Bussey-Saksida Touch Screen

Standard Tasks and Bibliography

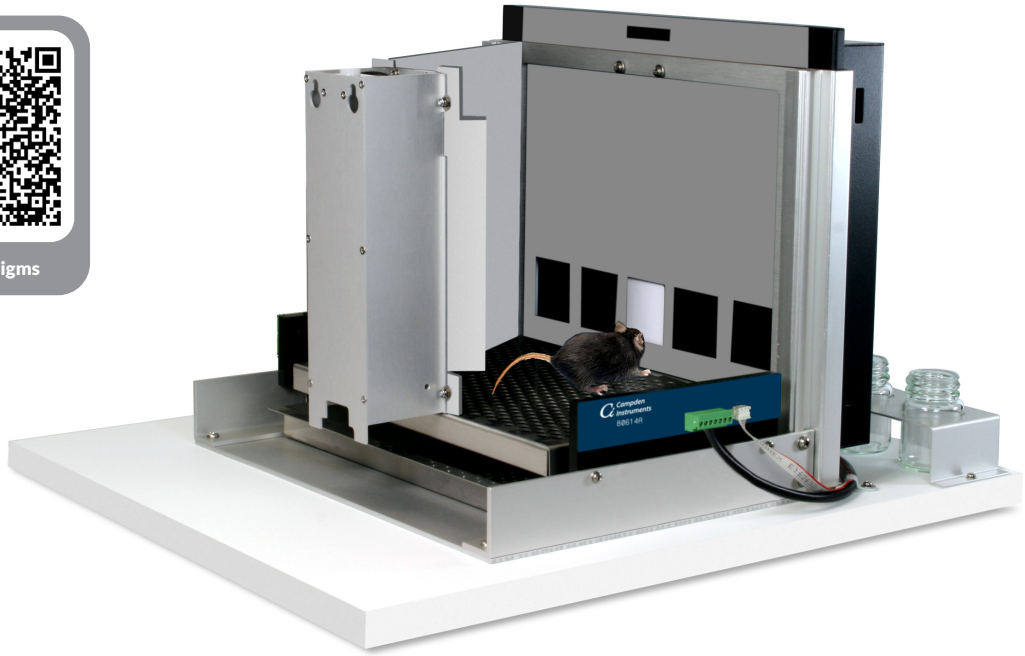
Campden Instruments

STANDARD PARADIGMS

Prewritten Standard Paradigms with established neuro-pathological relevance.

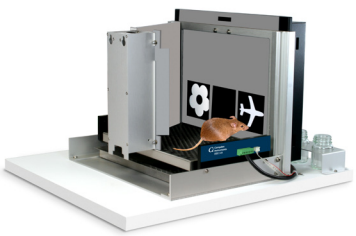
The Bussey-Saksida Touch Screen Chambers for Rats and Mice are designed for the **efficient and high-throughput cognitive evaluation** of rodents. There are many standard paradigms prewritten to include the entire battery of tasks necessary to **habituate, shape, and bring the animal to criteria** on 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.

View Paradigms



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.

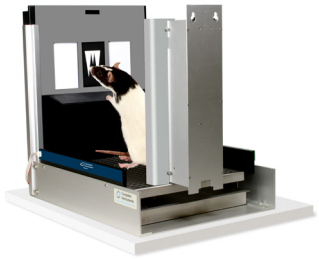


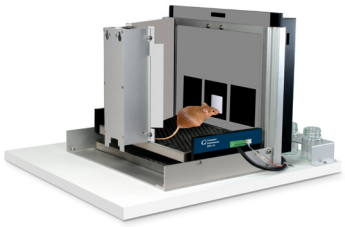
Paired Associate Learning (PAL)

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.



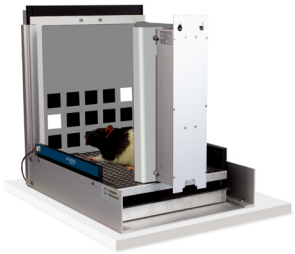


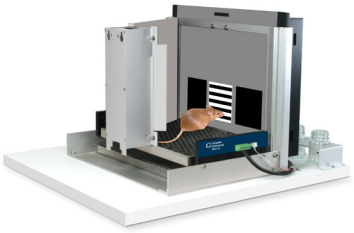
Extinction (EXT)

The task is very simple, but powerful. Like reversal, it is a test of behavioral 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.

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. A simpler version using 5 positions is available for mice.



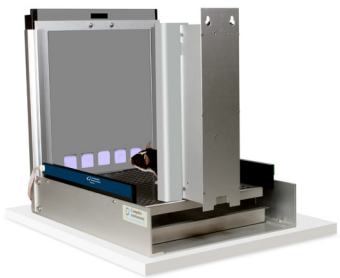


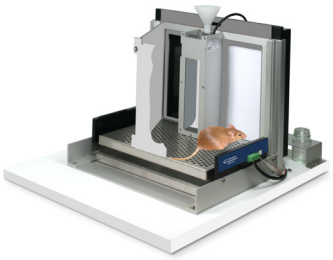
Rodent Continuous Performance Test (rCPT)

In the rodent Image CPT task, 5 different black and white images are used. They are shown briefly, one at a time and in a random order, on the touch screen. One of the images is designated the target stimulus. In order to obtain reward, the subject must touch the target stimulus and withhold from touching the non-target stimuli. This task keeps the differences between pre-clinical and clinical attention tasks to a minimum.

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.





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)

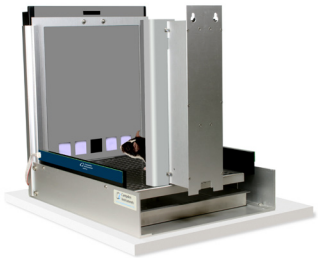
The subject is required to discriminate between two white squares on the screen. Responses to squares on one side of the screen will be rewarded, while responses on the other side of the screen will be punished with a timeout period. The distance between the two squares is varied from trial to trial.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

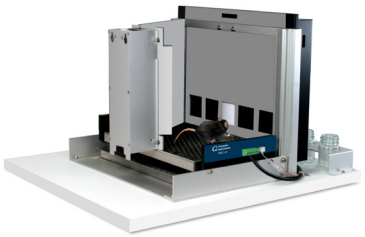
5-Choice Continuous Performance Test (5C-CPT)

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.

4-Choice Gambling Task (4C-GT)

Based on the Iowa Gambling Task, the rodent chooses from four illuminated windows. A touch in any of the windows will result in either a Win (food reward is delivered) or a Loss (timeout period with no reward). Each window is associated with a different amount of reward. The larger the associated reward, the lower the probability of receiving a Win and the longer the timeout if the trial results in a Loss. The subject must learn to avoid the high-risk, high-reward options in order to maximize earnings. The test is sensitive to serotonergic and dopaminergic agents.





Progressive Ratio (PR) and Effort-Related Choice (ERC) Tasks

The touch screen version of the ERC and PR tasks are designed to be equivalent to tasks commonly done with levers and nose pokes. Subjects must touch the screen progressively more times to receive reward. Comparing the touch screen results with the non-touch screen literature it is evident that the touch screen paradigm produces less variable data (consequently, easier to detect significant effects) and is more sensitive to manipulations which promote PR performance (useful when screening for drugs to alleviate low motivation).

RODENT TOUCH SCREEN BIBLIOGRAPHY

Collection of Relevant Research.

Task Overview and Optimization and Species Translation

Phillips BU, Heath CJ, Ossowska Z, Bussey TJ, Saksida LM. Optimisation of cognitive performance in rodent operant (touchscreen) testing: Evaluation and effects of reinforcer strength. *Learn Behav.* ***2017*** Feb 15. ***[PR, PD]***

Teemu Aitta-aho, Benjamin U. Phillips, Elpiniki Pappa, Y. Audrey Hay, Fiona Harnischfeger Christopher J. Heath, Lisa M. Saksida, Tim J. Bussey, and John Apergis-Schoute. Accumbal Cholinergic Interneurons Differentially Influence Motivation Related to Satiety Signaling. *eNeuro*. ***2017*** Mar-Apr; 4(2): ENEURO.0328-16.2017. ***[PR]***

Regina McCenery. Strawberry Milkshake Forever. *Eureka*, ***2016***, June 20. - http://www.criver.com/about-us/eureka/blog/june-2016/strawberry-milkshakes-forever.

Shepherd A, Tyebji S, Hannan AJ, Burrows EL. Translational Assays for Assessment of Cognition in Rodent Models of Alzheimer's Disease and Dementia. *J Mol Neurosci*. ***2016*** Nov;60(3):371-382.

Hvoslef-Eide M, Nilsson SR, Saksida LM, Bussey TJ. Cognitive Translation Using the Rodent Touchscreen Testing Approach. *Curr Top Behav Neurosci*. ***2016***;28:423-47. ***[5-CSRT, PAL, rCPT]***

Jared W. Young, J David Jentsch, Timothy J Bussey, Tanya L Wallace, and Daniel M Hutchenson. Consideration of species differences in developing novel molecules as cognition enhancers. *Neurosci Biobehav Rev*. ***2013*** Nov; 37(9 0 0). ***[PD, PAL]***

Oomen CA, Hvoslef-Eide M, Heath CJ, Mar AC, Horner AE, Bussey TJ, Saksida LM. The touchscreen operant platform for testing working memory and pattern separation in rats and mice. *Nat Protoc*. ***2013*** Oct;8(10):2006-21. ***[LD, TUNL]***

Mar AC, Horner AE, Nilsson SR, Alsiö J, Kent BA, Kim CH, Holmes A, Saksida LM, Bussey TJ. The touchscreen operant platform for assessing executive function in rats and mice. *Nat Protoc*. ***2013*** Oct;8(10):1985-2005. ***[PD, 5-CSRT, Ext]***

Horner AE, Heath CJ, Hvoslef-Eide M, Kent BA, Kim CH, Nilsson SR, Alsiö J, Oomen CA, Holmes A, Saksida LM, Bussey TJ. The touchscreen operant platform for testing learning and memory in rats and mice. *Nat Protoc*. ***2013*** Oct;8(10):1961-84. ***[PD, Auto, VMCL, PAL]***

Nithianantharajah J, Grant SG. Cognitive components in mice and humans: combining genetics and touchscreens for medical translation. *Neurobiol Learn Mem*. ***2013*** Oct;105:13-9.

Timothy J. Bussey, Deanna M. Barch. Mark G. Baxter. Testing long-term memory in animal models of schizophrenia: Suggestions from CNTRICS. *Neuroscience and Biobehavioral Reviews* ***2013*** Nov;37(9 Pt B):2141-8.

Test Batteries

Benevento M, Oomen CA, Horner AE, Amiri H, Jacobs T1, Pauwels C, Frega M, Kleefstra T, Kopanitsa MV, Grant SG, Bussey TJ, Saksida LM, Van der Zee CE, van Bokhoven H, Glennon JC, Kasri NN. Haploinsufficiency of EHMT1 improves pattern separation and increases hippocampal cell proliferation. *Sci Rep*. ***2017*** Jan 10;7 ***[PD, PAL, LD, Ext]***

Nilsson SR, Celada P, Fejgin K, Thelin J, Nielsen J, Santana N, Heath CJ, Larsen PH, Nielsen V, Kent BA, Saksida LM, Stensbøl TB, Robbins TW, Bastlund JF, Bussey TJ, Artigas F, Didriksen M. A mouse model of the 15q13.3 microdeletion syndrome shows prefrontal neurophysiological dysfunctions and attentional impairment. *Psychopharmacology (Berl)*. ***2016*** Jun;233(11):2151-63. ***[5-CSRT, PD, PAL, Ext, PR, TUNL]***

Hvoslef-Eide M, Mar AC, Nilsson SR, Alsiö J, Heath CJ, Saksida LM, Robbins TW, Bussey TJ. The NEWMEDS rodent touchscreen test battery for cognition relevant to schizophrenia. *Psychopharmacology (Berl)*. ***2015*** Nov;232(21-22):3853-72 ***[5-CSRT, rCPT, PD, TUNL PAL]***

DePoy L, Daut R, Brigman JL, MacPherson K, Crowley N, Gunduz-Cinar O, Pickens CL, Cinar R, Saksida LM, Kunos G, Lovinger DM, Bussey TJ, Camp MC, Holmes A. Chronic alcohol produces neuroadaptations to prime dorsal striatal learning. *Proc Natl Acad Sci U S A*. ***2013*** Sep 3;110(36):14783-8. ***[PD, Auto, Ext]***

Jess Nithianantharajah, Noboru H Komiyama, Andrew McKechanie, Mandy Johnstone, Douglas H Blackwood, David St Clair, Richard D Emes, Louie N van de Lagemaa, Lisa M Saksida, Timothy J Bussey, Seth G N Grant. Synaptic scaffold evolution generated components of vertebrate cognitive complexity. *Nature Neuroscience* ***2013*** Jan;16(1):16-24. ***[5-CSRT, PD, PAL, Ext, Auto]***

Progressive Ratio (PR) and Effort-Related Choice Task (ERC)

Heath CJ, Phillips BU, Bussey TJ, Saksida LM. Measuring Motivation and Reward-Related Decision Making in the Rodent Operant Touchscreen System. *Curr Protoc Neurosci*. ***2016*** Jan 4;

Heath CJ, Bussey TJ, Saksida LM. Motivational assessment of mice using the touchscreen operant testing system: effects of dopaminergic drugs. *Psychopharmacology (Berl)*. ***2015*** Nov;232(21-22):4043-57.

Gambling Task (4C-GT)

Wha Young Kim, Bo Ram Cho, Myung Ji Kwak, and Jeong-Hoon Kim. Interaction between trait and housing condition produces differential decision-making toward risk choice in a rat gambling task. *Sci Rep*. ***2017***; 7: 5718.

Rodent Continuous Performance Test (rCPT)

Adam C. Mar, Simon R. O. Nilsson, Begoña Gamallo-Lana, Ming Lei, Theda Dourado, Johan Alsiö, Lisa M. Saksida, Timothy J. Bussey, and Trevor W. Robbins. MAM-E17 rat model impairments on a novel continuous performance task: effects of potential cognitive enhancing drugs. *Psychopharmacology (Berl)*. ***2017***; 234(19): 2837–2857.

Kim CH, Hvoslef-Eide M, Nilsson SR, Johnson MR, Herbert BR, Robbins TW, Saksida LM, Bussey TJ, Mar AC. Erratum to: The continuous performance test (rCPT) for mice: a novel operant touchscreen test of attentional function. *Psychopharmacology (Berl)*. ***2016*** Sep;233(18):3471.

Beraldo CH, Hvoslef-Eide M, Nilsson SR, Johnson MR, Herbert BR, Robbins TW, Saksida LM, Bussey TJ, Mar AC. The continuous performance test (rCPT) for mice: a novel operant touchscreen test of attentional function. *Psychopharmacology (Berl)*. ***2015*** Nov;232(21-22):3947-66.

Pairwise/Visual Discrimination and Reversal (PD) – over 30 papers including

Bergstrom et al., Dorsolateral Striatum Engagement Interferes with Early Discrimination Learning. *Cell Reports* ***2018***, https://doi.org/10.1016/j.celrep.2018.04.081

Karly M. Turner, Christopher G. Simpson, and Thomas H. J. Burne. BALB/c Mice Can Learn Touchscreen Visual Discrimination and Reversal Tasks Faster than C57BL/6 Mice. *Front Behav Neurosci*. ***2017***; 11: 16.

Paired Associate Learning (PAL) - a further 9 papers including

Kim CH, Heath CJ, Kent BA, Horner AE, Bussey TJ, Saksida LM. Erratum to: The role of the dorsal hippocampus in two versions of the touchscreen automated paired associates learning (PAL) task for mice. *Psychopharmacology (Berl)*. ***2015*** Dec;232(24):4537

Visuo-Motor Conditional Learning (VMCL) – a further 3 papers including

Chudasama Y, Bussey TJ, Muir JL. (2001) Effects of selective thalamic and prelimbic cortex lesions on two types of visual discrimination and reversal learning. *Eur J Neurosci*. Sep;14(6):1009-20.

5-Choice Serial Reaction Time (5CSRT) - a further 8 papers including

Carola Romberga, Timothy J. Bussey Lisa M. Saksida. Paying more attention to attention: Towards more comprehensive cognitive translation using mouse models of Alzheimer's disease. *Brain Research Bulletin* ***2013*** Mar;92:49-55.

Trial-Unique, Delayed Nonmatching-to-Location (TUNL) - a further 6 papers including

Kim CH1, Romberg C, Hvoslef-Eide M, Oomen CA, Mar AC, Heath CJ, Berthiaume AA, Bussey TJ, Saksida LM. Trial-unique, delayed nonmatching-to-location (TUNL) touchscreen testing for mice: sensitivity to dorsal hippocampal dysfunction. *Psychopharmacology (Berl)*. ***2015*** Nov;232(21-22):3935-45.

Location Discrimination (LD) - a further 5 papers including

Coba MP, Komiyama NH, Nithianantharajah J, Kopanitsa MV, Indersmitten T, Skene NG, Tuck EJ, Fricker DG, Elsegood KA, Stanford LE, Afinowi NO, Saksida LM, Bussey TJ, O'Dell TJ, Grant SG. TNiK is required for postsynaptic and nuclear signaling pathways and cognitive function. *J Neurosci*. ***2012*** Oct 3;32(40):13987-99.

Video Touch

Jeffrey N.Stirman,, Leah B.Townsend, Spencer, L.Smith. A touchscreen based global motion perception task for mice. *Vision Research*, ***2016***, (127) 74-83

Further References

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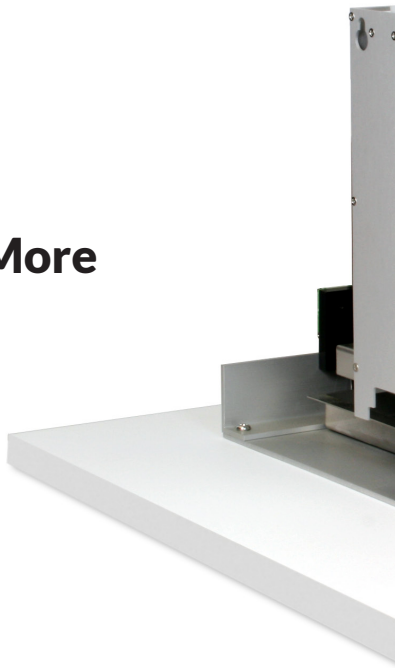

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