

OPERON

The ultimate automated tool for Intra/Extra-dimensional (ID/ED) ATTENTIONAL SET-SHIFTING TASK



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OPERON

Fully automated. Same animal for multiple testing paradigms

Background

Attentional set shifting is a measure of **cognitive flexibility** and **executive functions** widely assessed in humans by the Wisconsin Card Sorting Test (WCST) and the CANTAB Intra-/Extra-Dimensional set-shifting task (ID/ED).

The recently established automated two-chamber **“Operon ID/ED”** task for mice has proved to be an **effective preclinical tool for drug testing and genetic screening**, with direct translational valence in healthy human subjects and patients with schizophrenia (Scarsi et al. 2020).

Typical device applications

Attentional set-shifting abilities are core features of several neuropsychiatric disorders. While in humans the verbal response allows for well-established tests, such as the Wisconsin Card Sorting, **studying attentional set-shifting in mice is technically challenging, poor in reproducibility and time consuming** (Scheggia et al., Nature Communications, 2018).

Dr. Scheggia and Dr. Papaleo’s team invented a method called Operon (Scheggia et al. 2013), which:

- Allows for multiple testing paradigms, with the same mouse, across multiple dimensions.
- Is fully automated and software-controlled.
- Can be used with 2 (visual and tactile) or 3 (visual, tactile and olfactory) dimensions.

Product description

The instrument is composed of 2 compartments, divided by an automated sliding door, with an operant wall mounted on each side. The two compartments allow for the preparation of the subsequent task stimuli, while the mouse is still performing the current task, thus eliminating unwanted stimuli between the tasks.

Each operant wall includes double (left and right) automated tri-dimensional stimulators (visual, olfactory and texture), with 2 nose pokes and a pellet dispenser in the middle for the reward. 6 lights of 6 different colors are above each nose poke.

At Ugo Basile we have designed several unique components, specific for the Operon:

- **A Revolver System, lodging 6 out of 9 available different floor textures, providing automated tactile stimulation.**
- **An Odor Delivery System, managing 10 different odors, plus 2 channels for air cleaning.**
- **ANY-maze software, automatically managing all the Operon tools, following a pre-compiled protocol, and collecting the data.**

All is integrated, controlled and reported by the software to deliver the following outcome measures (and many more):

- **Number of trials to reach the criterion and number of errors.**
- **Time to reach criterion and to respond (latency).**
- **Mouse performance in a trial-by-trial base.**

- **Completely automated attentional set-shifting test**
- **Multiple stimuli across 3 dimensions (odors, lights, textures)**
- **10 different odors, 6 different lights, 9 different textures**



What does it do: overview

The intrinsic limitations of current ID/ED attentional set-shift tests in rodents make them sub-optimal in terms of animal biases, time consuming and manually intensive aspects.

This represents an obstacle to the expansion of the science community who can run these highly relevant tests, in terms of human diseases, at the neocortical level. The Operon method aims at overcoming these limitations by a novel task, made of sequential subtasks, all run in the same mouse, by using a two-chambered device.

The beauty of the Operon procedure is that it allows to study through different tasks, all run sequentially in the same mouse, different cognitive functions, different neural circuits and neurotransmitters and all of the findings have strong human translational implications (e.g. for testing antipsychotic agents, cognitive dysfunctions relevant to psychiatric and neurodevelopmental disorders, such as Schizophrenia and many others).

In summary, with the Operon method and Ugo Basile new device, scientists can, in an automated and accurate way:

- **Dissect the function of different cortical regions.**
- **Prevent superstitious conditioning to unintended aspects of the stimuli.**
- **Perform IDS/EDS (Intra-Dimensional-Shift and Extra-Dimensional-Shift) stages, both serving as internal control and contributing to form the cognitive attentional test.**

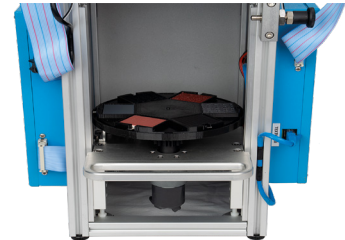


Hundreds of combinations of stimuli across three dimensions (olfactory, visual, tactile)

- 1 Pellet dispenser
- 2 House light
- 3 Pellet receptacle
- 4 Led lights (programmable)
- 5 Nose poke and odor delivery/aspiration hole
- 6 Texture floor



10-channel odour delivery with air delivery/suction system



Tactile disk

Features

3 dimensions: visual, tactile, odour, fully automated in protocol building and result acquisition

2 identical chambers divided by a sliding door

6 different textures where the mouse places its paw during nose-poking

Fully automated for both the experiment set up and the result view

10-channel odour delivery with air delivery/suction system

Benefits

Can run in 2 or 3 dimension modes for maximum flexibility

The experimenter sets up the full series of tasks and then does not need to interfere with the experimental environment as it will continuously adjusting the stimuli, on the basis of the animal nose-poking performance

Being rodents poorly visual animals, the automatically changing textures provide a robust dimension in addition to light and odour

The protocol can be flexibly changed and the results are shown as data, graphs, statistics or raw data

Many different odours can be used, as they are injected and sucked back, so that only the nose poke area contains them, while the chamber stays odour-free

Main References

F. Zoratto, E. Pisa, M. Presta, S. Macrì, 2021, "Validation of an automated task to evaluate cognitive flexibility in mice", EBBS Conference

F. Scarsi, D. Scheggia, F. Papaleo, 2020, "Automated Two-Chamber Operon ID/ED Task for Mice", Current Protocols

OPERON



Product code: 49503

Category: Behaviour, Conditioning, Reward

The Ugo Basile Operon automatizes the Intra-/Extra-dimensional (ID/ED) attentional set-shifting battery of tests offering visual, olfactory and tactile stimulations, all controlled by software and coupled to a 10-channel unique odor delivery system.

The set-up includes 2 compartments divided by a sliding door, so that when the mouse is in one compartment (e.g. running a simple discrimination task), the other compartment automatically sets up all the components (lights, textures and odors) for the next task (e.g. compound discrimination), allowing for a fast and fully automated run of the experiment.

Specifications Dual Chamber

Texture revolver	6 tiles (1 neutral grey painted, 1 honeycomb plastic, 1 velcro, 1 fine sandpaper, 1 coarse sandpaper, 1 aluminium foil)
Stimulus lights	1 set per each nose pokes (two nose pokes each chamber, each set is made by n° 6 diameter 3mm LEDs, of different colors (the customer can chose)
Nose pokes	2 nose pokes per each chamber, 12mm diameter, equipped with light-beam sensor to detect the animal action
House light	1 x LED lamp for each cage side (220lux, white)
Test/Data Management	via ANY-maze software (USB cable connection)
Chamber imension	180x180mm x 160mm height
Power	12VDC, 2A external power supply input 85-264 VAC, 50-60Hz

Specifications Olfactory

10 channel odor emission (fragrances can be chosen by customer, usually are paraffin solubles)
10 LEDs indicator of status, one red coloured per each channel
10 master switch, one per each channel, allows the customer to manually shut one single channel

Specifications Air Management

1 membrane pump capable of 2BAR generation
1 vacuum aspiration system, 4 channel (1 per each nosepoke of the dual chamber system)
2 knobs for manual regulation
No tank needed

Physical

Operon

Odor Delivery System

Dimensions	30x60x55(h)cm	57x27x45(h)cm
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Ordering Informations

49503	OPERON system including double chamber cage with sliding partition with two operant walls including pellet delivery, two nose pokes for olfactive stimulation and scoring, led lights and tactile stimulation by revolving floor. The system is controlled by ANY-Maze conditioning (not included; order 60000-C) and is designed to work with a 10-channel olfactory stimulator and aspiration system (not included, order 49550-005 and 49550-010, for those using also olfactory stimulation).
49550-005	Air Control System for Odor Delivery. Universal input 85-264 VAC, 50-60Hz
49550-020	Olfactory Delivery System for OPERON, 10 independent channels, each driven by an electrovalve for up to 10 different scents (valve operation through Any-Maze)

Software

60000-C	ANY-maze Software for Operon System
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more than 40,000 citations in the main bibliographic search engines.

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