

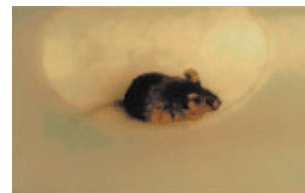


# WaterMaze

## A Video Tracking System for the Morris Water Maze

WaterMaze is an entirely new concept for taking the strain out of running Morris water maze experiments. WaterMaze incorporates a unique **Project Manager** for designing and executing complex experiments with multiple animals, starting points and platform positions. Reference memory, working-memory and other designs in which trials are interleaved in different ways can be accommodated easily. Once the Project parameters are specified, each day WaterMaze tells the user which animal to run next and to which platform. Even the most complex experiments can be run accurately and efficiently, for high-throughput experiments.

WaterMaze's **analysis** capabilities are unparalleled. Analyses can be viewed for single trials or exported for multiple trials directly to Excel. Scan through hundreds of trials easily with clickable animal and trial lists. Parameters include thigmotaxis, Moser's zones, Whishaw's corridor, Gallagher's proximity, quadrant times and crossings and more. Suggestions for new analyses from our users are regularly incorporated. Swim paths can be exported to standard drawing programs. Movies of each trial can be stored and viewed in the WaterMaze Analysis windows or exported to PowerPoint and other presentation software.



WaterMaze's **tracking** is robust and easy to set up with standard CCD cameras and video boards. No special lighting or video-processing hardware is necessary. Landmarks or other cues can be arranged in and around the pool without affecting tracking; the animal being tracked need not be darker or lighter than these objects. Multiple remote control switches can be placed around the pool, and the program can control multiple On-Demand (Atlantis) Platforms. Movies of each trial can be stored for later review or for export to PowerPoint or other presentation software.

WaterMaze goes far beyond existing programs in its ease of use and flexibility. Because it is designed in close consultation with users, WaterMaze is integrated seamlessly with the experiment. It is already in use in excellent laboratories in academia and in industry, including the laboratory where the watermaze was originally developed, and is poised to become the industry standard.

## The WaterMaze Project Manager

The Project Manager is designed to keep track of complex trial sequences for up to 50 animals at a time. The trial sequence for each animal can be specified independently. And for each animal, the number of trials to be performed, start position, and the platform position (or sequence of different platforms) can be different on each day. The program can be set such that each animal gets all its daily trials together before the next animal is run, or with all animals being trained on one trial before they are moved on to the next.

No matter how complex the experiment is, the Project Manager keeps track and tells the user at the start of each day how many trials are to be run for each animal. Then, through the course of a day's experiment, the program prompts the user for each animal in turn, showing on the video image the platform position and the starting location for the animal. If necessary, preset sequences can be overridden and trial performed in any user-specified order. At the end of each trial, data are saved in prenamed files automatically. Problem animals can be removed from the project at any time with the click of a button.

For all its flexibility, WaterMaze is easy to use. Because we are WaterMaze users as well as designers, we have taken extra care to make WaterMaze a natural extension of the experiment itself. Controls and menus are placed in logical and intuitive arrangements, so that even a complex protocol can be set up in a few minutes. Anyone familiar with Microsoft Windows will have no difficulty in learning to use **WaterMaze** quickly. **Help** routines are provided throughout the program.

## WaterMaze Analysis

The large image below shows a full-sized screen-shot of the Trial Viewer window. On the left is the complete list of animals in this project. The user has selected one animal for display by clicking on it. To the right of that is the list of all trials for the selected animal. The path and analyses for the selected trial are shown to the right.

The path window contains

- **Pool outline** (large blue circle)
- **Platform** (small blue circle)
- **Thigmotaxis corridor** (yellow circle). The width is adjustable.
- **Whishaw's corridor** (yellow box). The width is adjustable.
- **Gallagher's Proximity.** (Not shown)
- **Directionality vectors**(not shown).
- **Path points** (yellow dots)
- **Path corrected for tracking errors** (blue trace). There are no tracking errors in this trial.

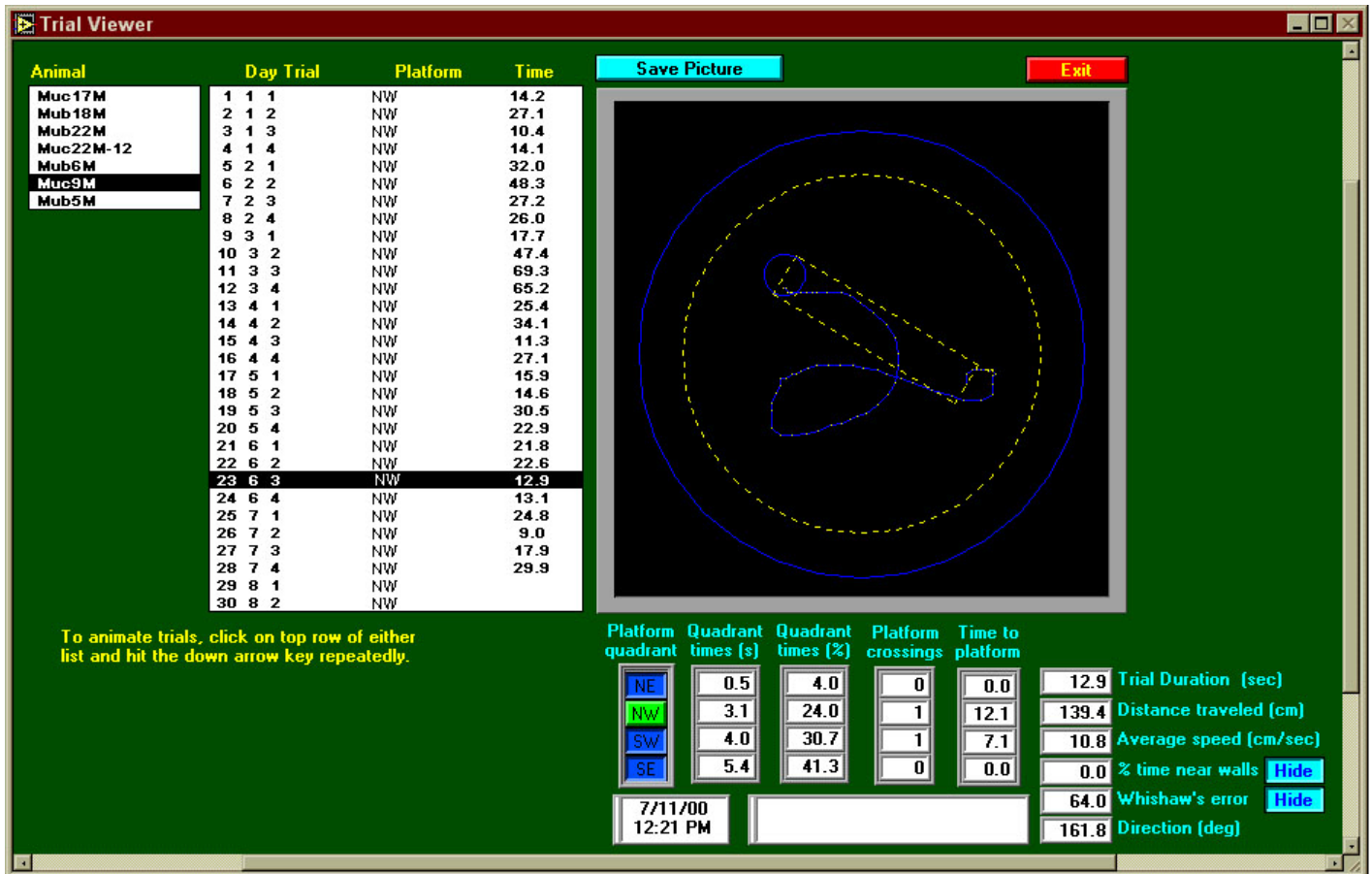
The colors of many the elements of the window can be changed by the user. The Save Picture button exports the picture to a post-script file, which is readable by

most presentation graphics programs. Below the path window are the parameters of the various analyses.

From a separate **Export** window, any combination of analysis parameters can be exported to a spreadsheet file for subsets of animals and trials.

A portion of a trial may be selected for analysis.

Double clicking on any trial in the trial list brings up the stored video of the trial in a separate window. The video can be exported to PowerPoint or other presentation software.



## WaterMaze Tracking

WaterMaze uses a state-of-the-art image-processing software and video-capture card. Images are acquired at up to 8 frames per second depending on computer speed. The program can track any moving object in the scene, identifying the swimming animal whether it swims over objects that are lighter or darker than it. A unique algorithm screens out changing shadows and lighting changes that might occur during the trial, making for rock-solid tracking. An on-line interpolation routine identifies and smoothes occasional loss of signal that can occur if an animal swims briefly underwater or under hanging cue objects. The path taken, with interpolated values, can be displayed in real time as the trial proceeds.

The image below is a screen shot of the tracking window. The yellow cursor over the mouse shows the computer's estimate of the current position of the animal. The yellow dots show the path taken by the animal.

At the end of each trial, the experimenter can type in notes concerning the trial just completed. After the intertrial interval, whose duration is specified by the experimenter, the path taken by the animal is automatically saved for later analysis (with other useful information about the trial). The program then displays the animal and platform location to be run on the next trial in the experimental sequence.

No special lighting is needed for WaterMaze to track animals. A few standard incandescent or halogen lamps placed strategically around the pool are sufficient. A special set-up window can be used to measure the evenness of lighting across the pool surface, which helps to eliminate deep shadows.

Remote switches can be used to start, stop and save trials. Multiple switches for each function can be placed around the pool if desired. With the program in auto-sequence mode, multiple trials can be performed without using the mouse or keyboard.

