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



(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



From: "Cognitive maps in rats and man", Tolman 1948

BRAIN RESEARCH

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:

то

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

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Place code



McNaughton & Wilson, 1993

EC2

EC deep

Global remapping



Derdikman & Moser, 2010



Contraction of the

Ramon y Cajal

ARTICLES

Microstructure of a spatial map in the entorhinal cortex

Torkel Hafting¹*, Marianne Fyhn¹*, Sturla Molden¹†, May-Britt Moser¹ & Edvard I. Moser¹

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



A single module



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

Brun et al. (2008). Hippocampus 18:1200-1212

Current & future directions

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

