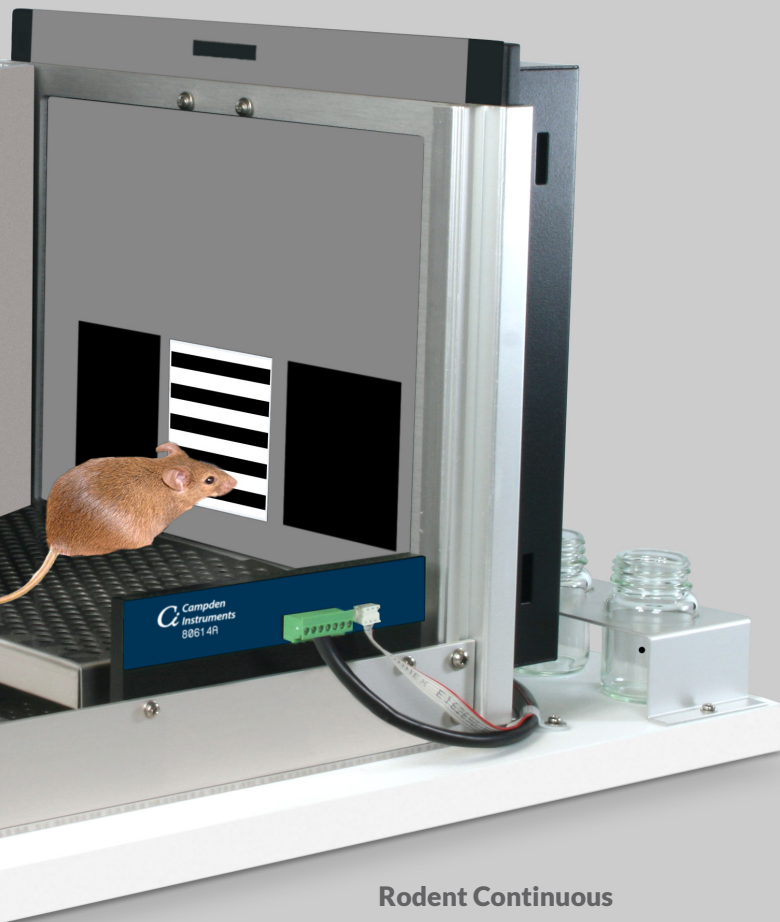# Bussey-Saksida

## The Second Generation Touch Screen System

A Translational Cognition Task Battery



**Rodent Continuous Performance Task**



**Two-choice Visual Discrimination Reversal**

## Lafayette Instrument

# THE BEHAVIORAL COGNITION TEST BATTERY

**A decade of continuous development.**

## Where it all began

In 2009, Professors Tim Bussey and Lisa Saksida, of the Translational Cognitive Neuroscience Lab Cambridge University, England; began a partnership with Campden Instruments to enlist engineering & manufacturing expertise and the Bussey-Saksida Rodent Touchscreen System was born. This rodent system was a progression of the CANTAB touch screen systems for NHP and Human subjects used in cognitive testing and diagnosis.

## A decade of development

Campden Instruments has built **over 1800 individual Bussey-Saksida Touch Screen chambers for over 300 Research Groups in over 25 countries**, integrating many third-party systems including optogenetics, video tracking, photometry, wireless and tethered electrophysiology, modular designs for exercise and dietary studies, day- night environmental control, and air-puff aversive stimuli.

New - Day/Night dimmer-timer control option

## Successful species

The Grey Mouse Lemur and Tree Shrew have also successfully been published in the rodent touch screens along with the 14 standard Tasks for rat and mouse.
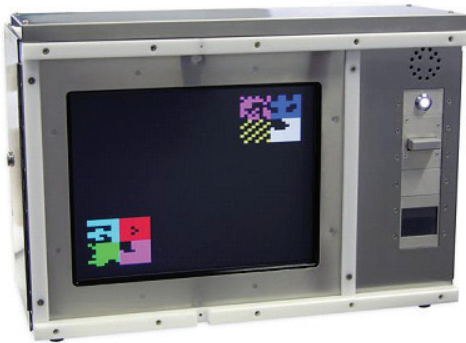
MCANTAB touch screen system

The multiple Task battery translates to primate species using the MCANTAB system include, Macaque, Squirrel Monkey, Rhesus, Baboon & Marmoset and human CANTAB Tasks.

MCANTAB and WhiskerServer® originate from the Department of Experimental Psychology, University of Cambridge, England. Whisker® has been cited in over 142 publications across more than 30 journals.

Bussey and Saksida are now resident at University of Western Ontario and provide a centre for the global community of researchers in rodent cognition.

## Full Paradigm task reference and bibliography is available

**Selected References**

Palmer, D., Dumont, J. R., Dexter, T. D., Prado, M. A. M., Finger, E., Bussey, T. J., & Saksida, L. M. (2021). Touchscreen cognitive testing: Cross-species translation and co-clinical trials in neurodegenerative and neuropsychiatric disease. In Neurobiology of Learning and Memory (Vol. 182, p. 107443). https://doi.org/10.1016/j.nlm.2021.107443

Lopez-Cruz, L., Bussey, T. J., Saksida, L. M., & Heath, C. J. (2021). Using touchscreen-delivered cognitive assessments to address the principles of the 3Rs in behavioral sciences. In Lab Animal (Vol. 50, Issue 7, pp. 174–184) https://doi.org/10.1038/s41684-021-00791-2
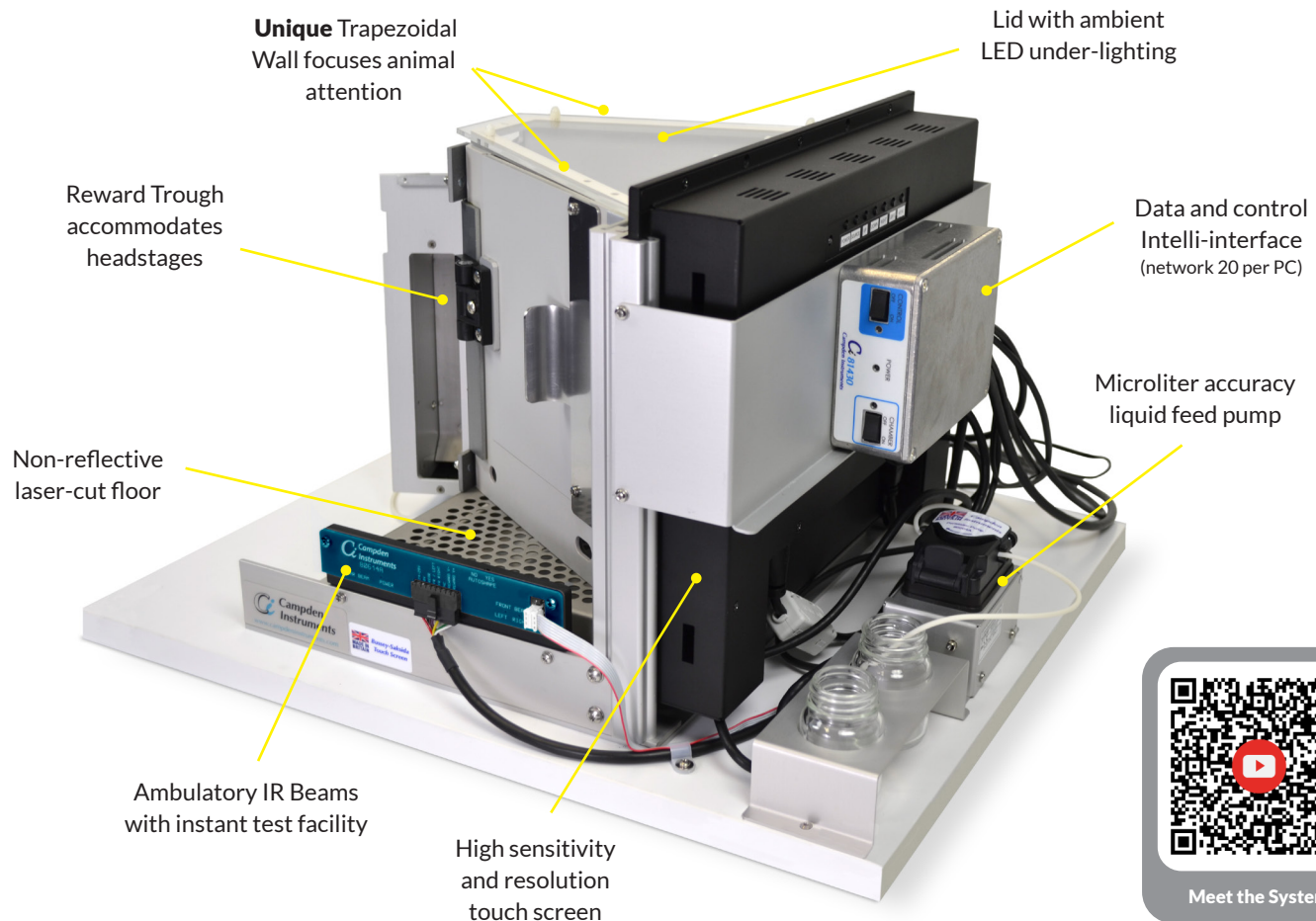
# THE SECOND GENERATION SYSTEM

## Evolution: The New Bussey-Saksida Chamber.

**Unique** Trapezoidal Wall focuses animal attention

Lid with ambient LED under-lighting

Reward Trough accommodates headstages

Data and control Intelli-interface (network 20 per PC)

Non-reflective laser-cut floor

Microliter accuracy liquid feed pump

Ambulatory IR Beams with instant test facility

High sensitivity and resolution touch screen

Meet the System

The Bussey-Saksida Chamber has always featured a **unique trapezoidal wall shape** in order to focus the animal's attention and facilitates the efficient and high-throughput cognitive evaluation of rodents. The chamber is **easily reconfigured** to a modular square arena with panels, levers, lights, and a range of other operators.

## New Features

- On-chamber intelli-interface, allows **up to 20 chambers to be networked to a single computer or laptop**
- Intelli-interface eliminates any possible interruption of the millisecond timing by third party software
- Opto-isolated TTL input and output lines available for 3rd party systems.
- Easier animal handling with side or top loading as standard
- Ambulatory motion IR beams now have an **instant test facility and greater sensitivity**
- **Video and observation is improved** by lighter walls and a non-reflective floor
- Chamber lid contains built-in ambient IR and visual LEDs for even lighting while eliminating reflectance and glare
- Reward trough has pellet and dual liquid feed options plus a wider aperture to accommodate head-staged animals
- Modular design **minimizes reconfiguration** to accommodate tethered animals and/or electrophysiology recording
- For Integration with electrophysiology, all contact points between animal and chamber (floor, reward trough etc.) have **optional electrical isolation** coating to prevent movement artefacts
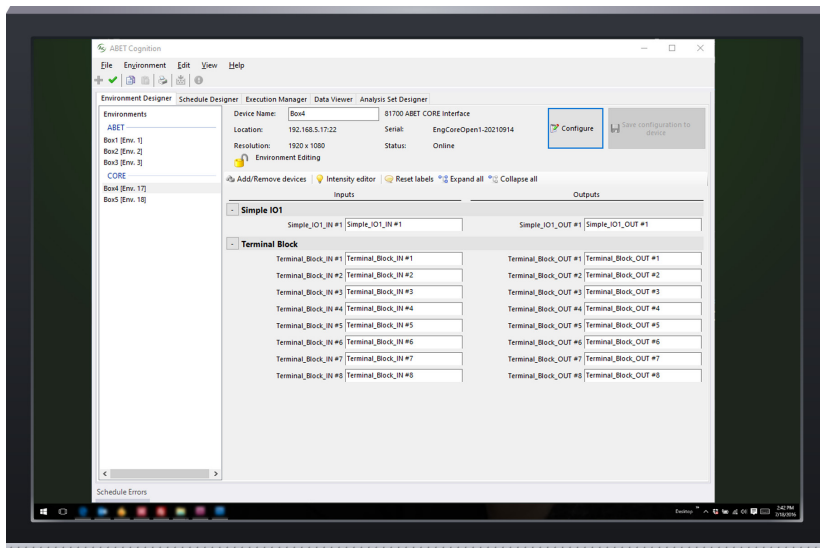
# OPERANT CONTROL SOFTWARE

## Sophisticated and user-friendly software makes controlling your chamber easy.

Tasks are designed to be plug and play and include all training stages

All Tasks can be edited for your own requirements

Write your own tasks from first principles and test them in the Virtual Interface

Import your own images and define on-screen location

## ABET Cognition

The standard Bussey-Saksida applications have been created using Lafayette Instrument's ABET Cognition software. ABET **controls all aspects of acquisition, control, and data analysis**. Standard Tasks with training are prepackaged in a format that the user may **easily use or edit and modify**. 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 Virtual Interface**
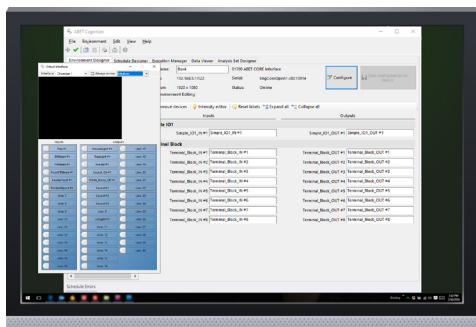
ABET Cognition can be installed on your office PC or laptop to use the Virtual Interface to duplicate the testing environment that you have in your lab - including a virtual touch screen giving a preview from the perspective of an animal. Write/program, review, and test schedules or analyse lab data while offline or disconnected from the lab hardware. Schedules and data are easily passed to and from your lab via a network connection or any removable media.

## Contact us for a demonstration!

### Touch Screen Webinar

A full Touch Screen webinar entitled **"Using Touchscreen Operant Systems to Study Cognitive Behaviors in Rodents"** is available from InsideScientific, by scanning this code on your mobile device or visiting: **https://youtu.be/JBh5BJ-kUuA**

**View Webinar**

# BENEFITS OF STANDARD PARADIGMS

## Prewritten Standard Paradigms with established neuro-pathological relevance.

**ABET allows usage of standard, original, and customized paradigms.** Standard Task Paradigms are available by arrangement with the University of Cambridge. Standard tasks include popular Tasks such as PD, PAL, 5CSRT, PRC, Location Discrimination, and many more. **All paradigms include training routines as well as the main experimental paradigm and the data analysis sets.** Full descriptions of standard paradigms are available upon request or by visiting our website.

| NHP/Human CANTAB Equivalent | Standard Tasks | Typical time to reach baseline RATS* | Typical time to reach baseline MICE* | Example neural systems involved | Clinical area showing impairment |
|---|---|---|---|---|---|
| NHP | Pretraining to touch an image and initiate a trial (All task except Auto and 5CSRT) | 1-2 weeks | 1-2 weeks (e.g., 7-8 week old C57BL6J mice: 5 days) | | Learning |
| Human/NHP | Pairwise / Visual Discrimination (PD) and Reversal Learning | Pretraining + 5-7 sessions test to reach base line | Pretraining + 5-7 sessions test to reach base line | Prefrontal Cortex, Perirhinal Cortex, Anterior Cingulate, Posterior Cingulate, Medial Frontal Cortex, Striatum, Dopamine system, Cholinergic system, NMDA receptors. Mediodorsal Nucleus of the Thalamus | Huntington's, Schizophrenia, Parkinson's, Learning, Cognitive Flexibility, Executive Function. |
| Human/NHP | Paired-Associate Learning Task for Rodents (PAL) | Pretraining + 35-45 sessions to 80% | Pretraining + 35-45 sessions to 70% | Hippocampus, Cholinergic system, NMDA Receptors, AMPA Receptors | Alzheimer's, Schizophrenia, Spacial Memory |
| NHP | Visuomotor Conditional Learning for Rodents (VMCL) | Pretraining + Approximately 20 sessions | Pretraining + Approximately 20 sessions | Dorsal Striatum, Posterior Cingulate Cortex | Huntington's, Parkinson's |
| Human/NHP | 5-choice Serial Reaction Time Task for Rodents (5CSRT) | ~30 sessions | Pretraining (ave 10 sessions) + 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 for Rodents (Auto) | Several sessions (no pretraining required) | Several sessions (no pretraining required) | Ventral Striatum, Amygdala, Anterior Cingulate Cortex, Nucleus Accumbens Dopamine, Pedunculopontine Tegmental Nucleus, D1 and NMDA receptors | Huntington's |
| Human/NHP | Trial-unique Nonmatching-to-Location Task for Rodents (TUNL) | Pretraining + Approximately 20 sessions | Pretraining + 6-24 Sessions to acquire the basic task | Hippocampus, Cholinergic system, NMDA Receptors, Prefrontal Cortex | Alzheimer's, Schizophrenia |
| NHP | Location Discrimination for Rodents (LD) | Pretraining + 10-20 sessions | Pretraining + 10-20 sessions | Hippocampus, Neurogenesis | Alzheimer's, Schizophrenia |
| NHP | Extinction for Rodents (EXT) | Approximately 4 sessions training + a sessions days extinction | Approximately 4 sessions training + a sessions days extinction | Infralimbic Cortex, Striatum and Amygdala | ADHD, OCD |
| Human | 5-Choice Continuous Performance Test for Rodents (5C-CPT) | Approximately 24 sessions (based on training in 5-hole box) | Approximately 13 sessions (based on training in 5-hole box) after training to 5-CSRTT | Dopamine, Serotonin, Cholinergic, Parietal, Muscarinic. | Schizophrenia, ADHD, OCD, Alzheimer's |
| NHP | Progressive Ratio and Effort Related Choice Task for Rodents (PR/ERC) | 16 sessions from first habituation to reach stable PR performance | 16 sessions from first habituation to reach stable PR performance | Dopamine | Motivation, Decision Making |
| Human | 4-Choice Gambling Task for Rodents (4C-GT) | Pretraining + 7 sessions familiarizing with choices available, then 20 sessions testing | Pretraining + 4 sessions familiarizing with choices available, then 13 sessions testing | Dopamine, Serotonin | Bipolar Disorder, Gambling, Depression, OCD, ADHD, Parkinson's, Schizophrenia, Impulsivity |
| Human/NHP | Rodent Continuous Performance Task: Image for Rodents (rCPT) | Pretraining + Approximately 30 sessions | Pretraining + Approximately 30 sessions | Cholinergic system, Anterior Cingulate Cortex | Schizophrenia, ADHD, OCD, Alzheimer's |
| Human | Delay Discounting for Rodents (DD) | Pretraining + approximately 13 sessions | Pretraining + approximately 13 sessions | Dopamine | Impulsivity, ADHD |
| NHP | Probabilistic Reversal Learning for Rodents (PRL) | Pretraining + Approximately 17 sessions | Pretraining + Approximately 17 sessions | Serotonin | Depression |

\* Depends on strain and age

# DELIVERED READY TO WORK

## Easy and productive plug & play hardware.

All validated Tasks are complete with all training stages (Habituate, Initiate Touch, Must Touch, and Punish Incorrect) along with the main paradigm, and data analysis sets for each stage.

- Load ABET Cognition software and run a Task in a few mouse clicks.
- Use the Database Explorer to compare sessions by strain, by date, or by Task, By experiment and more
- Use the Virtual Touch screen to visualize the Task as the animal does.
- Analyze data and build new programs away from the lab with the Virtual Interface

## The Importance of Acoustic Isolation: Prevent distraction during cognitive tasks

The Touchscreen chamber is akin to a student examination hall. People need a quiet environment without distractions to accomplish a task, and it is the same for an animal.



Isolation Chamber with
Faraday cage lining

- Isolation Chambers were designed with the Institute of Sound and Vibration at the University of Derby England.
- Attenuation level ensures that sound between chambers is attenuated to around 35 DB, approximating to the background noise of a quiet room.
- Ergonomically designed for ease of animal handling and welfare with a ventilation fan.
- Remote camera observation/recording system that uses visual or IR illumination.
- Isolation Chambers are optionally available with built-in Faraday Cage for electromagnetic compatibility, to ensure artefact free in-vivo recording.



Easy Install System

## The Easy-Install System

The Easy-Install trolley system rolls into your lab with all cables in place ready to connect to a PC and with a power distribution panel for all chambers, to statutory regulations.

- Keeps laboratory organized by hiding the many cables in trunking and the whole system is easily moveable for cleaning. The system is heavy due to the sound attenuation materials.
- User workstation with PC and camera observation monitor are located remotely from the system.

# SYSTEM INTEGRATIONS

**Third party integration ready chambers.**

## Optogenetic/Photometry/Miniscope Integration

- Reward trays that accommodate headstages
- Slotted lids with integral IR and ambient lighting for tethers
- Space above the chamber for a flexible cable length (if cables are too short, they become stiff and hinder the rodent)
- Top sliding shelf for mounting of commutators
- TTL inputs and outputs to communicate with third party software.
- Cable access points
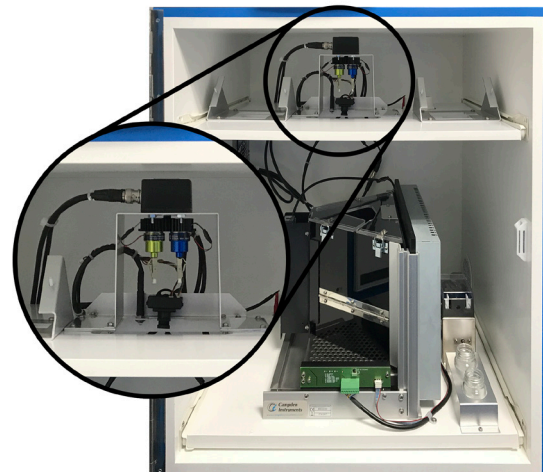


Mouse chamber integrated
with Optogenetic Stimulation
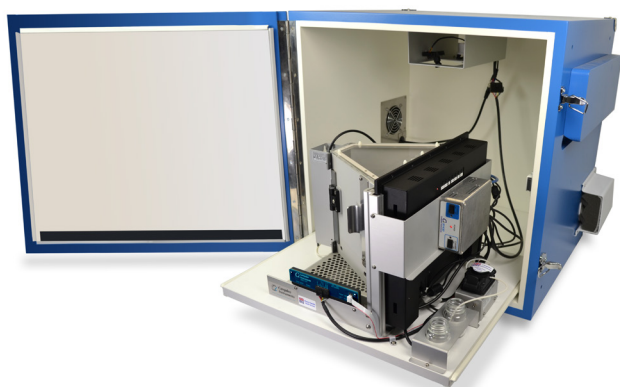
## Electrophysiology Integration

- Accommodation of tethered headstages and cables as described above
- Low emission pellet dispenser or liquid pump
- Shielded touch screen reward trough for head-stages
- Faraday cage and EMC gasket

## Video Tracking Integration

- Optimized IR lighting which evenly lights the chamber.
- Optimized ambient/house lighting which evenly lights the chamber.
- Light colored walls and floors to provide a contrast to animal colors
- Chamber design and materials reduce reflections which can fool the video tracking logarithms
- Animal image contour is captured accurately and without distortion
- TTL inputs and outputs to communicate with video tracking software.



New Illumination for high contrast video

# Contact Us for a Quotation, a Full Bibliography, and More

**Worldwide Office**

3700 Sagamore Pkwy N
Lafayette, IN 47904
USA

Phone:    (765) 423-1505
Fax:        (765) 423-4111

sales@lafayetteinstrument.com
www.lafayetteneuroscience.com

**European Office**

P.O. Box 8148
Loughborough, Leics.
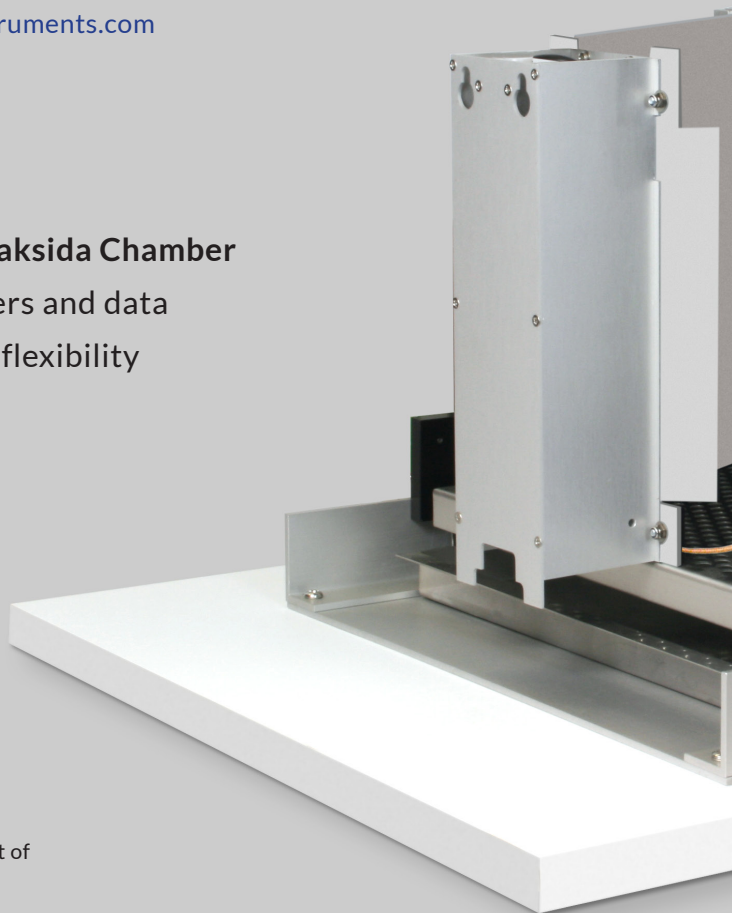LE12 7XT England

Tel:   +44 1509 814790
Fax:  +44 1509 817701

eusales@lafayetteinstrument.com
www.campdeninstruments.com

**Visit Our Website**

**The Second Generation Bussey-Saksida Chamber**
A control system for more chambers and data
chambers with more features and flexibility

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

**Lafayette Instrument.**