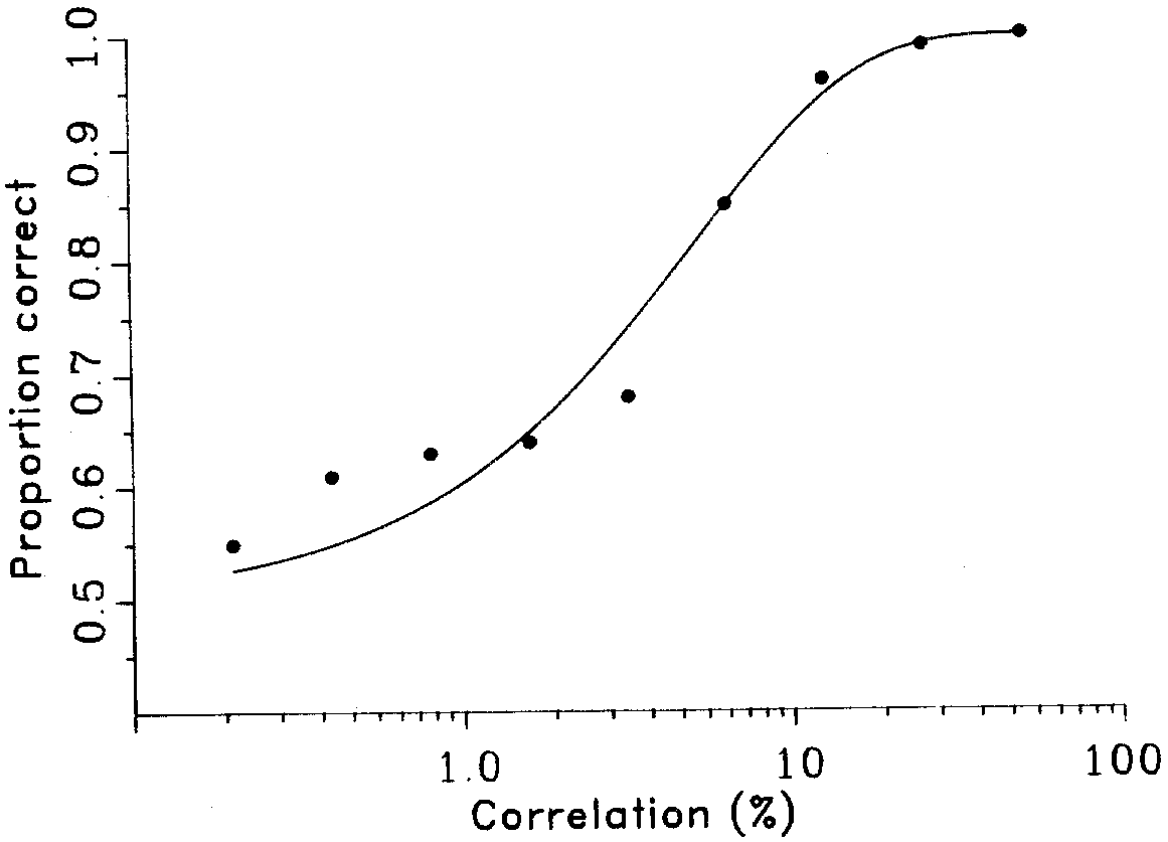
Newsome, Britten, Movshon and Shadlen

Stimulus for measuring motion sensitivity



Newsome, Britten, Movshon and Shadlen

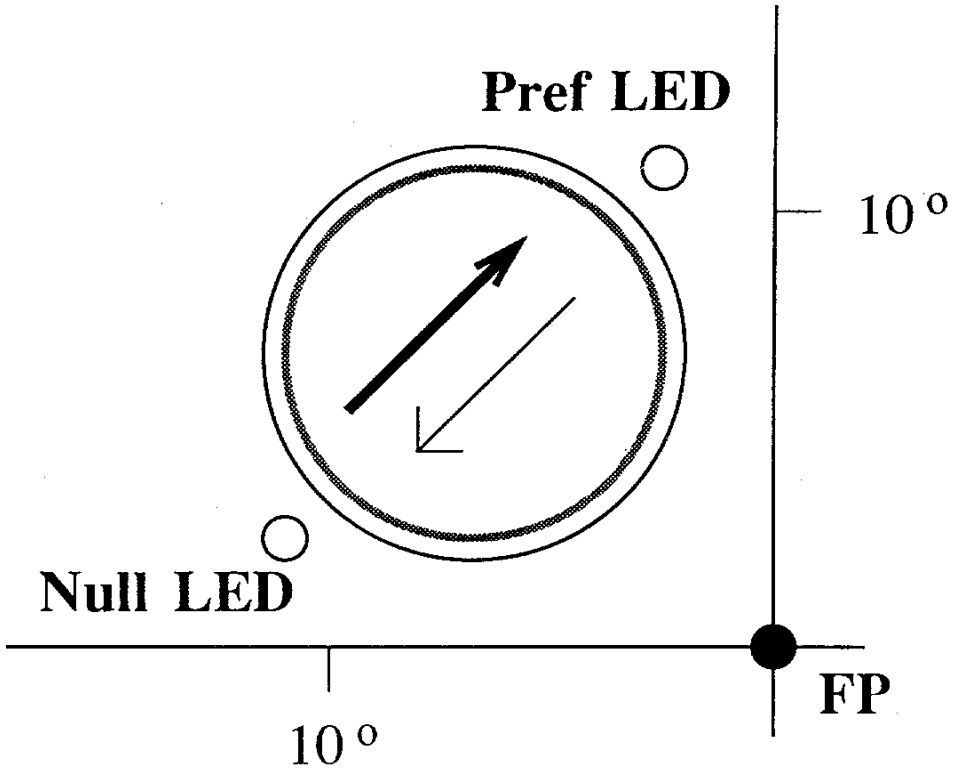
Motion sensitivity of a macaque



Newsome, Britten, Movshon and Shadlen

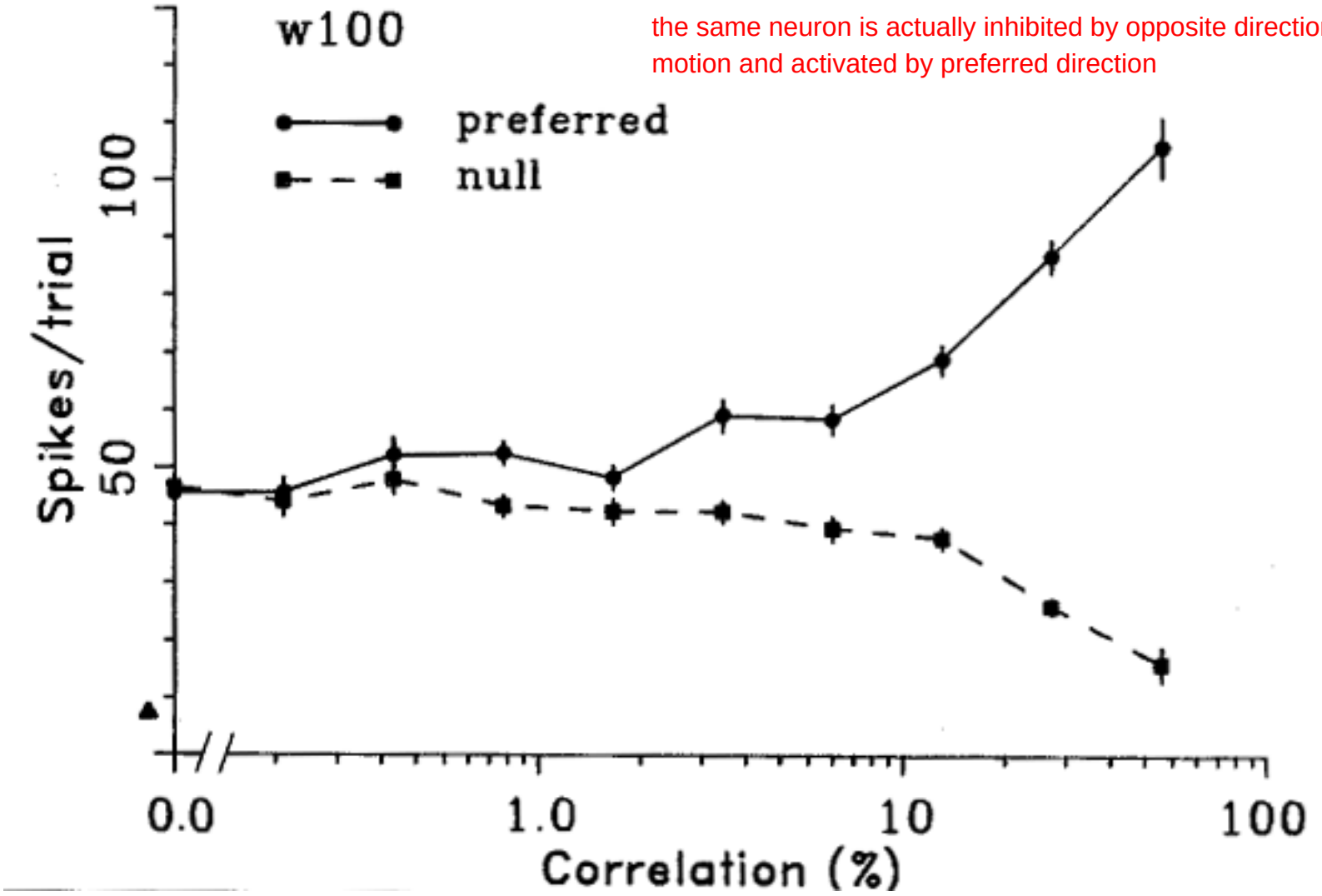
Protocol for measuring motion sensitivity of an MT cell and of the whole macaque

trained to identify direciton of motion of stimuli and recorded activity of MT neurons



MT := medial temporal area of visual cortex and its associated cells

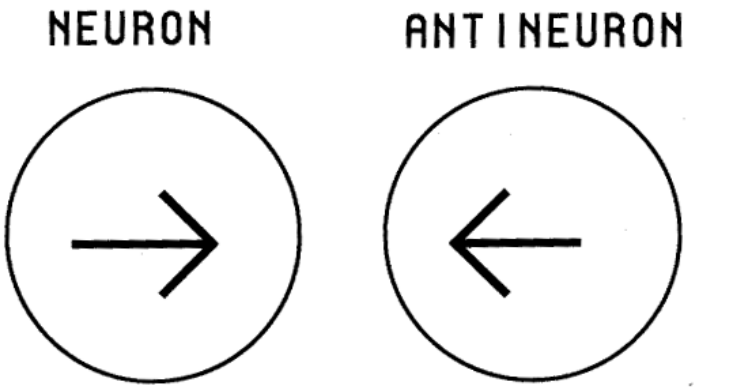
Responses of an MT cell



the same neuron is actually inhibited by opposite direction of motion and activated by preferred direction

Newsome, Britten, Movshon and Shadlen

A very simple model of perceptual decisions

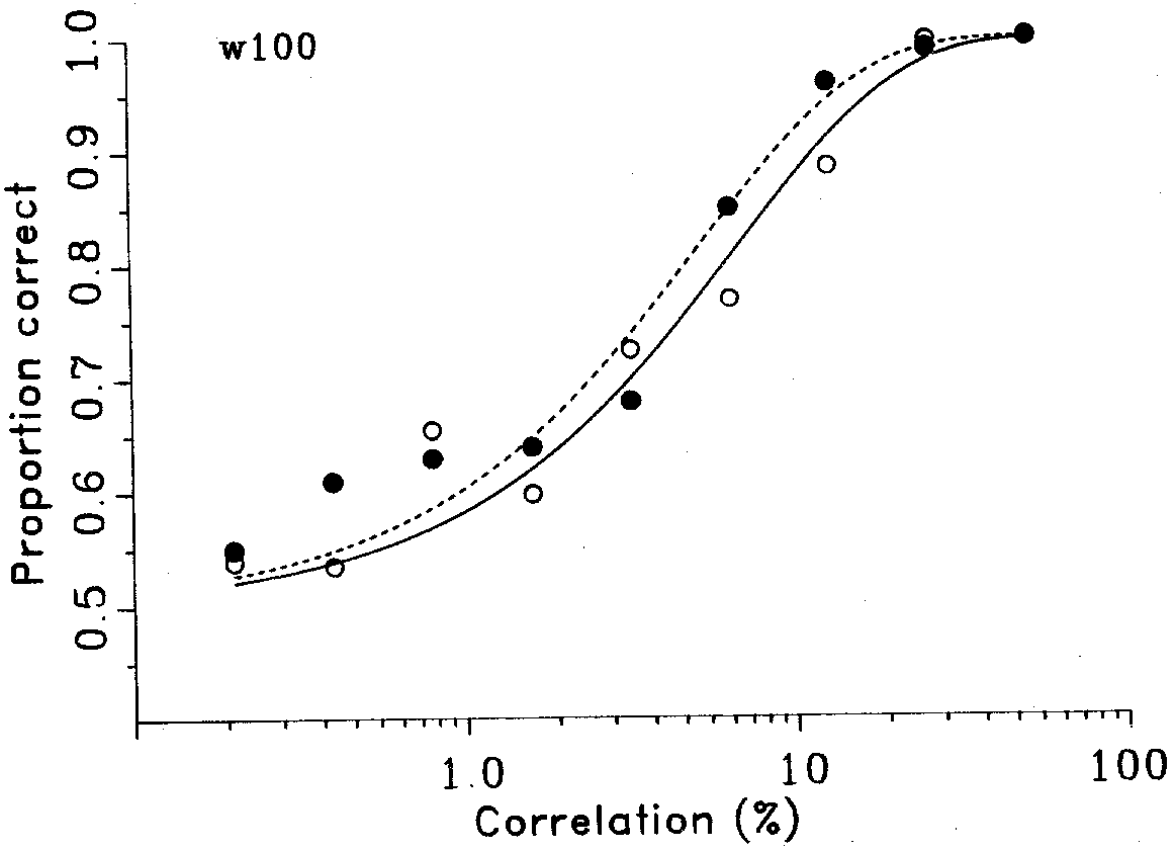


If neuron > antineuron, "right" decision

If antineuron > neuron, "left" decision

Newsome, Britten, Movshon and Shadlen

Perceptual and neural sensitivity



Newsome, Britten, Movshon and Shadlen

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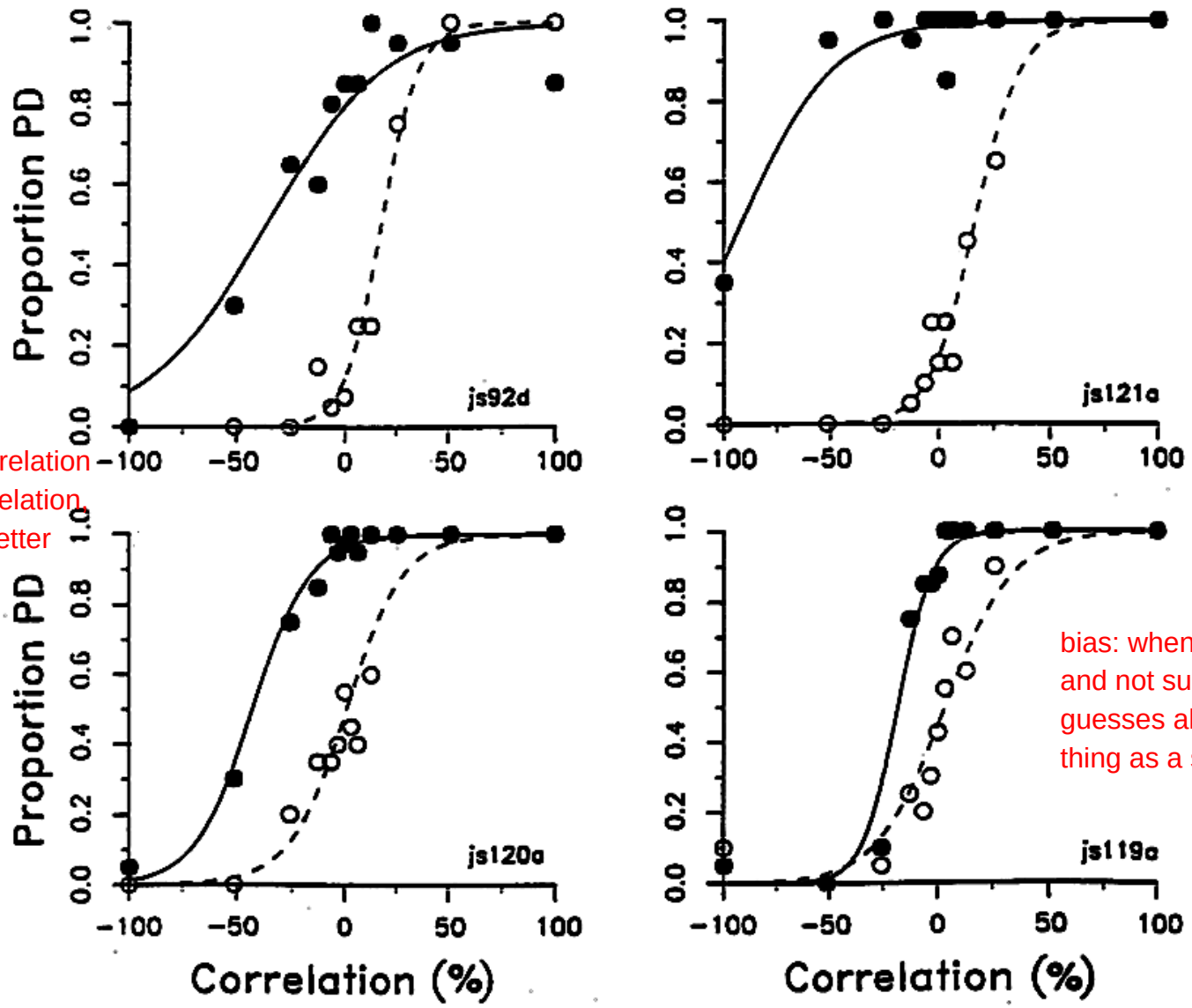
Functional map of direction selectivity in area MT

Malonek, Tootell and Grinvald, 1994

Microstimulation in MT influences perception



guessing at 0 = correlation
when increase correlation, monkey guesses better

bias: when often guessing and not sure, one simply guesses always the same thing as a strategy

same monkey, but 4 different sessions - setup same as in slide 32

Salzman, Murasugi, Britten and Newsome, 1992