

## Fear & Operant Conditioning Using Telemetry

Fear and operant conditioning studies are used in research to evaluate cognitive function during a state of stress. These studies may be enhanced by integrating DSI telemetry to measure cardiovascular endpoints. This technique allows researchers to gain a better understanding of the full cardiovascular response through observation of stress induced cardiovascular changes in real-time.

Cages used for the evaluation of cognitive function in animal models for fear and operant conditioning are available from our sister Harvard Bioscience companies, Coulbourn Instruments and Panlab.



### Physiological Endpoints

- Heart Rate
- Blood Pressure
- Sleep
- Temperature
- Activity
- EEG/EMG

### Behaviors Captured

- Freezing
- Lever Press
- Locomotor Activity

### Events to Synchronize

- Timing of foot shock or sound for fear conditioning
- Number of lever presses for operant conditioning

### Use Case – Fear Conditioning

Forced immobilization is commonly used as a model of stress in small laboratory animals, especially for inducing physiological stress to mimic human situations in small enclosures (claustrophobia) or post-traumatic stress disorder (PTSD). Researchers will look at this induced psychological stress and decipher the mechanisms involved in the adaptation to stress, as well as pathology/disease development. Fear is measured in subjects through a fear conditioning paradigm. For example, freezing behavior is a fear response that an animal displays when exposed to an anoxic event, such as a foot shock or abnormal airflow. Fear conditioning can be induced by exposing the animal to the same event several times, resulting in a freeze position. Freezing is then quantified by software or the researcher in seconds or percent of time frozen.

In patients, fear is accompanied by cardiovascular events such as an increase in heart rate. Such increases become pathological when the heart rate remains elevated over a long period of time and is often associated with cardiovascular disease. In rodents, similar events have been studied in which quantification of freezing behavior and measurement of physiologic parameters are combined.

Combining telemetry with fear conditioning can provide real-time cardiovascular, temperature and/or glucose data that will show the physiological effects of psychological stress in acute and chronic studies. These fear conditioning events can be acquired by Ponemah via the Signal Interface solution for synchronized recording with physiologic signals, such as blood pressure and ECG.

Recent publications have highlighted how a fear conditioning system can be combined with telemetry.

#### **Extinction of Fear Memory Attenuates Conditioned Cardiovascular Fear Reactivity**

<https://www.frontiersin.org/articles/10.3389/fnbeh.2018.00276/full>

#### **A mouse model of high trait anxiety shows reduced heart rate variability that can be reversed by anxiolytic drug treatment.**

<https://www.ncbi.nlm.nih.gov/pubmed/21320392>

#### **Use Case – Operant Conditioning**

In operant conditioning, animals are trained to learn a task by coupling events, such a lever press, with food intake or water. Generally, the animals are food or water deprived to motivate them. In addition, it is common for genetic knockout or pharmacological treatments to impair the learning process. Such impairments are frequently associated with the physiological measurement of heart rate, as an indication of stress, or EEG.

These operant conditioning events can be acquired by Ponemah via the Signal Interface solution for synchronized recording with physiologic signals, such cardiovascular, neurological, or temperature endpoints. Researchers may then perform EEG studies to evaluate cognition performance of animals. For example, a researcher may be interested in whether there are changes in frequency bands as a result of a specific behavioral test.

Recent publication has highlighted how operant conditioning can be combined with telemetry.

#### **Adaptation to a blood pressure telemetry system revealed by measures of activity, agility and operant learning in mice.**

<https://www.sciencedirect.com/science/article/pii/S1056871917300205?via%3Dihub>

#### **Novel technology for modulating locomotor activity as an operant response in the mouse: Implications for neuroscience studies involving “exercise” in rodents.**

<https://www.sciencedirect.com/science/article/pii/S0165027012004451?via%3Dihub>

#### **DSI**

Data Sciences International (DSI) offers complete systems that sense, transmit, acquire, and report physiologic data. In order to create a more robust study design, scientists rely on DSI technology to study specific targets as well as obtain a holistic view; allowing them to look at side effects that are upstream or downstream of the main pathology.

Visit DSI’s neuroscience solutions page to learn more about epilepsy and other CNS based approaches.

<https://www.datasci.com/solutions/neuroscience>