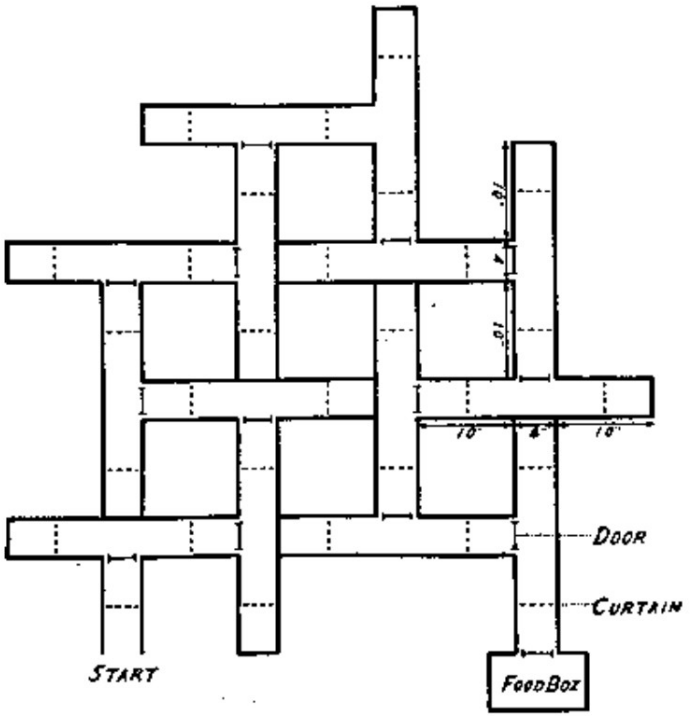
# Physiologizing cognition

December, 17 2014
Alexander Mathis

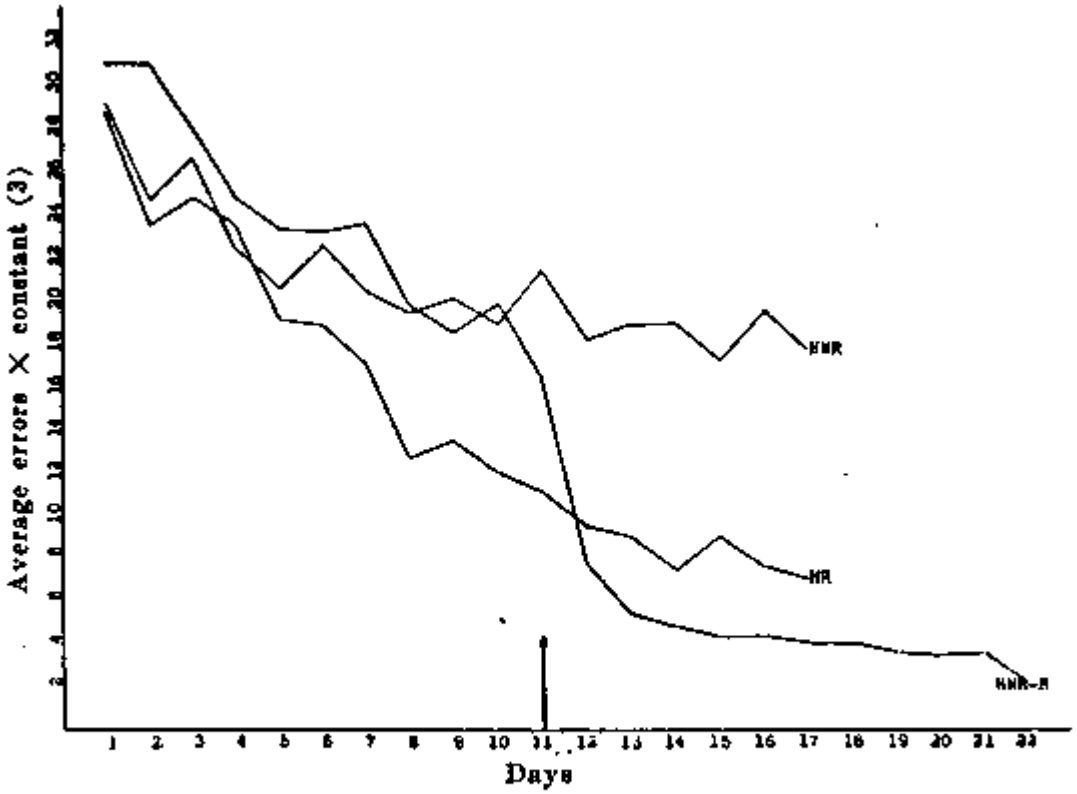
# Physiologizing cognition

Tolman writing to Hebb (1958):
"*I certainly was an anti-physiologist at that time and am glad to be considered as one then. Today, however, I believe that this (physiologizing) is where the great new break-throughs are coming..*"

# Latent learning




Plan of maze
14-Unit T-Alley Maze




Error curves for HR, HNR, and HNR–R

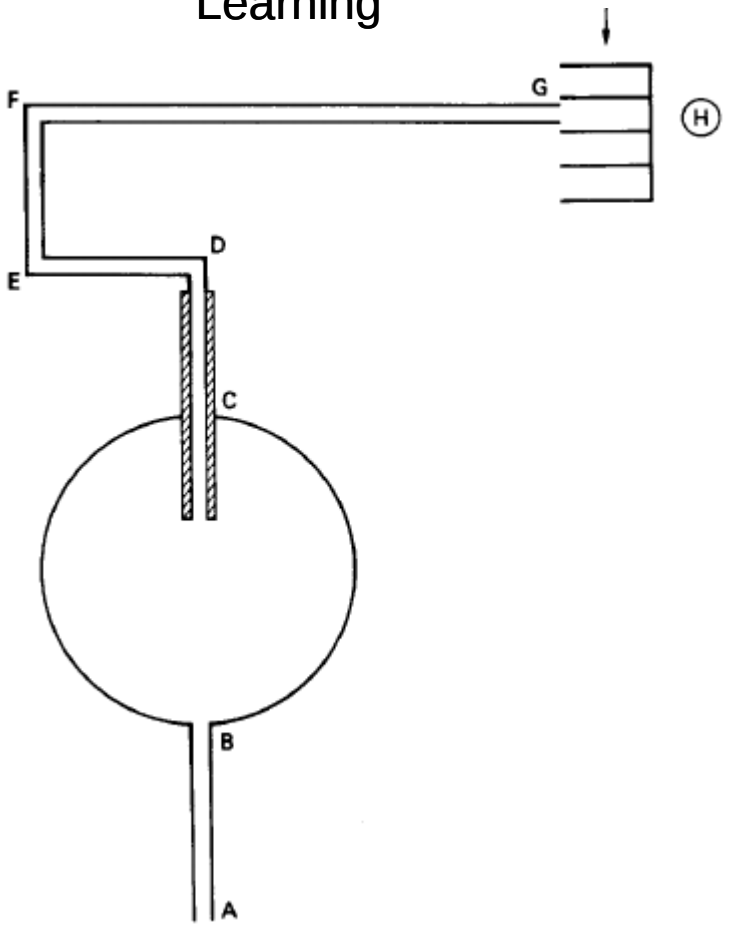
FIG. 6

(From E. C. Tolman and C. H. Honzik, Introduction and removal of reward, and maze performance in rats. *Univ. Calif. Publ. Psychol.*, 1930, 4, No. 19, p. 267.)

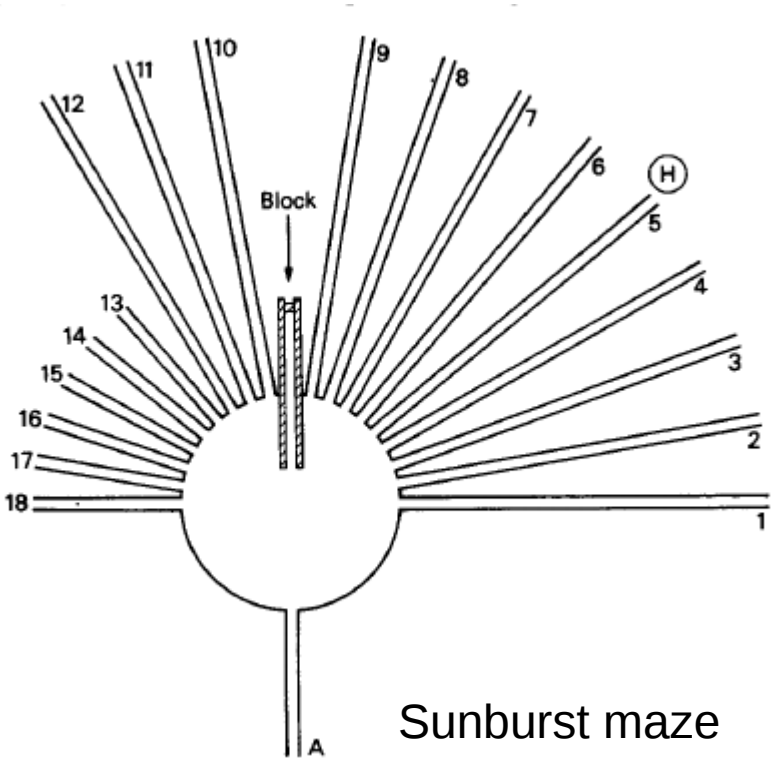
From: “Cognitive maps in rats and man”, Tolman 1948

# Cognitive maps

Learning




Blocking and testing




Sunburst maze

From: “Cognitive maps in rats and man”, Tolman 1948

## Short Communications

---

# The hippocampus as a spatial map. Preliminary evidence from unit activity in the freely-moving rat

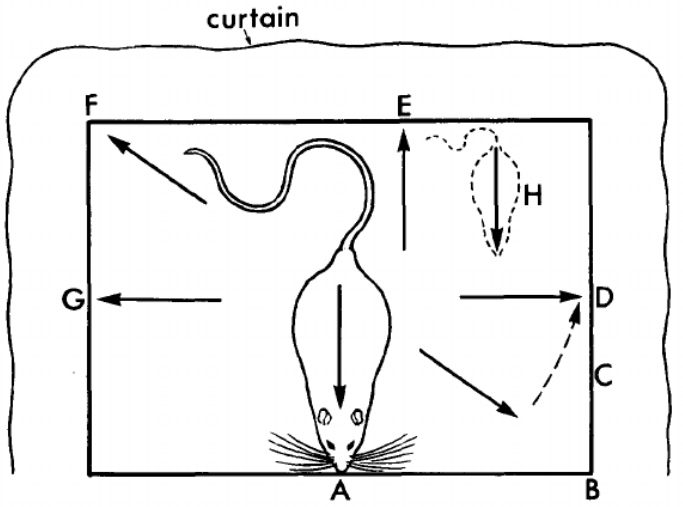
J. O'KEEFE
J. DOSTROVSKY*

Innovation:
- FET amplifier in microdrive
- study single units in freely moving animal
- correlating with a multitude of behaviors
  & sensory stimuli (sniffing, arousal, walking, etc.)

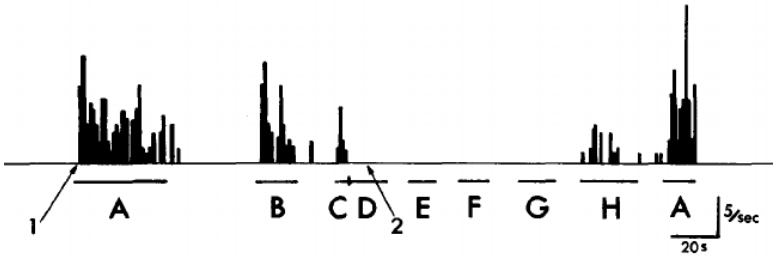
# Clustering response types

**Response types (76 units)**

- 14 'arousal'
- 21 'movement'
- 2 'expectations of animal'
- 31 no adequate stimulus/behavior (*despite "considerable, and sometimes drastic, attempts to fire them"*)
- **8 place & direction related (for 4 + stimulus)**




"We suspect, but have not proved, that these cells derive their orientation preferences from several **equipotential cues**, removal of any one of which is insufficient to disrupt the response."



# THE HIPPOCAMPUS AS A COGNITIVE MAP

JOHN O'KEEFE
AND
LYNN NADEL

Dedication:

TO

E. C. TOLMAN
Who first dreamed of cognitive maps in rats and men

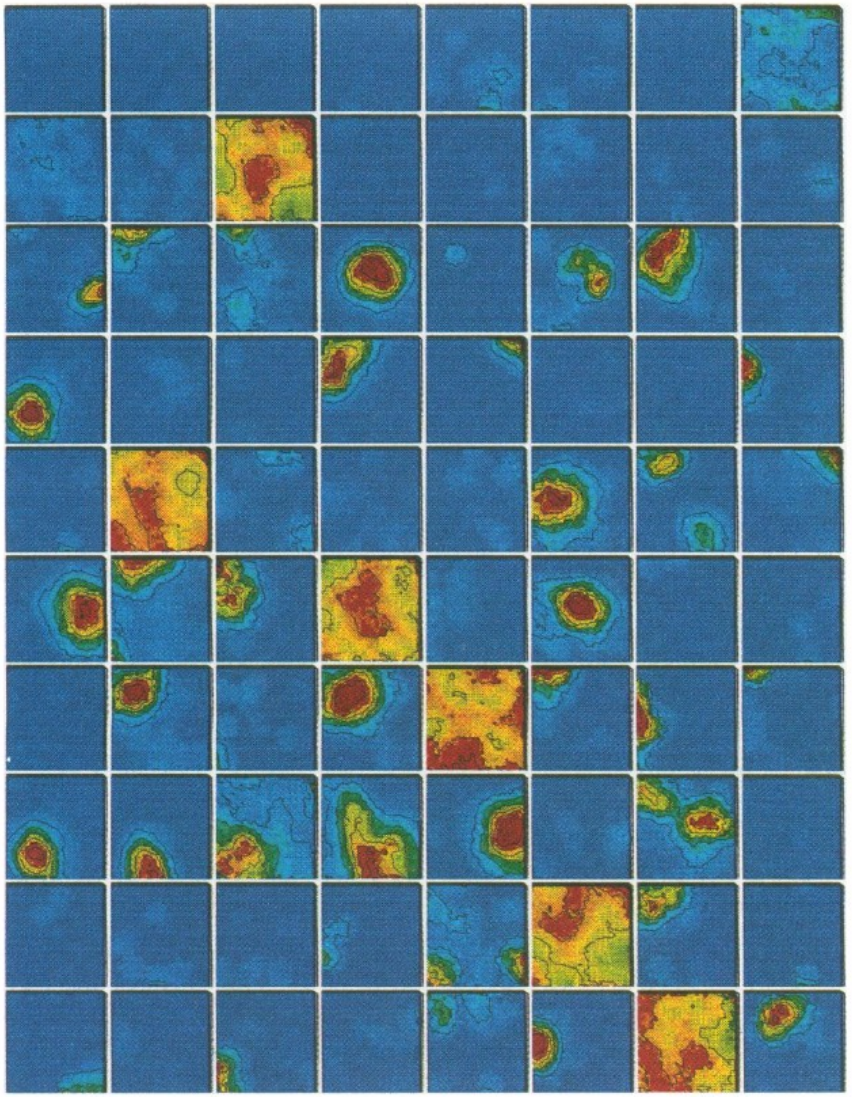
D. O. HEBB
Who taught us to look for those maps in the brain (Cell assemblies)

AND

A. BLACK
Who insisted that we pursue our route with rigour

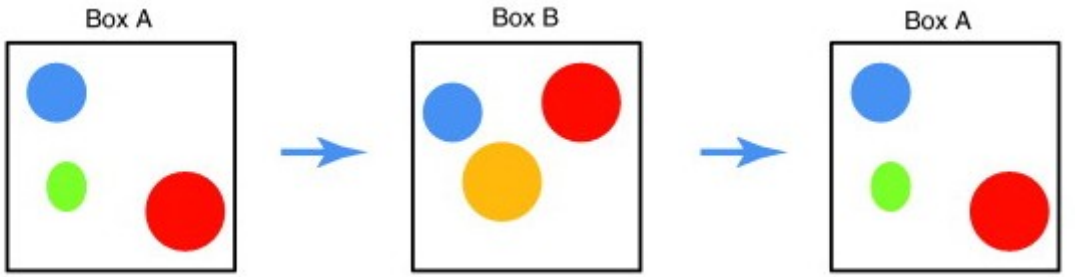
## Contents

# Place code



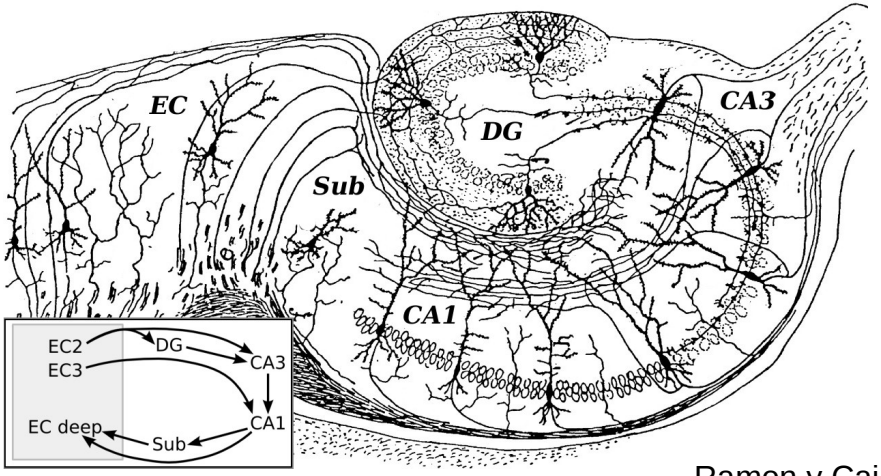
McNaughton & Wilson, 1993

## Global remapping




Derdikman & Moser, 2010

## Anatomy




Ramon y Cajal

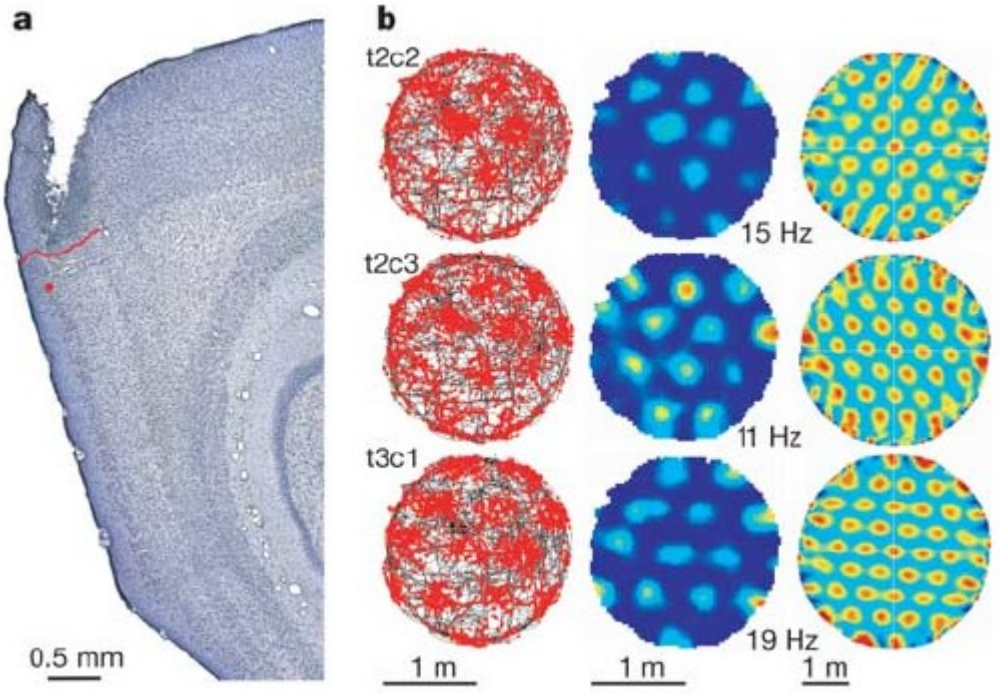
Vol 436|11 August 2005|doi:10.1038/nature03721 nature

ARTICLES

# Microstructure of a spatial map in the entorhinal cortex

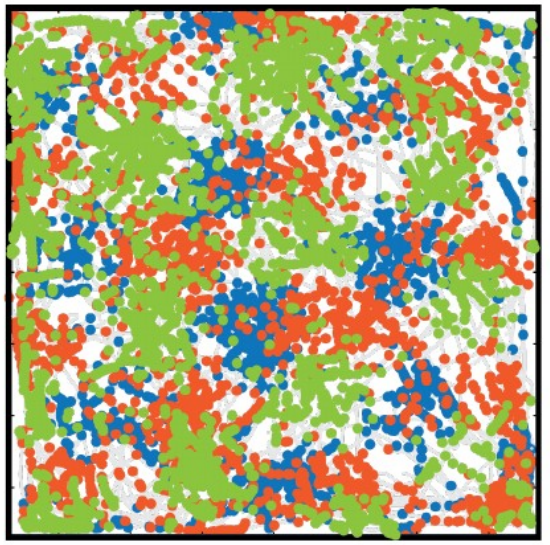
Torkel Hafting[1]*, Marianne Fyhn[1]*, Sturla Molden[1]†, May-Britt Moser[1] & Edvard I. Moser[1]

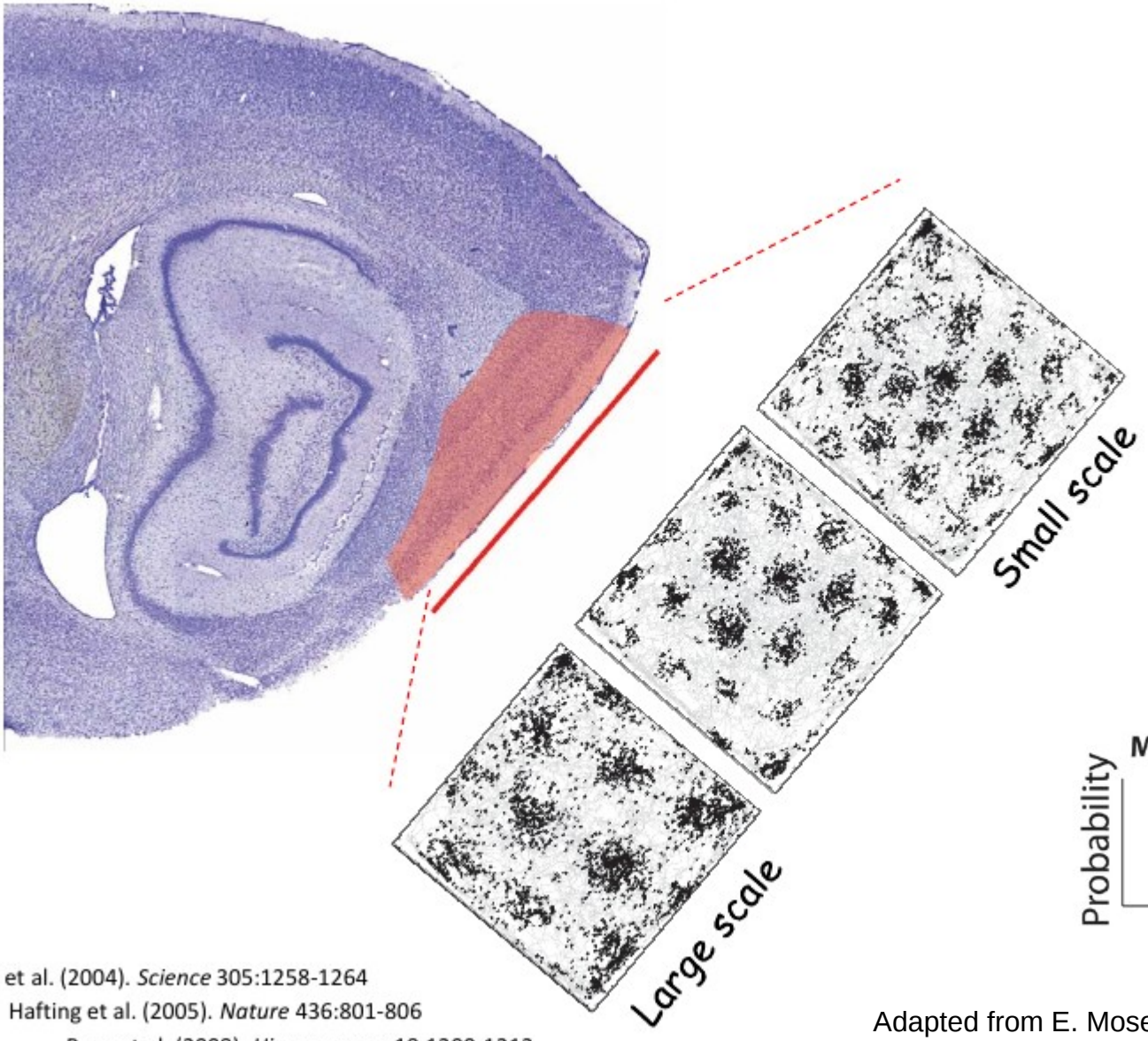
Innovation: 1. knew where to look (Brun et al. 2002)
2. larger arena!

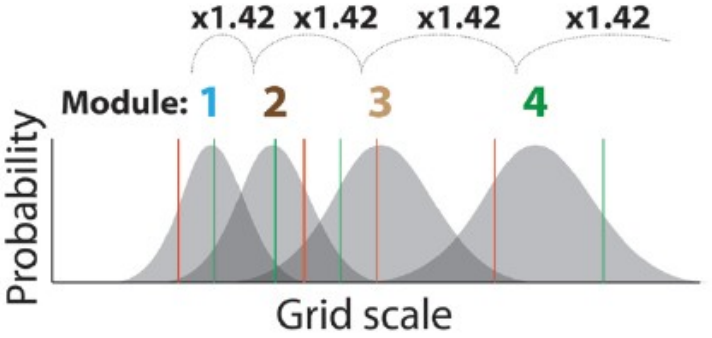


# Structure of grid code

A single module






Fyhn et al. (2004). *Science* 305:1258-1264
Hafting et al. (2005). *Nature* 436:801-806
Brun et al. (2008). *Hippocampus* 18:1200-1212

Adapted from E. Moser's Nobel Lecture
http://www.nobelprize.org/nobel_prizes/medicine/laureates/2014/edvard-moser-lecture-slides.pdf

# Current & future directions

- multiple rooms, large environments, additional tasks & model systems
- virtual environments (patching, imaging, disentangling senses)
- models & theory for grid and place cells