



**PETER PAZMANY  
CATHOLIC UNIVERSITY**



**SEMMELWEIS  
UNIVERSITY**



**Development of Complex Curricula for Molecular Bionics and Infobionics Programs within a consortial\* framework\*\***

Consortium leader

**PETER PAZMANY CATHOLIC UNIVERSITY**

Consortium members

**SEMMELWEIS UNIVERSITY, DIALOG CAMPUS PUBLISHER**

The Project has been realised with the support of the European Union and has been co-financed by the European Social Fund \*\*\*

\*\*Molekuláris bionika és Infobionika Szakok tananyagának komplex fejlesztése konzorciumi keretben

\*\*\*A projekt az Európai Unió támogatásával, az Európai Szociális Alap társfinanszírozásával valósul meg.



**Nemzeti Fejlesztési Ügynökség**

ÚMFT infovonal: 06 40 638 638

[nfu@nfu.gov.hu](mailto:nfu@nfu.gov.hu) • [www.nfu.hu](http://www.nfu.hu)

TÁMOP – 4.1.2-08/2/A/KMR-2009-0006





## Neurobiológia alapjai - Módszerek

# BASICS OF NEUROBIOLOGY - Methods

By Imre Kalló

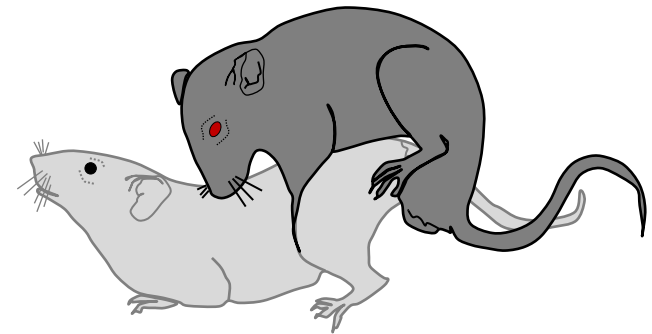
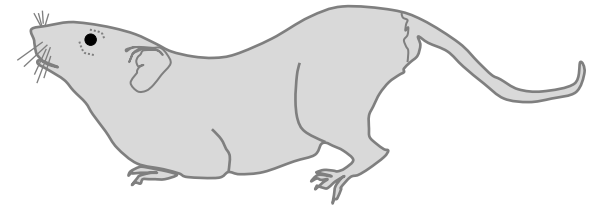
## METHODS IN NEUROBIOLOGY VIII.

### Behavioral studies

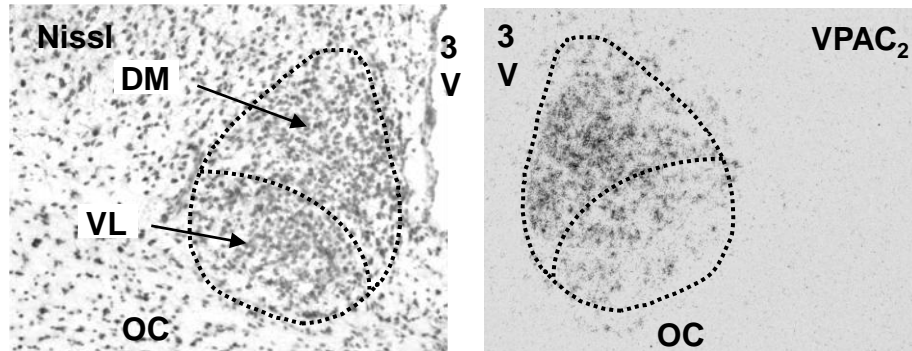
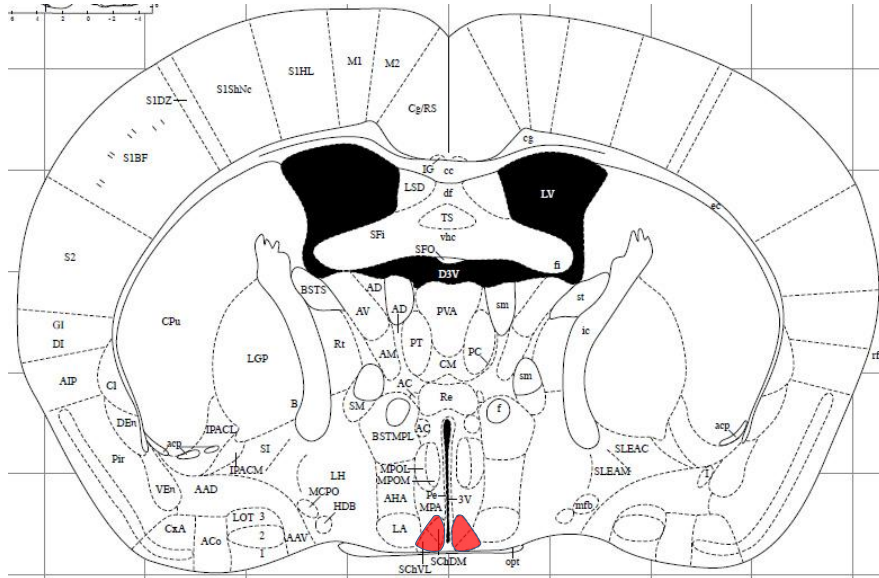
**Imre Kalló**

*Pázmány Péter Catholic University, Faculty of Information Technology*

- I. Histology techniques: light microscopic studies
- II. Applications using fluorescent dyes
- III. Histology techniques: electron microscopic studies
- IV. Techniques to map neuronal connections
- V. Molecular biological techniques
- VI. Living experimental models
- VII. Electrophysiological approaches
- VIII. Behavioral studies**
- IX. Dissection, virtual dissection, imaging techniques



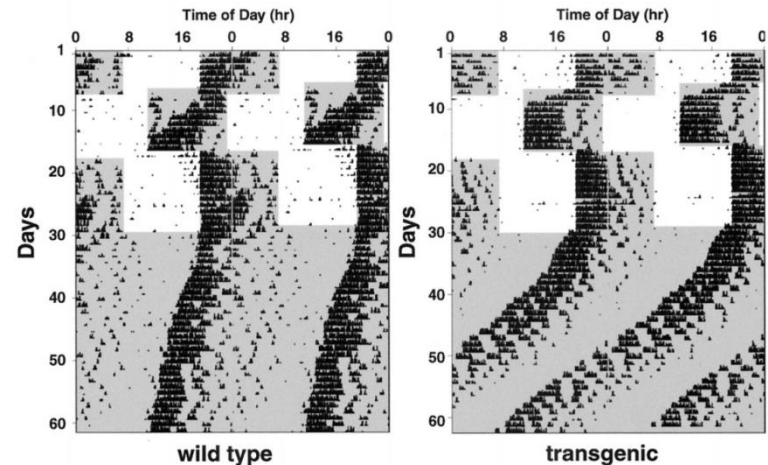
## SupraChiasmatic Nucleus (SCN)



## CIRCADIAN BEHAVIOUR

### Activity is monitored in running wheel

Overexpression of VPAC<sub>2</sub> in the mouse SCN generates a change in the circadian rhythm of the animal – free-running period is decreased!



Shen et al. Overexpression of the human VPAC2 receptor in the suprachiasmatic nucleus alters the circadian phenotype of mice. *Proc Natl Acad Sci U S A.* 2000 Oct 10;97(21):11575-80.

## MEASURING PHYSIOLOGICAL PARAMETERS EATING AND DRINKING BEHAVIOUR

### OBESITY



### ANOREXIA NERVOSA



### DIABETES INSIPIDUS

Patients are drinking a lot, and urinating a lot (~ 10 litres or more)! Cause: absence of the effect of Anti Diuretic Hormone (ADH) in the kidney.

Animal model is the Brattleboro rat. Mutation in the gene encoding vasopressin (ADH).



Animal models are developed to study pathological weight gain and weight loss.

#### Can be measured:

circadian time and frequency of eating, calorie intake, running wheel activity, basal metabolic rate etc.

Can not be measured: evaluation of self-image

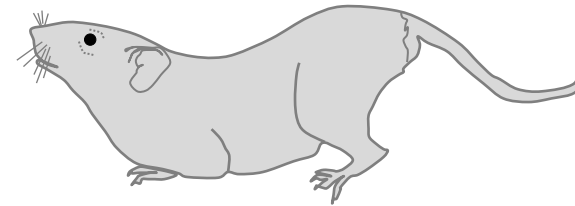
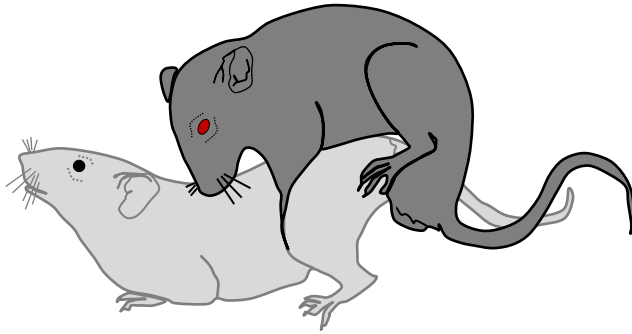
#### Can be measured:

circadian time and frequency of drinking, drinking volume and amount of urine

## REPRODUCTIVE BEHAVIOUR

### MALE SEXUAL BEHAVIOUR: MOUNTING

### FEMALE SEXUAL BEHAVIOUR: LORDOSIS



Determined by the testosterone surge at early postnatal period!



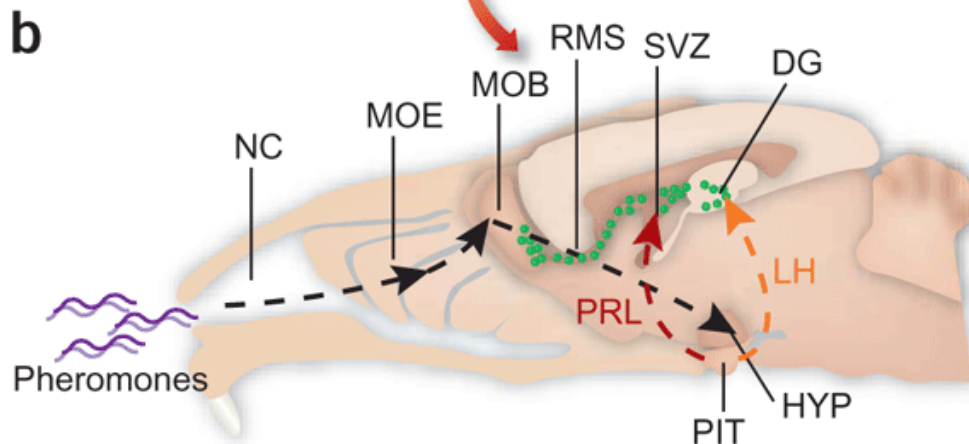
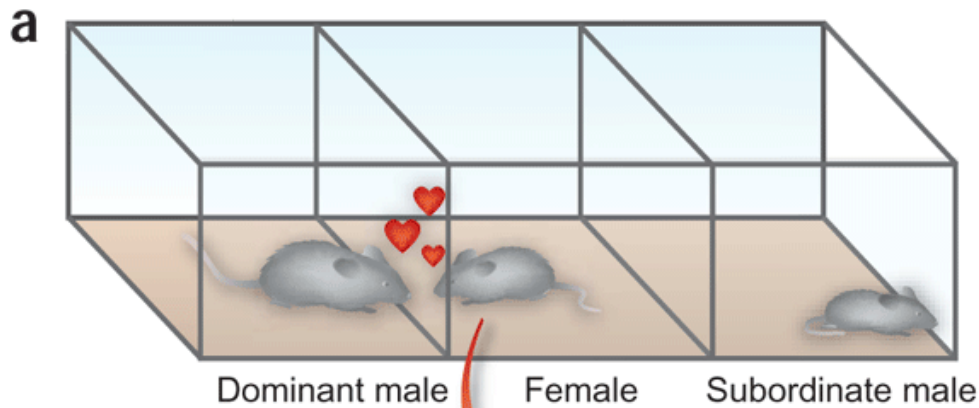
Absence of testosterone surge at early postnatal period!

If there is no testosterone effect in the brain at the critical period, sexual behaviour will be feminised – male pups will show lordosis behaviour. Caused by:

- gonadectomy
- lack of androgen receptor mediated effects (ARKO, Tfm)

If testosterone injected into the animal in the critical period (postnatal 3-5 days), sexual behaviour will be masculinised – female pups will show mounting behaviour.

## SOCIAL INTERACTION: SOCIAL INTERACTION, DOMINANT and SUBORDINATE animals

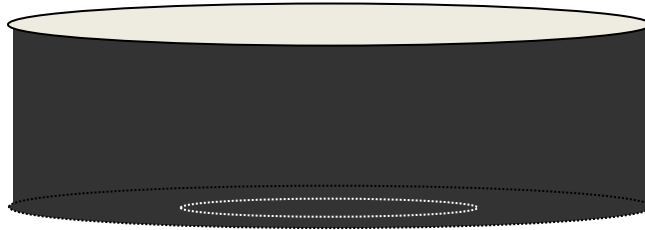


Pheromons of dominant males induces social preference and increased neurogenesis in the subventricular zone (SVZ) and dentate gyrus (DG) of female mice.

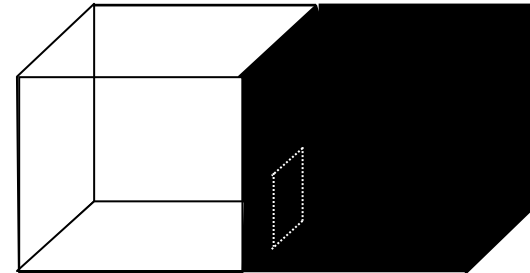
Derek P DiRocco & Zhengui Xia: *Nature Neuroscience* **10**, 938 - 940 (2007)

## BEHAVIORAL TESTS OF FEAR AND ANXIETY

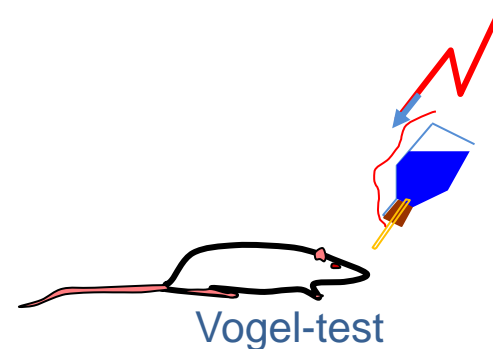
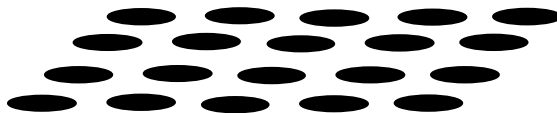
open field



light/dark box

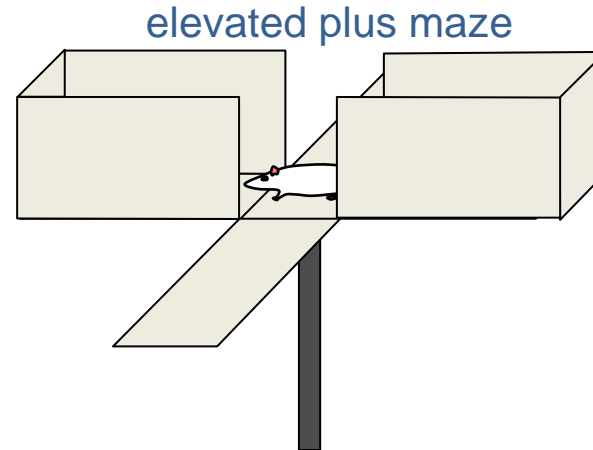


hole board

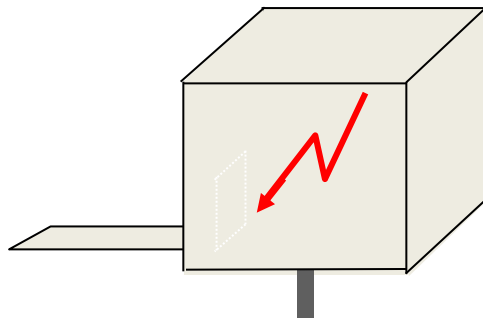




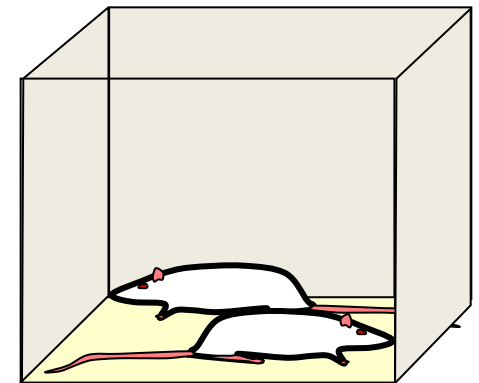
## BEHAVIORAL TESTS OF FEAR AND ANXIETY



passive avoidance

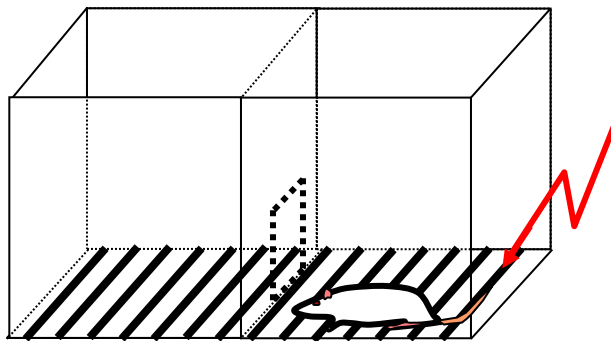


other, eg. shock-prod

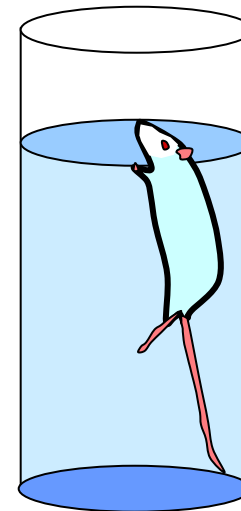


social interaction

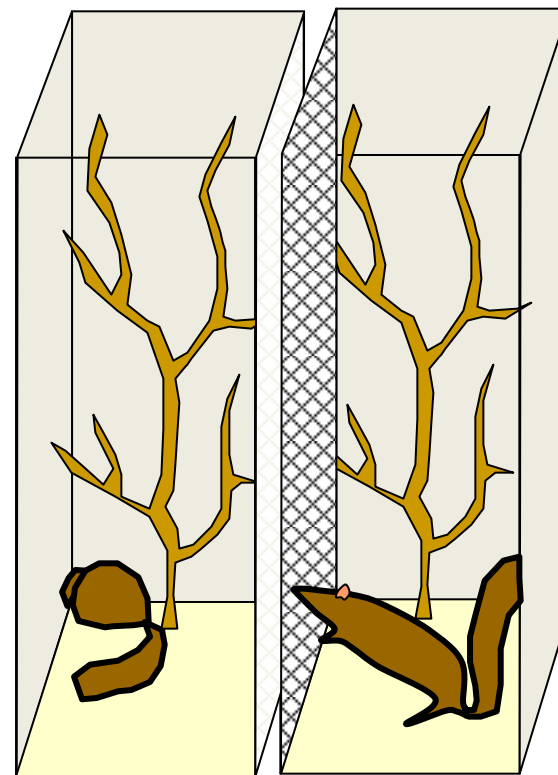
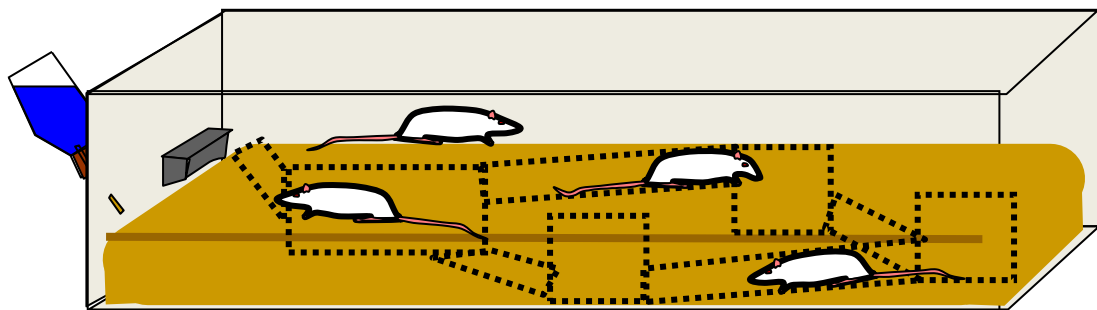
## BEHAVIORAL TESTS OF DEPRESSION



**Chronic mild stress**  
**Bulbectomy**  
**Flinder's sensitive line**  
**Sleep deprivation**



## BEHAVIORAL TESTS OF DEPRESSION

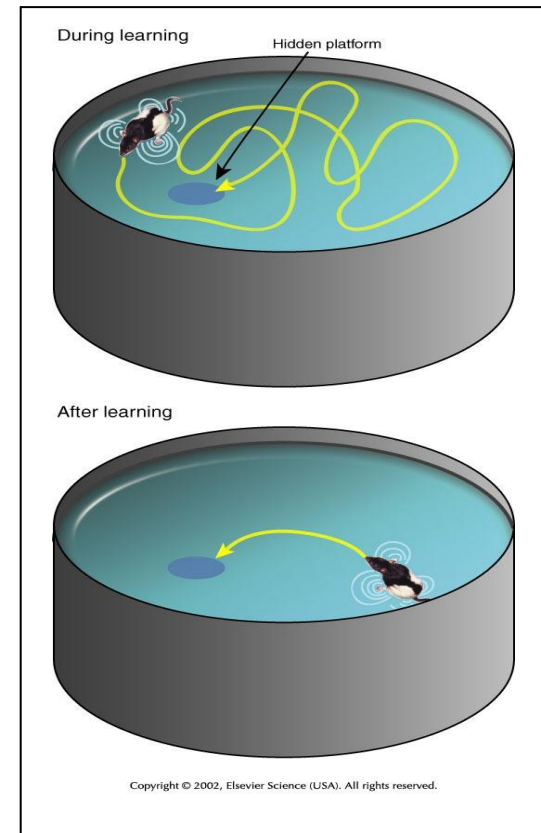


## COGNITIVE TASKS – SPATIAL MEMORY

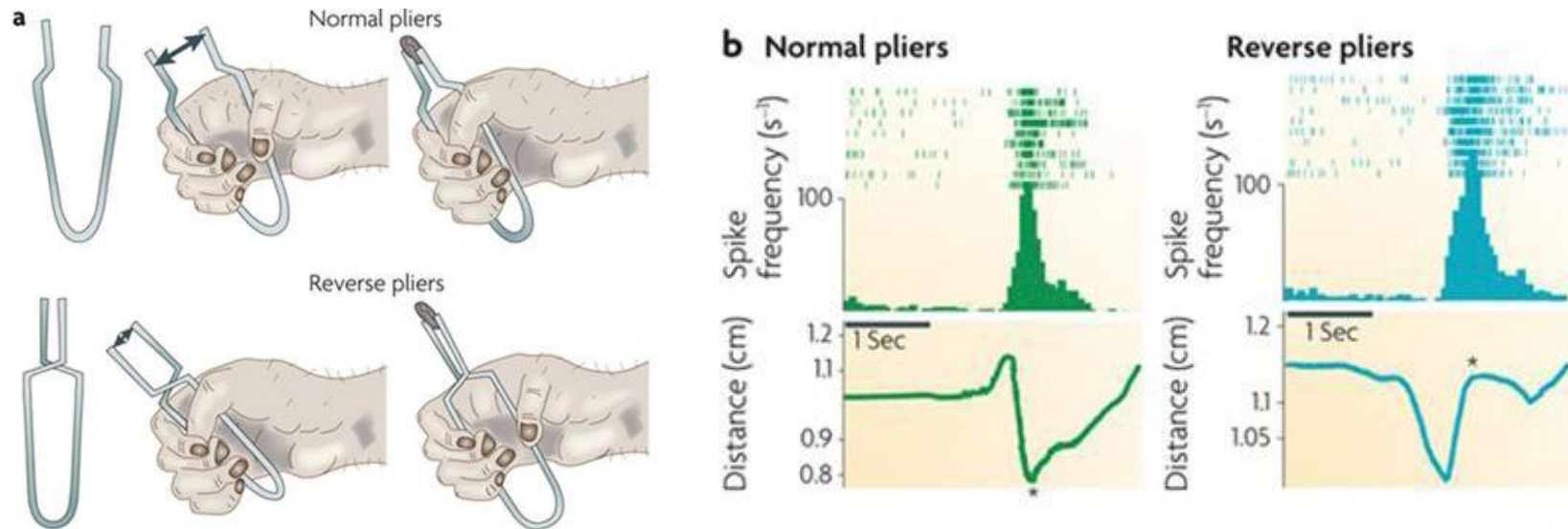
### **Morris watermaze** *Testing spatial memory*

The tank is about 2m wide with non-transparent water in it, within the swimming rat has to find a sub water level platform by using the laboratory furniture and other objects visible from the tank as orientation landmarks.

After random swimming, the rat learned about the position of the platform, and swims to it immediately from any point of the tank.



## CORRELATED ELECTROPHYSIOLOGY AND BEHAVIORAL TESTS PREMOTOR NEURONS ENCODE THE GOAL OF MOVEMENT



Nature Reviews Neuroscience **11**, 264-274 (April 2010)

## CORRELATED ELECTROPHYSIOLOGY AND BEHAVIORAL TESTS PREDICTION OF FUTURE

Future - planning

How predicts the future the brain?

„Turning to the left ” neuron in the hippocampus

A cell marks the direction of next turn with a change of its firing activity already at the running wheel.

When the cell makes a mistake, the animal does the same.



The position of the animal is shown by the led.

*Pastalkova és mtsai 2008 Science*