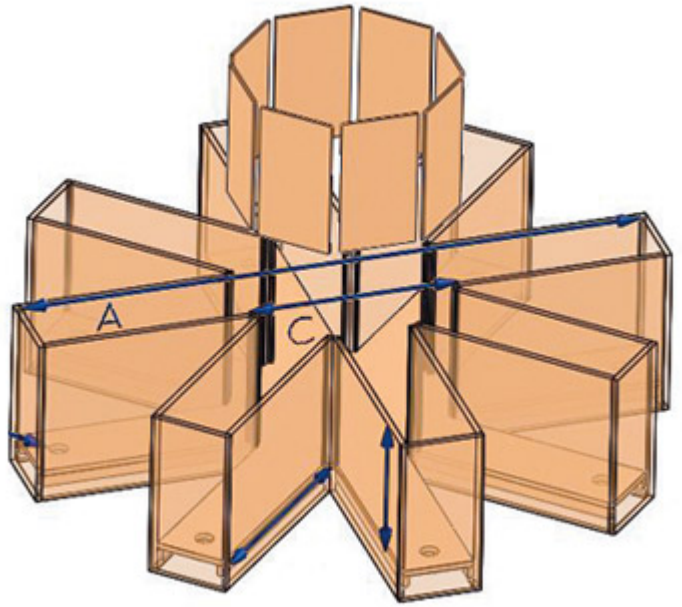
8-arm Radial Maze

- Testing spatial learning and memory, with food deprivation as stimulus
- Takes 3-4 weeks.
- Ideal for spatial learning or memory tasks



Experimental Process

- Radial Arm Maze's structure allows animals to select among eight arms.
- After selecting one arm, animals must return to the center before choosing another.
- Multiple versions of maze.
- Maze tests spatial memory
- Allows for relatively easy distinguishing between short-term and long-term memory learning and errors

Acoustic Startle

Background

- A test to measure the startle response to an acoustic stimulus.
- Measures PTSD and other stress disorders (mouse version).
- A modified form tests prepulse inhibition of the startle response.
- The Coulbourn Instruments Animal Acoustic Startle System provides a completely automated environment in which to implement all of the commonly employed startle protocols.
- Procedures such as habituation, pre-pulse, inhibition and fear-potentiated startle are easily set up

System's Setup

- A new, integrated design featuring built-in microphones within the acoustical chambers for automated SPL calibration.
- Superior reliability and assurance that the specific stimulus is delivered to each chamber through our four independent tone and white noise signal outputs.
- With these multiple outputs the impact of speaker variation between chambers is eliminated.
- Greater flexibility with the four independent signal sources as the controller can run up to four different protocols simultaneously.
- Easy system to use with our exclusive auto stimulus calibration procedure
- Press one button and after a few minutes every chamber is independently calibrated for all stimuli in the experiment

Acoustic Startle (2)

- The Animal Acoustic Startle System includes a sound attenuating chamber for one animal
- This animal is within an animal holder, a load-cell response sensing platform with an interface with our newly designed controller.
- The sound output of the startle audio transducer is up to 128 dB (note: this level of sound is damaging to the mouse)
- Either 20 Hz to 20 KHz white noise or with program selectable tone frequencies from 10 Hz to 25.5 KHz.
- Minimal animal handling: simply place the subject in the appropriate sized holder and on the response sensor platform in the chamber.

The neurobiology of startle.
Koch M.
Prog Neurobiol. 1999 Oct;59(2):107-28

Translational value of startle modulations.
Fendt M, Koch M.
Cell Tissue Res. 2013 Oct;354(1):287-95

Brain stem circuits mediating prepulse inhibition of the startle reflex.
Fendt M, Li L, Yeomans JS.
Psychopharmacology (Berl). 2001 Jul;156(2-3):216-24

The acoustic startle reflex: neurons and connections.
Yeomans JS, Frankland PW.
Brain Res Brain Res Rev. 1995 Nov;21(3):301-14

PhenoTyper

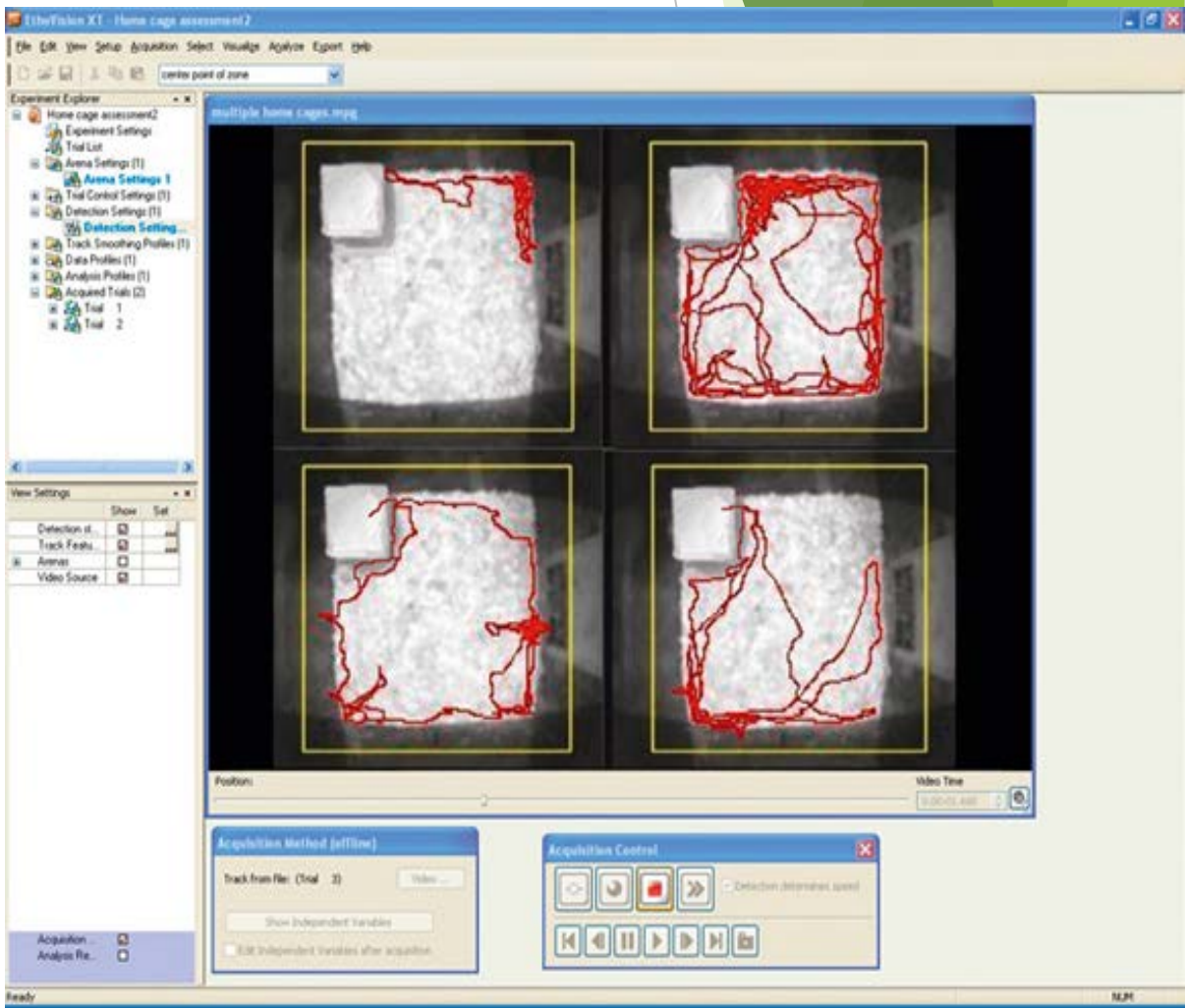
- PhenoTyper is an instrumented cage
- Available in a basic or home cage version.
- Every PhenoTyper is equipped with a top unit, including LED units and a camera
- Optionally with other sensor and stimuli devices, such as sound generators, operant conditioners, and optogenetic stimulus devices.
- Ideal for long-term studies. Our system is also capable of monitoring food and water intake. The system can be used for short- or long-term studies, up to weeks and months.

Activity PhenoTyper

Image of a four PhenoTyper setup

Example of PhenoTyper with pellet feeder and optogenetics

Example of tracking of four mice in the Phenotpypers.



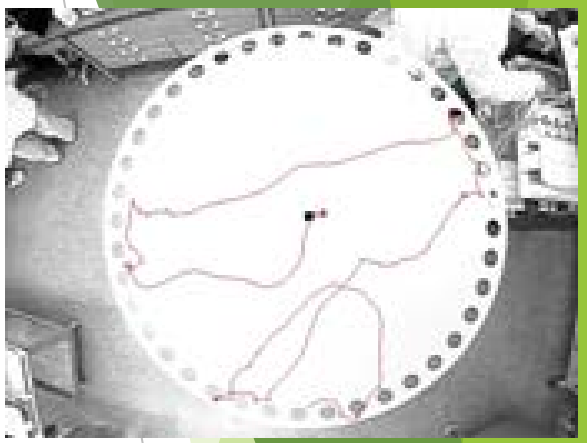
Automated Tube Test

- The Tube Test is a well-known test paradigm designed to measure (altered) social dominance and investigate social hierarchies in mice (Lindzey et al., 1961).
- The Automated Tube Test is a novel apparatus that fully automates the validated tube test procedures.
- Offers clear advantages over manual observation;
- Gives reproducible, reliable, and objective data;
- Measures an abundance of relevant parameters;
- Does not allow animals to injure each other;
- Only requires limited human intervention;
- Is ready-to-go; no additional data acquisition components are required;
- And provides guidance in setting up experiments and analyzing data

Barnes Maze

- Tests spatial learning and memory
- Uses bright light as stimulus
- Rodents are supposed to not like open spaces
- Learning this task takes about 5 days
- Differently sized versions available for mice

Track of beginning of learning



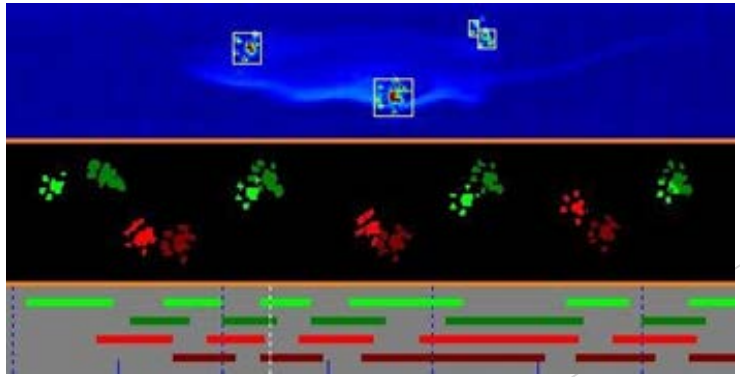
Track of animal that has learned the task

Beam Walking

- Tests motor coordination of mice (or rats)
- Variety of sizes and shapes of beams available.
- The movement of the animal can be videotaped for better analysis.
- Not all animals cooperate in this test
- Most mice have a fear of falling and prefer to go to a dark, escape area/box

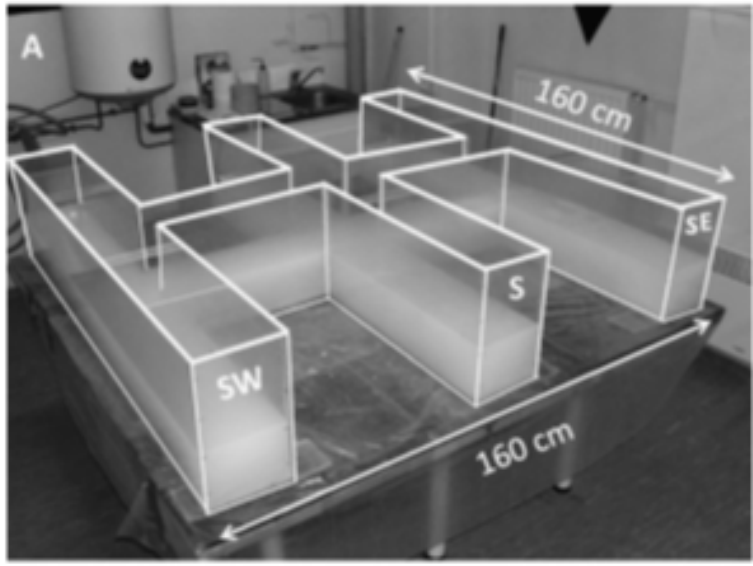
Catwalk

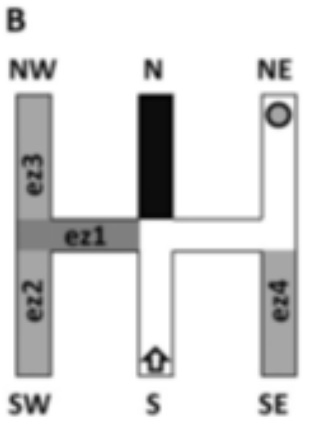
- Stepping/walking pattern of a mouse or rat can be analyzed
- Need to train mouse/rat to walk from one end of the corridor to the other end of the corridor
- The system records the footprints of the animal with a camera (image)
- Analyze the patterns of the footprints(and weight of footprints, works better in rats).
- Many other outputs from the analysis are possible.

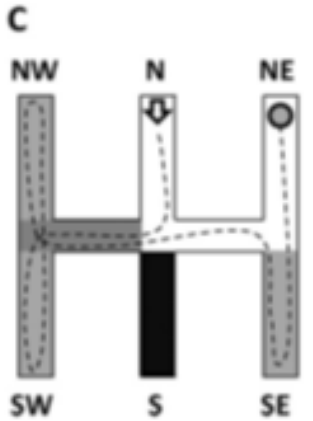


Double H Maze

- Water filled maze to test learning patterns (e.g., path, left-right choices or location of escape platform)
- Mice placed in a water maze escape task.
- Maze allows to test whether the mouse has “procedural” or “declarative-like” memory deficits.





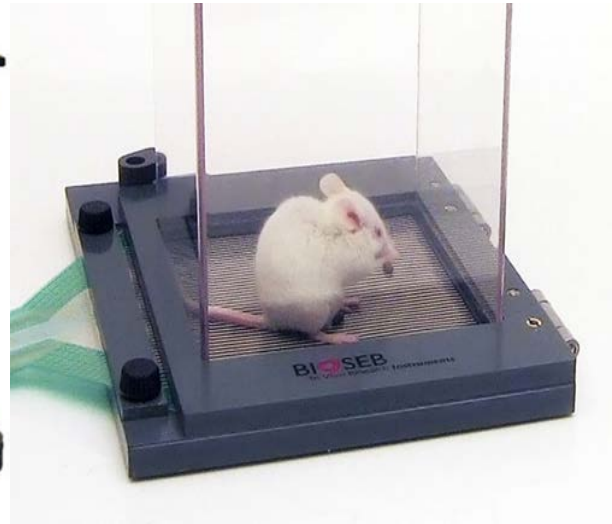


The double-H maze test, a novel, simple, water-escape memory task: Acquisition, recall of recent and remote memory, and effects of systemic muscarinic or NMDA receptor blockade during training

Sarah Pol-Bodetto, Hélène Jeltsch-David, Lucas Lecourtier, Nathalia Rusnac, Célia Mam-Lam-Fook, Brigitte Cosquer, Karin Geiger, Jean-Christophe Cassel*

Dynamic Weight Bearing

- The weight placed on each foot of the mouse (rat) is measured, this system can be used to detect motor problems, stroke, etc.



- Parameters measured

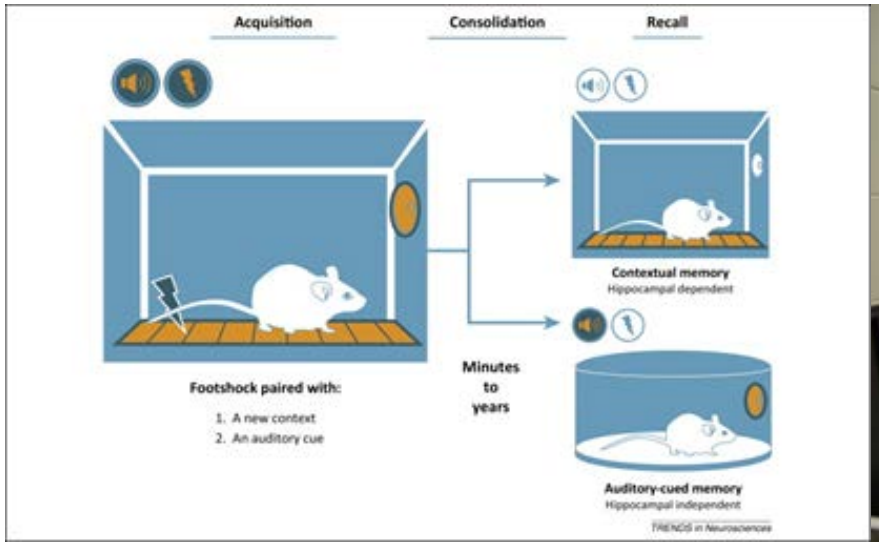
- Weight for each paw (g and % total animal weight)
- Weight for grouped front and rear paws (g and %total animal weight)
- Left/Right and Front/Rear weight ratio
- Surface for each paw (mm^2)
- Surface for grouped front and rear paws (mm^2)
- Variability (standard deviation/mean) for each parameter
- Parameters are given for each posture and as a mean for the whole experiment
- Duration of different postures (4 paws, rearing…) over the whole experiment (s)
- Total time spent on each paw over the whole experiment

Elevated Plus Maze Test/Zero Maze Test

- The Elevated Plus Maze centers on rodents' fear of open and elevated spaces.
- Arranged in a "+" shape,
- Elevated Plus Maze has two closed and two open arms, as well as an open center.
- Designed to be easy to clean by detaching arms.
- The animal is tracked (Noldus Ethovision XT 11) in the EPM or ZM for 4 min.
- The amount of time spend in the closed arms vs the open arms (or open area and closed area of the ZM) is a measure of anxiety.

Fear Conditioning

- Operant conditioning using shock and sound,
- I.e., simple Pavlovian learning and memory tests
- Both auditory and contextual fear conditioning are possible, and, of course fear extinction.
- Four units for mice, our system uses Freeze Frame software for automatic detection of the animal movement



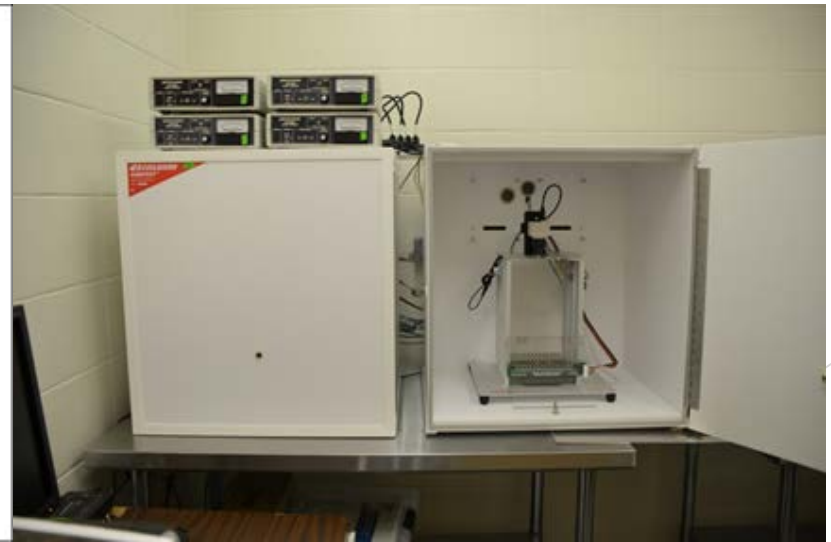
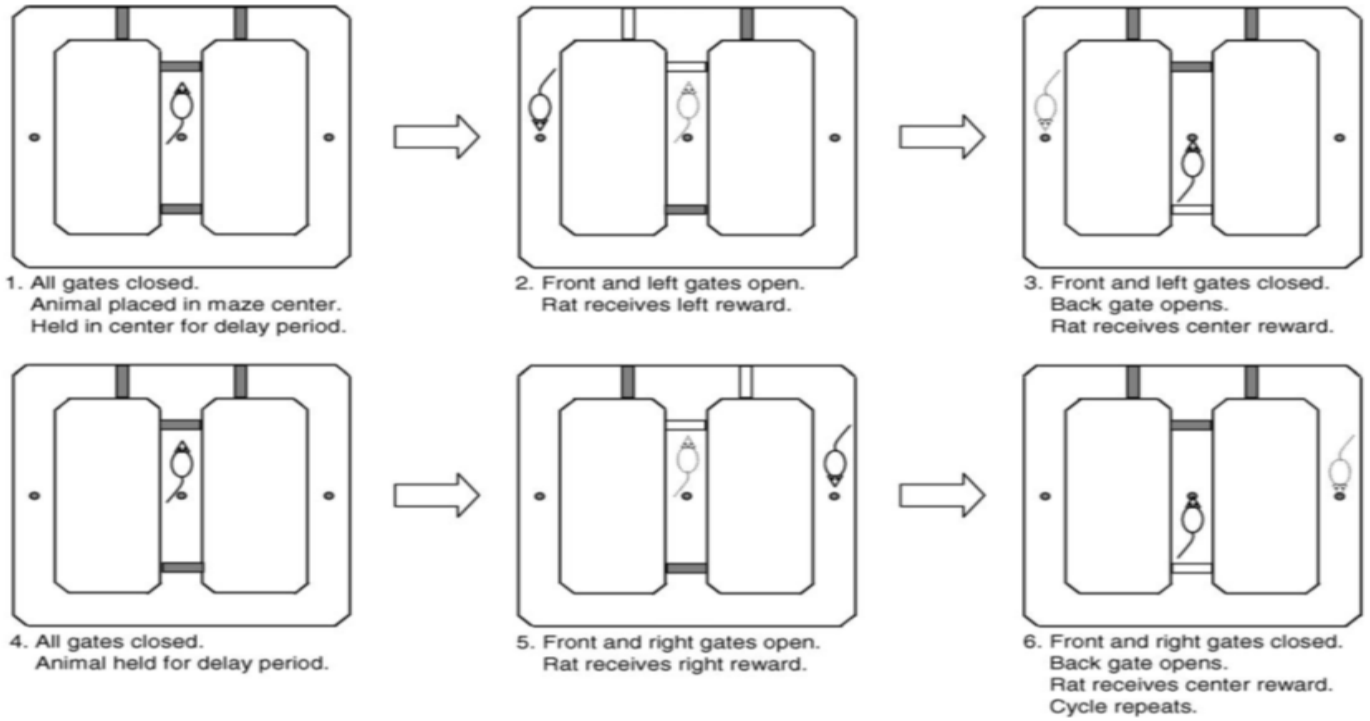


Figure 8 Maze

- Maze is used for testing delayed alternation (similar to the T-maze).
- Mazes are a traditional tool in assessing learning and memory performance, using food as the incentive to reach the goal
- Animals are either required to execute a specific search sequence or minimize time/errors for a reward.
- Shaping of rodent is shown in bottom image.
- Temporal measurements and error scoring are the key parameters recorded
- Maze is enclosed and has a cover, so the mouse cannot escape.



Foot Misplacement Task (FMT)

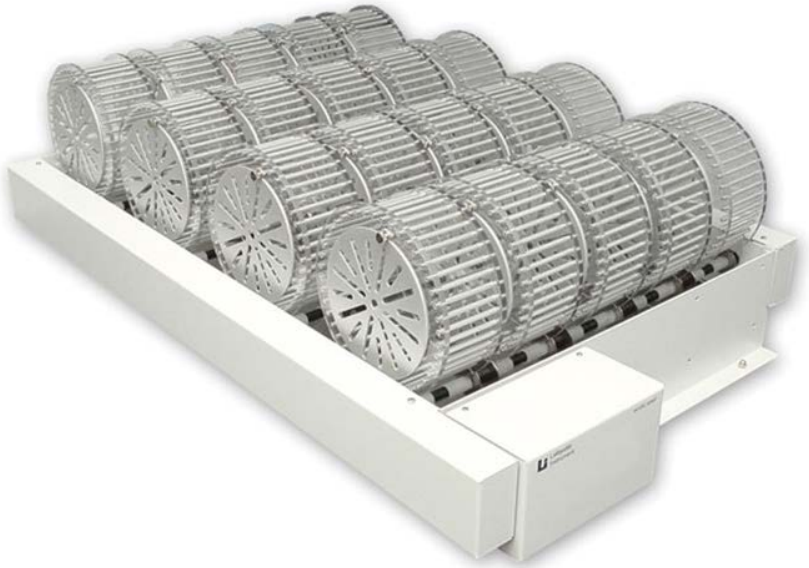
FMA

- Is a unique system to objectively detect gait or walking disorders, abnormalities of coordination and motor or reflex problems in small rodents (rat or mouse) in a highly accurate way, by recording the number, position and duration of errors (missteps or paws' slips as well as tail errors) of an animal walking in an opaque corridor on an horizontal ladder towards a dark compartment.
- The ladder bars can be removed to increase the difficulty of the exercise or create traps, and two sets of 77 infrared sensors are placed above and below the ladder to detect the animal's movement and any paw misplacements, knowing that the number of errors increases with the animals motor deficit and the difficulty of the required task.
- The instrument allows you to quantify the recovery of sensorimotor activity, and is of particular interest for studies on myopathy, ataxia, alcoholism, Parkinson's and Huntington's disease, recovery from brain or spinal cord injuries, and much more!

- 2 compartments (a departure and an arrival box) are located on each side of a long horizontal ladder encased in a corridor. The arrival box is a black compartment that attracts the animal, which walks towards the end of the ladder. On each side of the rungs, infra-red beams and sensors (77 sets both above and below the ladder) detect the rodent's movement and are used to recognize and record the exact position and duration errors in motor control (missteps or paw slips between any 2 bars).

Forced Running Wheels

- 20 mice can be forced to do a defined amount (speed of rotation) exercise for a defined period of time.
- Setup consists of two 10 wheel units.
- Right, wheels; below, controller



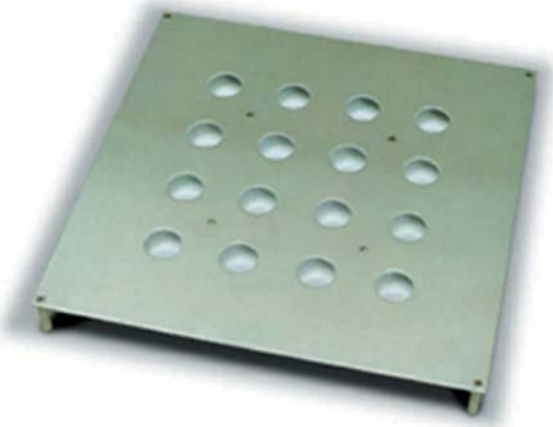
Grip Strength

- Grip Strength, measuring strength of grip of rodents
- Position of “grip” can be varied, allowing for testing of all paws or forepaws

.

Hole Board Maze

- Automated open field with a floor with holes to test either modified open field activity
- For learning, some holes in the floor are baited, others are not (requires food deprivation)
- The sensor rings provide information on the position of the animal, and in which hole it is dipping its nose/mouth.

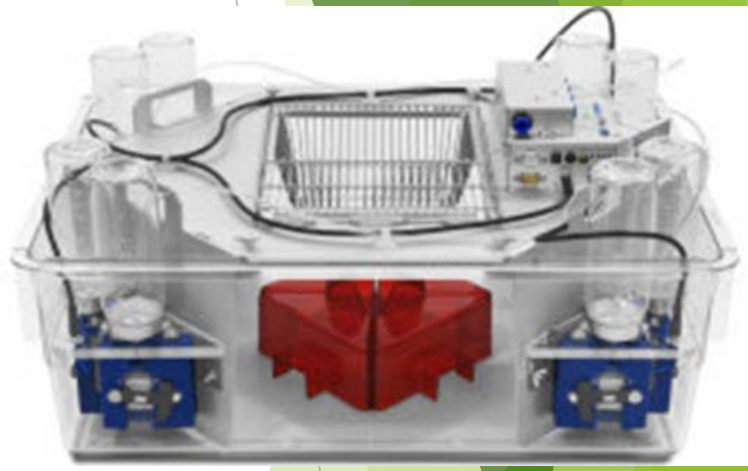


Hot/Cold Plate/Thermal Gradient Test

- Test measures pain sensitivity.
- The Analgesia Meter is based on a metal plate which can be heated to 65°C and cooled to -3°C (with an ambient temperature between 20°C and 25°C).
- An electronic thermostat maintains the plate's temperature and a front panel digital thermometer displays the current plate temperature.
- The Bioseb Cold and Hot Plate is designed to simple
- Is accurate to less than 0,5°C (EEC metrology standard) and perfectly constant in the animal holder system.
- The preset temperature will not change for more than 0,1°C when a 400g rat is placed on the plate, and return to the set temperature is almost immediate.
- System allows for stepped gradients of temperature.
- The animal's pain sensitivity resulting from exposure to heat or cold is tested by placing the animal (mouse or rat) on the surface of the plate
- The operator stops a timer at the instant the animal lifts its paw from the plate.
- The front panel timer then displays the number of seconds it took the animal to react
- Animal reaction time is a measurement of animal resistance to pain and is used to measure efficacy of analgesics.

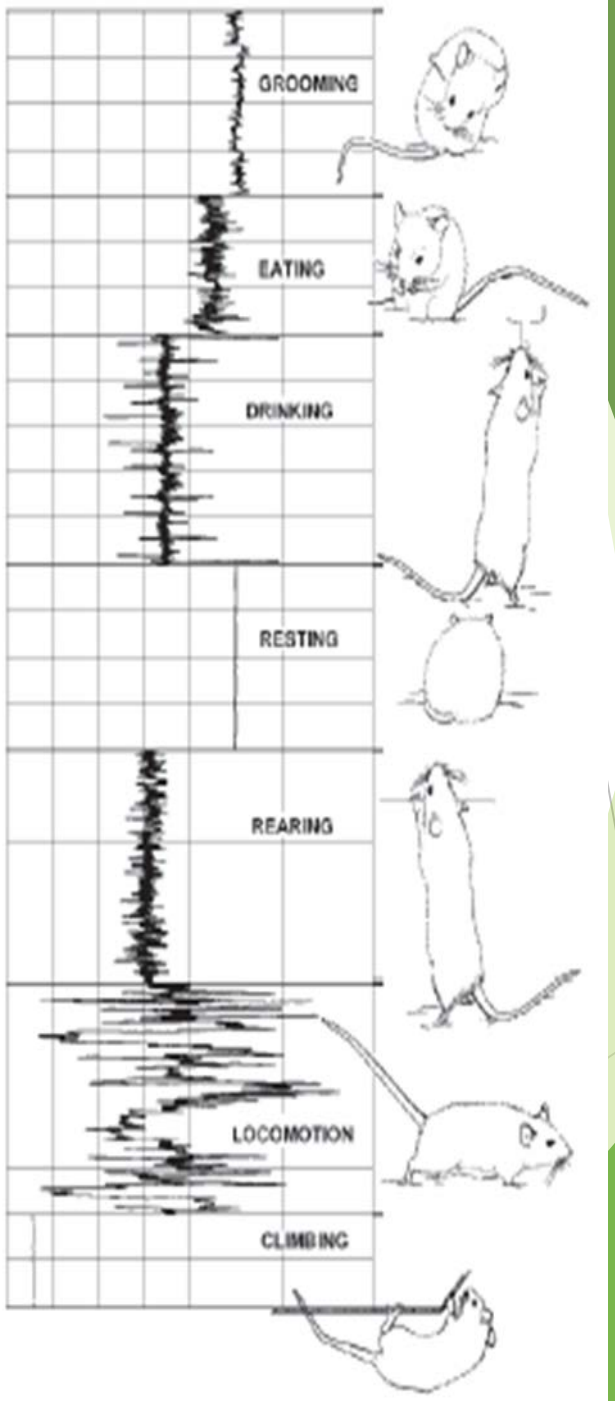
Intellicage

- Two of these cages are available where several mice can live together (note: works better for females).
- It can be used for regular and social learning, other social living patterns can also be measured
- We have two Animal Gates for individually controlled access to new arenas such as SocialBox for the monitoring of social interactions in mice.
- These cages are fully automated screening for behavioral and cognitive functions of mice living in social groups in a home cage equipped with 4 programmable operant corners.
- Transponder technology (each mouse is implanted with a transponder) permits assessment of individual performance.
- High level of standardization achieved by minimizing human disturbance and performing automated monitoring, it allows uninterrupted short- or long-term monitoring.
- Permits investigators to focus on mechanistic analysis of detected effects. It is animal friendly: group living reduces "stereotypes", more natural behavior can be observed
- User friendly software modules: no detailed behavioral know-how necessary.



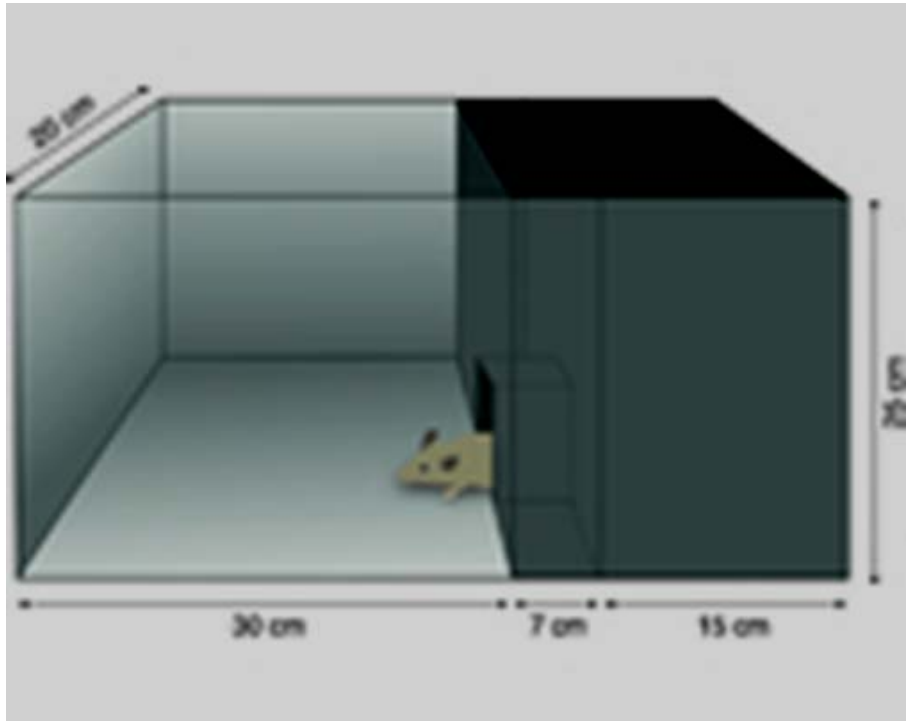
Laboras System

- System of 8 Activity Cages
- 8 mice can live in their home cage
- Computer tracks the vibrations the mouse makes
- Records activity, eating, drinking, grooming, epilepsy etc.
- Also good for circadian rhythms.

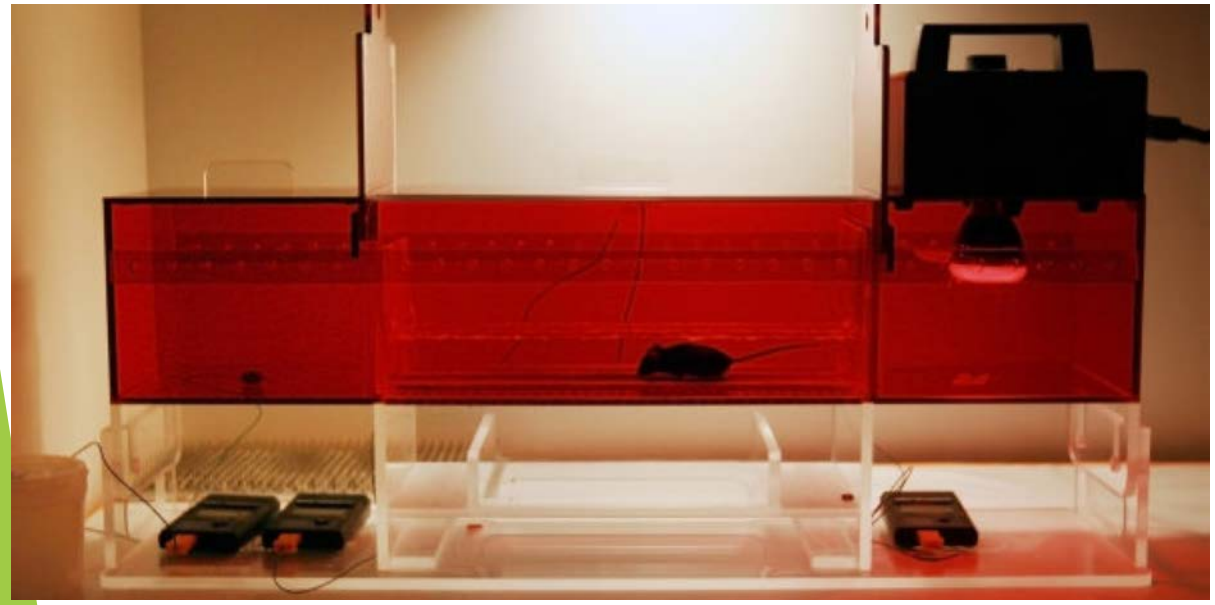


Light/Dark Box

- Video tracking of location of mouse in open vs dark part of the box (i.e., safe)
- Anxiety related.
- The amount of time spend in the dark part and the number of entries are recorded.



Mechanical Conflict System (MCS)



- Morrow Method provides an operant method of pain testing with rodents that complements reflexive methods
- Addressing cognitive and motivational processing.
- Rodents are placed on one side of a height-adjustable array of nociceptive probes
- They are given the opportunity to cross the array to escape from an aversive lighted area to a preferred dark area.
- The array consists of blunt tapered probes that are painful but not sharp enough to cause any tissue damage when walked on by the rodent
- Using various pain models, studies can be done with such measured responses as:

-Number of complete crosses

-Time to exit the light chamber (latency)

-Time to cross the probes, etc.

- Significant stimulus response relationships have been observed between probe height and these measured responses

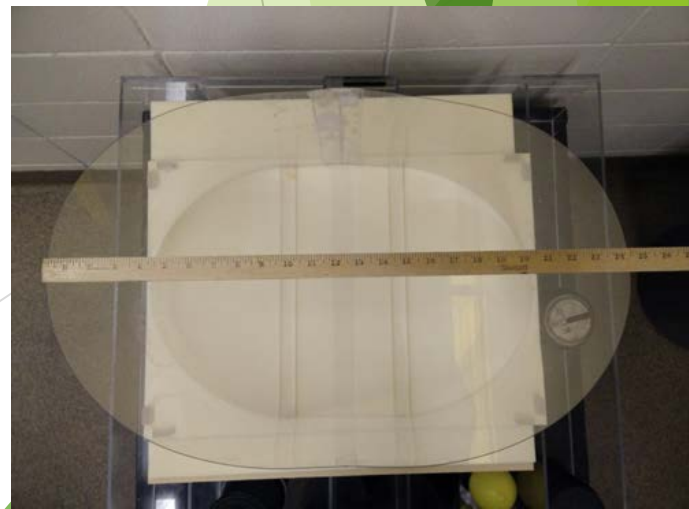
Montoya Staircase test

- Test of skilled forearm reaching in mice
- Tests motor coordination (both rat and mouse version available).
- The staircase apparatus provides a simple, efficient and easy way to quantify the testing of skilled paw reaching for both the rat and the mouse.
- Two food pellets are placed onto each step of two staircases located one on either side of a central platform (two widths supplied).
- The animals are placed in a box relevant to their size and can reach down either side of the platform to grasp, lift, and retrieve food pellets from the steps of the staircase.
- The numbers of pellets removed provides a quantifiable measure of the distance and efficiency of reaching skill.
- Animals must make a coordinated reach and grasp to retrieve a pellet.
- They cannot simply scoop up pellets, which can confound the interpretation of results when measuring reaching into tubes.
- The numbers of pellets removed and the number of pellets knocked down to lower steps provide separate measures of how far the animal can reach, and from how far it can make a coordinated reach, grasp, and retrieval of the pellet
- This test provides an objective quantification of reaching, measured simply in terms of numbers of pellets displaced and retrieved.
- Does not require observer ratings of numbers of reaching attempts, success, or efficiency. The staircase test has been adopted by several groups investigating the effects of unilateral lesions in the basal ganglia and motor systems of the brain because it is sensitive to the effects of drugs and grafts.

Rat vs Mouse

Object Recognition

- Testing single trial visual/olfactory/tactile memory
- Uses either a three-chambered box, or a modified, oval, open field.
- The one-trial object recognition task involves memory of a familiar object in parallel with the detection and encoding of a novel object.
- Provides the basis for the study of a wide range of cognitive and neuropsychological functions and processes in rats and mice.
- Unlike in humans, primate and pigeon studies, object recognition in rats and mice has been mostly limited to memory while little is known about object perception, and acquisition of a representation of an object.
- The testing procedure: rodents are exposed to the arena for 10-20 min, the next day they are exposed to two similar/identical objects for 10 min, after a defined interval (anything from 5 min to 24h) the animal is tested with one similar and one different object. One measure is the % of time spend looking at the new object. For this either you can videotape or use the three point body module (i.e., nose center of body and tail) the core has.



Open Field Test

- Ideal for testing emotionality and the evolution of basal activity
- System also tracks how animals respond to environmental modifications.
- Animal is tracked in an Open Field (square box) for 4 min (other times, e.g., longer are possible, and of use for longer term changes in basal activity/behavior).
- Amount of time spend in the center of the arena vs the side is a measure of anxiety. We have both see-through and non-see-through versions of this task.
- Main measures:
  - Ambulation (time moving vs time not-moving)
  - Rearing: number of times the animal stand on its hind limbs.
  - Self grooming: number of times the animal grooms, and/or licks/washed/scratched various parts of its body.
  - Activity in center
  - Fecal droppings: number of fecal droppings excreted

Anxious Mouse

Less Anxious Mouse

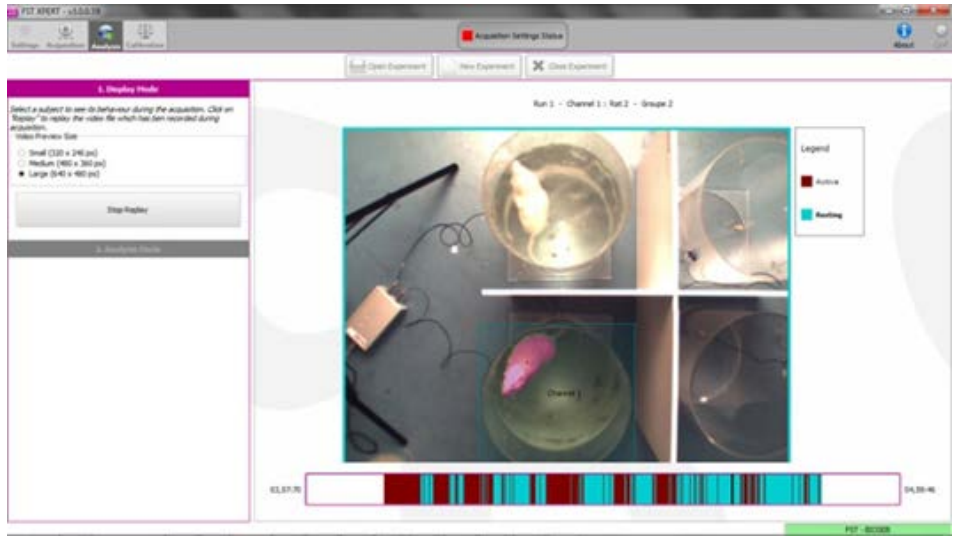
Place Preference

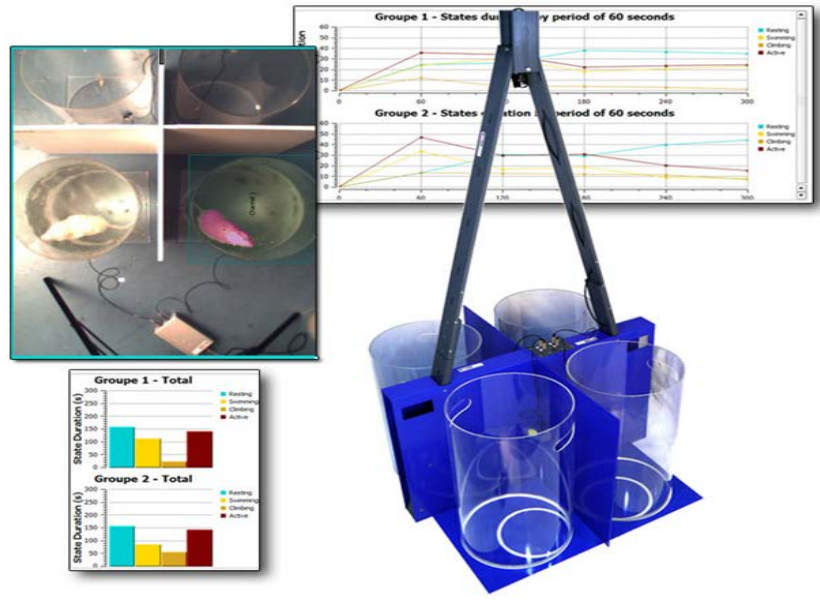
- Video tracking of preference of mouse for the location of the mouse

- Different looking sides are associated with either reward or punishment.

Porsolt Forced Swim Test (FST)

- Common behavioral test for the development and screening of antidepressant and anxiolytic drugs to identify new treatments and understand the biological mechanisms of current treatments.
- Mice (or rats) are observed while forced to swim in a water filled cylinder, the proportion of swimming/floating is a measure of “behavioral despair” or “learned helplessness”.
- Both the “manual” measuring of activity systems and an automated system.
- The automated system uses both the info from the camera and the info from vibration sensitive sensors
- System can be trained to analyze the data to your specifications





Rotameter

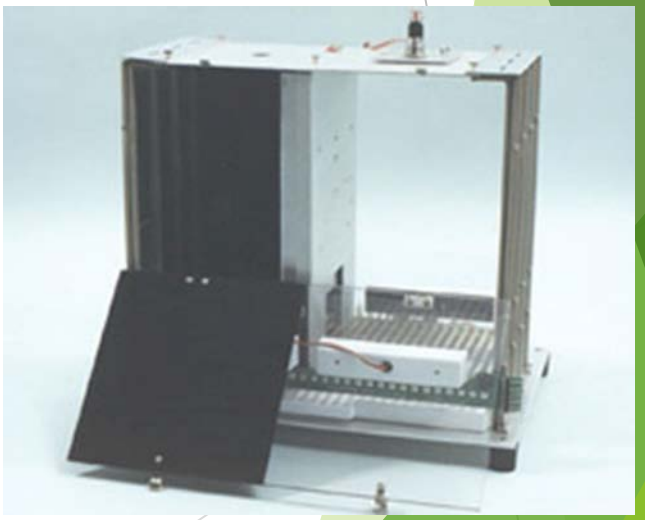
- Assessment of left/right turning movement in mice (rats) that have received unilateral brain damage or unilateral injections of a drug.
- TSE Rotameter is a computer-controlled system designed to analyze rotations in rodents induced by unilateral brain lesions.
- The animal, connected to a rotation sensor can move unrestricted in a special unit.
- Sensor monitors clockwise and counterclockwise rotations with a resolution of 1/250 turn and records changes of directions.
- The TSE Rotameter software for Windows allows the adjustment of filter settings to change detection sensitivity according to the specific needs of the user.
- Experiments can be started and stopped independently in all connected units. The software provides graphical and numerical evaluation of experimental data and export files for further statistics.

Running Wheel Cages

- 20 cages available (one mouse per cage)
- 20 mice can live in their home cage with a running wheel in it
- A computer tracks activity (very good for circadian rhythms)
- ClockLab analysis is available (circadian rhythm analysis).

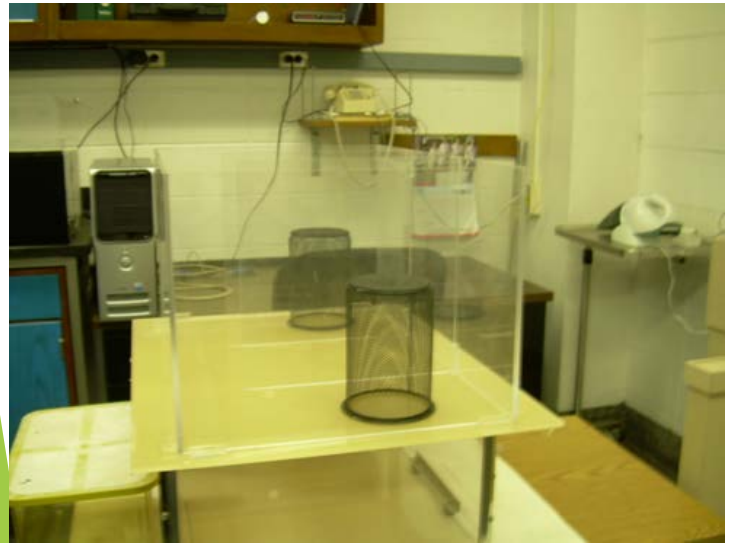
Shuttle Boxes

- Testing basic memory skills (Pavlovian learning)
- Either food rewards or shock as reward/stimulus, e.g., passive (active) avoidance etc.
- System used is modular, it has an automatic door, and a shocker floor, the walls are changeable, feeders are possible or other inserts.



Social Recognition

- Testing memory for conspecifics/strangers, other sex etc.
- This test, usually a three-chambered setup is used.
- Depending on the question it is run similar to Object Recognition- mice are exposed to the arena for 10-20 minutes.
- Next day they are exposed to two similar/identical subjects for 10 min.
- After a defined interval (anything from 5 min to 24h) the animal is tested with one the same and one different subject.
- Another version of this task is to measure the difference in time spend with an object vs a subject (see image), this is used for autism- like behavior.

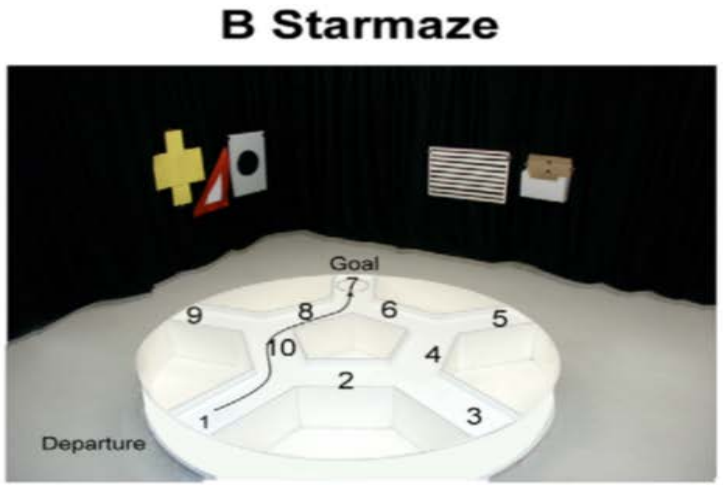


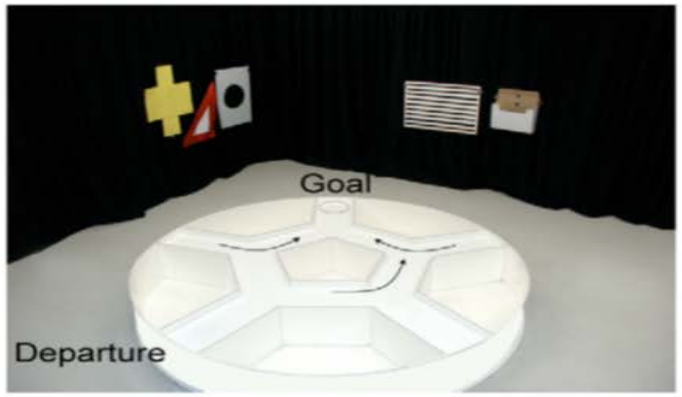
Sonotrack

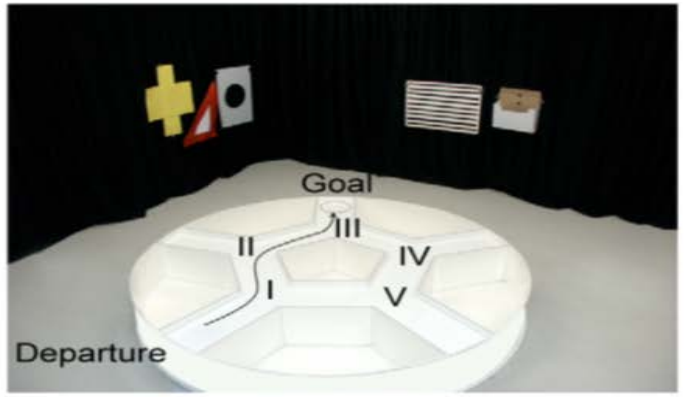
- System for measuring ultrasonic vocalizations of rodents,
- Sonotrack is an advanced non-invasive measurement system to record, analyze and playback ultrasonic vocalizations (USV) of animals.
- Sonotrack is designed to record the full spectrum of ultrasound vocalizations from 15 kHz to 125 kHz without the need of pre-tuning. The extremely low-noise amplifiers enable recording of ultrasounds that were previously impossible with other systems.
- Unlike other systems, it not only detects the presence of USV but provides detailed information about the ultrasonic vocalizations too.
- Sonotrack not only records and converts the ultrasounds in a for humans audible signal but also provides several graphical presentations of the recorded sounds.
- The automatic Ultrasound Vocalization Counter makes it possible to analyze your recorded signals automatically and reliably

Star Maze

- An insert in the water maze to test learning patterns of the mice in the water maze escape task







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Early detection of age-related memory deficits in individual mice

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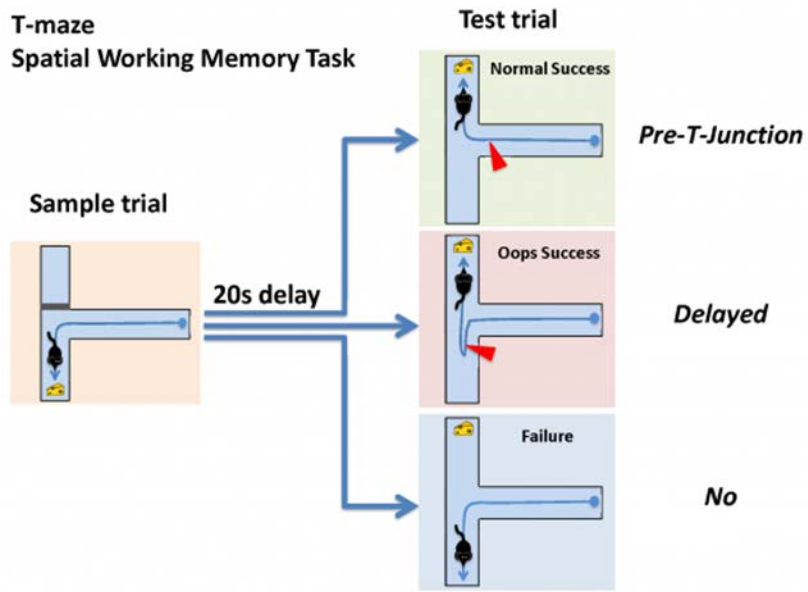
T-maze and Y-maze

- Testing simple Pavlovian learning skill
- Ideal for spatial learning or preference tasks
- T-maze structure allows animals to select between two arms based on memory or reward
- Y-maze allows animals to select between two arms based on memory or reward.
- Y-maze's arms have a gradual turn, animals understand the layout more quickly than a T-Maze, decreasing learning time.
- Versions used can be used both with and without doors.
- We do have some modified versions of these mazes, and we have both mouse and rat versions.



Tail Flick

- Measuring pain/heat sensitivity in tail
- Mouse or rat is put in the container with the tail sticking out, the container is put on the holder
- Tail is gently put in the groove of the baseplate, and when the animal is not moving its tail
- Press the button and the light turns on heating the tail.
- The system detects when the animal moves or “flicks” the tail

Rotorod Test

- SDI ROTOR-ROD system exploits the natural fear of falling response to study motor coordination
- Rotarod test has a range of falling heights and strategically placed photo beams to avoid false falls,
- There are different beams for the animals to walk on. System is set to accommodate both mice and rats.
- Predefining the exercise desired for animals to do is necessary
- Usually it takes about three sessions for the animals to learn how to stay on the beam.
- Improvement or loss of function over time is measurable with this system

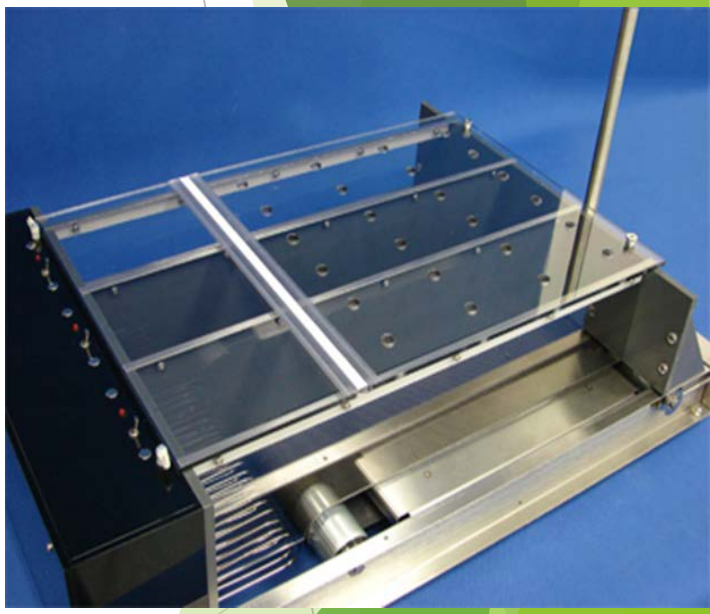
Touch Screens

- Preconfigured set of tests is available and includes:
  - -Five choice serial recognition task
  - -Paired Associate Learning (PAL)
  - -VisuoMotor Conditional Learning (VMCL)
  - -Three-choice Visual Discrimination Reversal

- The system uses rewards for the learning part of the task (and the testing part of the task), mice, in general, need about 3 weeks to learn the basics of the task.

Treadmill

- Forced exercise, multiple lanes and speeds, fixed speed and increasing speed, incline is possible, shock is available (both mice and rats).
- Exer-3/6, a general purpose three (rats) or six (mice) lane animal exerciser utilizing single belt construction with dividing walls suspended over the tread surface.
- Exer-3/6 can be supplied with or without a stimulus assembly.
- An electrical stimulus system option is composed of three or six shock grids, each with individual on/off switches.
- Stimulus intensity is adjustable and LED lamps indicate which stimulus grid is active. Design of electrical stimulus grid reflects special attention to avoid injuries to animals.
- Animals are exercised in three or six compartments made of durable plastic (clear Lexan or opaque PVC). The drive motor controller provides smooth and continuous adjustment of speed in the range 3-100 m/m.
- The exercising belt is made with special material that facilitates the animals' grip and is easy to clean.
- Software included, provides remote control over the treadmill and settings for speed and acceleration, records distance traveled and data is saved in CSV format for Excel or similar statistical software.



Visual Cliff

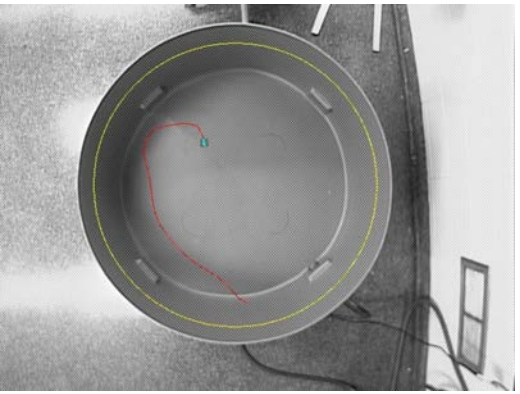
- Testing vision of mice
- Observing if mice will walk on a clear plate over a table's edge or not

Water Maze Test

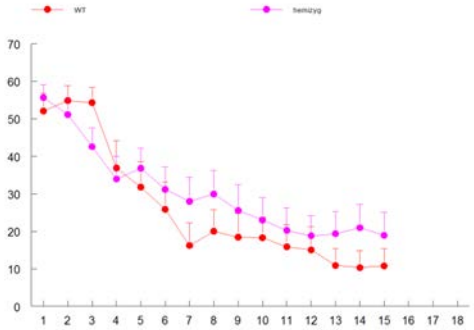
- Test measures the spatial learning and memory performance of the animal (assumed to be related to hippocampal functioning)
- Animals run for four or three trials a day in the pool for 5 days, with a hidden escape platform (0.5 cm below the water surface)
- After the last trial a probe trial is given, with no escape platform (memory test)
- Learning is indicated by the shortening of the latency to find the escape platform

Water Maze Test (2)

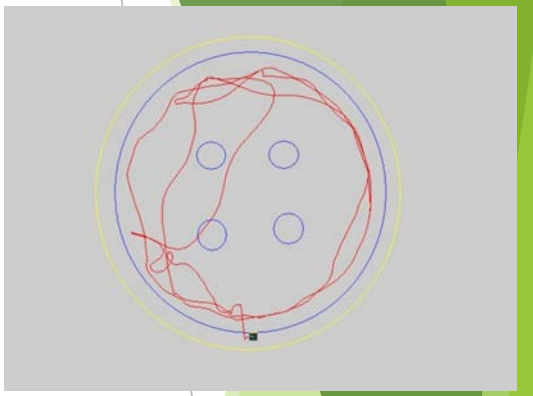
Pool Plus Track



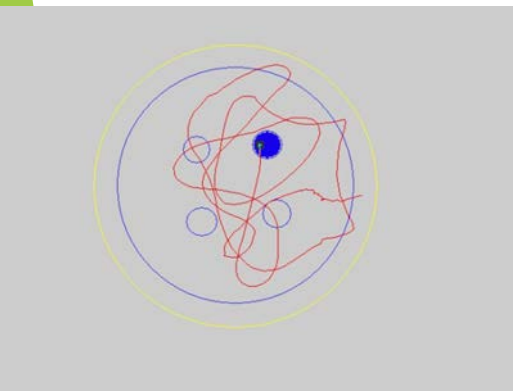
Learning Curve



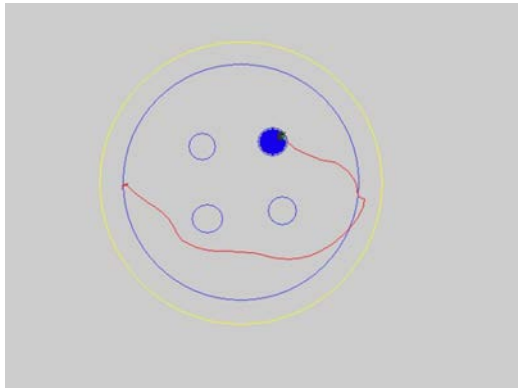
Bad Probe Trial



Early trial: Learning



Later trial: Learning



Good Probe Trial