Title of Challenge

Rodent Big Brother: automated recording of rodent activity and temperature in the home cage

Background

Measurement of the activity of individual rats or mice in their home cage provides useful information in studies from basic research through to drug discovery and development. This includes:

- Detecting and assessing toxicological effects (for example effects on the central nervous system) of candidate drugs, including physical dependence;
- Characterization of agents targeting disorders of the CNS;
- Behavioural phenotyping of genetically altered animals;
- Studies of circadian rhythms.

Measurement of body temperature in rodents may also be used in each of the research applications above; particularly for some toxicology studies (1) and the assessment of physical dependence.

Activity and temperature can currently only be measured separately, unless surgically implanted telemetry devices are used (e.g. 2, 3); however the surgery required places an additional welfare burden on the animals. Activity can be measured non-invasively using transparent cages and photocell beams or infrared movement sensors (e.g. 4), or by placing the cages on mechanical sensor platforms (e.g. 5). However, this requires animals to be singly housed, which is not ideal for social species such as rats and mice which live in groups.

Video tracking systems, with individuals marked with different colours, can be used for group-housed rodents but these methods are not readily incorporated into standard caging with wire mesh lids, especially when measuring simultaneously from multiple cages; also, video tracking in darkness requires infrared lighting, which would not enable discrimination between individuals marked with different colours.

The aim of this challenge is to develop an integrated system which combines measurement of activity and temperature in rodents that can be used with group housing and without surgery.

ID microchip transponders which measure temperature already exist and may potentially be utilised for this challenge. These chips are about 14 mm x 2 mm, and are injected subcutaneously in the nape of the neck. Examples include the IPTT-300 (PLEXX, Netherlands; BioMedic Data Systems Inc., USA) (6). Accelerometers have been used to record and characterize behavioural movements in rodents (7), but so far only when worn externally.

3Rs benefits

The development of a non-surgical, automated approach to measure activity and temperature in animals supports reduction and refinement by avoiding the need for surgery or single housing. It would enable incorporation of these additional measurements into existing study types, thereby reducing the number of separate standalone studies. It could potentially impact on the welfare of thousands of animals.

More broadly, this technology could also be used to provide additional information for other studies where early identification of animals with subdued activity or changes in body temperature could be used to improve humane endpoints.

Need for collaboration

The multi-disciplinary nature of this challenge means that expertise from a number of different sectors will be needed to provide a solution. It would be valuable to engage sectors that are not normally associated with the biosciences such as sensor electronics. Software development for data handling may also form part of the proposal.

Overall objectives

To develop an automated non-surgical system, which can be used in rats and mice, to measure activity and temperature over a minimum of a 24 hour period.

Key performance requirements

A small, unobtrusive detector that:

- Does not require complex wiring to/from cages;
- Must work with standard rodent cages;
- Must detect both animal activity and temperature;
- Must be minimally invasive e.g. using a subcutaneous ID chip;
- Must allow normal use of cages (e.g. cages go through robotic cage washers);
- Can transmit wirelessly to a receiver that collates the data;
- Has a mechanism to automatically log the precise timing of the light-dark cycle;
- Has a mechanism to automatically log when technicians are in the room;
- Can measure time spent at each end of the cage (not necessarily X-Y co-ordinates);
- Can potentially measure rearing behaviour (i.e. rats standing on hind legs);
- Could potentially distinguish other types of motor activity and specific movements (e.g., eating; drinking; tremor; convulsions);
- Is quick to set up and start recording, with minimal configuration/adjustment;
- Is GLP/ 21 CFR Part 11-compliant to convert the proximity data from the detectors into activity counts and temperature measurements for each individual animal;
- Can detect and flag-up erroneous data;
- Data collection need not be continuous, minimum requirement would be collected, for example, in 5 minute bins every 30 minutes for 24 hours.

Final prototype that:

- Can be used to assess, optimize and validate the system using 4 cages, 12 animals;
- When scaled up should deliver recordings for several large, unrelated studies in parallel, in separate rooms (e.g. toxicology studies);
- Can incorporate the study design for toxicology studies (3-5 rats/cage or up to 6 mice per cage and between 24 to 80 animals in total per study).

Industry sponsors

AstraZeneca

In-kind contributions

AstraZeneca will run evaluation/optimization/validation studies in rats and mice in their laboratories, with a view to peer-reviewed publication. AstraZeneca has extensive experience in running and handling data from toxicology studies and will provide this expertise for the project.

Industry sponsor access to foreground IP

AstraZeneca's participation is conditional on a provision entitling them to use the results of the programme in their research and development (R&D) activities, in the form of a non-exclusive, royalty-free usage right on the results obtained under such project for the purpose of carrying out R&D activities for discovering novel commercial pharmaceuticals.

Duration

Up to three years

Budget

Up to £500,000 in total, inclusive of VAT where applicable

Funding model

Although success in this project will require a multi-disciplinary approach, there are various ways in which this could be managed. It is unlikely that an applicant from a single organisation would be able to access all the required expertise, and applications are therefore welcomed from consortia in which one organisation takes the lead (the Contractor) on behalf of the others (the Subcontractors). More than one such consortium could be funded, particularly if the proposed technologies take substantially different routes.

References

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Keywords

Activity, body temperature, home cage, rats, mice, automation.