Extracellular Multi Unit Recording in Fear Conditioning in Mice Using a Telemetry Approach in an Automated Home Cage (DualCage) Environment

René F. Jansen[1]
rene.jansen@falw.vu.nl

Anton W. Pieneman[1]

Andries Ter Maat[2]

[1]Behavioral Neuroscience Group, Center for Neurogenomics and Cognitive Research, Neuroscience Campus Amsterdam, VU University Amsterdam, The Netherlands

[2]Department of Behavioural Neurobiology, Max Planck Institute for Ornithology, Seewiesen, Germany

Manfred Gahr[2]

Oliver Stiedl[1]

ABSTRACT

Fear conditioning is an important test in behavioral neuroscience to investigate the neural systems and molecular basis of various aspects of emotional learning across a wide range of species. Dysfunction of the fear circuits is assumed to underlie mechanisms of affective disorders and is frequently investigated in rodent models. While generally the scientific focus has been on the assessment of behavioral readouts such as freezing, we extended to autonomic measures [1] and now include electrophysiological measures in freely moving mice. We developed a radio-telemetry approach to perform extracellular recordings of neurons in freely moving birds that has now been adapted to mice. Experiments were performed in our novel fully automated DualCage (see Abstract by Stiedl et al., presented at this conference) environment to explore the dynamics neural responses in fear conditioning in male C57BL/6J mice without human interference. We used auditory trace fear conditioning to explore phasic responses to an explicit (tone) cue. Auditory trace fear conditioning occurred with five tone-shock pairings with tone and shock separated by 15-s trace intervals to render this behavior tests hippocampus-dependent [2]. Electrical extracellular activity was recorded using a modified version of the transmitter used in zebra finches [3]. This transmitter uses a single channel to record extracellular electrical activity at frequencies between 100 and 15000 Hz. The transmitter weighs ~1.1 gram (batteries included) and this low weight ensures that it interferes minimally with the normal activities of the animal. The main modification is that the transmitter now runs for 5 days on a single battery as opposed to 24 hr for the original design. This extended battery life allows us to run extended training/retention test protocols without the need to handle the animal for battery changes. As in the original design, electrodes are glued into place using dental cement and can, therefore, not be moved. This procedure provides for the necessary long-term mechanical stability, albeit at the expense of the flexibility of adjustments of the recording position using drive-mounted electrodes. Preliminary experiments indicate that auditory trace fear conditioning in the DualCage produces learning-specific changes in fast extracellular field potential oscillations in the CA1 region of the hippocampus of male C57BL6/J mice.

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