TSE systems

TSE Maze Systems

Multi-purpose learning & memory testing systems for small laboratory animals

– Specifications subject to change without notice –

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TSE Maze Systems

System description

The **TSE Maze systems** are modular systems for studying animal behavior in a maze environment. All mazes are available in different sizes. The maze experiment analysis is completely computerized.

The mazes come complete with infra-red sensors for monitoring animal location, with a control unit and PCI interface for connection to an IBM compatible PC.Alternatively, the **TSE VideoMot2 system** analyzes the maze experiment by video tracking with a camera mounted above the maze.

Mazes with infra-red sensors

Radial Maze, 8 equally sized arms

Radial Maze for mice

The Radial Maze is used to investigate into the effects of drugs or brain injury on learning and memory performance.

Animal	Length (mm)	Width (mm)	Height (mm)
Rat	425	145	225
Mouse	300	60	150

- The walls are made of opaque gray PVC and can be individually inserted in guide rails.
- Clear acrylic lids allow spatial orientation using extra-maze cues.
- Infra-red sensors located at the arm entries monitor the animal's transfers from the arms in the center and vice versa. The side-walls are pierced at these points.

- Manually operated doors may be used to close individual arms. At the end of each arm is a food crib in which pellets can be placed if the arm is to be baited.
- At the end of each arm is a food crib in which pellets can be placed if the arm is to be baited.
- Infra-red sensors located at the cups serve to monitor the removal of the pellet.

A variety of hardware options allow to configure each maze type according to the requirements of the paradigm to be evaluated. All results can be stored in the form of an export file for further complex analyses with commercially available spreadsheet programs such as EXCEL.

Options:

- Automatic pellet feeders for continuous refilling.
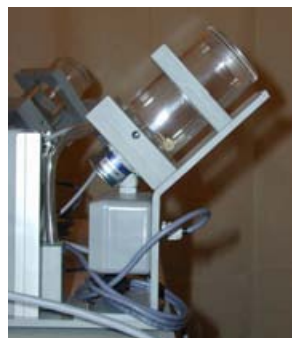
- Transparent arm walls may be provided to make it easier to detect extra-maze cues.
- Software-controlled motorized doors.

In the usual **Radial Maze task** food is available at the end of each arm or in selected arms only (e.g. only 4 of 8 baited). The animal has to learn to visit each arm without going back to an already-visited and therefore empty arm. This is performed in training trials.

A variety of trial parameters can be defined by the user to adjust the experiment to his individual needs. Among them are the termination criterion, the feeding pattern and whether specific doors are to be closed.

Learning and memory impairments due to brain injury or drug treatment will influence the performance of the animal in subsequent test runs.

The maze can also be run with non-baited arms or using the continuous refilling option.
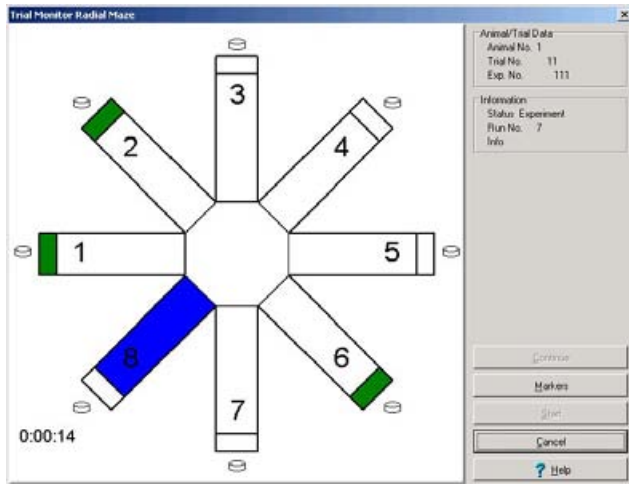
The running experiment

During the running trial a so-called trial monitor allows the user to see the status of the experiment at a glance. The animal location is symbolized by blue color. The presence of a pellet in a crib is symbolized with green color.

The complex behavioral analysis allows a variety of parameters to be calculated.

In the baited maze **Working memory** deficits increase entries to arms which have already been visited in the same trial. **Reference memory impairment** causes the animal to forget which arms usually have food across several spaced trials.

- **Total Trial Time**
- **Center Time**
- **Arm Time**
- **Total Arm Entries**
- **Total Errors (RM+WM)**
- **Reference Memory - Error**
- **Working Memory - Error (WMc+WMi)**
- **Working Memory correct - Error**
- **Working Memory incorrect - Error**

In addition a locomotor pattern evaluation is provided. Drug-induced effects may be an increased or reduced activity or an uneven distribution of locomotion, i.e. restriction to specific sectors of the maze or preference for distinct arms.

The way the animal visits the arms may also reveal specific spatial localization strategies. Unilateral brain injury usually produces a distinct propensity to go to adjacent arms, i.e. a stereotypic response strategy, resulting in reduced behavioral variability (perseverative locomotor patterns).

Arm Entries/ Arm Bias

- Total Time
- Total Arm Entries
- Entries Arms 1-8
- Arm Bias

The total number of entries shows whether a substance induces psychomotor activation or reduced locomotor activity. A preference for distinct arms is expressed in the so-called arm bias. A higher arm bias score indicates a higher frequency of entries into a fewer number of arms, which represents an uneven locomotor activity across the maze.
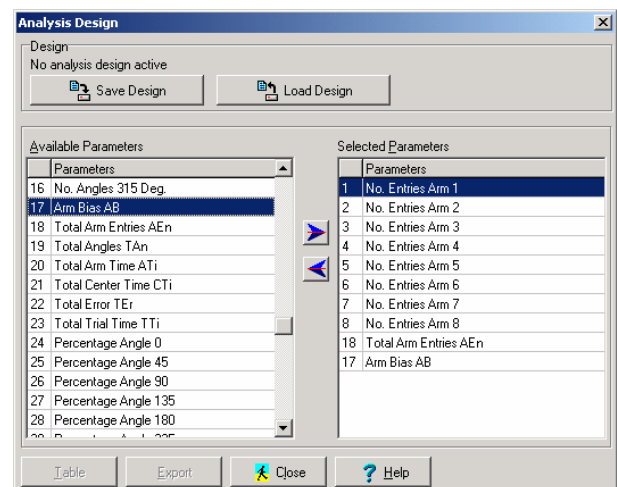
Angles/ Angle Bias

- Total Number of all angles Moved
- Number of individual angles visited
- Angle Bias

When leaving an arm, an animal has the option to either re-enter that arm (0° turn) or enter any of the remaining 7 arms. A strongly preferred angle of turn is expressed as an increased angle bias score (higher frequency of turns made at fewer different angles). A bias may be a result of a neurochemical asymmetry within the motor system.
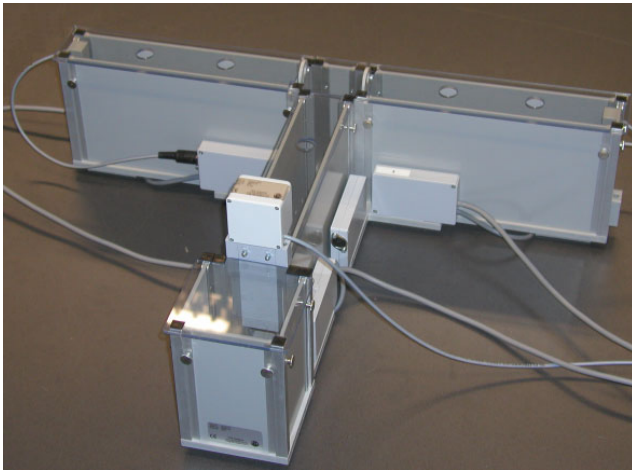
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Angle Frequency

- Total Number of All Angles Moved
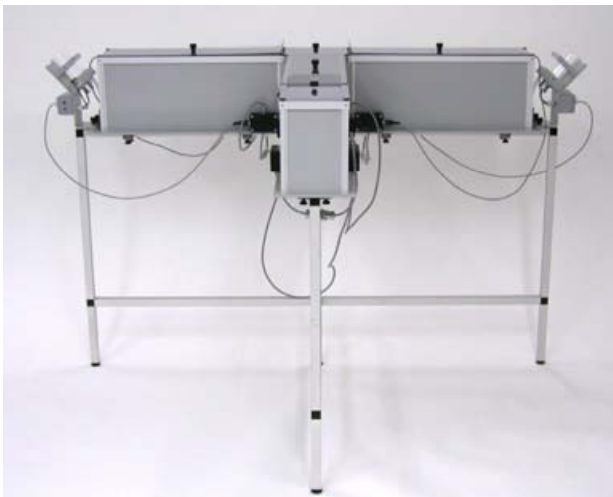- Percentage frequency of individual angles visited

Angle representation: 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° turn.

The frequency of angles is used to determine which particular angle is preferred.

T-Maze

*Mouse system
With additional start box - table-top system*

*Rat system
With additional start box and supporting frame*

The T-Maze is a widely used apparatus to evaluate spatial learning and alternation behavior as well as conditional discriminative learning and working memory. Due to its modular design our T-Maze system can be run in different configurations.

- The T-Maze consists of 2 choice arms and 1 start arm mounted to a square center.
- Both choice arms are equipped with food cups mounted to the end wall for positive reinforcement.
- Manual doors are provided to close specific choice arms in forced choice alternation tasks.
- Maze floor and walls are made from grey PVC to evaluate spatial alternation.
- The arm and center lids are made from clear plexiglass for spatial orientation (extramaze cues).
- Special 3-point infra-red sensor combinations mounted to the arm entrances monitor the transfer between compartments.


Start box: Manual door

Options:

- White or black or black&white striped walls for visuospatial discrimination experiments are available on request.
- A start box with a manually operated door can be mounted to the end of the start arm.
- Automatic doors for the arms and the start box are available.
- The food pellets can also be delivered with automatic pellet feeders.
- The lids of both choice arms can be equipped with software-controlled lamps to provide a discriminative stimulus for light-dark discrimination experiments.
- For acoustical discrimination a loudspeaker is required that is fixed centrally above the T-Maze - user-defined WAV files can be applied using a soundblaster card that is mounted into the computer.
- Aluminum supporting frame.

The software package T-Maze provides a variety of pre-defined standard paradigms, such as:

- Spatial discrimination task
- Light-Dark discrimination task

- Acoustical discrimination task

- Delayed & forced alternation task
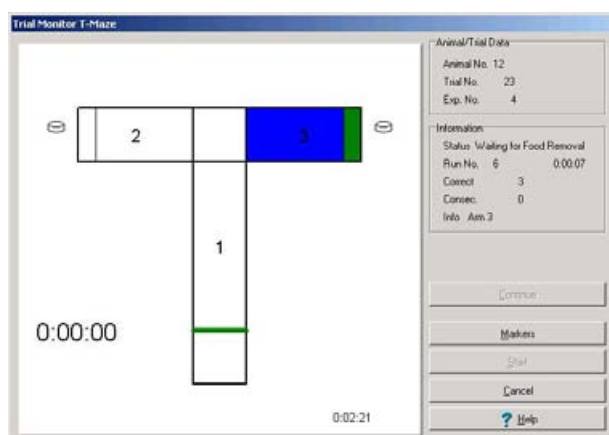
The running experiment

The analysis generates results tables listing among others the number of correct and incorrect decisions as well as decision times allowing to evaluate working memory performance.

One of several results tables

When you order a T-maze make sure you inform us about the exact hardware requirements of your specific paradigm.

- The walls of the two closed arms can be individually inserted into guide rails.

- The whole maze is fastened to a support frame made of aluminum (standard height: 700mm).

- The maze is equipped with location sensors directly behind the arm entrances to monitor the animal's position.
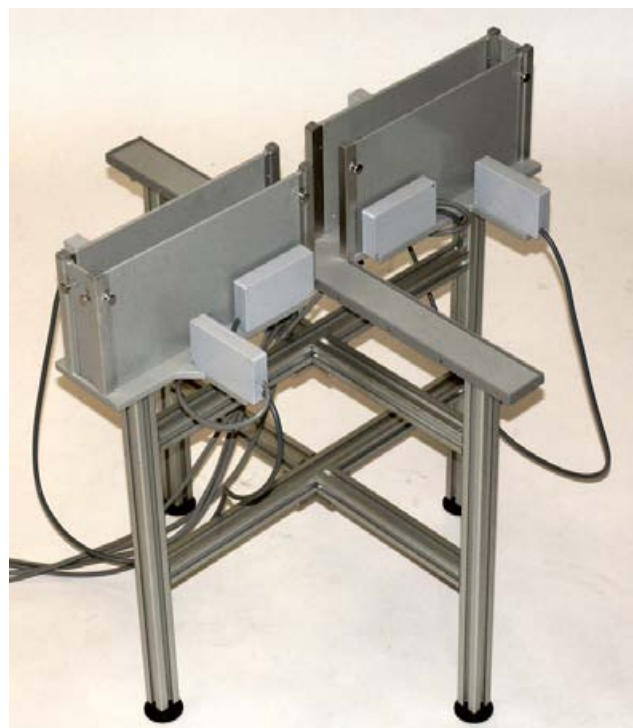
Elevated Plus-Maze

The Elevated Plus-Maze test is one of the most widely used models to assess **anxiety** in small rodents.

- The maze consists of 4 arms arranged in the shape of a cross.

- Two opposing arms have 2 side walls as well as an end wall ("closed arms"); the two other opposing arms have no walls ("open arms").

- The standard material is opaque gray PVC.

- Size example for a mouse maze:

Length (mm)	Width (mm)	Height (mm)
300	50	150

Elevated Plus Maze for Mice

The **Elevated Plus-Maze task** data analysis generates a detailed results table. The results parameters currently available are shown below:

- Total number of arm entries

- Entries to closed arms

- Entries to open arms

- Percentage frequency of entries to open arms (OAx100/TA)

- Total trial duration in seconds

- Time spent in center

- Percentage share of CT in total trial duration (CTx100/TT)

- Time spent in closed arms

- Percentage share of CIT in total arm time

- Time spent in open arms

- Percentage share of OT in total arm time

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"Normal" animals avoid the open arms, i.e. the time spent in the open arms (alternatively expressed as a percentage or ratio of total arm time) and the number of visits to the open arms (alternatively expressed as a percentage or ratio of total arm entries) is decreased. Total arm entries are used as a measure of general activity. Anxiogenic and anxiolytic effects can therefore easily be recognized.

Elevated Zero Maze

The Elevated Plus-Maze test is widely used to assess anxiety in small rodents.

- The maze consists of 4 quadrants arranged in the shape of a circle.

- Two opposing quadrants have 2 side walls ("closed arms"); the two other opposing quadrants have no walls ("open arms").

- The standard material is opaque gray PVC.

- Size example for a mouse maze:

Outer diameter (mm)	Arm width (mm)	Wall height (mm)	Ledges (mm)	Base height (mm)
400	55	110	5	400

Elevated Zero Maze for Mice

"Normal" animals avoid the open arms, i.e. the time spent in the open arms (alternatively expressed as a percentage or ratio of total arm time) and the number of visits to the open arms (alternatively expressed as a percentage or ratio of total arm entries) is decreased. Total arm entries are used as a measure of general activity. Anxiogenic and anxiolytic effects can therefore easily be recognized.
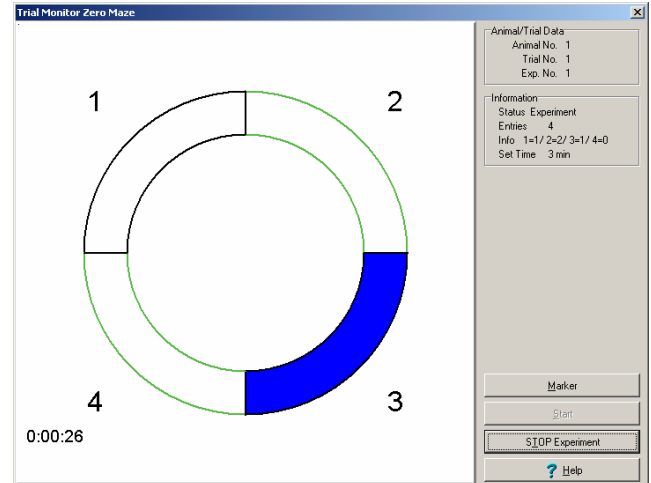

The running experiment

The **Elevated Zero-Maze task** data analysis generates a detailed results table. The results parameters currently available are shown below:

- Total number of quadrant entries
- Entries to closed quadrants
- Entries to open quadrants
- Percentage frequency of entries to open quadrants
- Total trial duration in seconds
- Percentage share of CT in total trial duration (CTx100/TT)
- Time spent in closed quadrants
- Percentage share of CIT in total quadrant time
- Time spent in open quadrants
- Percentage share of OT in total quadrant time

Y-Mazes "Continuous Alternation"

Continuous spontaneous alternation behavior in the Y-Maze is a measure to assess short-term spatial memory. All 3 arms look alike and no artificial motivators are used here, i.e. no food or punishment is given as reinforcers.
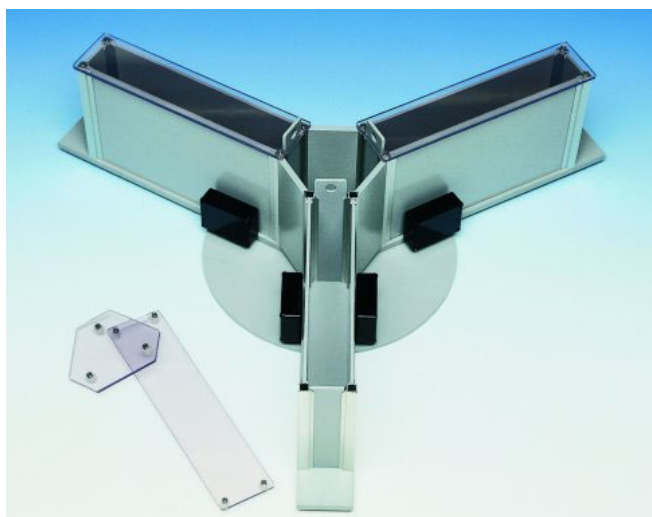
Y-Maze for mice
Continuous Spontaneous Alternation

Y-Mazes are available in a number of different configurations. A specific set of hardware options has to be ordered to run a specific paradigm.

- A Y-Maze always consists of 3 identical arms mounted symmetrically (120 degrees between arms) to an equilateral triangular center compartment.

- 3 manual doors are provided to close specific arms in forced choice alternation tasks.

- Maze walls are made from grey PVC.

- The arm and center lids are made from clear plexiglass for spatial orientation (extramaze cues).

- Special 3-point infra-red sensor combinations mounted to the arm entrances monitor the transfer between compartments.

- Size example for a rat maze:

Length (mm)	Width (mm)	Height (mm)
425	145	225

- The standard system is placed on a table.

Options:

- All 3 arms can be equipped with food cups.

- The walls can be provided in other colors or patterns or can be made of acrylic.

- Grey nontransparent PVC lids are available on request.

- The lids can be equipped with software-controlled lamps to provide uniform dim illumination ("house-light"). They can then also be used as software-controlled cue lights.

- Automatic doors for all 3 arms or for selected arms only are available as an option.

- Optional rotating outer circle used to return the animal to a specific start arm without the help of an operator.

- A shock floor can be provided for avoidance tasks.

- The maze is available with an aluminum base.

Evaluation varies depending on the task and is not described in detail here.

3 of several possible configurations are described below as examples.

Configuration 1: "Continuous Alternation"

Continuous spontaneous alternation behavior in the Y-Maze is a measure to assess short-term spatial memory. All 3 arms look alike and no artificial motivators are used here, i.e. no food or punishment is given as reinforcers.

The analysis generates results tables calculating the number of alternations (=successive entries into each of the three arms on overlapping triplet sets) and %spontaneous alternation performance (=ratio of actual to possible alternations). The percentage of alternation is calculated as: (successive triplet sets/total number of arm entries-2)x100.

Configuration 2: "Discriminative Learning "

Here the correct arm differs in its visual appearance (e.g. wall color or pattern or floor structure is different from the other arms). For light-dark conditional discrimination tasks the maze features additional cue lights. If required acoustical discrimination tasks can be performed by generating sounds or WAV-files – a loudspeaker and a sound card are required here. Food pellets are usually used as positive reinforcers.

The analysis generates results tables listing among others the number of correct and incorrect decisions as well as decision times allowing to evaluate working memory performance.

Configuration 3: "Avoidance Learning"

This maze corresponds to configuration 2 but has a foot shock grid (negative reinforcement) instead of pellet cups/pellet feeders. When the animal makes an incorrect decision it is punished by a short foot shock.

This maze can also be used to assess the effect of shocking on exploratory behavior by measuring the animal's avoidance of an arm in which it has previously received a foot shock.

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When you order a Y-maze make sure you inform us about the exact hardware requirements of your specific paradigm.

Mazes without sensors for Video Tracking or manual operation

TSE Systems provides a whole range of non-automated mazes suitable for manual observation or for use with a videotracking system such as the **TSE VideoMot2 system**.

Water Mazes
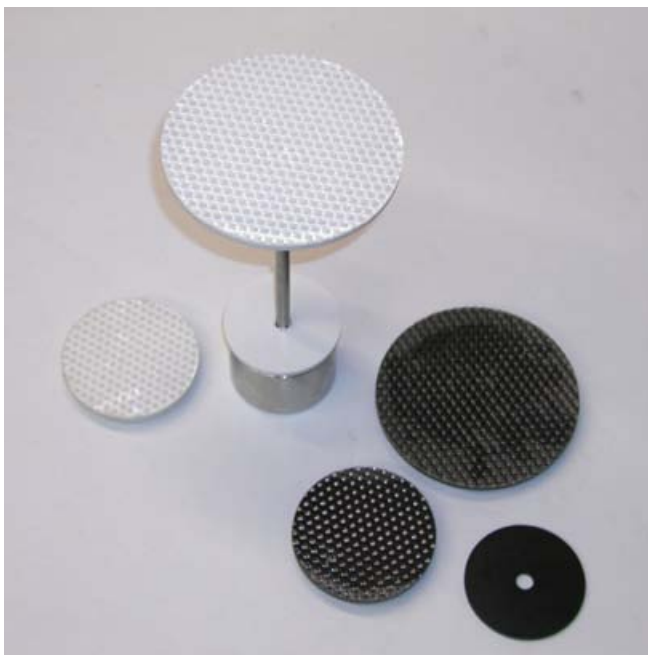
Available colors for Water Mazes:

White (-W) for dark unmarked animals in clear water, Black (-B) for white unmarked animals in clear water. If white water is to be used, both colors are suitable, although we recommend a white pool (white animals have to be marked with a black spot).

Available platform shapes, sizes & colors:
Round 10cm or 14cm diam., square-shaped 10x10cm or 14x14cm, black or white or acrylic.

302050-WM/1200	**Water Pool for Morris-Water-Maze test** Diameter **1200 mm**, height 600 mm, water height max. 300 mm, cap for water outlet, 1 platform.
302050-WM/1600	**Water Pool for Morris-Water-Maze test** Diameter **1600 mm**, height 600 mm, water height max. 300 mm, cap for water outlet, 1 platform.
302050-WM/1800	**Water Pool for Morris-Water-Maze test** Diameter **1800 mm**, height 600 mm, water height max. 300 mm, cap for water outlet, 1 platform.

We also provide Atlantis Platform for Rats.

Diameter 140 mm, height 300 mm (released), 190 mm (submerged) (i.e. rise distance 110 mm), load approx. 1000 g. Complete with control unit, TTL adapter to VideoMot2 interface and cable set. The top of the platform can either be black or white (please specify with your order) and is easily exchangeable. When the animal is detected above the platform for a user-defined time period (delay) the platform rises automatically to the surface.
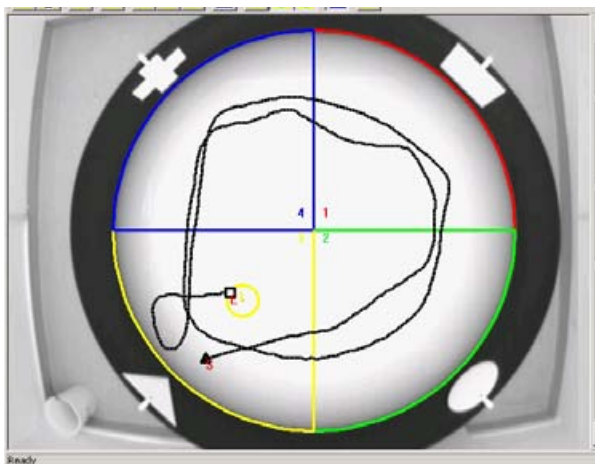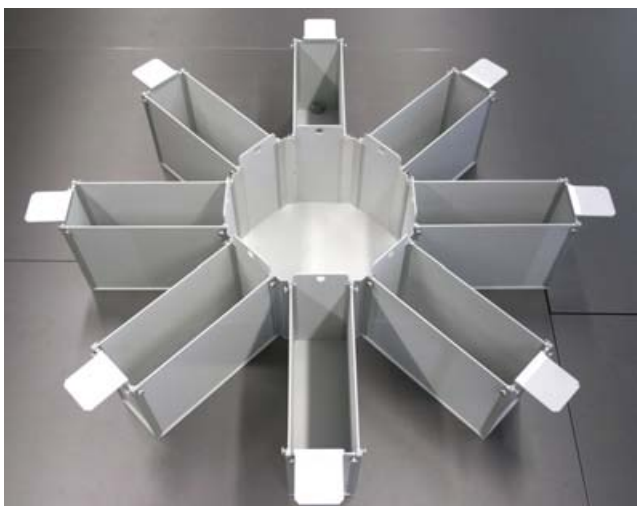
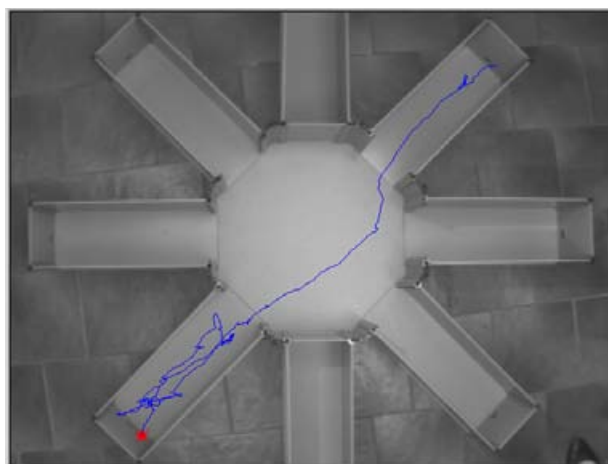*The TSE VideoMot2 system also provides water maze analyses*

341020-M	**Radial Maze Mouse** Dimensions: arm length 300 mm, arm width 50 mm, wall height 150 mm.
341020-R	**Radial Maze Rat** Dimensions: arm length 425 mm, arm width 145 mm, wall height 300 mm.

Radial Maze

Radial Maze analysis with the TSE VideoMot2 system

Barnes Maze

The radial maze consists of 8 arms and an octagonal center compartment that can be easily assembled. The maze is constructed from PVC and aluminum. Each arm can be closed with a door made from PVC. A food bowl is mounted to the rear wall of each arm. Marker plates made from white PVC can be used to mark the individual arms with numbers. Dimensions can be also custom-built.
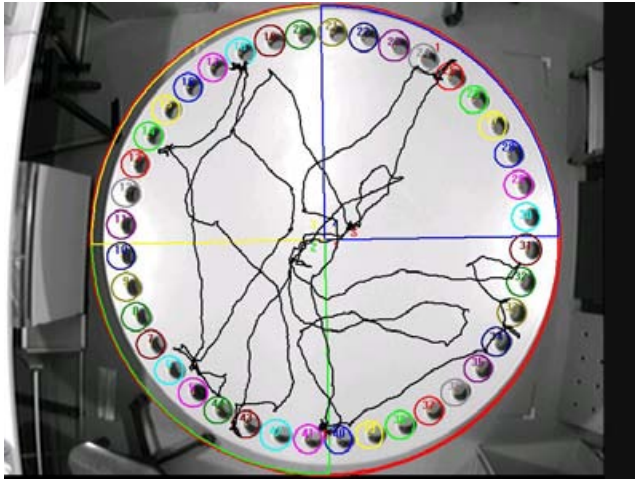
Available colors for Radial Maze: White (-W) and Light Gray (-LG) for dark animals, Dark Gray (-DG) and Black (-B) for white animals. Please specify with your order.

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Barnes maze analysis

The Barnes maze consists of a round plate with a diameter of 1220 mm, 10 mm thickness, made from PVC with 40 circular holes (50 mm diameter, the distance from the hole center from the outer rim is 75 mm). Other hole numbers and diameters on request. An escape tunnel made from PVC can be mounted below each hole (50 mm inner diameter, 80 mm depth, length variable between 120 and 160 mm). The animal can be easily removed from the tunnel after the experiment is finished. A start tube made from gray PVC is included in the scope of supply. The maze is mounted on an aluminum base raising it 800 mm above the floor. Other heights on request. Optional: Integrated or stand-alone mounting units for extra-maze cues.

Available colors for Barnes Maze: White (-W) and Light Gray (-LG) for dark animals, Dark Gray (-DG) and Black (-B) for white animals. Please specify with your order.

302050-BM/M   Barnes Mazes Mouse
Rat systems are available on request.

Y Maze "Continuous Alternation"

This Y-maze consists of 3 identical arms mounted at 120 degrees to one another. It is manufactured in one piece for easy cleaning. The maze is constructed from PVC. A base frame is optional.
The maze can also be custom-built.

Available colors for Y-Maze: White (-W) and Light Gray (-LG) for dark animals, Dark Gray (-DG) and Black (-B) for white animals. Please specify with your order

341021-M/SA	**Y-Maze Mouse** Dimensions: arm length 325 mm, arm width 85 mm, wall height 150 mm
341021-R/SA	**Y-Maze Rat** Dimensions: arm length 425 mm, arm width 145 mm, wall height 225 mm

T-Maze

The T-Maze is also available as a non-automated system for use in the TSE VideoMot2 system or for non-automated observation.

T-Maze with manual doors

The plus maze consists of 2 open and 2 closed arms mounted at 90 degree to one another and separated by a central square-shaped platform. The maze is constructed from PVC and mounted on an aluminum base raising it above the floor. Dimensions and height can be also custom-built.

Available colors for Elevated Plus Mazes: White (-W) and Light Gray (-LG) for dark animals, Dark Gray (-DG) and Black (-B) for white animals. Please specify with your order

The T-Maze consists of 2 choice arms and 1 start arm mounted to a square center. Manual doors are provided to close specific choice arms in forced choice alternation tasks.

341011-M	**Elevated-Plus-Maze Mouse** Dimensions: arm length 300 mm, arm width 50 mm, wall height 150 mm, ledges 5mm, base height 500 mm.
341011-R	**Elevated-Plus-Maze Rat** Dimensions: arm length 425 mm, arm width 145 mm, wall height 225 mm, ledges 10 mm, base height 700 mm.

Elevated Plus Maze

Elevated Plus Maze for rats

Zero Maze

The zero maze consists of 2 open and 2 closed equally-sized quadrants. The maze is constructed from PVC and mounted on an aluminum base raising it above the floor. Dimensions and height can be also custom-built.

Elevated Plus Maze for mice

Available colors for Zero Mazes: White (-W) and Light Gray (-LG) for dark animals, Dark Gray (-DG) and Black (-B) for white animals. Infra-red translucent black material and clear acrylic are available on request. Please specify with your order.

341012-M	**Zero Maze Mouse** Dimensions: outer diameter 460 mm, arm width 55 mm, wall height 110 mm, ledges 5 mm, base height 400 mm.
341012-R	**Zero Maze Rat** Dimensions: outer diameter 940 mm, arm width 55 mm, wall height 190 mm, ledges 10 mm, base height 700 mm.

If you want to use the maze in a video system please tell us the color of your animal under study. The maze will then be provided in a material suited for your requirements.

Partial list of users

- Abbott GmbH & Co. KG, Ludwigshafen, Germany
- Academy of Sciences, Prague, Czech Republic
- Albert-Ludwigs-Universität Freiburg, Freiburg, Germany
- Charité - Universitätsmedizin Berlin, Berlin, Germany
- Consiglio Nazionale delle Ricerche - CNR, Roma, Italy
- DSM Nutritional Products AG, Kaiseraugst, Switzerland
- Eberhard Karls Universität Tübingen, Tübingen, Germany
- Ecole Polytechnique Federale de Lausanne - EPFL, Lausanne, Switzerland
- EGIS Pharmaceuticals Ltd., Budapest, Hungary
- elbion AG, Radebeul / Dresden, Germany
- ETH Zürich, Schwerzenbach, Switzerland
- Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany
- Friedrich-Schiller-Universität Jena, Jena, Germany
- Georg-August-Universität Göttingen, Göttingen, Germany
- INSERM, Le Kremlin-Bicetre, France
- Johann Wolfgang Goethe-Universität, Frankfurt, Germany
- Karolinska Institute, Stockholm, Sweden
- Karol Marcinkowski University of Medical Sciences, Poznan, Poland
- Katholieke Universiteit Leuven, Leuven, Belgium
- Leibniz-Institut für Neurobiologie, Magdeburg, Germany
- Max-Planck-Institut für Hirnforschung, Frankfurt, Germany
- Medizinische Hochschule Hannover - MHH, Hannover, Germany
- Medizinische Universität Innsbruck Kinderklinik, Innsbruck, Austria
- Merck KGaA, Darmstadt, Germany
- National University of Singapore, Singapore, Singapore
- NeuroSearch A/S, Ballerup, Denmark
- Otto-von-Guericke-Universität Magdeburg, Magdeburg, Germany
- Purkyne Military Medical Academy, Hradec Kralove, Czech Republic
- Ruhr-Universität Bochum, Bochum, Germany
- Sanofi-Aventis Deutschland GmbH, Frankfurt am Main, Germany
- Solvay Pharmaceuticals B.V., CP Weesp, The Netherlands
- Suven Life Sciences Limited, Hyderabad, India
- Texas A&M University, College Station, TX, USA
- University of Copenhagen, Copenhagen, Denmark
- University of Hawaii, Honolulu, HI, USA
- University of Prince Edward Island, Charlottetown, Prince Edwards Is, Canada
- Universität Bremen, Bremen, Germany
- Universität Ulm, Ulm, Germany

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TSE Systems is a leading supplier of sophisticated research instrumentation in the global life science market. Our focus is on providing the total customer solution, with modular designs of integrated hardware and software platforms for neuroscience, metabolic and behavioral phenotyping, drug screening and toxicology.

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TSE_Maze System_20101013