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neuroscience™
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Bussey-Saksida

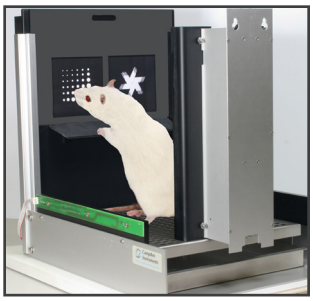
Touch Screen Chambers for Rodents

- ✓ Prewritten standard paradigms available with established neuro-pathological relevance
- ✓ Tasks translate directly to validated monkey and human touch models e.g. CANTAB
- ✓ Published use in psychological and pharmaceutical research journals
- ✓ Easily write your own customized schedules
- ✓ Bring animals to criteria in just a few weeks or even days
- ✓ Modular design allows for quick and versatile screening

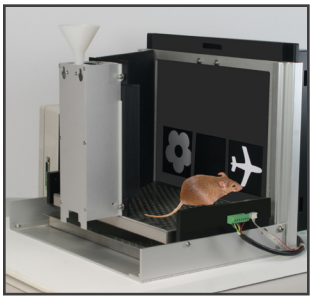
Paradigms

Our Bussey-Saksida Touch Screen Chambers for Rats and Mice are designed for the efficient and high-throughput cognitive evaluation of rodents. For these systems we offer many standard paradigms, prewritten to include the entire battery of tasks necessary to habituate, shape, and bring the animal to criteria on that particular application, as well as collect and analyze data. These standard tasks, described here, translate directly to well established monkey and human touch models.* The pre-written task schedules and analysis files are customizable to your research requirements.

Two-choice Pairwise/Visual Discrimination Reversal (PD)



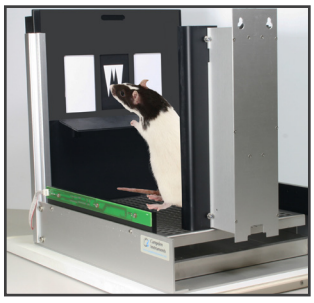
The task involves learning that one of two shapes displayed simultaneously on the screen is correct. Touching the correct stimuli (S+) will be rewarded with food. Touching the incorrect stimuli (S-) will be punished with a timeout. Once the task has been learned, the stimuli are reversed so that the S+ stimuli now becomes the S- stimuli and vice versa. This reversal learning requires inhibition of prepotent responses and is known to be dependant on the prefrontal cortex.



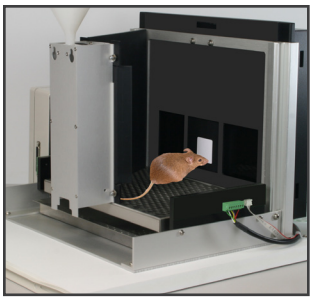
Paired Associate Learning (PAL)

In humans, a similar task has proved to be highly effective for the early detection of Alzheimer's disease. In the PAL task for rodents, subjects learn and remember which of three objects goes in which of three spatial locations. On a given trial, two different objects are presented; one in its correct location; the other in an incorrect location. The subject must choose which stimulus is in the correct location. The task has been shown to be sensitive to cholinergic transmission and to hippocampal dysfunction and can dissociate glutamate from acetylcholine receptor function in the hippocampus.

Visuomotor Conditional Learning (VMCL)



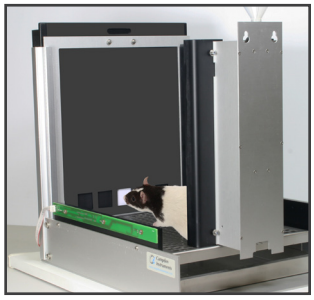
This is a habit or stimulus-response task in which the rodent learns a rule of the type "If shape A is presented, respond to the left location; if shape B is presented, respond to the right location". This type of test is sensitive to damage in the dorsal striatum and is therefore relevant to Huntington's and Parkinson's disease.



Extinction (EXT)

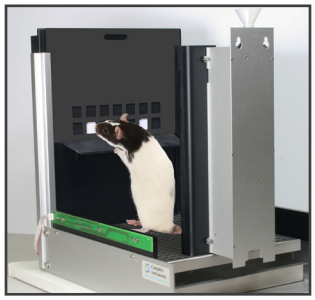
The task is very simple, but powerful. Like reversal, it is a test of behavioural inhibition, but with different requirements. In fact, some animals are impaired on reversal, but not extinction, and vice versa. Subjects are first required to respond to a white square presented in the center window to obtain reward. Once criterion is reached, extinction of the response is tested in sessions where responses to the stimulus are no longer rewarded.

5-Choice Serial Reaction Time (5CSRT)



This task requires the rodent to respond to a brief visual stimuli presented randomly in one of 5 locations. This task in rodents is sensitive to cortical manipulations, especially those involving prefrontal cortex, and is highly dependent on cholinergic transmission.

Paradigms

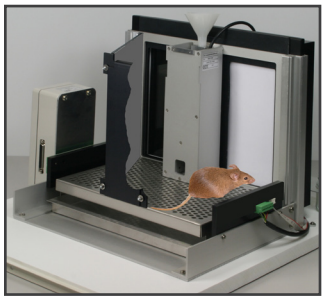


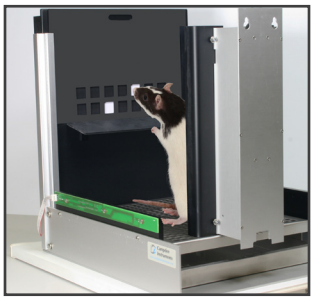
Trial-Unique Nonmatching-to-Location (TUNL)

TUNL can be thought of as a version of delayed nonmatching-to-place (DNMTP), in which the subjects are presented with a sample location, and following a delay, with the (incorrect, S-) sample location and a (correct, S+) nonmatching location. DNMTP has been shown to be vulnerable to non-spatial mediating strategies. TUNL eliminates these problems by using multiple, trial-unique locations, preventing the use of mediating strategies. Animals with lesions in the dorsal hippocampus or decreased hippocampal neurogenesis were impaired when the locations were close together, but not when they were far apart. This feature also renders the task exquisitely sensitive to hippocampal dysfunction, tapping both the role of the hippocampus in memory and in pattern separation.

Autoshaping (AUTO)

The task measures a Pavlovian response to the screen. This is a rapidly administered test of simple classical conditioning that is dependent on a reward system centered on the ventral striatum. White vertical rectangles are presented on either side of the reward tray. One side is always followed by delivery of food reward, the other never. Reward is independent of screen approach. Approaches to the screen are measured via an IR beam detector either side of the food tray.



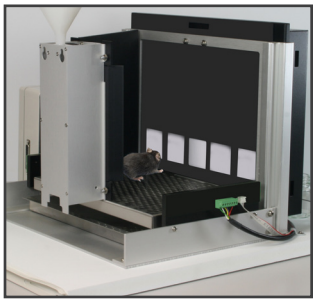


Location Discrimination (LD)

The rodents are required to discriminate between two white squares on the screen. Responses to squares on one side of the screen will be rewarded, while responses on the other side of the screen will be punished with a timeout period. The distance between the two squares is varied from trial to trial. Animals with lesions in the dorsal hippocampus are impaired when the locations are close together, but not when they were far apart.

5-Choice Continuous Performance Test (5C-CPT)

Like the 5-choice serial reaction task, this task requires the rodent to respond to .a brief visual stimulus presented randomly in one of 5 locations. In addition some trials present visual stimuli in all five locations together and for these trials the subject must learn to withhold a response. This go/no-go task measures both attentional and inhibitory systems within a single task paradigm, enabling the assessment of vigilance.



Easy to Write Customized Schedules

In addition to supporting the standard tasks listed previously, the hardware and software that make up the Bussey-Saksida System are designed to provide every principle investigator the tools to build unique schedules to meet their exact research needs. Add images or special criterion to an existing task or start from scratch using the Schedule Builder tab of the ABET II Touch software.

*** References**

Bussey TJ, Holmes A, Lyon L, Mar AC, McAllister KAL, Nithianantharajah J, Oomen CA, Saksida LM. New translational assays for preclinical modelling of cognition in schizophrenia: The touchscreen testing method for mice and rats. *Neuropharmacology*. **2012** Mar;62(3):1191-203. Epub 2011 Apr 21.

Talpos JC, Winters BD, Dias R, Saksida LM, Bussey TJ. A novel touchscreen-automated paired-associate learning (PAL) task sensitive to pharmacological manipulation of the hippocampus: a translational rodent model of cognitive impairments in neurodegenerative disease. *Psychopharmacology (Berl)*. **2009** Jul;205(1):157-68. Epub 2009 Apr 9.

Paradigms

Animals can learn quickly and be conditioned rapidly!

Task	Typical time to reach baseline (post-pretraining) RATS	Typical time to reach baseline (post-pretraining) MICE (depends on strain and age)	Example neural systems involved	Clinical area showing impairment
Pretraining to touch an image and initiate a trial (PD, PAL, LD, VMCL & TUNL)	1-2 weeks	1-2 weeks (e.g., 7-8 week old C57BL6J mice: 5 days)		
Pairwise / Visual Discrimination (PD)	5-7 days	5-7 days for young mice	Prefrontal Cortex, Perirhinal Cortex, Striatum, Dopamine system, Cholinergic system, NMDA receptors	Huntington's, Schizophrenia, Parkinson's
Paired Associate Learning (PAL)	35-45 sessions to 80%	35-45 sessions to 70%	Hippocampus, Cholinergic system, NMDA Receptors, AMPA Receptors	Alzheimer's, Schizophrenia
Visuomotor Conditional Learning (VMCL)	approximately 20 sessions	approximately 20 sessions	Dorsal Striatum, Posterior Cingulate Cortex	Huntington's, Parkinson's
Location Discrimination Learning (LDL)	2-4 weeks	2-4 weeks	Hippocampus, Neurogenesis	Alzheimer's, Schizophrenia, Depression
Trial-Unique Nonmatching-to-Location (TUNL)	approximately 4 weeks	Not proven with mice	Hippocampus, Cholinergic system, NMDA Receptors	Alzheimer's
5 Choice Serial Reaction Time (5CSRT)	30 sessions	Pretraining (ave 10 days) + 3 weeks to 80% @ 2 sec baseline	Prefrontal Cortex, Basal Forebrain, Cholinergic (Accuracy), Serotonin (Impulsivity), Noradrenaline (Distraction), Dopamine (Motivation)	Alzheimer's, Depression, Huntington's, Schizophrenia, ADHD, OCD
Autoshaping (AUTO)	several sessions	several sessions	Ventral Striatum, Amygdala, Anterior Cingulate Cortex	Huntington's
Extinction (EXT)	approximately 4 days training + a few days extinction	approximately 4 days training + a few days extinction		ADHD, OCD

About the Task Paradigms

Rat and Mouse Paradigms for the Bussey-Saksida Touch Screen Chambers, by arrangement with the University of Cambridge technology company, CEL. All paradigms include the training routines as well as the main experimental paradigm and the data analysis sets.

The CamTouch Technical Standard

The industry standard for touch screen hardware and software.

All Bussey-Saksida Touch Screen Tasks, developed at the University of Cambridge, are performed on hardware conforming to the following technical standard. This standard defines all aspects of the animal's interactions.

Due to the complexity of touchscreen system hardware, electronics and software this standard ensures conformity. Comparisons are valid and simple to carry out.

Display of the Stimulus

Display Type
- TFT

Screen Size
- Mice: 12.1 inch (landscape)
- Rats: 15.0 inch (portrait)

Screen Resolution
- Mice: 800 x 600
- Rats: 768 x 1024 (rotated)

Screen Refresh Rate
- 60Hz

Image Format
- Bitmap

Image Size and Shape
- Task specific
  (based on grid size – scaled or cropped to fit)

Mask Dimensions
- Relates to image size and shape (task specific)

Software Image Presentation
- Whisker® *www.whiskercontrol.com*
  ABET II Touch® (Whisker Client) Lafayette Instrument
  images held in cache memory for presentation timing and concurrent display

Chamber Environment

Bussey Trapezoidal Walls
- Mice: 185mm
- Rats: 345mm

Environment Square Area
- Mice: 188 cm^2
- Rats: 368 cm^2

Perforated Floor
- Mice: 6mm diameter with 9mm pitch
- Rats: 10mm square with 14mm pitch

Mask Dimensions
- Task specific (as above)

Recording of the Response

Touch Array and Sensitivity
- Infra-red with increased sensitivity

Touchscreen Computer Specifications
- 2.5GHz Pentium Dual Core
- 4GB RAM
- Configure for multiple IR array and Multiple SVGA
- Network system (if installed) to be free from interference by running of other applications, especially anti-virus and other security software scanning

Software for Touch Capture
- Universal Pointer Device Driver (UPDD)
  www.touchbase.com
- Whisker® *www.whiskercontrol.com*
- ABET II Touch® (Whisker Client) Lafayette Instrument Company

Reward Systems

Rat
- 45mg grain based food pellet

Mouse
- Sweet liquid reward calibrated to 7ul

Evolving Standards

We anticipate that The CamTouch Standard will evolve as more tasks are developed.

Currently under development
- Visual acuity test
- Moving images tasks

Other chamber configurations that have already been developed, include
- Grid bar floor
- Plain floor
- Square smooth-sided walls
- Square modular walls

Hardware

Modular, adjustable design allows for high throughput screening.

- The Bussey-Saksida chamber has a unique trapezoidal wall shape to focus the animal's attention and is made from machined parts that simply slot together. The chamber can also be configured to a modular square chamber with panels, levers, lights, and a range of other operators.
- The reward tray can be moved to a position in front of the screen for tasks such as Pavlovian Autoshaping, and to the rear of the chamber for tasks such as Pairwise / Visual Discrimination.
- Not just a touch screen, this is the ultimate modular chamber for high throughput. For example, do Visual Discrimination and Reversal in the morning and Five Choice Serial Reaction Time Task in the afternoon.
- To enable such a high throughput, the chamber can be taken apart and reassembled in seconds for easy cleaning.

Trapezoidal Wall Configuration

Easy-Install System

The Easy-Install was developed for the Bussey-Saksida Touchscreen Systems due to the large number of cables and connections that these systems require. Designed as a factory built, pre-cabled system that could be taken from a transit crate in one piece and wheeled into place, the Easy-Install eliminates the effort needed to handle, move, and install individual stations and their connections to the system interface and control.

AC power connections are made to an integrated supply bus requiring only one plug going to a single AC outlet. This reduces the number of AC cables and provides for a safer environment as earth grounding is properly terminated.

Computer and Interface connections are easily made as all cables are routed to the PC location, above the cubicles. The user's monitor, keyboard and mouse can be located away from the system as needed. Note: Computer and Interface are not part of the Easy-Install these are purchased separately. Workstation monitor, keyboard, and extra length cables are also sold separately.

Customized system integrations are available upon request.

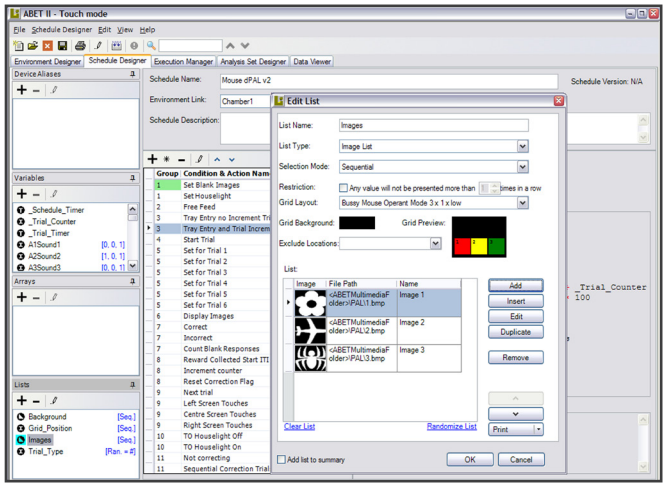
Easy-Install System

Software

Sophisticated and user-friendly operant software makes controlling your chamber easy!

ABET II Touch Software for Operant Control

The standard Bussey-Saksida applications have been created using the ABET II Touch Software. The standard paradigm or schedule is sold as .abetSch format that the user may edit and modify. The images used in the standard applications are also available for use in new original schedules created by the user, or user generated images may be added to the image list. Every effort has been made to make this intuitive and logical to the non-programmer, but we are on stand by, ready to assist in your efforts to produce original research.



ABET II Touch Software Components and Features

Execution Manager

- Load a purchased application or user created schedule on a single chamber or multiple chambers with a single operation
- Adjust Variable values if required globally or by individual test chamber
- Enjoy the security of the most comprehensive results database of any system

Data Analysis and Raw Data Viewer

- Prepared Data Analysis Sets are provided with each purchased application
- Load one or multiple sessions for viewing
- Select your data source, date range, or multiple selection criteria to isolate only the sessions of interest
- Display Session information, raw data, event totals, reduced data, IRT's, and Bins
- Summarize data from multiple datasets with analysis filter and report generator
- Copy or export selected data or entire data views to Excel® or a statistical package of your choice

Schedule Designer

- Create a schedule in a single workspace with user friendly tools. You point and click while ABET II writes the code.
- Label and define simple variables, timers, counters, constants, and lists as needed
- Draw from lists in truly random order, random without repeat, random without replacement or sequential order

Whisker® Multimedia

ABET II Touch relies on the ***Whisker***® operating system to control the advanced graphical output on multiple screens, and touchscreen input from multiple chambers when running the Bussey-Saksida Rat and Mouse Test Chambers. This is the same underlying platform used in the CANTAB test stations. This product has been cited in over 142 publications across more than 34 journals.

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The Bussey-Saksida Chambers and ***WhiskerServer***® originate from the department of Prof. Trevor Robbins, Experimental Psychology, University of Cambridge, England.