

# Cortical stimulation experiments

Daniel C. Kiper

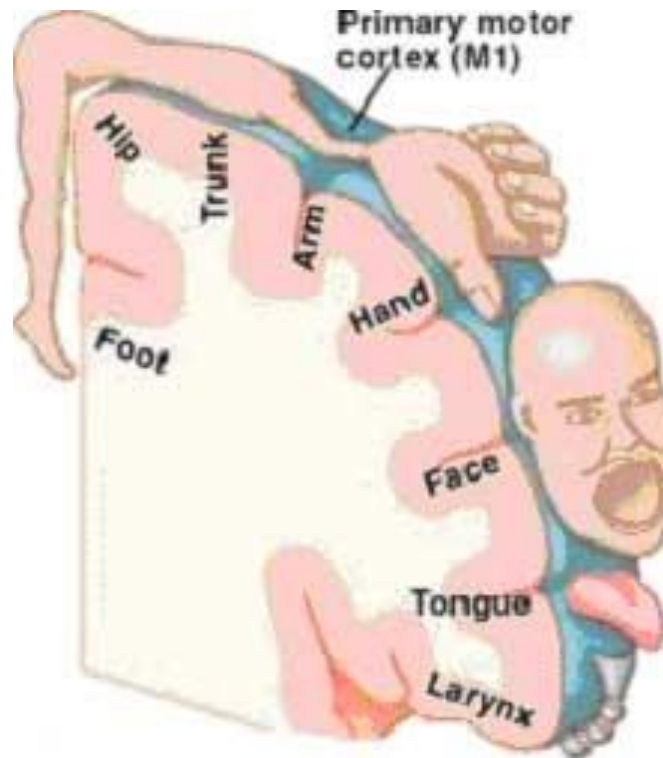
Nov. 29, 2018

<http://www.ini.uzh.ch/~kiper/consciousness.html>

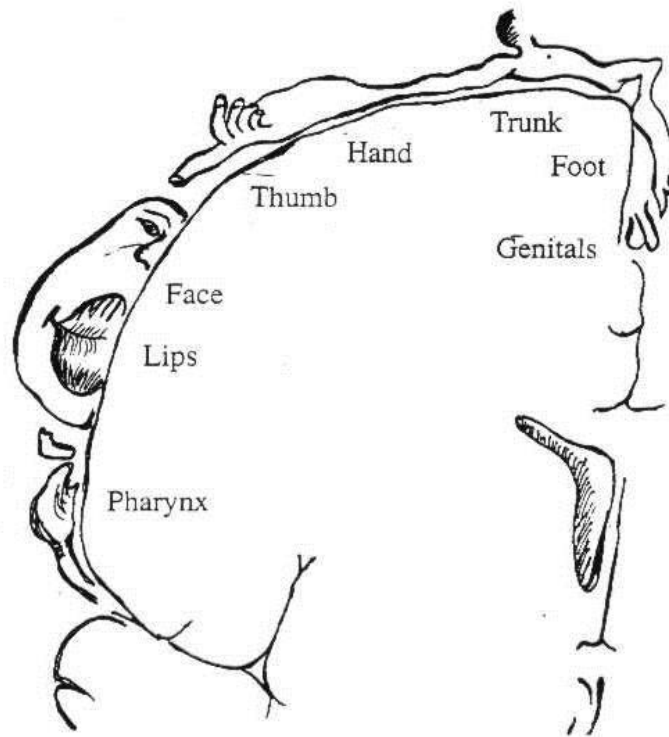
# Wilder Penfield (1891-1976)



# Motor homonculus



# Somatosensory homonculus

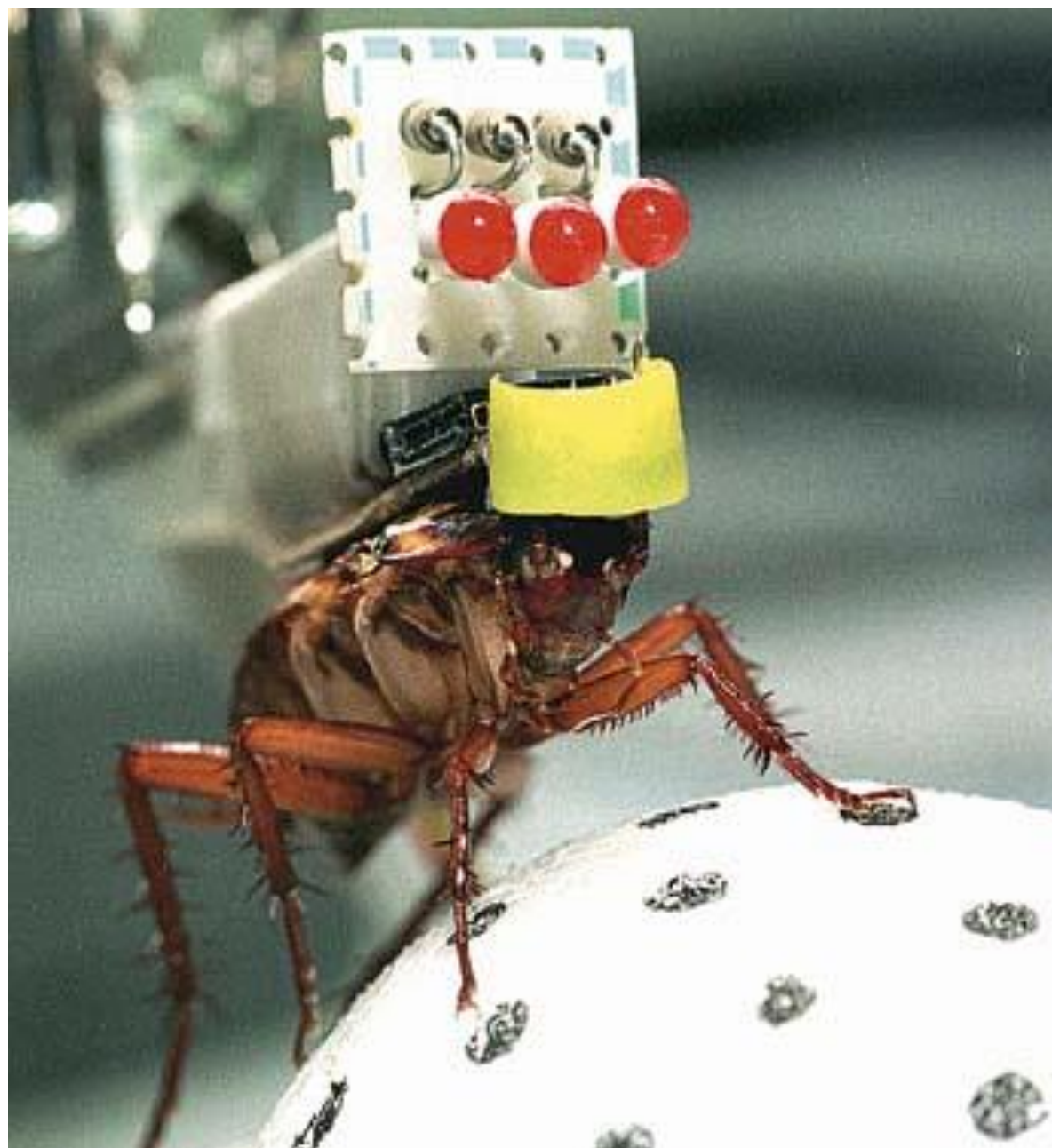


# Wilder Penfield's Brain Stimulation Work

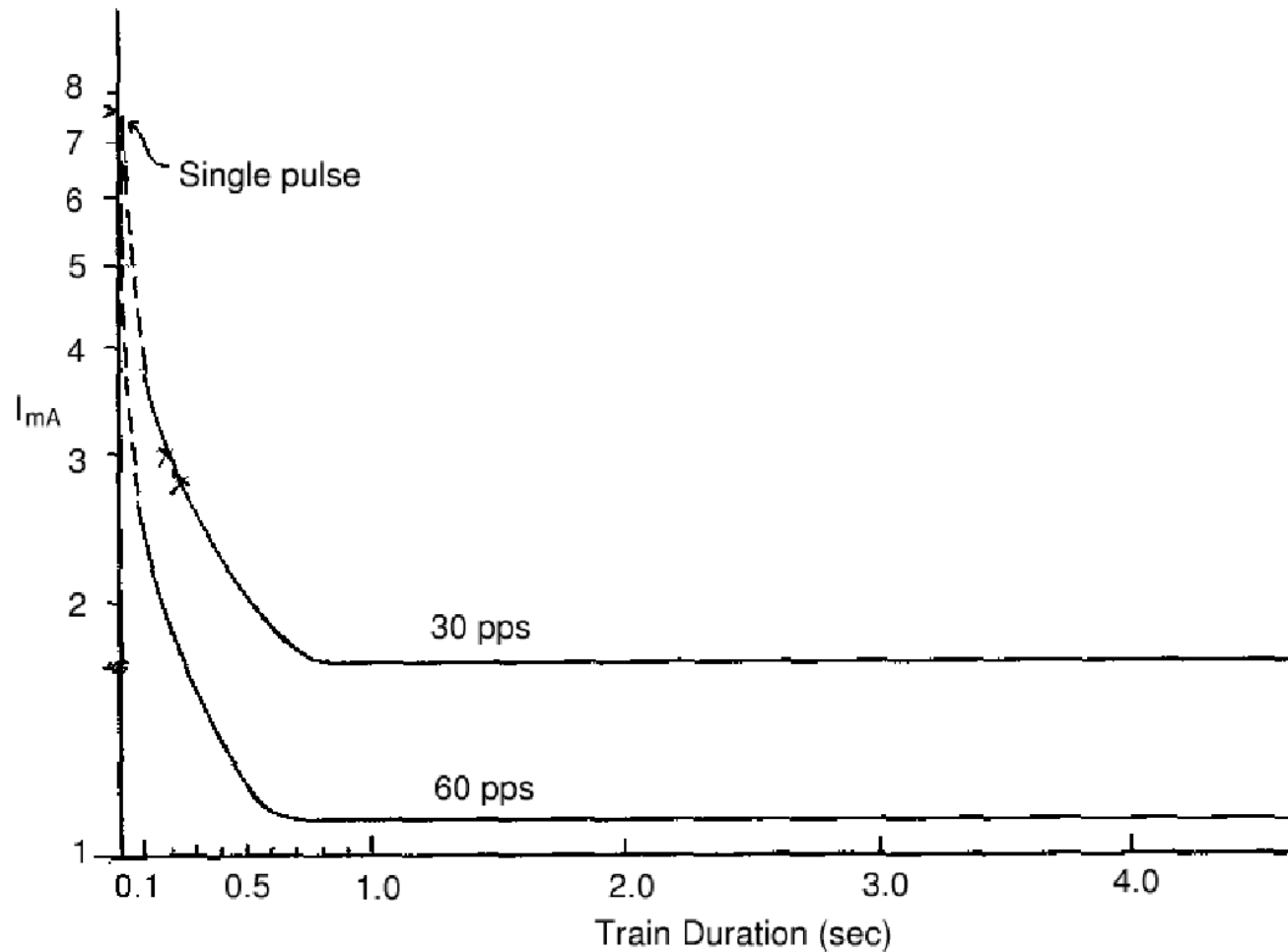
- Penfield's Research (as it is usually reported):
  - ▶ Penfield stimulated the cortexes of patients about to undergo brain surgery
  - ▶ Some of these patients reported vivid memories during stimulation
  - ▶ Penfield concluded that memories are highly stable, and that the brain contains a complete record in great detail of past experience
- Penfield's Data (which is usually not reported):
  - ▶ Penfield had 1,132 cases
  - ▶ Penfield only found memories during stimulation in those patients whose temporal lobe cortex was stimulated. The number who had temporal lobe cortex stimulation was 520 patients.
  - ▶ Of these, only 40 patients -- 7.7% -- had a memorial event!
  - ▶ Of these 40 patients, not all had a multisensory perceptual event.
    - 24 had an auditory experience
    - 19 had a visual experience
    - 12 had combined auditory and visual experiences
    - 5 had a vague experience like a thought or flashback
- How Truthful Were the Memories Recalled?

# José Manuel Rodríguez Delgado





# Brain stimulation experiments



**Libet's Time-On Theory**



# Libet's dual stimulation studies: cortex and skin

*Stimulating the Cortex*



-500ms

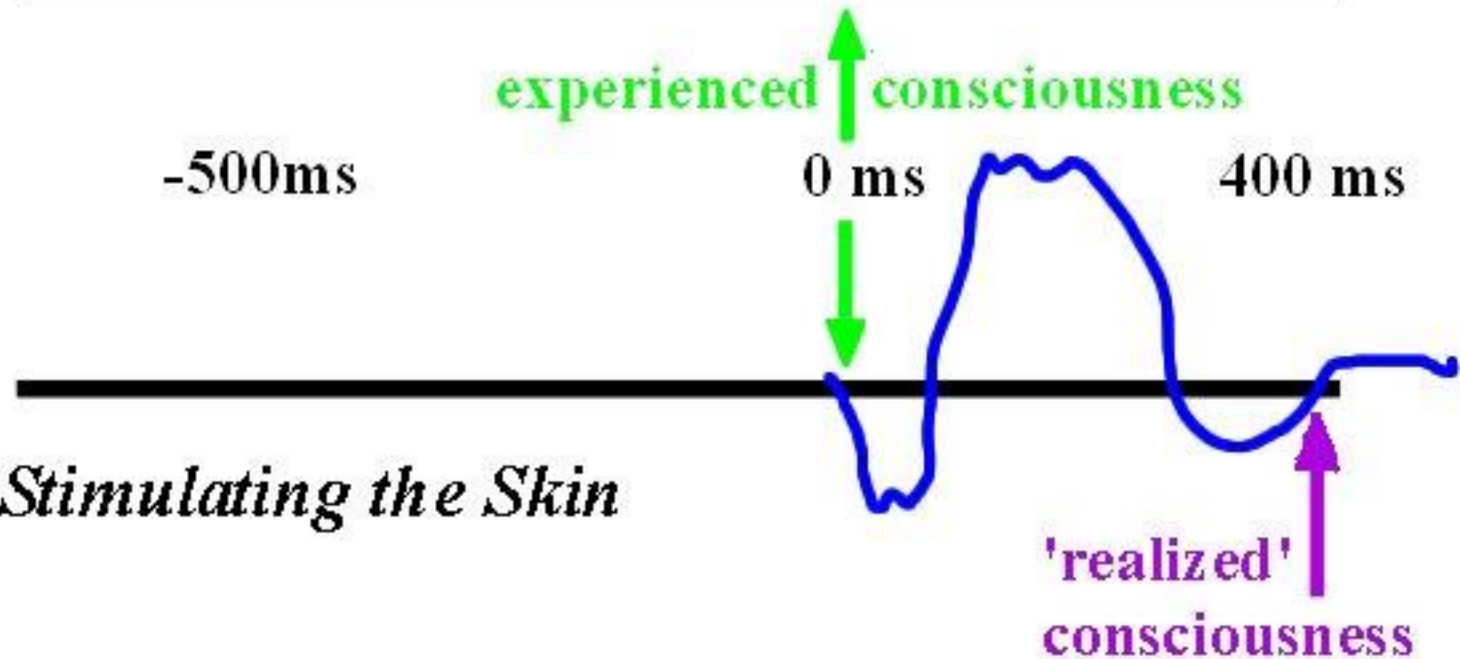
experienced consciousness

0 ms

400 ms

*Stimulating the Skin*

'realized' consciousness

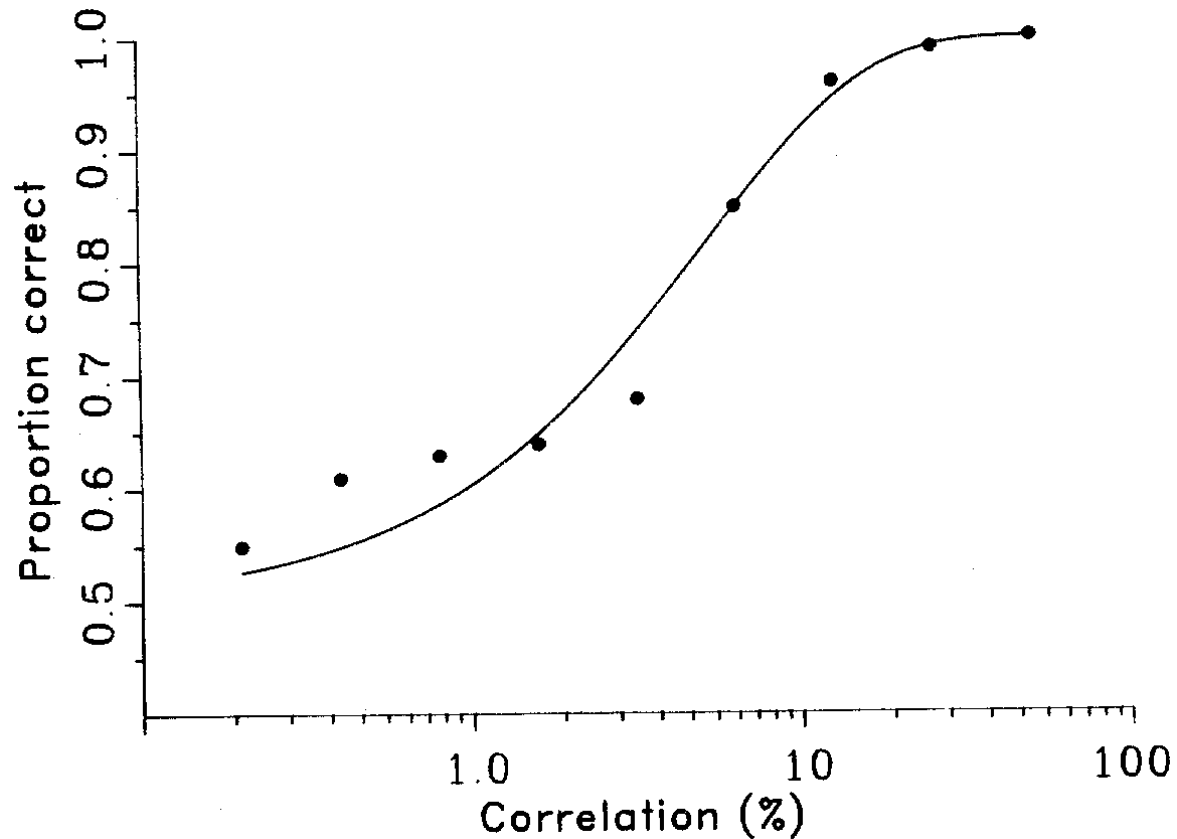


# Area MT and the perception of visual motion

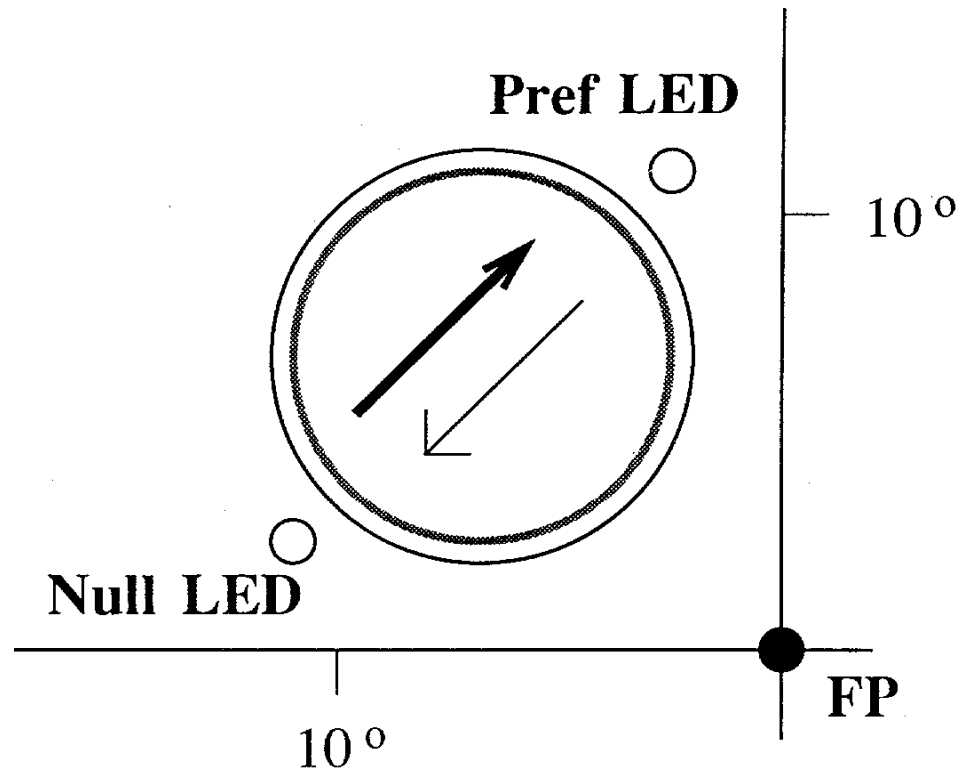
# William T. Newsome



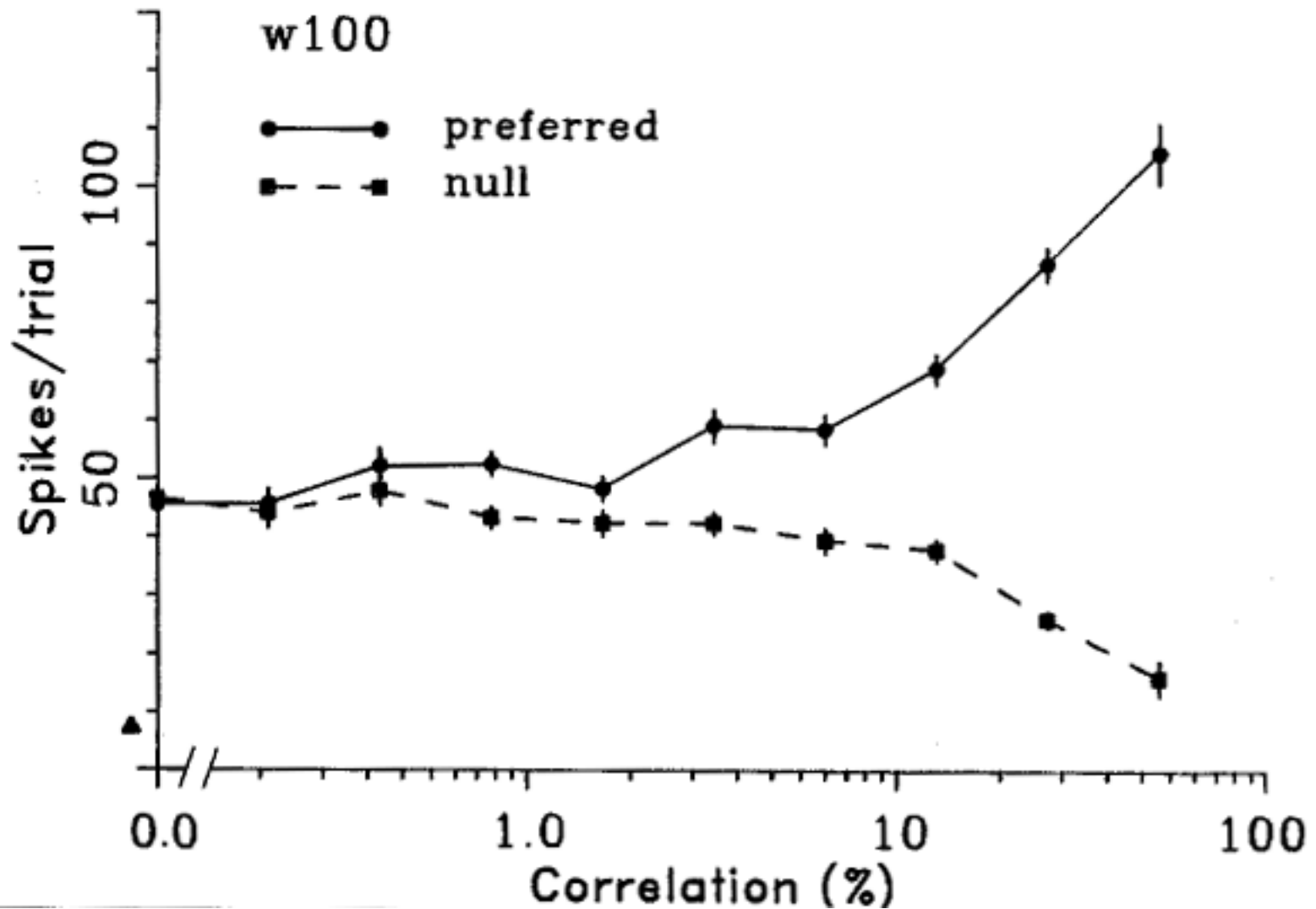
# Motion sensitivity of a macaque



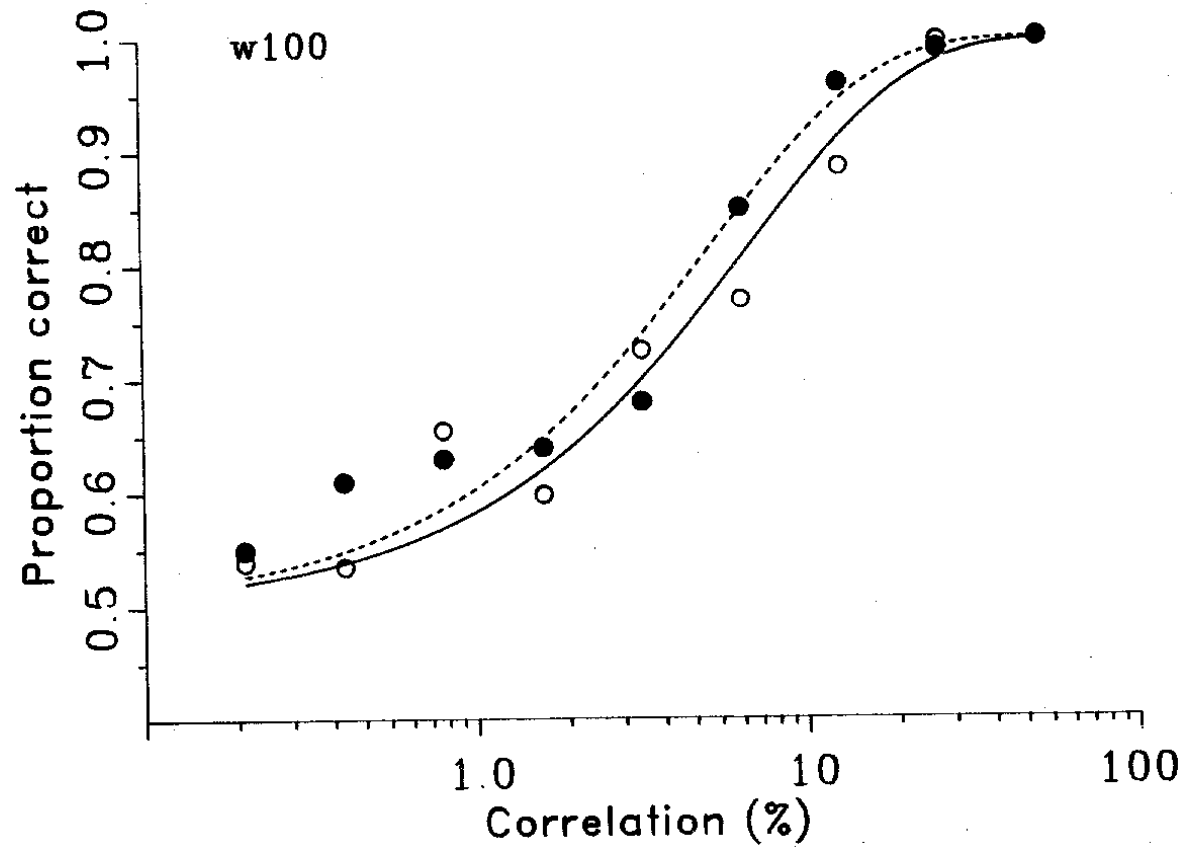
# Protocol for measuring motion sensitivity of an MT cell and of the whole macaque

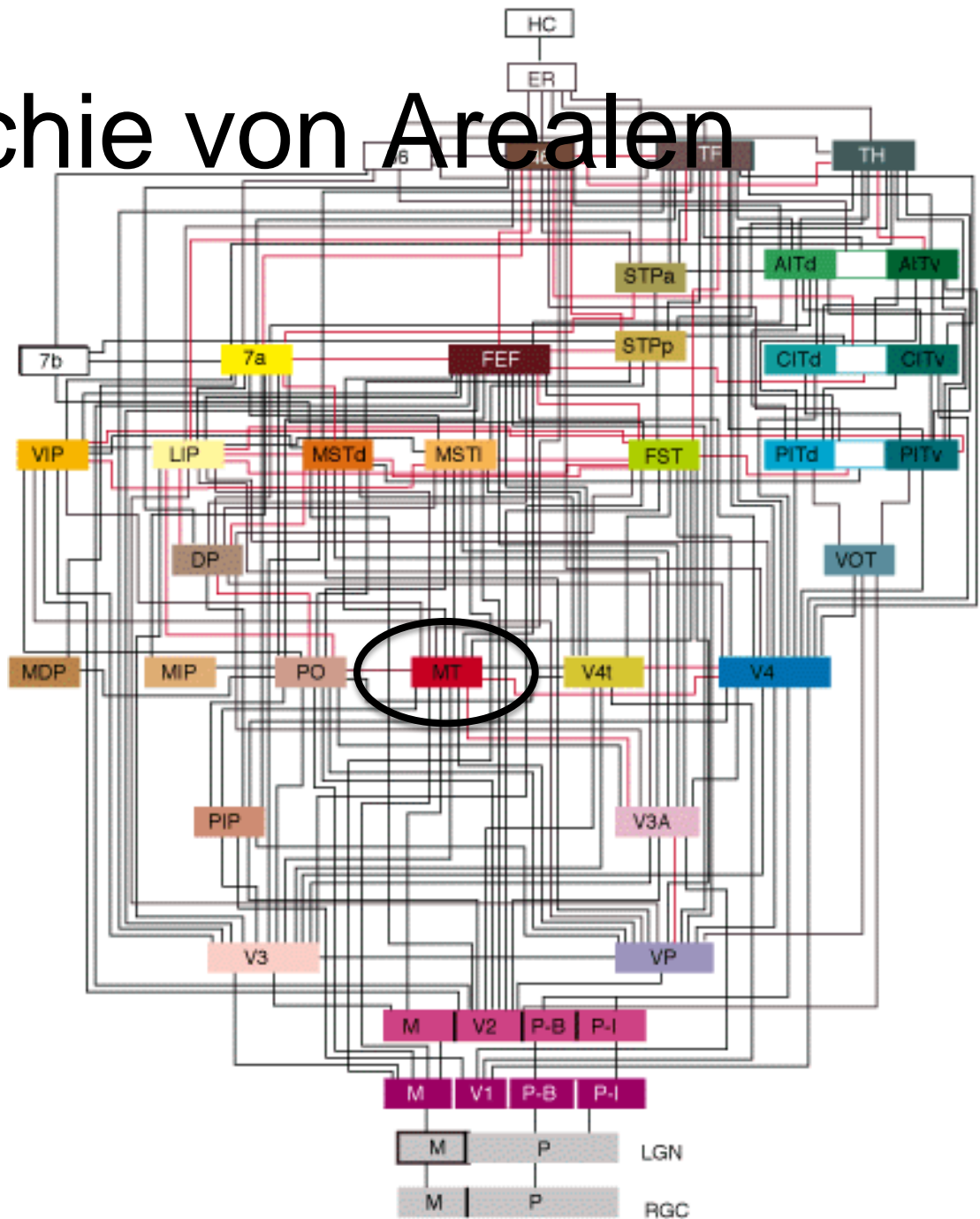


# Responses of an MT cell



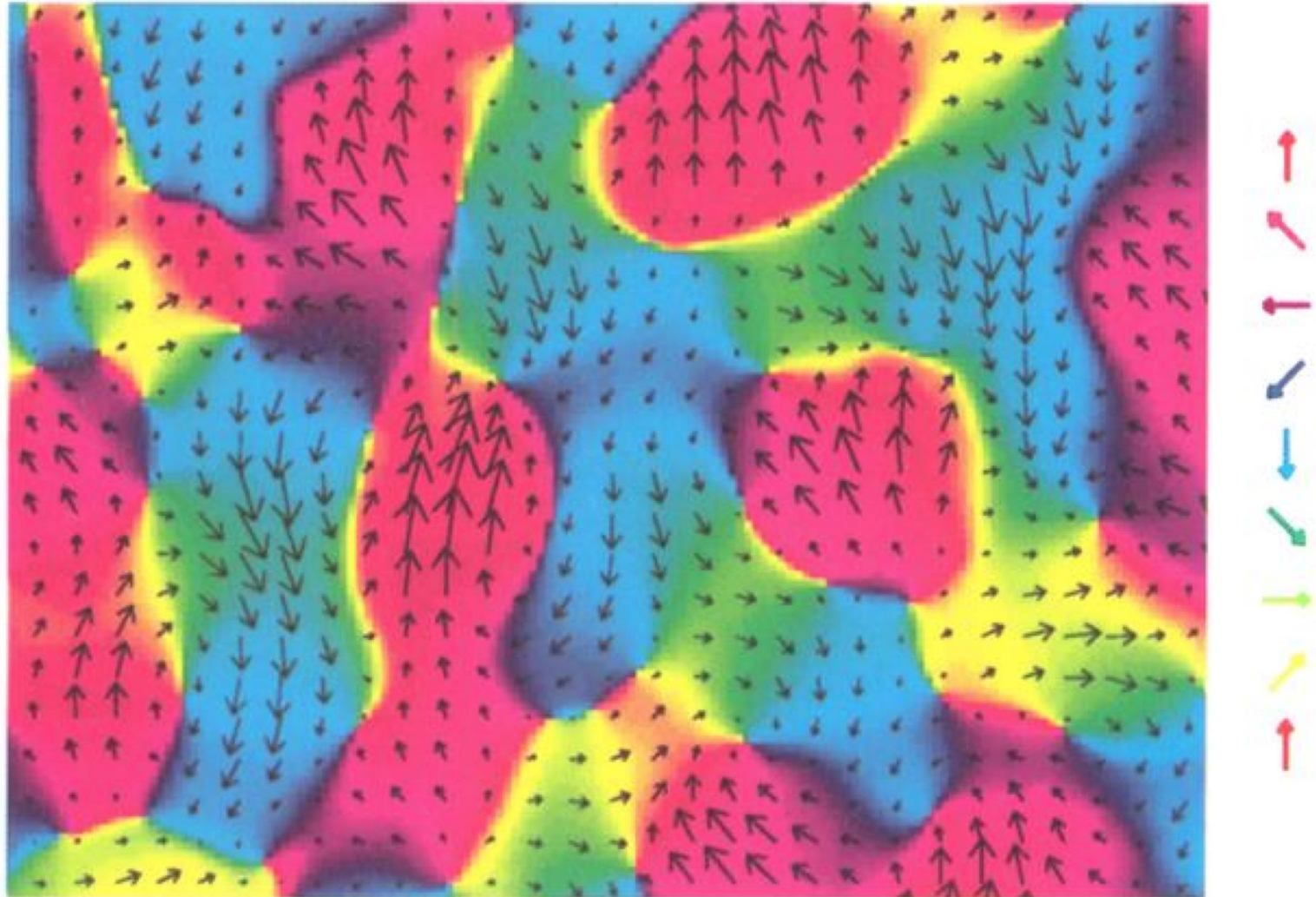
# Perceptual and neural sensitivity





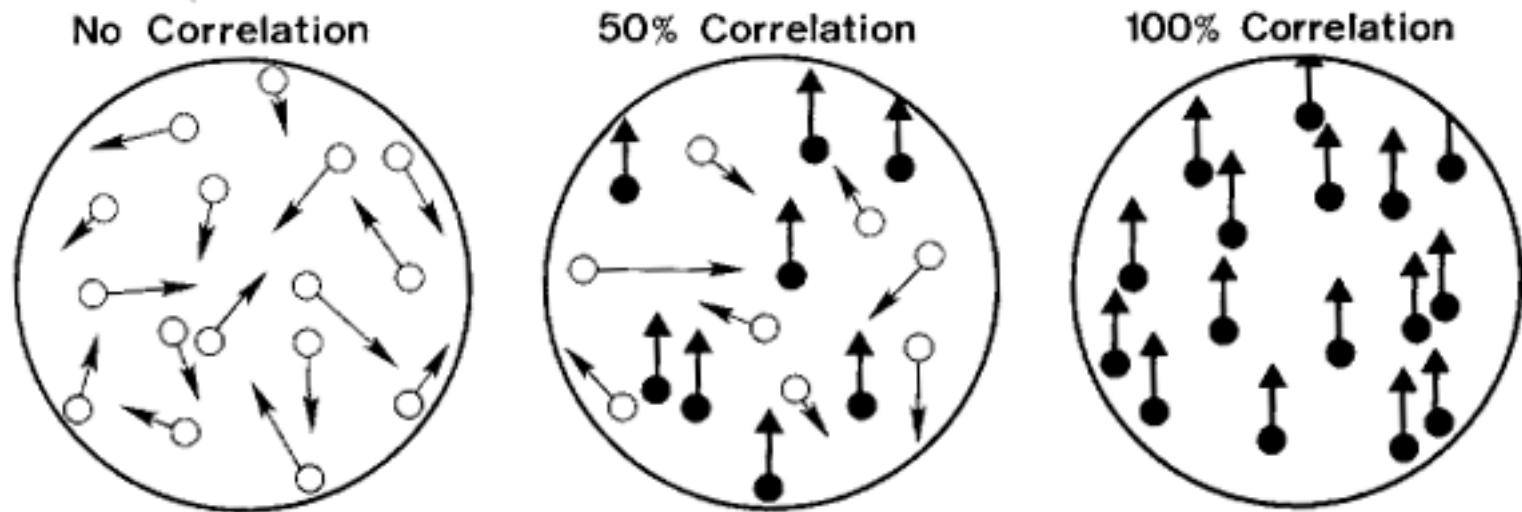


# Darstellung von Bewegung (Areal MT)



1 mm

# Stimulus for measuring motion sensitivity









# Wahrnehmung von Bewegung

nach unten

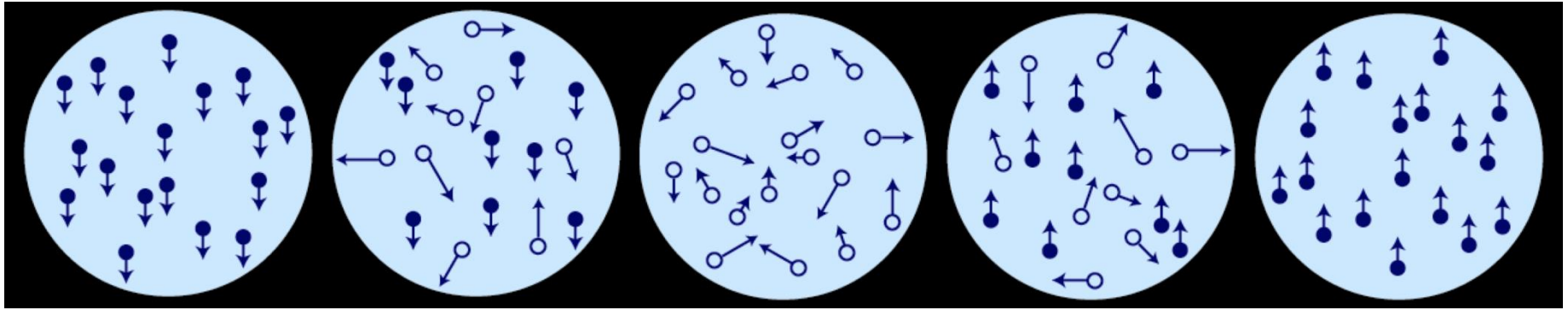
stark

schwach

nach oben

schwach

stark



# Wahrnehmung von Bewegung

nach unten

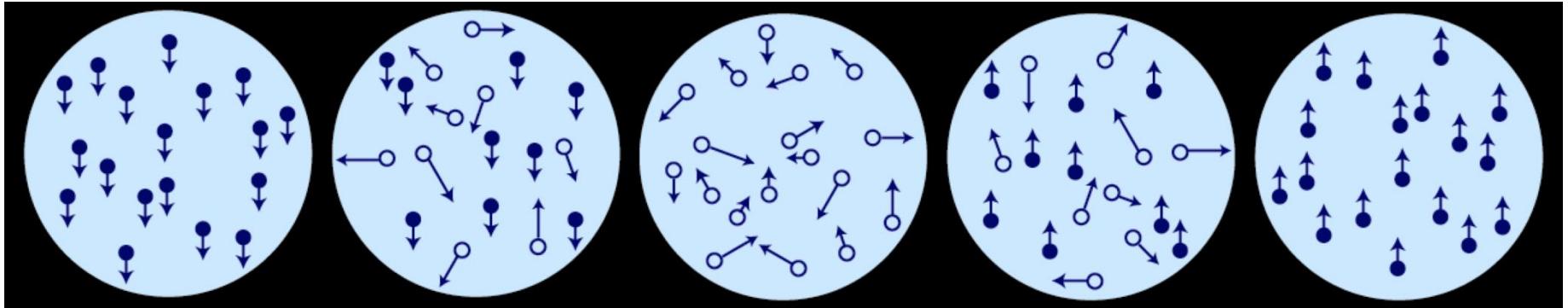
nach oben

stark

schwach

schwach

stark



100%↓

30%↑

70%↓

50%↑

50%↓

70%↑

30%↓

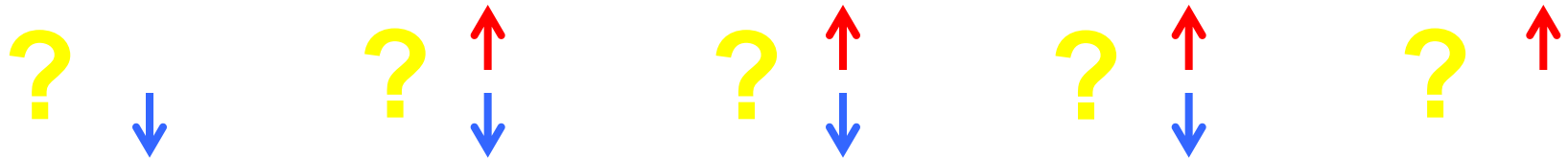
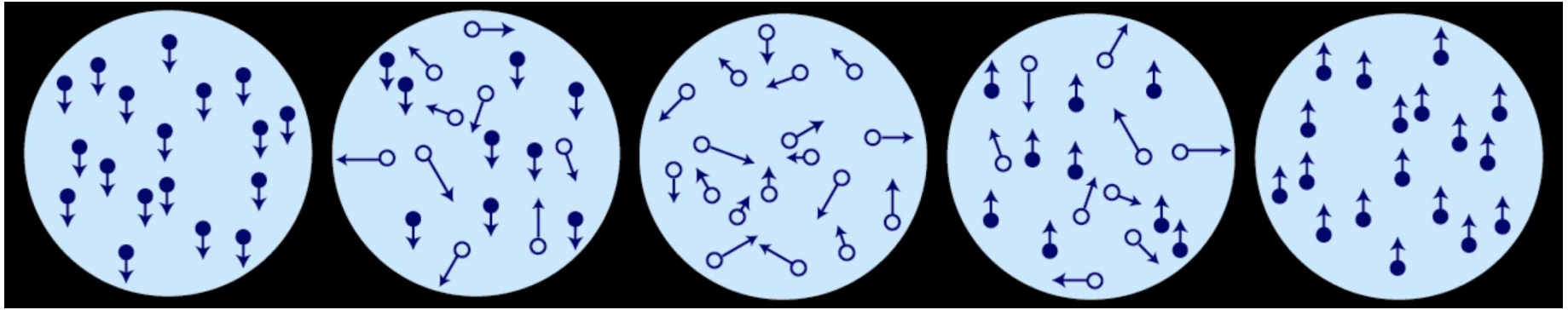
100%↑

Wahrnehmung

# Wahrnehmung von Bewegung

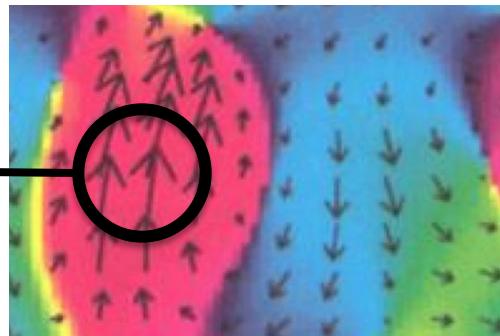
*nach unten*  
*stark*      *schwach*

*nach oben*  
*schwach*      *stark*



*Wahrnehmung*

*Künstliche  
Aktivierung*





# Wahrnehmung von Bewegung

nach unten

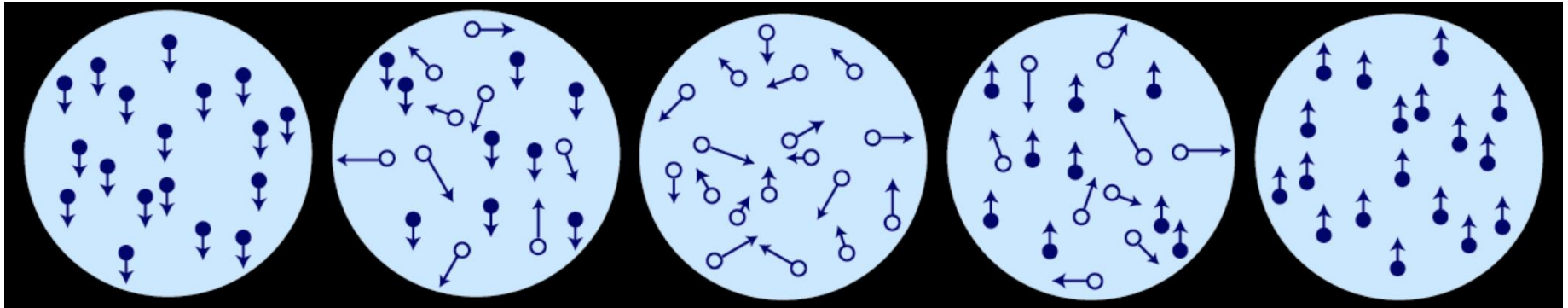
nach oben

stark

schwach

schwach

stark



30%↑

50%↑

70%↑

100%↑

100%↑

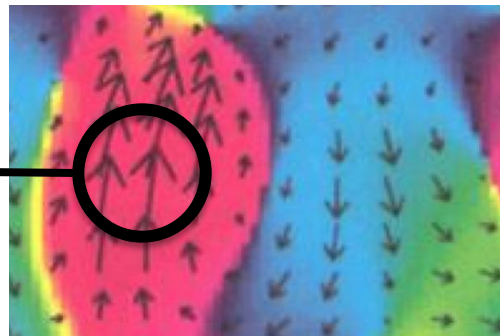
70%↓

50%↓

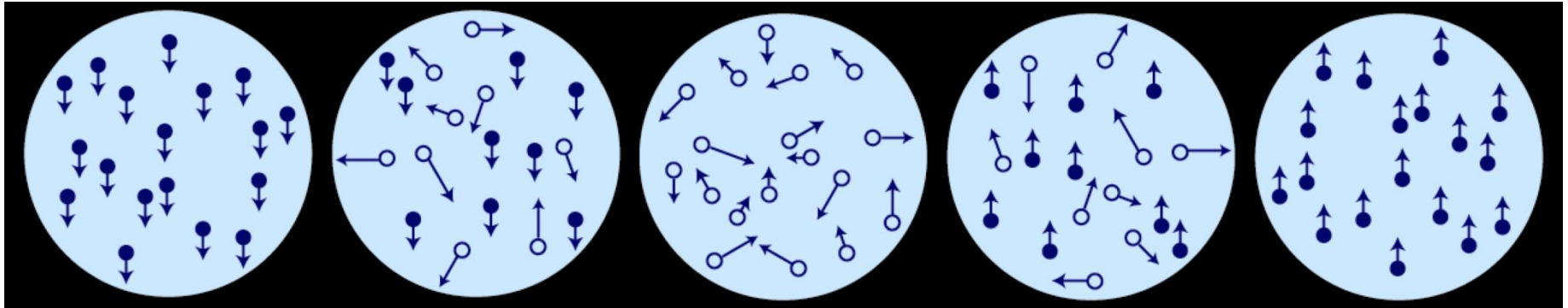
30%↓

Wahrnehmung

Künstliche  
Aktivierung



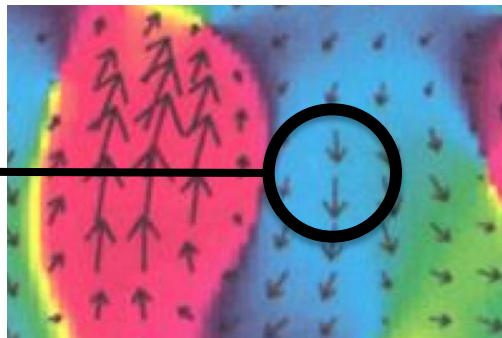
# Wahrnehmung <sup>^</sup> *nicht vorhandener* <sub>und</sub>



100%↓      100%↓      30%↑      50%↑      70%↑  
70%↓      50%↓      30%↓

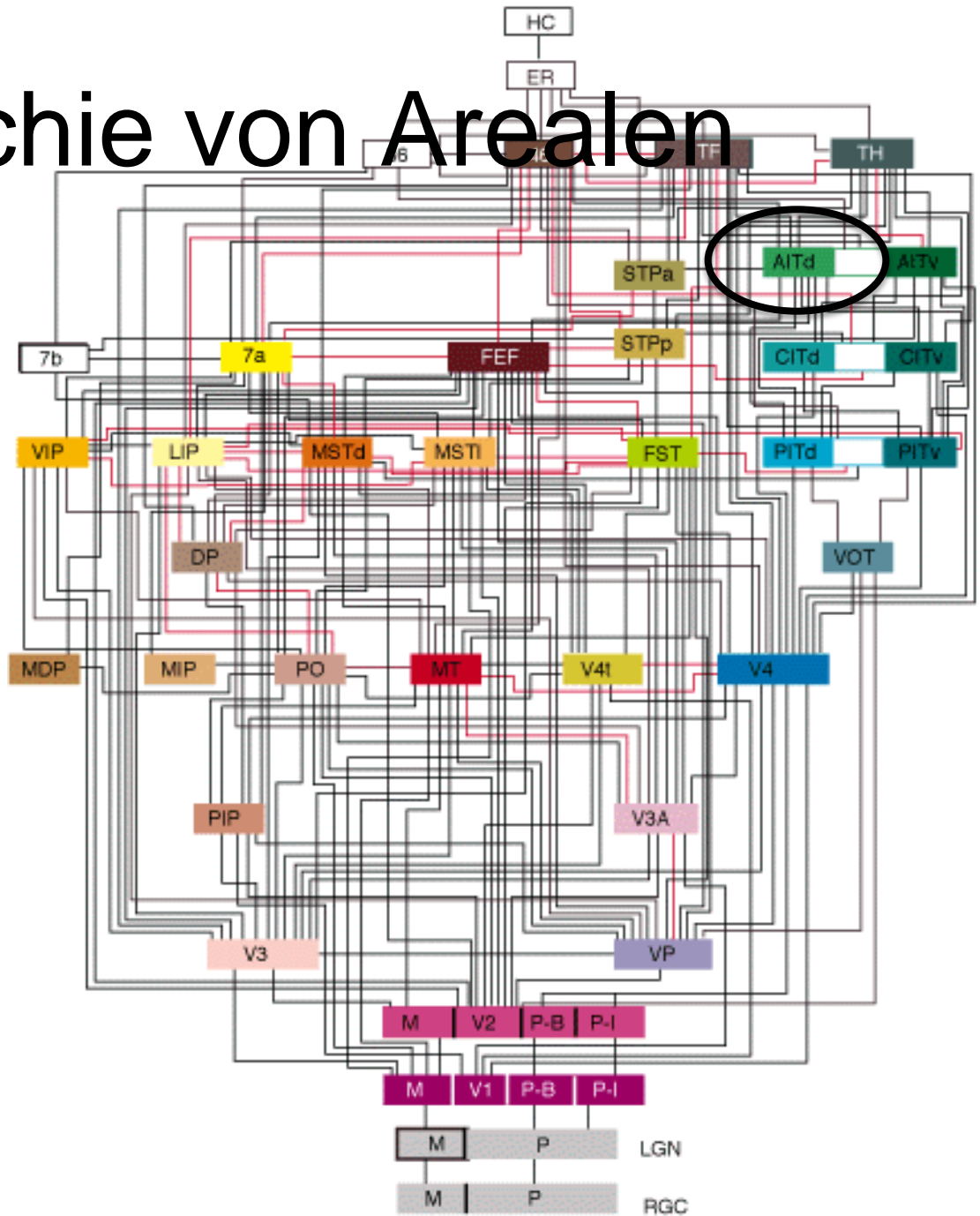
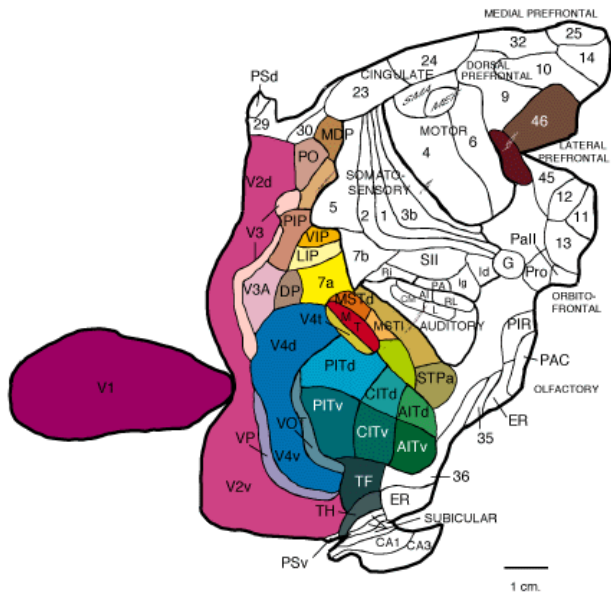
*Wahrnehmung*

*Künstliche  
Aktivierung*

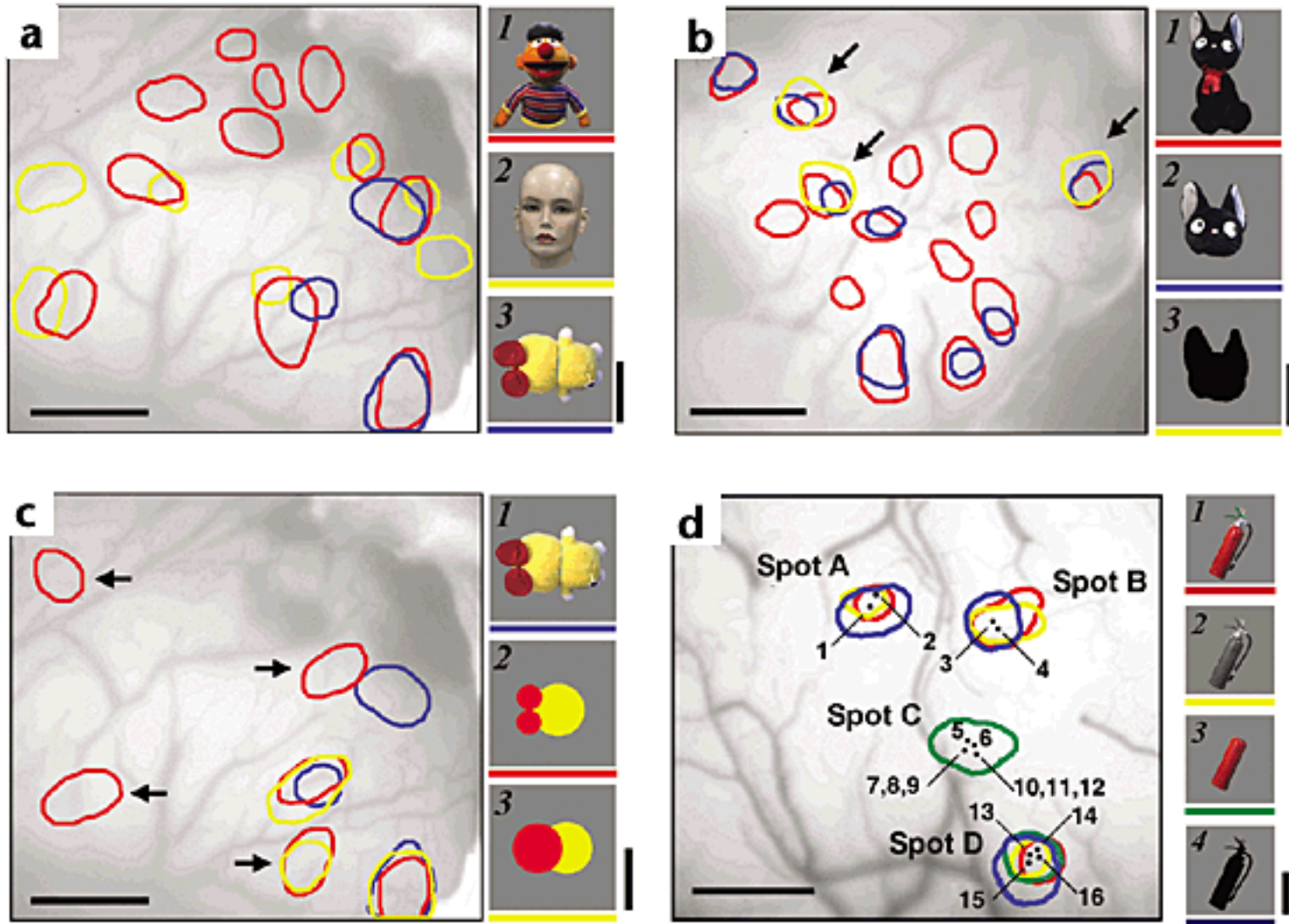


*~1'000 aktivierte  
Nervenzellen  
(von 1'400'000'000)*

# Eine Hierarchie von Arealen



# Darstellung von ganzen Objekten (Area IT)





# Nicht vorhandene

Objekt (O)

wahrgenommene Gesichter

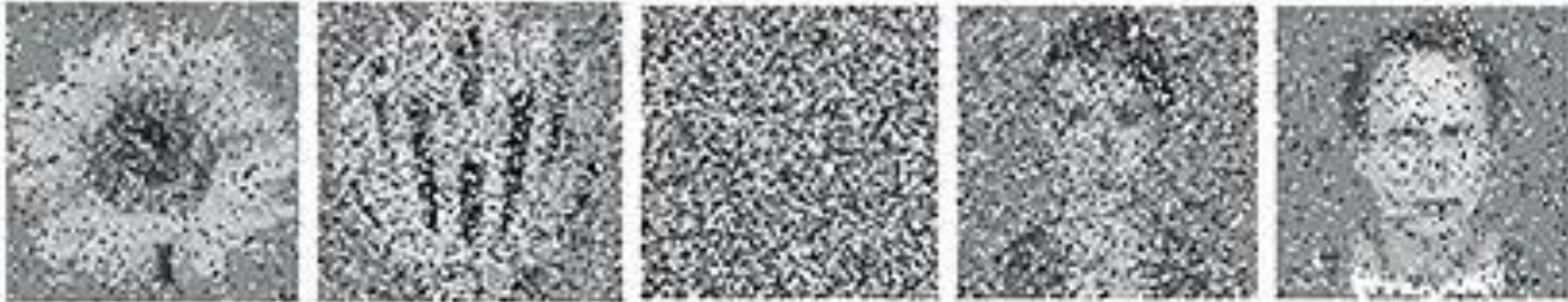
Gesicht (G)

*stark*

*schwach*

*schwach*

*stark*



30%G

50%G

70%G

100%G

100%O

70%O

50%O

30%O

*Wahrnehmung*

# Nicht vorhandene

Objekt (O)

wahrgenommene

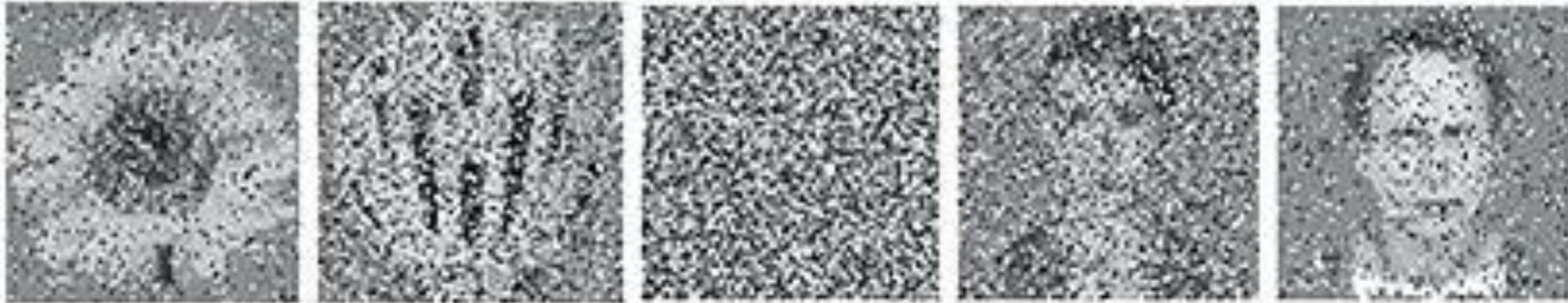
Gesicht (G)

stark

schwach

schwach

stark



30%G

50%G

70%G

100%G

100%G

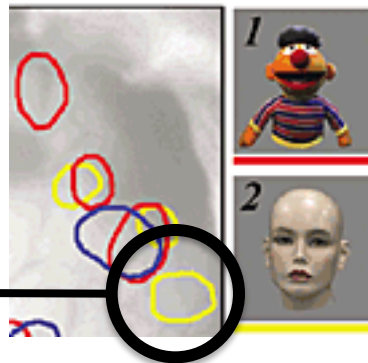
70%O

50%O

30%O

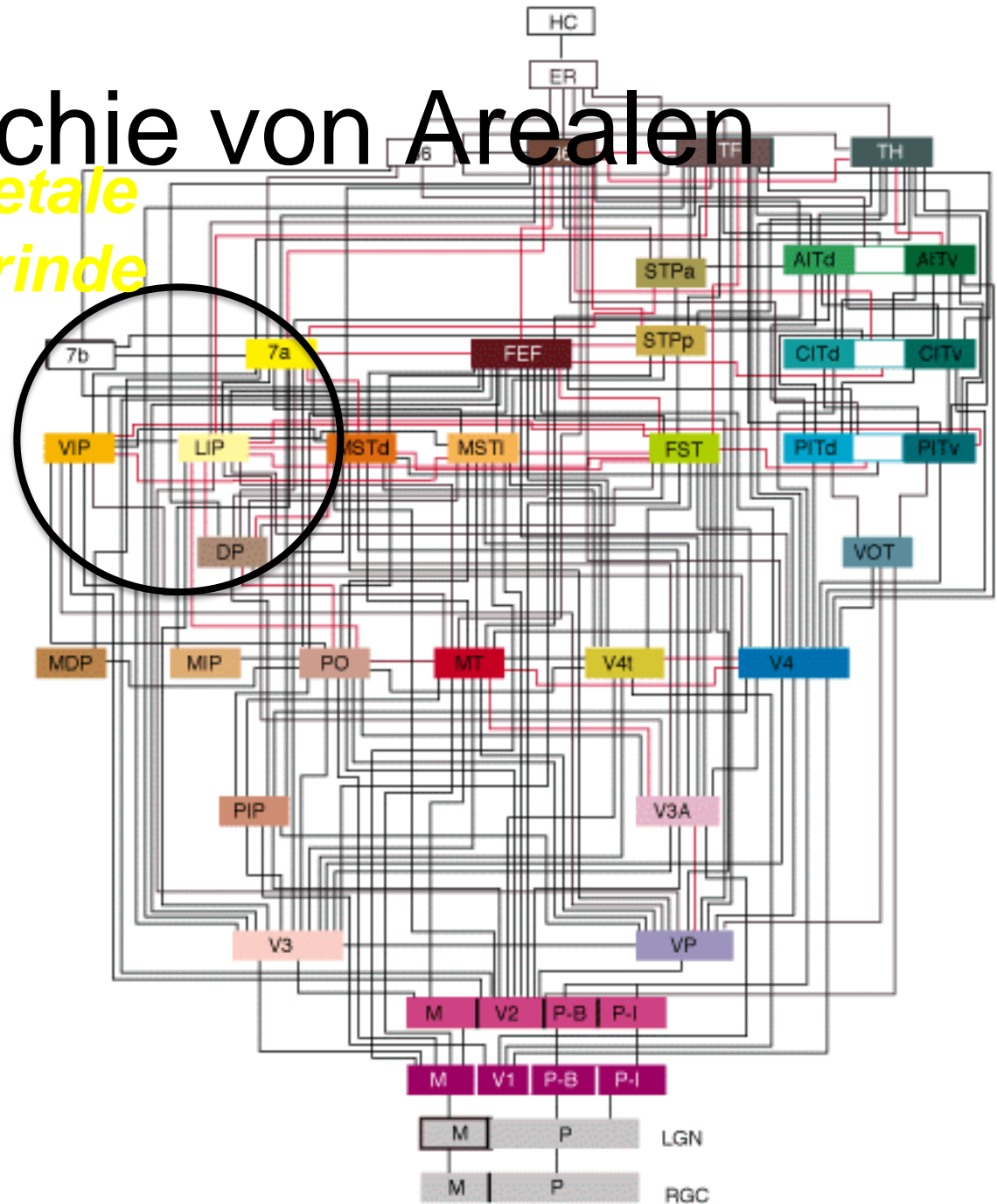
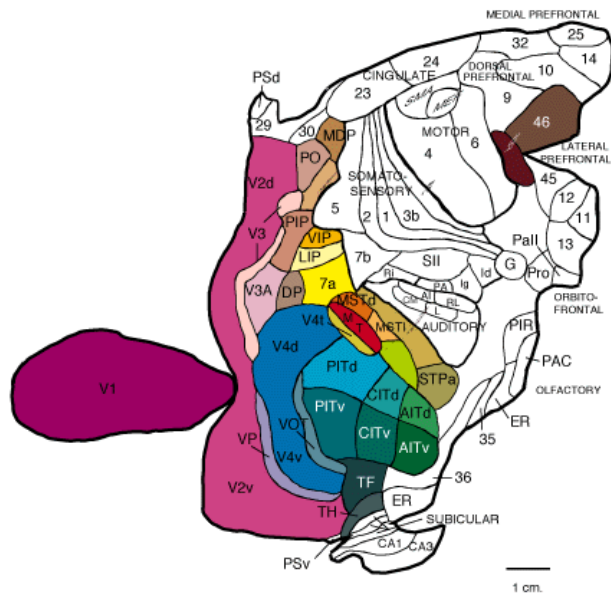
Wahrnehmung

Künstliche  
Aktivierung



# Eine Hierarchie von Arealen

## Parietale Hirnrinde



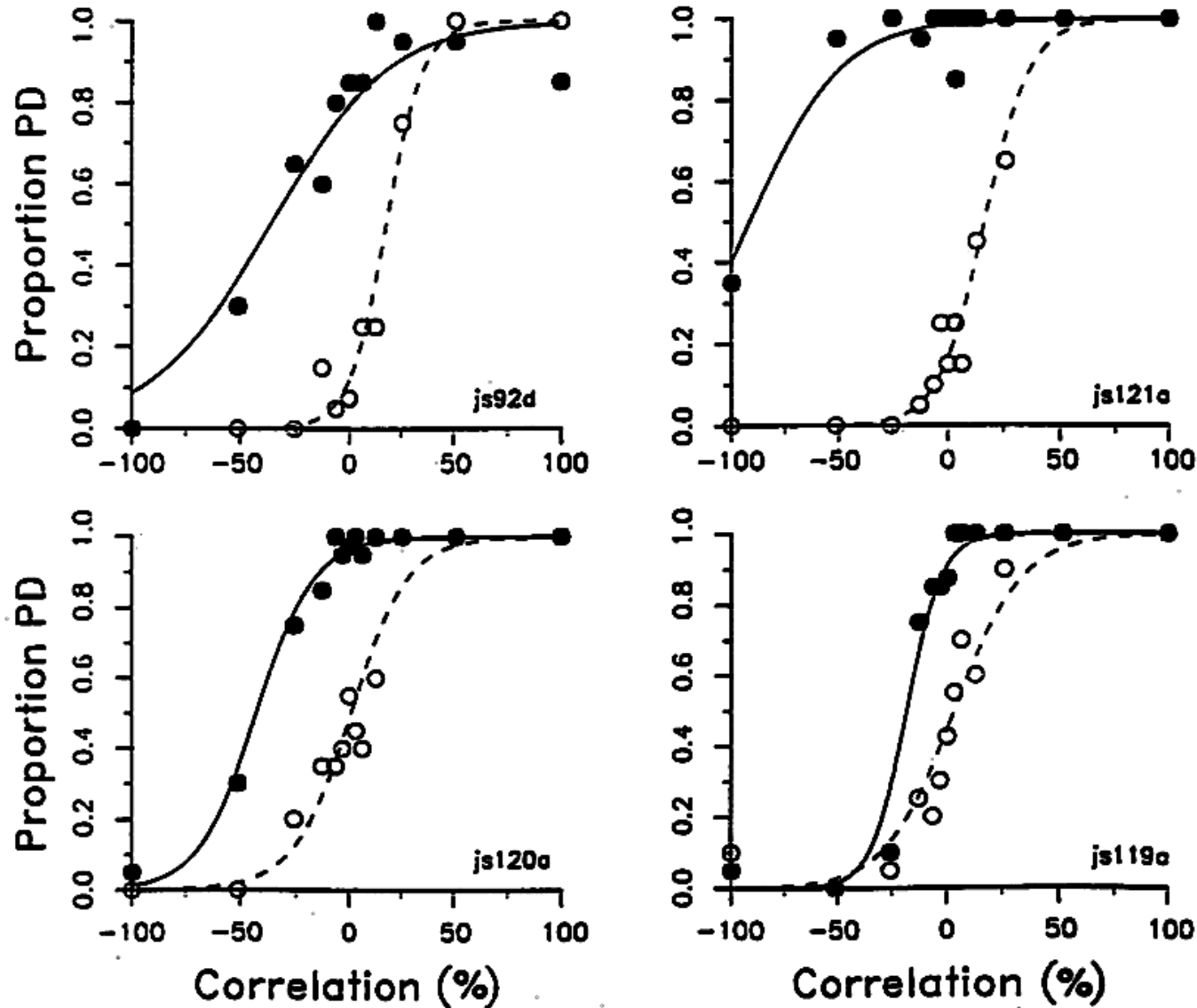


# Functional map of direction selectivity in area MT





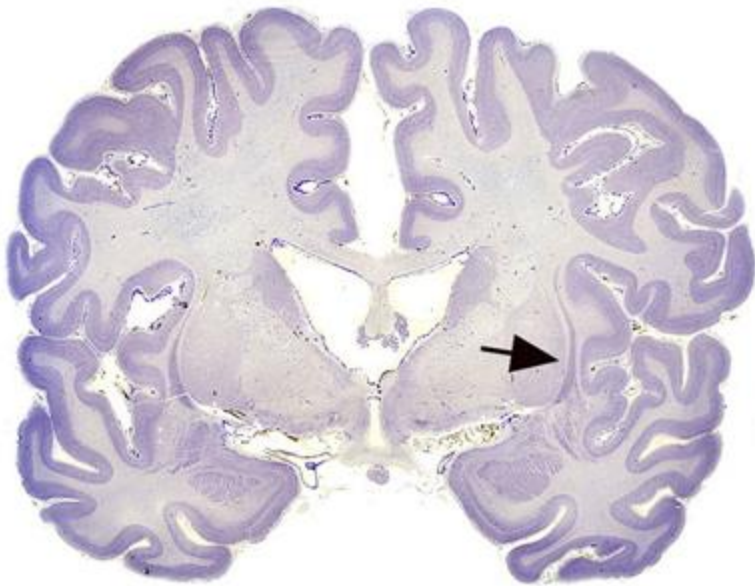
# Microstimulation in MT influences perception



# The Claustrum

A

Human



B

