

Spatial Memory in mouse model



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Roseline.poirier@universite-paris-saclay.fr

Institut de Neurosciences Paris
Saclay UMR CNRS 9197

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**To show different methodological approaches used
in the field of Neurosciences**

✓ **Behavioural approaches**



SPATIAL MEMORY

- Ability to encode, store and retrieve spatial information

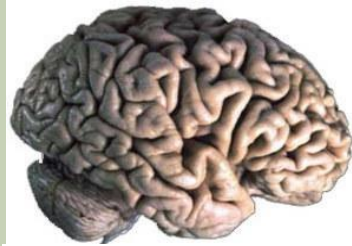


- In animals, crucial for survival

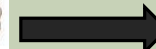
4

Memory is the process that allows us:

Encode
information



Keep it
intact



Return it,
on
request

Learning & memory task :

Training
Session



Restitution

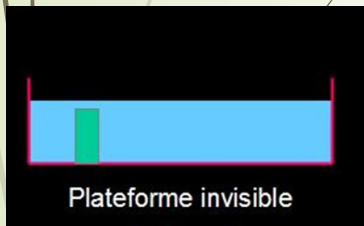
Learning

=Memory test

Morris water maze task

Developed by Richard Morris, 1981

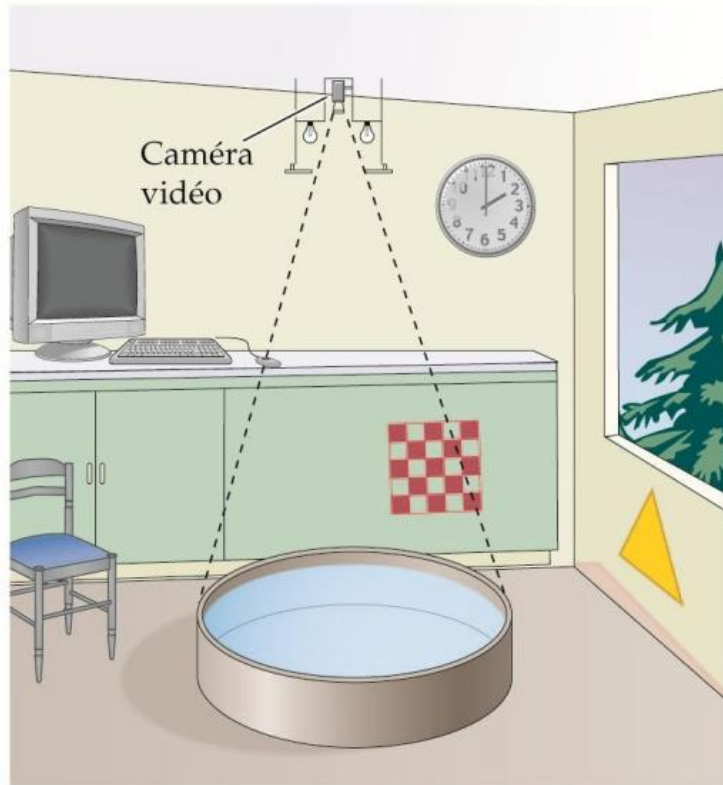
Apparatus : a tank (diam140cm) filled with opaque water (white paint) to hide a platform (diam:10cm)



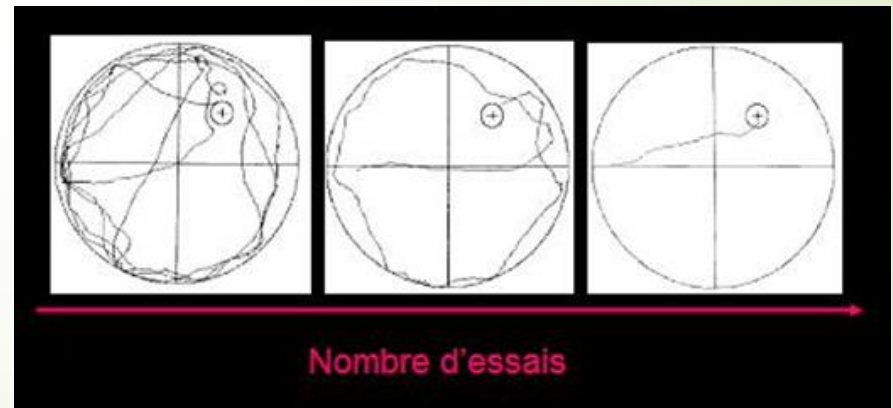
Lateral view

PRINCIPLE: to learn the position of the submerged platform to escape the water, using distal environmental cue

Morris water maze task

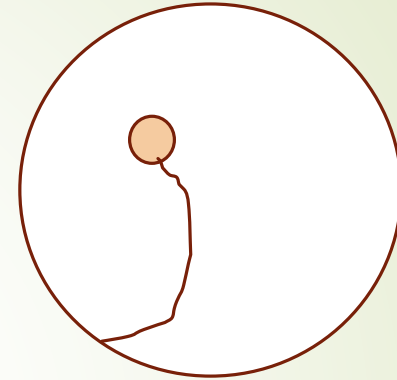
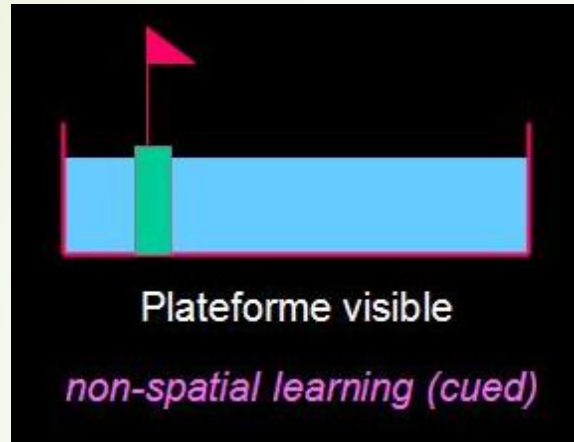


- To perform this navigation task, the animal have to **develop a mental spatial representation of the room in order to take the shortest route to the platform.**



Morris water maze task

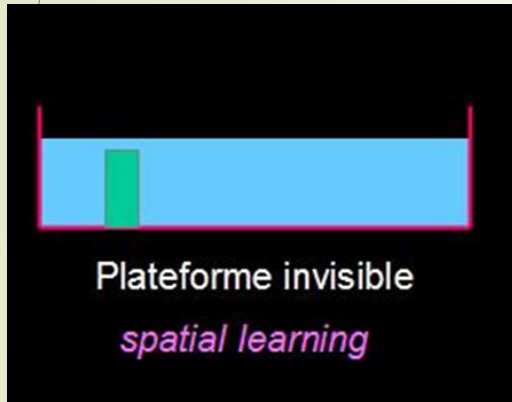
Several versions of this task :



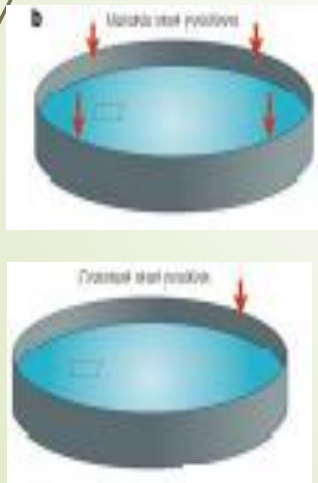
- Visible platform (flag for ex):

Morris water maze task

Several versions of this task :



- **Hidden platform** : several protocols :
 - Distributed learning
 - Massed learning



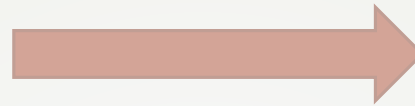
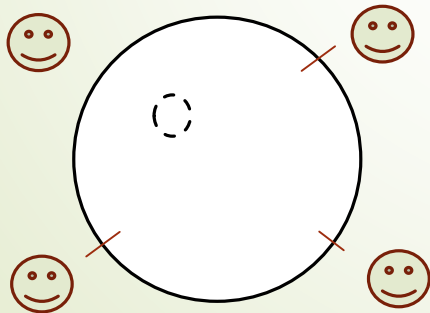
- various starting points
- A single starting point.

Training protocol :

Training
Session

Learning

9-12 trials
distributed in 3 or
4 sessions with ITI
15 minutes



Time required for
consolidation

Restitution

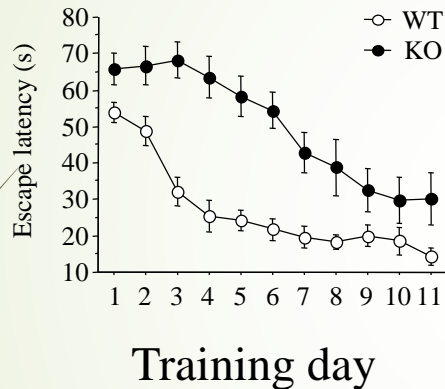
=Memory test

- TP : During training, time to reach the platform.

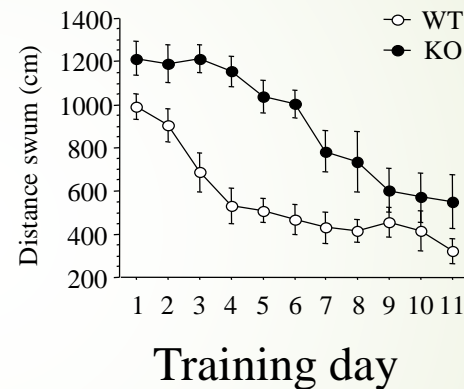
Morris water maze task

Examples of results during training :

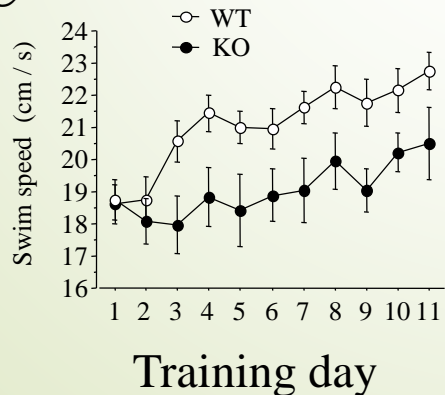
A



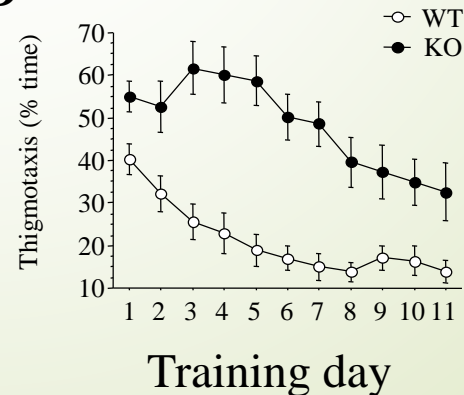
B



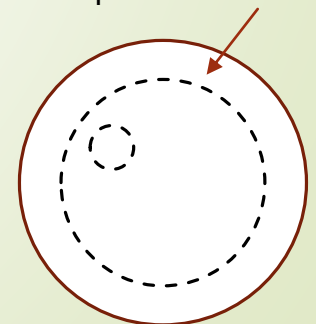
C



D



Peripheric zone



Training protocol :

Training
Session

Learning



Time required for
consolidation

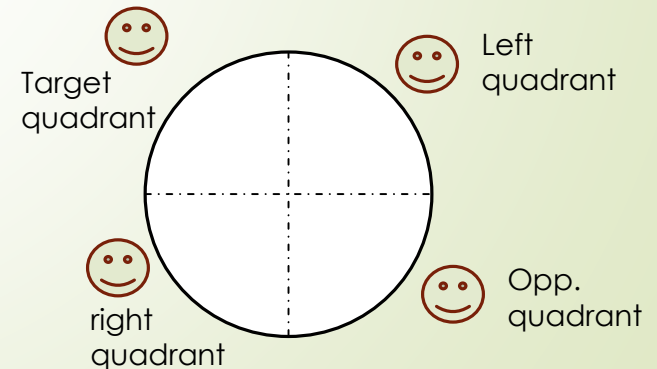
Restitution

=Memory test

one trial (60sec)

the platform is removed.

We analyze time spent in
each quadrant.

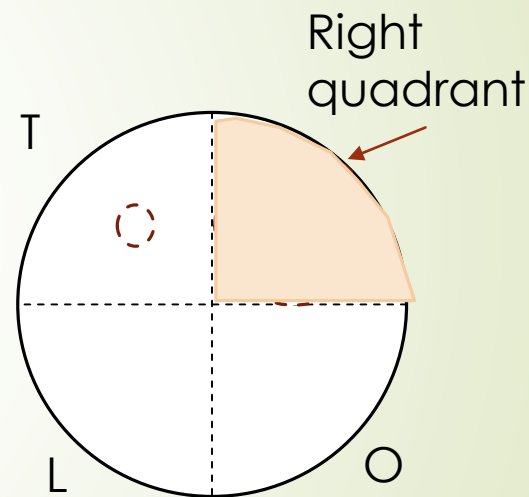
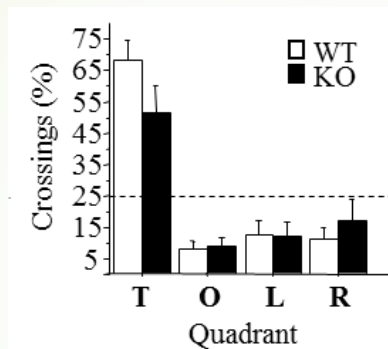
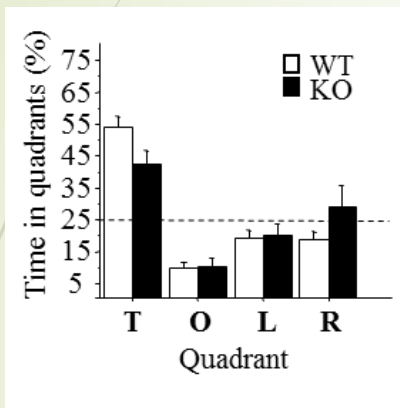


Morris water maze task

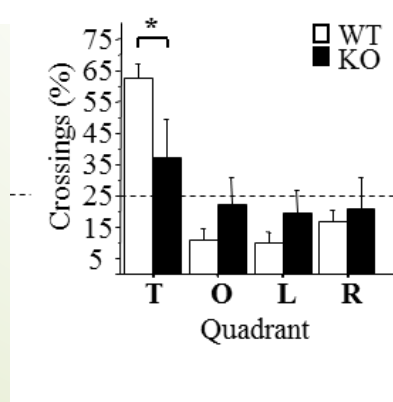
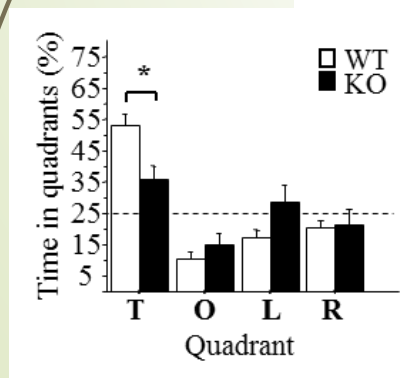
12

Examples of results of memory test :

24-h delay



9-day delay



Other behavioural tasks (spatial memory)

Barnes maze

Top
view



Principle:

14

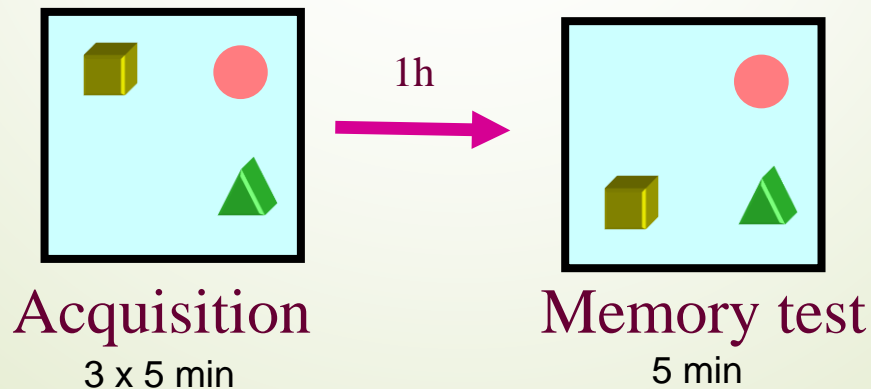
Object location recognition task



PRINCIPLE : Based on the spontaneous tendency of rodents to **preferentially explore (sniff) a displaced object** (new location) over previous location

➤ **Attraction for novelty**

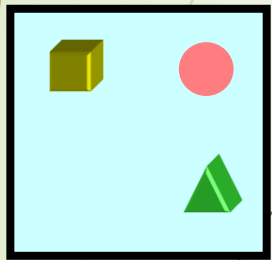
Spatial memory (to remember the object location)



Objet location recognition task

Acquisition

3 x 5 min

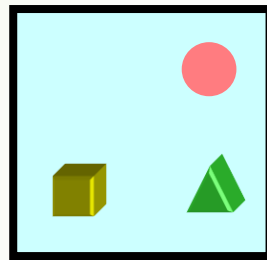


30' - 1h



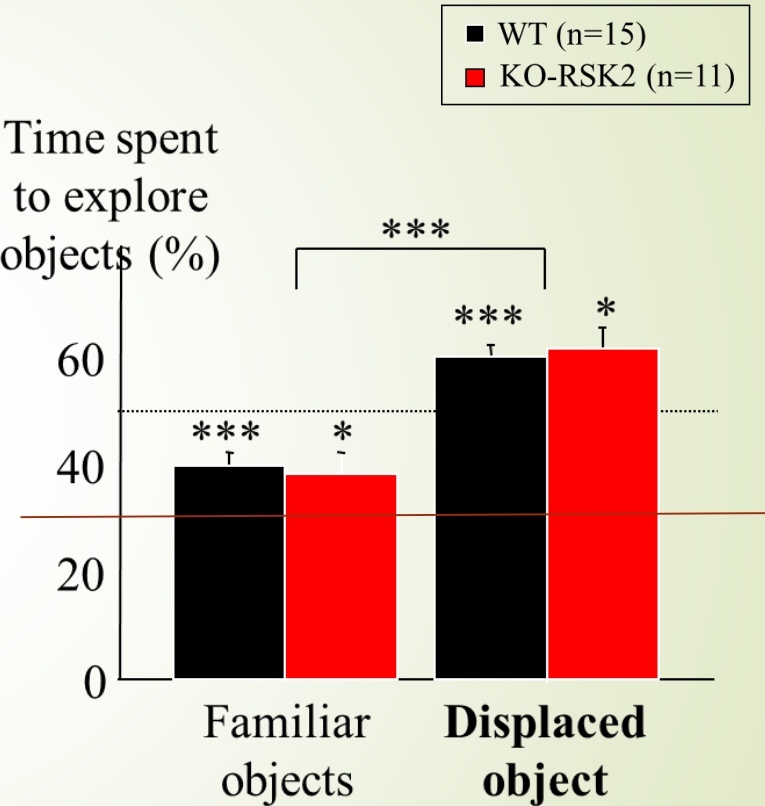
Memory test

5 min



Spatial memory (to remember the object location)

Time spent to explore objects (%)



Objet location recognition task



Advantages :

spontaneous exploration behaviour,
No food or water restriction of animals

Allows an evaluation of the locomotor activity, anxiety, thigmotaxis

Disadvantages

Spontaneous behaviour is very sensitive to experimental conditions

The measurement of the exploration is delicate

Other behavioural tasks (spatial memory)

The radial maze

Goal : to learn and remember the location of food reward using environmental distal cues



Labcoat ! (blouse in french !)
For analyses: Laptop if you want /
paper it's OK !

	Team A	Team B	Team C	Team D
9.00- 9.15	Explanations			
9.15-10.00	MWM	Barnes	Object R.	Object R.
10.00- 10.45	Object R.	MWM	Barnes	analyses
10.45-11.30	analyses	Object R.	MWM	Barnes
11.30-12.15	Barnes	analyses	analyses	MWM
12.15-13.00	Retention test- Analyses and report			

MWM : 6 mice (for all students)

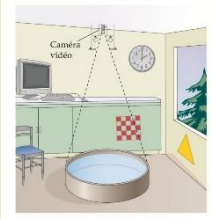
Barnes : 6 mice (for all students)

Object location Recognition : 1 mouse for each team

ORGANIZATION !

LabCoat ! (blouse in french !)

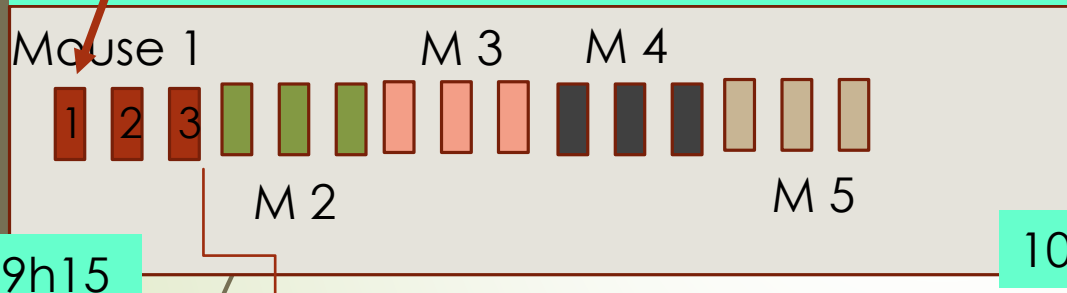
MWM



For a group of 15-16 students , we have 5 mice (M1 –M5)
Each team of 3-4 students have to train mice
In final, each mouse have to do 12 trials
organized in 4 sessions of 3 consecutive trials.

Each trial = 60 sec max to reach PF + wait time on plateform : 30 sec

1st session : trials 1-3 for each mouse

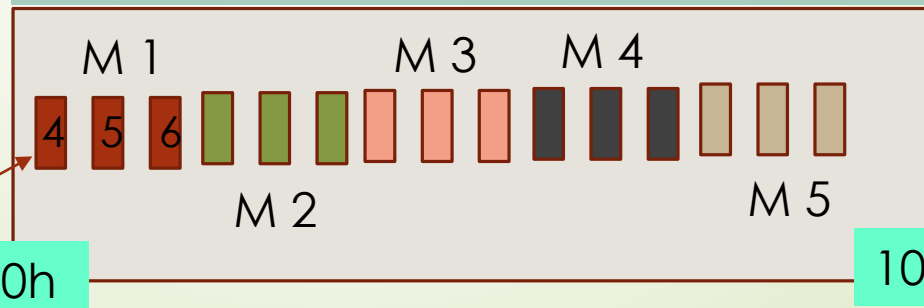


1st team of students : **team A**

Mouse 1 :
BREAK in
its cage!

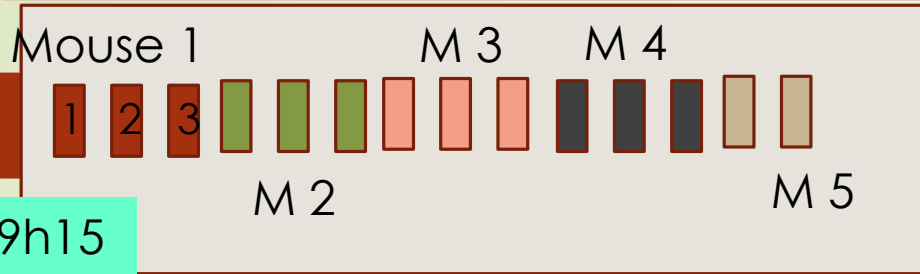
Mouse 1 is
coming
back !

2nd session



2nd team of students : **team B**

1st session : trials 1-3 for each mouse



1st team of students :
team A

Trials 1-2-3

2nd session



team B

Trials 4-5-6

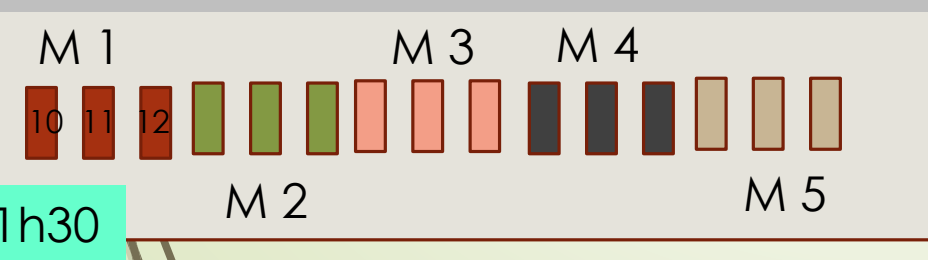
3rd session



team C

Trials 7-8-9

4th session : trials



team D

Trials 10-11-12

END of learning...

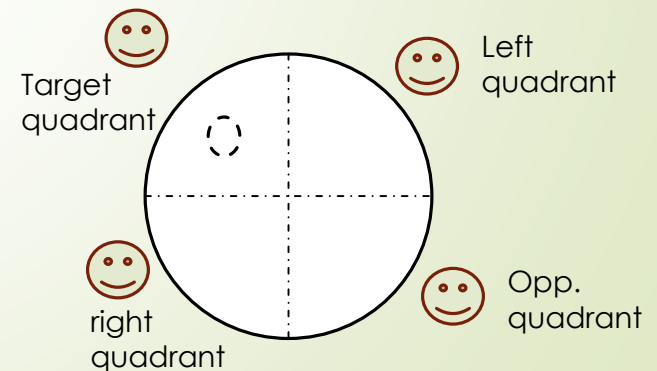


=Memory test

one trial (60sec)

the platform is removed.

We analyze time spent in each quadrant.



Time expressed in %



In the context of teaching (total duration 4h), this memory test will take place immediately after the end of learning.

So **it's not a long-term memory test!**

...but same methodology

	Team A	Team B	Team C	Team D
9.00- 9.15	Explanations			
9.15-10.00	MWM	Barnes	Object R.	Object R.
10.00- 10.45	Object R.	MWM	Barnes	analyses
10.45-11.30	analyses	Object R.	MWM	Barnes
11.30-12.15	Barnes	analyses	analysis	MWM
12.15-13.00	Retention test - Analyses and report			

MWM : 5 mice (for all students)

Barnes : 5 mice (for all students)

Object location Recognition : 1 mouse for each team

Barnes maze

5 mice (for all students)
Learning & memory test

(... but also after the end of learning)



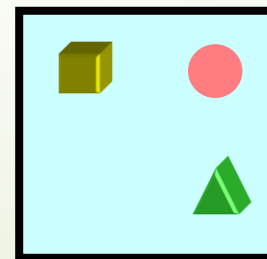
Objet location recognition task

1 mouse for each team

For analyses, graph with 4 mice

Acquisition

3 x 5 min

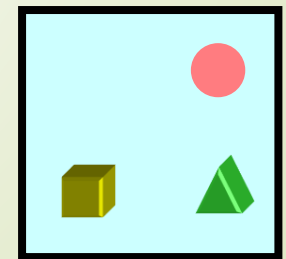


It depends !



Memory test

5 min



Report / Compte rendu

- **After practice, you have to perform a report (with a binome if you were 4 ; or in trinome)**
- **Please report due January, 25 – next Tuesday (the 21st)
pdf version to roseline.poirier@universite-paris-saclay.fr**

Introduction: generalities and goal of study

Mat & methods: description of device/ protocols

Results: graphs and description (...not only memory test !)

Discussion/ Interpretation of results / (Did mice learn or not ? Did they remember or not ? Your opinion about the behavioural task and protocols used...)

2025, January, the
14th

ORGANIZATION FOR TP
SPATIAL MEMORY



GRP 1 matin 9h-13h

Group 1



Atia	Aya
Bentayaa Idrissi	Kenza
BONAZEBI NKONDANI NKONDO	Gibrelle
CORREIA	José
Costa	Maëva
DUFOSSE'	JULIE
Efimenko	Veronika
GUILLET-ANDRE	ATHÉNAÏS
Harithas	Shynika
Holguin Urbano	Santiago
HUYNH	Vu Viet Khanh
Laignel	Selene
Meftah	Yasmine
Outtier	Camille
ROLLAND DU ROSCOAT	Paul
Suthakaran	Raagavi
Vazquez	Salma

Grp 1A (4 étudiants)

-
-
-
-

Grp 1B (4 étudiants)

-
-
-
-

Grp 1C (4 étudiants)

-
-
-
-

Grp 1D (5 étudiants)

-
-
-
-
-

2025, January, the
14th

ORGANIZATION FOR TP
SPATIAL MEMORY



Group 2



ALADHAM	Mohammed
AUVARO	Alyssa
Beucher	Louise
Denis	Téo
Kouam	Ioanna
RICHARD	Diego
RIGAUDIAS	Camille
ROBIN	Noé
Shinkre	Janhavi
Stanković	Petra
Venkatesan	Shashank
Vu	Thi Hong Nhung
Shatkenova	Zariat
Odorico	Thomas
Maillard	Julien
Sabatier	Jean-Baptiste

**GRP 2 afternoon - 13h30-
17h30**

Grp 2A (4 students)

-
-
-
-

Grp 2B (4 students)

-
-
-
-

Grp 2C (4 students)

-
-
-
-

Grp 2D (4 students)

-
-
-
-