TEATIME

Final conference

INSPIRING LECTURES

POSTER SESSION

THE TEATIME JOURNEY – SHAPING THE FUTURE OF LAB ANIMAL MONITORING

INTERACTIVE WORKSHOP

SEPTEMBER 2-3, 2025
HELSINKI, FINLAND

VENUE: Porthania,
University of Helsinki's city centre campus

HYBRID FORMAT

TheBehaviourForum.org

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UNIVERSITY OF HELSINKI

HiLIFE HELSINKI INSTITUTE OF LIFE SCIENCE

COST Action CA20135 (TEATIME): Improving biomedical research by automated behaviour monitoring in the animal home-cage (2021-2025)

Final Conference

TEATIME journey – Shaping the Future of Lab Animal Monitoring

September 2-3, 2025, Helsinki

Welcome to the TEATIME Final Conference

Dear Delegates,

We are pleased to welcome you joining in *The TEATIME Journey: Shaping the Future of Lab Animal Monitoring*. During this conference, we will explore the latest work that is redefining home cage monitoring in laboratory animal research.

TEATIME represents a four-year collaborative effort to advance animal welfare and data quality through innovative monitoring technologies. This conference marks the culmination of that endeavor, bringing together experts from diverse fields to share insights, novel technologies and their experiences in TEATIME. It has been an immense pleasure to grow the network and get to know new people dedicated to the progress of this field of biomedical research. Your contribution has been invaluable, many collaborations have been initiated and together we have shared the joys and sorrows in science, but also in life beyond the lab. TEATIME has become a family!

As with all TEATIME events, I hope that you take the opportunity to make new connections and explore new avenues of science. TEATIME will be ending in October 2025, but we have several avenues of work that will continue such as our Forum to discuss behaviour (https://www.thebehaviourforum.org/), our updated catalogue of home cage technologies (https://www.cost-teatime.org/about/technologies/) and our work towards producing a repository for home cage data as in our recent publication (https://osf.io/preprints/osf/fsg83_v1).

In order to keep in touch, make sure that you join our TEATIME Network (see the pop-up on the home page of our website (www.cost-teatime.org) and www.thebehaviourforum.org. I also wish you the best for you own research and new collaborations that have been established within TEATIME.

Thank you for joining us. Together, let's shape the future of lab animal monitoring.

Vootele Voikar, the Chair of TEATIME Action

On behalf of organizing committee – Sabine Hölter-Koch, Lior Bikovski, Maša Čater, Jan Rozman, Marion Rivalan, Philipp Villiger, Rasneer Sonia Bains, Dragan Hrncic, Hilary Gates, Oliver Stiedl, Alice Melloni, Silvia Mandillo, Diana Cunha-Reis, Selin Cevik, Aurora Hämäläinen

Thanks to the COST Association for supporting our network, and University of Helsinki and Helsinki Institute of Life Science as local organizers.

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TEATIME

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Wednesday, September 3, 2025

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Damien Huzard (NeuroNautix, Montpellier, France)

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Stuart Peirson (University of Oxford, UK)

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Elodie Ey (Université de Strasbourg, France) & Fabrice du Chaumont (Institut Pasteur, Université de Paris Cité, France)

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Lex Kravitz (Washington University in Saint Louis, MO, USA) via Zoom

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Sonia Bains (Mary Lyon Centre at MRC Harwell, UK)

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ABSTRACTS

TUESDAY 2 SEPTEMBER

SESSION 1: Legacy of TEATIME – closing the circle

Chair: Sabine Hölter - Helmholtz Zentrum Munich, Germany

TEATIME network - dream team of animal behaviour analysts

Vootele Voikar
University of Helsinki, Helsinki Institute of Life Science, Laboratory Animal Center, Finland

In March 2020, I contacted several colleagues with a proposal to set up a discussion group for openly sharing the best practice and challenges in mouse behavioural phenotyping field. The initiative was met with great enthusiasm. Ironically, this coincided with lockdowns due to COVID-19 pandemic, and people were seeking new ways to communicate – we discovered that online meetings can be very productive, and the group started to grow. Discussions about sustainability and real impact of this developing community led us to the COST Actions – bottom-up interdisciplinary networks, bringing together researchers and innovators to investigate a topic of their choice for 4 years. For us, such an emerging topic in biomedical research with animal models was Automated Home Cage Monitoring – still a considerably new and unexplored area, but rapidly evolving with new technologies becoming available. We suggested that HCM will be a game-changer to improve research, and to support the 3Rs principle. The rest is history with TEATIME launched in October 2021. In this presentation, the benefits and strengths of networking will be presented, along with challenges encountered. We may close a circle in this conference, but new doors are already open!

From Review to Resource: Developing an Interactive Catalogue of Home Cage Monitoring Technologies

Silvia Mandillo
Institute of Biochemistry and Cell Biology, CNR Consiglio Nazionale delle Ricerche, Monterotondo (Rome), Italy

To support the advancement and wider adoption of home cage monitoring (HCM), the TEATIME COST Action assembled a diverse team of researchers, facility managers, welfare specialists, and equipment developers to assess the current landscape. This effort began with a systematic review of the literature and a survey of the needs and interests across user groups. Then, a curated catalogue of approximately 50 HCM systems, representing a broad spectrum of available technologies was compiled by TEATIME members. This dynamic and interactive database is continuously updated and offers detailed, searchable information on system types, technological features, behavioral parameters measured, open-source availability, manufacturers, and more. It also includes links to key references, validated protocols, and contact details for experienced users who can offer practical support for implementing specific systems. In this presentation, we will share the collaborative journey of building this unique and evolving resource. We aim to highlight the power of an interdisciplinary network of HCM enthusiasts working together to provide the scientific community with a practical tool - one that not only facilitates the use of HCM technologies but also promotes their ongoing refinement and innovation.

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Building a Home for the HCM Community: The Story of thebehaviourforum.org

Marion Rivalan
CNRS, Institute of Neurosciences of Paris-Saclay NeuroPSI, Saclay, France

This talk retraces the journey behind the creation of thebehaviourforum.org, a community-driven platform born from a shared need: a space for users of Home Cage Monitoring (HCM) systems to connect, exchange, and grow together. What began as a clear signal from the community—through surveys and discussions, notably in Prague—evolved into a collaborative effort to build something lasting. From forming an initial brainstorming team to choosing the right platform (inspired by image.sc), every step involved intentional decisions: crafting categories, defining tags, drafting terms of use, and navigating the question of access. Trust in the community became a guiding principle, embracing a wide range of voices from open science advocates to commercial contributors. With the creation of a moderating team and the forum's launch in July 2023, the platform has since operated smoothly, steadily growing and adapting. The talk will reflect on promotion strategies, the impact of the two Virtual Mobility grants, and lessons learned in building and nurturing an inclusive digital community around behavioural monitoring in lab animals.

The Mouse Behavior Ontology (MBO): A Unified Ethogram-Ontology for Harmonizing Rodent Behavior Data in Home Cage Monitoring Research

Damien Huzard [1], ***Leonardo Restivo*** [2], ***Marion Rivalan*** [3]
[1]*NeuroNautix, Montpellier, France;* [2]*Department of Fundamental Neuroscience, University of Lausanne, Lausanne, Switzerland;* [3]*Institute of Neuroscience Paris-Saclay, CNRS, University of Paris-Saclay, 91400 Saclay, France*

The increasing adoption of rodent Home Cage Monitoring (HCM) systems at different scales has led to a growing need for standardized methods of data collection, annotation, and analysis. To address this challenge, we present an innovative approach that strives to integrate the ethogram of spontaneous rodent behavior with a formal ontology: the Mouse Behavior Ontology (MBO). By combining the descriptive power of a community-backed behavioral ethogram with the inferential capabilities of ontology-based knowledge representation, the MBO enables a comprehensive and reproducible recording of rodent behavior within the HCM system. This integration has far-reaching implications for different stakeholders, improving experimental design, facilitating data sharing and reuse, and enhancing animal welfare. The MBO facilitates harmonization across research laboratories and disciplines, enabling the sharing and reuse of behavioral data collected in different HCM systems, therefore promoting consistency and efficiency in data interpretation across laboratories and institutions.

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SESSION 2: COST building the bridges, boosting the careers

Chair: Selin Cevik - Mersin University, Türkiye

Finding My Place in Science: How TEATIME Opened Doors to Scientific Dialogue

Philipp Villiger
Universität Zürich UZH, Department of Physiology, Switzerland

This talk will be about my personal story, covering aiming for a PhD and finding my own research interests. Throughout my entire PhD journey, which started not long ago in 2022 and finished this summer, I was part of the incredible TEATIME community. Through its diverse activities, including training schools, short-term scientific missions (STSMs), young researcher meetings, and workgroup meetings, TEATIME provided a welcoming, interdisciplinary space that helped me find my own research focus. TEATIME didn't just expand my network, it expanded my mindset. It encouraged me to engage, contribute, and collaborate beyond the scope of my PhD project. In this talk, I will reflect on how these opportunities shaped my academic path and illustrate how networks like TEATIME are essential for fostering dialogue, innovation, and a strong sense of community among early-career researchers. This talk will share my personal journey of pursuing a PhD, navigating the search for my own research interests, and growing within the broader scientific community. From the very beginning of my PhD in 2022 until its completion in the summer of 2025, I was fortunate to be part of the TEATIME COST Action, an inspiring and supportive network that played a significant role in shaping my current academic path. Through its wide range of activities, including training schools, short-term scientific missions (STSMs), young researcher meetings, and workgroup events, TEATIME provided an interdisciplinary and inclusive environment where I was able to explore different perspectives, and connect to researchers across Europe. In this talk, I will reflect on how these opportunities influenced my development and emphasize the essential role that such networks play in supporting early-career researchers through community, dialogue, and innovation.

Shaping the Future of Lab Animal Professionals – personal experiences from a young researcher

Sophie Schober
Karl Landsteiner University of Health Sciences (KL), Krems, Austria; Institute of Science and Technology (ISTA), Klosterneuburg, Austria

COST Actions are tailored to fund research and innovation networks. The COST TEATIME Action aims to connect researchers interested in home-cage monitoring (HCM) technologies across Europe and beyond. Furthermore, it enables young researchers and students to grow their ideas by sharing them with other Action members and getting funding from the Action. Here, different Action activities (working group meetings, training, grants) and their benefit for young researchers will be discussed. Teatime includes experts in animal research including 3Rs methods, care and welfare of laboratory animals, education and training, ethics and policy, and regulation of animal experiments. The interdisciplinary background of the members is highly beneficial for professional development. The offer of conferences, webinars, workshops and training schools for free makes training and education accessible for everyone regardless of someone`s budget. The possibility of leading sub-working groups gives young scientists a first insight into project management. With the help of senior researchers they

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can develop their own skills within a collaborative setting. The low level access to funding enables and motivates people to apply for grants and conduct research activities abroad. Altogether, everyone can benefit from COST Actions and promote their careers. Moreover, it is a great opportunity to build up a network for further projects.

Home cage monitoring in a classic neuropharmacology lab. Sure! But... How?

Davor Virag
Department of Pharmacology & Croatian Institute for Brain Research, University of Zagreb School of Medicine, Zagreb, Croatia

35 years ago, my mentor suggested the intracerebroventricular streptozotocin rat model of sporadic Alzheimer's disease, focusing on insulin resistance in the brain. 5 years ago, as a med student, I was introduced to the work by Jan, my friend and colleague, then a PhD student. We'd noticed some odd behavioural features and wanted to dig deeper by monitoring the animals 24/7. Supported in the intent by my mentor and colleagues, somewhere between the DIY electronics, the drugs, and the rats' behaviour, my PhD started to take shape. Well, the behaviour turned out to be particularly tricky, the reason perhaps best illustrated by a joke: "What do you call a biologist who can only name one species? - A medical doctor." A few months in, still taming the wires and microcontrollers, I hear Jan say: "Hey, there's this COST action, take a look!" - "Sure, sure, as soon as I get this done..." A few months more, after my presentation at a neuroscience conference, I met Silvia. TEATIME does training schools too? You don't say... Three years later - wait, what, already? Well, time flies when you're having fun, and TEATIME sure was fun. And that's the least of it - let me tell you the whole story.

SESSION 3: Short talks from selected abstracts

Chairs: Maša Cater - University of Ljubljana, Slovenia
Dragan Hrncic - University of Belgrade, Serbia

Toward a Computational Understanding of Affect in Mice

Oren Forkosh
The Hebrew University, Jerusalem, Israel

While advances in homecage monitoring have opened new windows into spontaneous behavior, the challenge now lies in interpreting these behaviors through the lens of affect and emotion. In this talk, I will present our efforts to develop a computational framework for measuring affective states in mice, focusing on mood, emotional reactivity, and internal drives. By leveraging high-dimensional behavioral data collected continuously in enriched social settings, we aim to move beyond simplistic proxies for welfare and toward a more nuanced, temporally resolved understanding of what mice feel. I will share recent progress on behavioral paradigms for assessing optimism bias, detecting emotional shifts across the estrous cycle, and modeling persistent affective traits alongside dynamic states. These approaches offer a pathway for linking emotion, personality, and social context, and raise new possibilities for studying animal cognition and well-being from the animal's perspective. Keywords: affective states, emotion in animals, behavioral modeling.

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Challenges and opportunities of using automated home-cage monitoring in CNS injury and repeated anaesthesia models to refine behaviour assessment and animal care

Jordi L.Tremoleda
QMUL, London, UK

Advancements in automated home-cage monitoring technologies are increasingly enabling the refinement and reduction of animal use in preclinical research. These systems offer considerable translational potential by facilitating continuous, non-invasive observation of animal behavior within their home environment. However, despite their promise, broader implementation in standard academic settings remains limited due to a range of logistical and technical barriers. Our research focuses on evaluating the refinement potential of such technologies in preclinical models subjected to repeated anesthesia and/or central nervous system (CNS) injury. Specifically, we aim to obtain comprehensive data on spontaneous social and maintenance behaviors of individual animals within group-housed settings. While these systems allow for valuable behavioral insights, several limitations persist. These include a predominant focus on locomotor parameters, use of simplified and less enriched housing conditions, challenges in distinguishing individual versus group-level data, potential welfare concerns related to animal identification methods (e.g., RFID chipping), and restricted access to raw data and software customization. Moreover, limited institutional support for advanced data analytics and data sharing further constrains the broader utility of these tools in academic research. Through examples drawn from our ethogram-based and automatically acquired behavioral datasets in CNS injury and anesthesia models, we will discuss these challenges and reflect on the practical and operational requirements necessary to enhance the accessibility, reproducibility, and translational impact of automated behavioral monitoring in academic settings.

AI-Derived Digital Biomarkers for Early Disease Detection in Rodent Models Using Home Cage Monitoring

Stefano Gaburro, Giorgio Rosati
Tecniplast, Spa, Italy

Early, non-invasive disease detection in rodent models is critical to improving translational outcomes in preclinical research. We report the use of AI-driven analysis of continuous behavioral data from digital ventilated cages (DVCs) to identify predictive digital biomarkers of disease onset. These systems enable passive monitoring of spontaneous activity and circadian patterns under standard housing conditions, eliminating the confounding effects of handling and acute stress. Machine learning algorithms trained on longitudinal data detect subtle deviations in behavior preceding clinical signs in models of neurodegeneration, inflammation, and metabolic disorders. Our findings support the integration of AI-derived digital biomarkers as decision-making tools for early intervention, enhanced reproducibility, and refinement of animal studies.

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Identifying cardiovascular risk by nonlinear heart rate dynamics analysis: Translational biomarker from home cage monitoring of mice to humans

Torben Hager[1], Agorastos Agorastos[2], Sven Ove Ögren[3], Oliver Stiedl[1,4]

[1]Center for Neurogenomics and Cognitive Research, Vrije Universiteit Amsterdam, The Netherlands; [2]Division of Neurosciences, II. Department of Psychiatry, School of Medicine, Faculty of Health Sciences, Aristotle University of Thessaloniki, Greece; [3]Department of Neuroscience, Karolinska Institutet, Stockholm, Sweden; [4]Department of Health, Safety and Environment, Vrije Universiteit Amsterdam, The Netherlands

The beat-by-beat fluctuation of heart rate (HR) in its temporal sequence (HR dynamics) provides information on HR regulation by the autonomic nervous system (ANS) and its dysregulation in pathological states. Commonly, linear analyses of HR and its variability (HRV) are used to draw conclusions about pathological states despite clear statistical and translational limitations. Therefore, our main aim was to compare linear and nonlinear HR measures, including detrended fluctuation analysis (DFA), based on ECG recordings by radiotelemetry in C57BL/6N mice to identify pathological HR dynamics. We investigated different behavioral and a wide range of pharmacological interventions which alter ANS regulation through various peripheral and/or central mechanisms including receptors implicated in psychiatric disorders. This spectrum of interventions served as a reference system for comparison of linear and nonlinear HR measures to identify pathological states. Physiological HR dynamics constitute a self-similar, scale-invariant, fractal process with persistent intrinsic long-range correlations resulting in physiological DFA scaling coefficients of α~1. Strongly altered DFA scaling coefficients (α≠1) indicate pathological states of HR dynamics as elicited by (1) parasympathetic blockade, (2) parasympathetic overactivation and (3) sympathetic overactivation but not inhibition. The DFA scaling coefficients are identical in mice and humans under physiological and pathological states by defined pharmacological interventions. We demonstrate the importance of tonic vagal function for physiological HR dynamics in mice, as reported in humans. Unlike linear measures, DFA provides important translational measures that reliably identify pathological HR dynamics based on altered ANS control as likely mechanism of increased cardiac mortality in psychiatric disorders.

Missing virtual women

Marija Heffer[1], Srećko Gajović[2]

[1]Department of Medical Biology and Genetics, Faculty of Medicine Osijek, J. J. Strossmayer University of Osijek, Croatia; [2]University of Zagreb School of Medicine, BIMIS – Biomedical Research Center Šalata, Zagreb, Croatia

The biological sex is determined by sex chromosomes, genomic imprinting, and hormonal fluctuations during development. Consequently, nearly every cell in a multicellular organism exhibits sex-specific activities and responses to external stimuli. Non-communicable diseases are subsequently sex-dependent, which affects their onset, symptoms, progression, comorbidities, and treatment responses. Although recent guidelines encourage the inclusion of both sexes in research, they do not mandate it. These recommendations were introduced by the U.S. Food and Drug Administration in 2014, the NIH in 2016, and adopted by Horizon Europe in 2021, beginning implementation in 2022. The SARS-CoV-2 pandemic temporarily relaxed these regulations due to the urgent need for antiviral drugs and vaccines, slowing the collection of sex-specific data. Historically, females were often excluded from studies because of hormonal fluctuations, therefore resulting in a need for more study participants and higher total costs. No less a reason for excluding women from the studies was the neglect of clinically relevant sex differences. Technologies like home cage monitoring coupled with open data repositories are potential solutions to address the centuries-long neglect of female data.

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However, the use of these methodologies also shows significant biases against females—by 2020, only 23% of mouse studies and 16% of rat studies used females. AI algorithms in medicine tend to be as well male-biased, creating a "missing virtual woman." Subsequently, the AI based diagnostics or interventions could be misleading in case of female patients. Addressing these gaps is crucial for equitable and accurate healthcare.

Phenotyping behavioural deficits in pre-weaning mice using a custom, low-cost video monitoring system

***Michal Milczarek*[1], *Mike Ashby*[1], *Anthony Isles*[2]**
[1] *University of Bristol;* [2] *Cardiff University*

Traditional behavioural research in rodents often relies on invasive out-of-cage tests that are poorly suited for studying early development—a crucial period for investigating disorders like autism and schizophrenia. By contrast, advances in computer vision now enable scalable, non-invasive monitoring throughout an animal's lifespan. Automated deep learning analysis accelerates behavioural assessments, reduces human bias, and can produce more robust and replicable results. Our research employs mice with Grin2A mutations which result in altered NMDA channel composition. Although abnormal NMDA channel function has been linked to schizophrenia in both human and animal models, little is known about its impact during early development, when receptor composition and behaviour change most dramatically. In my talk, I will outline the tools I have developed and challenges I have encountered in the study of mouse pup behaviour. I will discuss the potential of these methods for studying neurodevelopment as well as other applications, including welfare monitoring. More specifically, I will describe a home-made, low-cost video monitoring set-up that can be readily deployed at most mouse facilities. I will discuss the data that can be generated with this system, including instantaneous algorithmic motion tracking as well as post-hoc AI-driven analysis of mouse trajectories. I will detail the challenges related to processing large volumes of data and solutions that can be deployed to make it more feasible and I will give an outline of analytic methods that can be used to derive meaningful insights from the collected data. [non-invasive, home-cage, monitoring]

From need to device: The Mouse Position Surveillance System (MoPSS)

Pia Kahnau
German Federal Institute For Risk Assessment, German Centre for the Protection of Laboratory Animals

Initially, we had a simple question: For a preference test, we wanted to know how long the mice stay in which cage? Twelve female mice were kept in two P2000 cages connected by a tube. Two RFID antennas were placed around these tubes to track the mice. However, it soon became clear that, despite the RFID transponders and antennas, the location of the mice could not be precisely determined. Therefore, we had to optimise the system, which we finally managed to do. In a subsequent study, we demonstrated that the MoPSS is highly effective for home cage-based preference tests. The MoPSS was further developed and used to address other research questions. By dividing the home cage with a wall containing a tube and RFID antenna, we could measure activity in the home cage over several weeks and determine differences between treatment groups. Additionally, the activity of 20 mice in a self-developed modular housing system (six 80x80 cm modules) was recorded over several months. The next development is a gate system that will enable mice to move individually from one

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cage to another. This will enable behavioural tests to be developed in which mice can be tested independently and undisturbed by group members, without human influence.

RTFED: an open-source, versatile tool for home-cage monitoring of behaviour and brain recording in mice

***Hamid Taghipourbibalan*[1], *James Edgar McCutcheon*[1]**
[1]*Dept. of Psychology, Faculty of Health Science, UiT The Arctic University of Norway, Tromsø, Norway*

Traditional methods for studying feeding and reward-driven behaviours often involve frequent handling or relocation of animals to specialised chambers, causing stress, limiting 24/7 monitoring, and potentially confounding behavioural outcomes. While commercial systems exist, they are often expensive, closed-source, and difficult to customise, restricting their usefulness across varied research needs. The Feeding Experimentation Device (FED3) marked a major step forward by offering affordable, programmable, and flexible tools for studying feeding and operant behaviour. However, its full potential remains underutilised due to user-interface limitations. To address this, we introduce RTFED an open-source, versatile platform that expands FED3's capabilities for real-time, home-cage behavioural monitoring. Compatible with both Raspberry Pi and Windows, RTFED allows continuous logging and live transmission of feeding events and operant tasks. It also supports event-triggered video recording via USB cameras and sends TTL pulses for synchronising behaviour with photometry recordings. A defining feature of RTFED is its modular, customisable architecture, enabling researchers to adapt both software and hardware for their specific needs. Additional tools, including remote data logging and email alerts, allow for dynamic experimental adjustments without disturbing the animals. By reducing reliance on proprietary tools and minimising experimenter intervention, RTFED enhances reproducibility, accessibility, and the ecological validity of behavioural studies, making it a valuable asset for modern neuroscience research.

WEDNESDAY 3 SEPTEMBER

SESSION 4: From bedding to bedside

Chair: Oliver Stiedl - Vrije Universiteit, Amsterdam, the Netherlands

The neurobiology of social dysfunction: a transdiagnostic and translational approach

Martien Kas
Groningen Institute for Evolutionary Life Sciences, University of Groningen, the Netherlands

The current nosology of neuropsychiatric disorders allows for a pragmatic approach to treatment choice, regulation and clinical research. However, without a biological rationale for these disorders, drug development has stagnated. The EU-funded PRISM project aimed to develop a quantitative biological approach to the understanding and classification of neuropsychiatric diseases to accelerate the discovery and development of better treatments. By combining clinical data sets from major worldwide disease cohorts and by applying innovative technologies to deeply phenotype stratified patient groups, we have identified and replicated a set of quantifiable biological parameters for social

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dysfunction common to Schizophrenia (SZ), Major Depression (MD), and Alzheimer's Disease (AD). To test for causality of these human findings, we have applied chemogenetic and neuroimaging technologies in freely moving group housed mice that were monitored longitudinally in semi-natural environments. These animal studies provide direct evidence for a causal relationship between Default Mode Network integrity and social dysfunction, with potential implications for developing targeted treatments in precision psychiatry.

From Lab to Real Life: How Ecological Momentary Assessment and Intervention (EMA/EMI) advance human addiction research

***Fuschia Serre*[1], *Marc Auriacombe*[1,2]**

[1]*Addiction team, Sleep, Addiction and Neuropsychiatry Lab (SANPSY), CNRS UMR 6033, University of Bordeaux, Bordeaux, France;* [2]*Addiction Treatment Department, CH Charles Perrens and CHU de Bordeaux, Bordeaux, France*

To better understand the risk factors underlying relapse- the core expression of addiction- it became essential to examine how symptoms fluctuate in the hours leading up to substance use and relapse. Among these symptoms, craving is a highly dynamic phenomenon, fluctuating within hours in response to both internal states and various external cues—making it difficult to capture reliably in traditional experimental settings. To address this challenge, we leveraged smartphone-based Ecological Momentary Assessment (EMA) to explore the temporal dynamics of relapse in real-time and in real-world environments. This approach enabled us to monitor patients' experiences as they occur in daily life, providing a more reliable report and ecologically valid understanding of relapse processes. Through statistical analyses tailored to time-series data, we demonstrated that craving plays a pivotal role in the cascade that leads to substance use and relapse. Building on these findings, we developed Craving-Manager, a therapeutic smartphone app that delivers interventions (EMI) during high-risk moments—precisely when support is most needed. As a next step, we are exploring the use of wearable sensors (24/7 monitoring) to identify biomarkers of craving in daily life, with the goal of better understanding the biological underpinnings of relapse and enhancing the precision of just-in-time interventions.

Physiological Sensing Anywhere

Hugo Plácido da Silva

Instituto de Telecomunicações / Instituto Superior Técnico, Lisboa, Portugal

Abstract: Physiological data has had a transforming role on multiple aspects of animal monitoring, which currently goes beyond the laboratory research domain to which they were traditionally associated with. Today physiological monitoring is a matter of interest for students, researchers, and other key stakeholders in a multitude of areas, motivating new developments in sensing, processing, and knowledge extraction. Regardless of the context, in the past physiological monitoring was heavily bounded by the cost and limited access to adequate support materials. The state-of-the-art has been contributing to mitigate such limitations and, in particular, low-cost hardware and open source software enable anyone to create a multitude of projects and applications involving physiological monitoring. In this talk there will be a revision of case studies involving both laboratory animal monitoring and human monitoring, describing some of the supporting tools and use cases sustained in previous research. Key topics will include sensor integration, distributed sensing, wearable, and invisible devices.

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SESSION 5: Bridging Drug Discovery and Animal Welfare

Chair: Alice Melloni - Istituto Italiano di Tecnologia, Genova, Italy

Industrial In Vivo Research: Navigating Data Quality and Welfare Compliance in a Changing Landscape

Stefania Gobessi
IRBM S.p.A., Pomezia, Italy

Despite recent FDA announcements encouraging the exploration of non-animal alternatives, in vivo research remains essential in early drug development, offering critical insights into pharmacokinetics, pharmacodynamics, and safety profiles. Within the industrial sector, there is a growing imperative to generate high-quality, reproducible data while adhering to evolving animal welfare standards. For biotech companies advancing their own pipelines and for CROs supporting integrated drug discovery programs, producing reliable and translatable in vivo results is fundamental to scientific and operational success. This requires rigorous experimental design, standardized procedures, and strategies to minimize biological variability. Equally important is a strong commitment to refinement, through technologies that reduce animal stress and intervention while enhancing data reliability. Across the industry, advanced in vivo tools are increasingly being adopted—such as home cage monitoring systems, metabolic cages, automated serial blood sampling, and programmable pumps for continuous infusion. These innovations enhance both data integrity and animal welfare by limiting manual handling and improving physiological relevance. In this evolving landscape, high-quality in vivo services are no longer merely operational benchmarks. They are a vital enabler of ethical, efficient, and scientifically robust drug discovery. As regulatory expectations and societal values shift, the industry is redefining preclinical standards—where thoughtful experimental practices and welfare refinement are not trade-offs but synergistic drivers of success.

Where next for HCM in preclinical research? Challenges and Opportunities

***Sara Wells*[1,2,3], *Sonia Bains*[1], *Claire Witham*[2], *Peter Johnson*[3]**
[1]*Mary Lyon Centre at MRC Harwell, UK;* [2]*MRC's Centre for Macaques, Porton Down, UK;* [3]*The Francis Crick Institute, UK*

Home cage monitoring (HCM) systems have revolutionized preclinical research by enabling continuous, minimally invasive observation of laboratory mice within the environment they are reared in. Over the last four years we have learnt how this approach offers unique opportunities to capture nuanced behavioural, physiological, and circadian data that are often missed in traditional endpoint-focused studies. By improving data quality and animal welfare, HCM aligns with the 3Rs and supports more reproducible science. However, widespread adoption faces several challenges, including data standardization, resource costs, integration with existing workflows, and the high computational demands of long-term monitoring. Ethical considerations around surveillance and interpretation of complex behavioral metrics, open data sources and security/confidentiality also require careful navigation. This talk will discuss current technical, logistical and conceptual hurdles and celebrate the opportunities overcoming these will bring.

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FAIR3R: a Preclinical data sharing portal

***Benoit Petit-Demoulière*[1], *Hamid Meziane*[1], *Nathanaël Debanne*[1], *Yann Herault*[2]**
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FAIR3R, developed by PHENOMIN-ICS is a transformative platform designed to enhance the sharing of preclinical data from animal models in alignment with FAIR principles (Findable, Accessible, Interoperable, Reusable) and the 3R framework (Reduce, Refine, Replace). Being set as a FAIR-compliant infrastructure, the platform ensures datasets are globally identifiable via persistent identifiers (DOI), richly described with standardized metadata, and indexed in searchable repositories. Machine-actionable approach enables automated data discovery and integration, critical for addressing the growing complexity and volume of preclinical data. FAIR3R directly supports data sharing among organizations and network partners in biomedical research, reducing redundant animal studies by maximizing reuse of existing datasets. Its design aligns with pharmaceutical industry initiatives that leverage shared preclinical safety and off-target pharmacology data to streamline drug development and improve predictive toxicology. The platform's emphasis on interoperability, ensures compatibility with diverse analytical workflows, facilitating meta-analyses that refine experimental protocols and reduce animal usage. By embedding the 3R principles, FAIR3R promotes ethical research practices: Reduction through minimized duplication, Refinement via improved experimental designs informed by shared data, and Replacement potential through enhanced computational models. PHENOMIN-ICS's expertise in translational research underscores the platform's robustness, while its FAIRification framework—encompassing secure access protocols and reusable licensing—ensures compliance with data privacy and intellectual property standards. FAIR3R represents a critical step toward global harmonization of preclinical research, fostering collaboration, accelerating discovery, and upholding ethical standards in animal research.

Enhancing Metadata Management for Reproducibility in Preclinical Research

Damien Huzard
NeuroNautix, Montpellier, France

Preclinical research involving animal models—particularly behavioral experiments—generates complex, multiscale datasets where metadata plays a critical role in ensuring scientific rigor. However, metadata management in this domain is often inconsistent, incomplete, or entirely absent. Key information about experimental design, animal housing, treatment protocols, environmental conditions, and data provenance is frequently scattered across formats and locations, making it difficult to interpret, reproduce, or reuse findings. This abstract discusses the pervasive issue of metadata fragmentation in preclinical workflows and its consequences for reproducibility and data interoperability. We highlight common pain points encountered in laboratory settings, such as poorly structured documentation, lack of standardization across entities (e.g., subjects, cages, procedures), and insufficient integration between digital tools used in data collection and management. These challenges not only hinder collaboration but also compromise the long-term value of preclinical datasets. We propose a framework for improving metadata practices through modular, structured data models aligned with FAIR principles (Findable, Accessible, Interoperable, Reusable). By treating metadata as a first-class component of the research process—and not as an afterthought—we argue for a shift toward intentional, schema-driven design in experimental recordkeeping. The approach

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fosters transparency, facilitates automation, and ultimately strengthens the foundations of reproducible science.

SESSION 6: From Idea to Ideal, success stories from across the field

Chair: Sonia Bains - Mary Lyon Centre MRC Harwell, UK

Combined sleep and circadian rhythm assessment in the home cage: The journey so far...

Stuart Peirson
University of Oxford, UK

The COMPASS passive infrared (PIR) system was developed around 10 years ago, to enable simultaneous circadian and sleep phenotyping in our lab. This was all published as an open science project - to encourage uptake and enable others in the research community to measure sleep and circadian rhythms - rather than via commercialization. Here I will describe our journey over the last decade and the challenges and opportunities of this open science approach. Whilst we originally developed this for our own research needs, focusing on simplifying the end-user's experience and providing support from hardware, software and data analysis tools, as well as guidance on experimental design has been key to expanding our user base and managing user expectations.

Live Mouse Tracker, an evolving behavioural monitoring tool

Fabrice de Chaumont[1] & Elodie Ey[2]
[1]Institut Pasteur, France;[2]University of Strasbourg, France

Understanding complex behavioural traits such as decision-making or social interactions in mice requires high precision long-term individual following of mice. Here, we present a real-time method for behaviour analysis of mice housed in groups that couples computer vision, machine learning and Triggered-RFID identification to track and monitor animals over several days in enriched environments. This system - Live Mouse Tracker or Live Rat Tracker - extracts a thorough list of individual and collective behavioural traits and provides a unique phenotypic profile for each animal. Such a method is of high interest to understand rodent social organisation or to characterize mouse models of disorders affecting specifically social behaviour. This method is now upgraded by the combination with test modules allowing to evaluate specific cognitive functions at the individual level, while still keeping the animals housed in groups.

FED3: An open-source device for training mice

Lex Kravitz (via Zoom)
Washington University in Saint Louis, MO, USA

Understanding feeding behavior in rodents is crucial for answering many questions in neuroscience and metabolic research. We developed FED3 (Feeding Experimentation Device 3) to address this need. FED is an open-source, battery-powered device that was engineered for continuous, automated

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measurement of feeding and operant behavior in rodent home cages. We have released FED3 as an open-source project, and it is now in use by >300 labs in >20 countries. FED3 enables around the clock behavioral monitoring without experimenter intervention, at a much lower price than traditional commercial systems that measure food intake or operant behavior. This lecture will describe our motivation for producing FED3, strengths of the home-cage approach vs. traditional operant equipment, and the future of the FED3 project. In addition, the lecture will describe how FED3 was disseminated as an open-source design, and how this dissemination path has enabled it to reach many more researchers than traditional commercial dissemination plans.

SESSION 7: Future perspectives beyond TEATIME – opening new doors

Chair: Jan Rozman - University of Luxembourg, Luxembourg

Implementing machine learning pipelines for continuous home cage monitoring

***Claire Witham*[1], *R. Sonia Bains*[2] *and Sara Wells*[1,2]**

[1]*Centre for Macaques at MRC Harwell, Salisbury, UK;* [2]*Mary Lyon Centre at MRC Harwell, Oxfordshire, UK*

Machine learning models (including models such as Yolo and Deeplabcut) need continual monitoring to ensure they remain accurate, particularly if using the models for home cage monitoring over longer time periods. Models are often trained on relatively small initial datasets and then deployed to run on new data. However, they can be very susceptible to small changes in the input data and start producing erroneous results. The changes can be minor (e.g. a change in lighting or camera position) but they can have a big effect on the output. In the machine learning, pipelines are commonly used with steps to monitor the input and output to the model so that the model remains accurate. It is often necessary to retrain the model on new data to ensure it remains valid; this process is called continual learning. We are currently implementing a pipeline to continuously monitor foraging and enclosure use in 22 groups of rhesus macaque monkeys using video from CCTV cameras. The underlying models for this pipeline use Yolo (v11) to detect and segment monkeys and a variety of objects in the enclosure including platforms and enrichment. This had produced various challenges including changing enrichment, varying amounts of daylight and changes in group sizes. I will show the metrics we are using to monitor the pipeline and how we decide when the models need retraining. We are using the experience of the macaque pipeline to establish best practice guidelines for other machine learning based pipelines in mice and monkeys.

Rodent home cage monitoring as a strategy in preclinical safety assessments to mitigate central nervous system-related risks

***Ajeesh Koshy Cherian* (via Zoom)**

GSK, USA

Attrition due to central nervous system (CNS)-related adverse events is a major concern in drug development. As such, CNS safety pharmacology assessment is included in the 'core battery' studies as outlined in the ICH S7A guidelines, traditionally relying on the FOB/Irwin test in rodents. However, this conventional method has limitations due to its subjective nature and snapshot observations, which can fail to predict clinical outcomes accurately. This talk explores the potential of rodent home cage monitoring as a superior alternative, emphasizing continuous, automated, non-invasive behavioral

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assessment across multiple days. Through a multi-company initiative evaluating three compounds—previously passed through standard safety tests but later failed, including two in clinical trials—we tested if home cage monitoring will uncover CNS-related events missed by traditional methodologies. Interestingly, significant findings in all three compounds that were not observed in the original classic safety pharmacology tests were detected. Additionally, home cage monitoring offers substantial animal welfare benefits, including social housing and reduced stress, and allows for the integration of more refined study designs that may require fewer animals. By addressing the gaps in current CNS safety assessments, home cage monitoring has the potential to reduce drug development attrition rates and enhance participant safety. This presentation will discuss integrating this method into early CNS screening and repeat dose toxicity studies, positioning it as a viable alternative to conventional approaches.

Opportunity in Uncertainty: Strategic Thinking for TEATIME and Preclinical Automated Behavioral Monitoring

Indrek Heinla
University of Tartu and Estonian Research Council, Estonia

The future is not an extension of the present. In an increasingly volatile, uncertain, complex, and ambiguous (VUCA) world, scientists face the paradox of applying linear models to nonlinear, dynamic systems. In the past we have explored how critical uncertainties such as wobbling trust in science, unstable funding, alternatives to animal use and AI could affect our domain. This talk intends to broaden the conventional mindset by applying strategic foresight as a necessary complement to scientific rigor. It highlights how cognitive biases—such as confirmation bias, groupthink, and projection bias—limit our ability to envision alternative futures. We ask: what skills must preclinical researchers develop today to remain relevant tomorrow? What future scenarios are we preparing for—and what futures are we ignoring? What non-technological drivers may reshape our field in unexpected ways? How can we create a research culture where talents feel empowered to challenge assumptions? And how can we foster innovation culture that is resilient across different future paths? This presentation offers a critical but hopeful perspective on navigating uncertainty, encouraging DIY-mindset, and future-literate thinking in neuroscience.

Framework for a FAIR repository of Home Cage Monitoring data: Showcasing the power of collaborative thinking

R Sonia Bains[1], Damien Huzard[2], Benoit Girard[3], James Edgar McCutcheon[4], Pawel M. Boguszewski[5], Davor Virag[6], Leonardo Restivo[7], Lars Lewejohann[8,9], Michael C. Ashby[10], Jan Rozman[11], Hamish Forrest[1], Marion Rivalan[12], Hilary Gates[1], Otto Kalliokoski[13]

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Biomedicine, University of Luxembourg, Luxembourg; [12]*Institute of Neuroscience Paris-Saclay, CNRS, University of Paris-Saclay, 91400 Saclay, France;* [13]*University of Copenhagen, Department of Veterinary and Animal Sciences, Faculty of Health Sciences, Copenhagen, Denmark*

Home cage monitoring (HCM) systems generate continuous, high-resolution behavioural and physiological data, offering unprecedented insights into animal behaviour. However, the full potential of these technologies remains underutilized due to fragmented data sharing practices. To address this, we emphasize the urgent need for a centralized, FAIR-compliant (Findable, Accessible, Interoperable, Reusable) data sharing platform or repository tailored to HCM data. Over the past two years, the Data Repositories working group of European network COST Action TEATIME, have systematically evaluated existing data sharing platforms and identified their limitations in accommodating the unique demands of HCM datasets. Building on this evaluation, we propose an ideal solution and a supporting framework that aligns with FAIR principles, enabling efficient, secure, and standardized data sharing across the research community. Establishing such infrastructure is a critical step toward enhancing our understanding of rodent behaviour and pave the way for innovative applications of machine learning and big data analytics in biomedical research.

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Automated Pupillometry as a Non-Invasive Biomarker for Neural Circuit Function and Systemic Health in Freely Behaving Mice

***Gabriel Peinado Allina*[1], *Oskar Ikäheimo*[1], *Petri Ala-Laurila*[1,2] *Giuseppe Balistreri*[3]**

[1]Department of Neuroscience and Biomedical Engineering, Aalto University, Finland; [2]Faculty of Biological and Environmental Sciences, University of Helsinki, Finland; [3]Department of Virology, Faculty of Medicine, University of Helsinki

Objective, non-invasive biomarkers are essential for advancing preclinical neuroscience and improving animal welfare. Here, we introduce a patented pupillometric system that continuously monitors the pupillary light reflex (PLR) in mice, capitalizing on the well-mapped neural circuitry linking retinal photoreceptors to brainstem nuclei. This technology enables automated, remote assessment of neural circuit function and general health, circumventing the limitations of traditional invasive monitoring. Our findings reveal that changes in pupil dynamics provide an early, sensitive indicator of neural dysfunction, preceding behavioral manifestations in models of viral infection. In proof-of-concept studies, we successfully tracked the progression of neurotropic viral infections and their physiological impact using PLR metrics, highlighting the system's potential for early disease detection and intervention studies. By integrating real-time health monitoring with neural circuit analysis, this platform offers a transformative tool for neuroscience research, with broad applications in disease modeling and therapeutic development.

The dog as potential model for human mental disorders

Adriana Amfim

Faculty of Veterinary Medicine, Spiru Haret University

Behavioral genetics attributes an important role to heredity, while also evaluating aspects related to environmental factors. Regarding the dog, a variable number of tandem repeats (VNTR) in SLC6A3 have been associated with stress-related behaviors: lowered posture, hypervigilance in different stages of training, and episodic changes in behavior. Epigenetics for example shows that prenatal exposure of a fetus to maternal stress could determine epigenetic methylation of promoter regions of glucocorticoid receptor. In humans the psychoemotional correlation for the assessment of stress, anxiety, depression in humans with somatic stress can highlight the diagnostic potential of some epigenetic markers (miR-21 and miR-26) with a role in preventive medicine. Exposure to stress can alter the expression of stress-related genes in animals through epigenetic mechanisms, potentially affecting their behaviour and mental health. In dogs, chronic stress can lead to behavioural issues such as aggression, anxiety, and fearfulness.

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The Potential of Automated Animal Monitoring Technologies to Enhance Animal Welfare: Lessons Learned from the TEATIME COST Action Collaboration

***Aleksandra Bartelik*[1], *Anna Kiryk*[2]**

[1]Institute of Microbiology of the Czech Academy of Sciences, Prague, Czech Republic; [2]Nencki Institute of Experimental Biology PAS, Warsaw, Poland

Improving the welfare of laboratory animals is essential for generating reliable and reproducible research results - an important goal in biomedical research. Traditional methods of behavioral observation often rely on short, isolated time points and usually require frequent close contact between the animal and the experimenter, which can introduce stress and uncontrolled variability into experimental outcomes. To improve the welfare and minimize some of the stress factors, researchers have developed systems that enable automatic observation of animals in their familiar home-cage environment. Home Cage Monitoring (HCM) systems enable the long-term, automated tracking of animal activity, behavior, and metabolic parameters with minimal human intervention. The systems provide a lot of data on well-being and health-related behaviors, including food and water intake, activity levels (e.g., reduced activity as a sign of declining health, increased activity possibly indicating aggression), and physiological parameters such as body weight, temperature, and heart rate. These systems can signal the need for intervention in animals and thus support strategies to improve animal welfare. Animal care staff and facility managers responded that they do not yet use HCM systems in their daily work. However, a significant proportion of all non-users indicated interest in future implementation. These findings, drawn from a survey released by the TEATIME COST Action (CA20135), reflect growing awareness of HCM's potential benefits and underscore the need to make such systems more accessible and feasible for routine use. (animal welfare, animal behavior, home cage)

The hidden phenotype of mild traumatic brain injury: the added value of home cage assessment

***Lior Bikovski*[1,2], *Chaim G. Pick*[3,4]**

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Mild traumatic brain injury (mTBI) is often dismissed due to the absence of overt symptoms and clear imaging markers, yet it is associated with persistent cognitive, emotional, and behavioral deficits in both humans and animal models. Traditional behavioral assays, limited in duration and often confounded by stress and novelty, may fail to detect subtle but clinically relevant phenotypes. This talk will highlight how home cage monitoring (HCM) unveils a hidden layer of mTBI-related impairments that escape standard evaluation. Using the PhenoTyper system, we continuously assessed mice following mTBI in both cognitive and non-cognitive domains. We identified clear alterations in circadian dynamics, habituation patterns, wheel-running behavior, and stress recovery, with mTBI mice showing increased but fragmented activity, diminished habituation, and prolonged avoidance after mild stressors. In cognitive tasks, mTBI mice exhibited abnormal reversal learning trajectories despite preserved basic discrimination performance, suggesting deficits in cognitive flexibility. Complementary treadmill and maze-based assays confirmed mild but persistent deficits in memory without clear motor or anxiety-like impairments, emphasizing the need for continuous, low-stress assessment tools. These results indicate that mTBI induces a complex, under-recognized behavioral

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phenotype that becomes visible only through HCM's temporal and environmental sensitivity. Our findings support the integration of HCM into preclinical mTBI research, offering a refined lens through which to detect and understand subtle yet impactful behavioral changes. This approach not only enhances translational relevance but also refines phenotyping for intervention development.

Exploring the metabolism-behavior axis in Fat and Lean mice: setting the stage for home-cage monitoring

***Maša Čater*[1]; *Simon Horvat*[1]**

[1] *University of Ljubljana, Biotechnical Faculty, Department of Animal Sciences, Domžale, Slovenia*

Obesity results from imbalanced energy metabolism, with skeletal muscle and the brain playing key regulatory roles. We study a unique polygenic mouse model for obesity (Fat) and leanness (Lean), developed through 60 generations of bidirectional selection. Fat mice have five times more fat mass than Lean mice, despite similar food intake, and develop metabolic syndrome and diabetes. Our genetic mapping identified Pla2g4e as one of the most differentially expressed genes. Its product, cPLA2ε, is associated with energy balance and lipid metabolism. Overexpression in the hypothalamus and skeletal muscle of Fat mice suggests behavioral effects. We assessed behavior in both lines at 3 and 8 months using the open field, elevated plus maze, three-chamber sociability test, light-dark box, and sucrose preference test. Fat mice were more exploratory, more active, and exhibited higher anxiety than Lean mice. While anhedonia was similar, Fat mice consumed less liquid. Social behavior was sex-specific: Fat females showed greater social interaction and better social memory. Age-related effects were most notable in sociability and preference for social novelty. These findings suggest Pla2g4e-related metabolic disturbances influence behavior in a sex- and age-dependent manner. However, conventional behavioral tests offer only brief snapshots and may miss subtle, cumulative, or circadian changes. Future studies using home cage monitoring (HCM) will allow continuous, non-invasive tracking of spontaneous behaviors, enabling detection of nuanced phenotypes, diurnal patterns, and social dynamics. HCM is a powerful tool to advance our understanding of the metabolism–behavior relationship and its relevance for early detection of neuropsychiatric and metabolic disorders. Pla2g4e, obesity, behavior

Laboratory Animal Use in Türkiye: Numbers and Species

***Enver Çavuşoğlu*[1]**

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Laboratory animals are one of the cornerstones of biomedical research. The reliability and translatability of experimental models are directly related to the suitability of the animal species used and the standardization of experimental conditions. Laboratory animal use in Turkey is regulated in line with both ethical and scientific responsibilities. In this study, a general assessment of the current numbers and the distribution of species used in laboratory animal use in Türkiye is presented. The data were prepared using official laboratory animal use reports (between 2018-202) published by the Animal Experiments Center Ethics Committee of the Ministry of Agriculture and Forestry. Laboratory animal use in Turkey ranged between 236,297, 213,641, and 209,212 in 2018, 2019, and 2020, respectively. The most commonly used species are fish (28-37%), rats (17-24%), other birds (10-24%), mice (11-19%), and other birds, respectively. While the most commonly used experimental animal in European countries is the mouse, the most commonly used species in Türkiye are fish and rats. In addition, the

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total number of animals used has shown a decreasing trend from 2018 to 2020. This situation is thought to be due to the impact of the coronavirus pandemic. Turkey shows similar trends in the use of laboratory animals to European countries in quantitative terms; however, there is a need for more standardization in species diversity and ethical assessment processes. In particular, in order to increase the translatability of experiments and improve animal welfare, progress should be made in supporting alternative non-animal models, personnel training and data transparency. In this context, establishing a central database on the use of laboratory animals will strengthen the monitoring of species-based usage trends and the reproducibility of experimental data. Encouraging practices that comply with national and international ethical norms will facilitate the integration of the research ecosystem in Turkey with global standards.

On the importance of rigorous management of rodent colonies and behavioural study reproducibility: lessons from a rat model of epilepsy

***Diana Cunha-Reis*[1,2]**

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The Li2+-pilocarpine rat model of Mesial temporal lobe epilepsy (MTLE) involves inducing an acute seizure that then triggers epileptogenesis characterised by spontaneous recurrent seizures (SRSs). We explored differences in seizure susceptibility, epileptogenesis and mortality in Wistar Han rats from two distinct animal providers, Harlan Iberica (Envigo, Env) and Charles River (CR). Status epilepticus (SE) induced with pilocarpine (10 mg/kg, i.p. + additional doses every 20m until SE) under peripheral cholinergic blockade (methyl-scopolamine, 1 mg/kg, i.p.)1 in 46/50 adult (10 weeks-old) male Wistar Han rats, pretreated 24h earlier with LiCl (300 mg/kg, i. p.). SE was allowed to progress for 30m to 1h 30m and terminated with diazepam (i.p., 10 mg/kg). Seizure latency and severity2, mortality, pilocarpine dosing to reach SE and behavioural outcomes were evaluated in Env and CR rats. Env rats were larger/heavier (343.4±6.6 g, n=25) than CR rats (307.4±4.4 g, n=25) and required more pilocarpine doses (2.5±0.2, Env) to experience SE than CR rats (2.0±0.2). SE (1h 30m) induced high mortality (CR-80%; Env-50%) but all survivors developed SRSs. SE (1h) reduced the mortality (CR-75%, Env-30%), decreasing SRSs success rate in CR rats (50%). SE (30m) further decreased the mortality (CR-50%, Env-14.3%) with no SRSs developing in CR and reduced SRSs success rate in Env rats (83.3%). This illustrates marked differences in seizure susceptibility, survival and epileptogenesis success rate from previous studies1 and between Wistar Han rats from distinct providers highlighting the need to address its causes and to improve animal research reporting practices to avoid animal distress. 1. Glien et al. (2001) Epilepsy Res. 46 :111; 2. Lüttjohann et al. (2009) Physiol. Behav. 98, 579.

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The Sable Database – a searchable, local repository of indirect calorimetry data

***Vibeke Kruse*[1], *Morten Dall*[1]**
[1]*Rodent Metabolic Phenotyping Platform, Novo Nordisk Foundation Center for Basic Metabolic Research, University of Copenhagen, Denmark*

Indirect calorimetry systems provide home-cage monitoring data in high resolution, enabling metabolic characterization of drug candidates and genetic modifications in rodents. Collected data includes food intake, oxygen consumption, activity data, and voluntary wheel running. Indirect calorimetry is a major activity in our platform, and in 2024 we performed 41 experiments across our four Sable Promethion Systems, testing a wide range of mouse strains, diets, and experimental protocols. Yet, experiments are rarely analyzed beyond individual research questions. To enable comparison of data across experiments, we have taken the first steps in collecting all data from 22 studies in a Sable Database – a searchable data catalogue written with a Shiny R user interface, where users can find datasets according to specific parameters, explore previous recordings, and compare runs. The framework has a built-in data processing pipeline, allowing easy expansion as additional data is produced. We will present parameters and strategies for metadata collection, show general workflow for data processing, and an early version of the user interface. All code is available on Github, allowing other institutions to replicate the setup. We believe the Sable Database can be a valuable in-house resource, assisting users in setting up experiments, and allow meta-analysis of indirect calorimetry data, by allowing users to compare data across runs. We believe the Sable Database can serve as a 3R initiative by allowing users to answer research questions based on available data.

The BEATBOX: a behavioral and ecological open-source automated operant box

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The BEATBOX is a behavioral and ecological open-source automated operant box designed for mice. In these boxes, animals have access to water ad libitum and need to perform a behavioural task to get a food pellet. The goal of the task can be modified to suit the research question in need for example either a decision-making or a reversal learning task. The animals are pre-trained to get used to the box by getting step by step familiar with the different modules: feeder, passage and screens. There is also a camera on top of the box which allows for 24/7 monitoring of the animals. The recordings however are only done at specific times in order not to saturate the system with data. This behavioural system is at the moment only adapted for one animal at the time but previous studies in the lab have shown that mice that live in these boxes do not have anhedonia. As a user of the box, I am researching the effects of an intermediate dose of LSD in the behaviour of mice. Key words: home-cage system, behavioural task, LSD

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Scove-Cage: Automated Analysis of Locomotor Activity and Behaviors in Mice Using an AI-Supported Home-Cage Monitoring System

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This study aimed to develop and validate Scove-Cage, a domestically produced, AI-supported system designed for long-term and automated monitoring of locomotor activity, sleep-wake cycles, and basic behavioral patterns of mice in their natural environment (home-cage). Methods: The system includes 18 transparent cages (28×30 cm), each equipped with high-resolution cameras enabling continuous 24-hour recording during both light and dark phases. Lighting and ventilation are remotely controlled. A pose estimation model based on the ResNet50 deep learning architecture was trained on a dataset split into 95% training and 5% testing, with 300,000 training iterations. The AI-powered analysis software automatically calculated behavioral parameters, including time spent in central (central zone) and peripheral (thigmotaxis zone) areas, zone entries, food and water consumption durations, and total sleep and activity times. Results: The pose estimation model achieved a training error of 2.4 pixels and a test error of 6.58 pixels. With a p-cutoff threshold of 0.6, the test error was 6.75 pixels. This precision enables continuous 24-hour behavioral monitoring. The system successfully detected spatial activity, feeding, and sleep parameters, and captured subtle behavioral changes often missed by conventional behavioral tests. Data outputs were generated in Excel (for statistical analysis) and PNG (for visualization), enabling efficient and comprehensive evaluation. Conclusion: Scove-Cage provides a sensitive, automated solution for long-term behavioral analysis of mice under reduced stress conditions. Its high-accuracy AI-based approach enhances behavioral phenotyping in preclinical research and supports advanced translational applications. Keywords: Home-cage, behavioral analysis, artificial intelligence

The International Mouse Phenotyping Consortium, a Catalog of mammalian gene function

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The International Mouse Phenotyping Consortium (IMPC, https://www.mousephenotype.org/) is an international effort by 21 research institutions to identify the function of every protein-coding gene in the mouse genome.

The IMPC's mission is to create a comprehensive, standardised catalogue of mammalian gene function that is freely available for researchers. To achieve this, the IMPC is knocking out each of the roughly 20,000 genes that make up the mouse genome. Through this work, the IMPC delivers a sizeable reference dataset that not only underpins research in diverse domain-specific projects and databases, but additionally serves the wider research and clinical community, where the IMPC genotype–

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phenotype knowledge contributes to the molecular diagnosis of patients affected by rare disorders. Thus, IMPC data is used to investigate basic biology mechanisms that can lead to new therapeutic targets or to narrow down a suspected list of genes in patients in rare or complex disease studies. IMPC has made major gene discoveries in deafness, diabetes, circadian rhythms, metabolism, vision, pain and rare disease genetics.

IMPC data is standardised, mutant phenotypes are annotated with mammalian phenotype (MP) ontology terms and is highly quality controlled and analysed by experts using a reproducible analysis pipeline using the OpenStats BioConductor package. Data is released biannually via the IMPC portal (https://www.mousephenotype.org/) and is also made available from the Mouse Genome Database and OpenTargets for model organism and translational users respectively.

Data Release 22.1 (December 2024) comprises 9,774 phenotyped lines corresponding to 9,073 human orthologs, while 11,208 genes have a genotype confirmed line.

IMPC's impact is tracked through curation of the scientific literature and via bibliometric analysis from the National Library of Medicine. These reveal >270,000 citations and ~8100 publications which use IMPC data or IMPC materials (ES cells, lines etc). IMPC will complete an additional 1800 gene knockouts by 2027.

Translational value of experimental sleep fragmentation: link to anxiety and depression – like behavior

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Sleep, in which we spend a third of our lives, is a vital physiological process regulated by the nervous and endocrine systems. Sleep disorders are very frequent in the general population with profound effects on mental health. The hallmark features of obstructive sleep apnea (OSA) are disruption of sleep architecture in form of sleep fragmentation jointly with intermittent hypoxia. Many of the endocrinological and behavioral changes observed in OSA patients cannot be unilaterally explained by the effect of sleep fragmentation or intermittent hypoxia, due to their concomitant occurrence. In contrast, an experimental in vivo model of sleep fragmentation allows elucidation of these questions. To mimic sleep fragmentation in an experimental rat model we used a treadmill programmed to interrupt the sleep of experimental rodents at a frequency characteristic of patients with severe apnea during the first 6 hours of the light phase of the light-dark cycle. This model allowed us to assess anxiety and depression – like behavior upon acute and chronic sleep fragmentation by the battery of behavioral tests including open field, elevated plus maze, light- dark and forced swimming test. Time profile of anxiety and depression development in the current model was congruent with findings in OSA patients. The association between sleep architecture disruption and hormonal status alterations was also demonstrated, especially in the hypothalamic-pituitary-adrenal and hypothalamic-pituitary-gonadal axis. Experimental models of sleep fragmentation could be a valuable tool in elucidating OSA mechanisms, comorbidities and potential therapies.

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Assessing Maternal Behavior in Breeding Dams Using YOLO-Based Video Analysis in Enriched Cages

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Breeding mouse dams are often overlooked yet essential contributors to biomedical research. Postpartum estrus enables female mice to become pregnant immediately after parturition, potentially leading to continuous cycles of pregnancy and lactation when co-housed with a male. While this enhances colony productivity, it also places substantial metabolic and behavioral demands on dams to ensure pup survival through sustained maternal care.

To assess whether maternal behavior is changed after the first, second, or fourth consecutive litter, we implemented a non-invasive, home cage monitoring approach. One-hour videos of enriched individually ventilated cages (IVC) were recorded during both light and dark phases on every third postpartum day.

However, cage enrichment can partially or fully obstruct the dam from view, limiting the applicability of existing automated detection algorithms. To overcome this, we are developing a custom pipeline based on the single neural network YOLOv8n algorithm (Ultralytics) trained to detect IVC side view features (walls, food hopper, water bottle, house, nest) and dams in complex home cage environments. Preliminary post-processing in R enables estimation of time spent on and off the nest as a proxy for pup-directed versus self-directed behavior.

While the detection algorithm is still being refined to improve robustness and accuracy, our approach highlights the feasibility and value of automated, longitudinal monitoring of maternal location in enriched home cages. Ultimately, this work aims to improve the understanding of how repeated, continuous reproductive cycles affects maternal care.

A modular and scalable system to observe and test mice under near-natural conditions

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Laboratory mice are traditionally housed in small groups of 3 to 5 in shoe-box sized conventional laboratory cages while mice under natural conditions are organized into much larger social units. In such extended social networks, mice form hierarchically organized communities with distinct socio-spatial patterns. We strongly believe that observing more natural groups allows to exploit the full potential of animal models for biomedical research. We introduced a modular housing system for large groups of mice that allows us to observe them 24/7 by combined audio, video, and RFID surveillance. The system consists of multiple modules interconnected by tunnels revealing the identity of each passing mouse. In addition to RFID tracking, mice can be observed 24/7 using video cameras and microphones capable of recording ultrasonic vocalization. The system makes it possible to experimentally change environmental conditions, for example by redistributing the availability of food and water resources. In addition, access to individual modules can be restricted by means of a gate

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system that only opens for certain RFID tags. Thereby we can not only observe natural behavior under near natural conditions but also can carry out complex experiments within their home environment.

Digital ventilated cage interlinking: a home-cage monitoring approach for mouse behavioral testing

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The Digital Ventilated Cage (DVC) system, developed by Tecniplast S.p.A., has advanced animal welfare in research facilities by enabling precise control of environmental conditions and continuous non-invasive animal monitoring directly within the home cage. Beyond improving housing conditions, the DVC also facilitated the identification of novel digital biomarkers in murine disease models.

In this study, we investigated the potential of the DVC system to support behavioral testing traditionally performed outside the home cage. Specifically, we focused on three widely used paradigms - novel object recognition (NOR), light/dark (LD), and three-chamber (3C) tests - using a novel setup called interlinking. This configuration connects multiple DVC cages via frontal tunnels, enabling mice to move freely between them.

Following a period of habituation to the interlinking, animals were individually tested. Data were automatically recorded by the DVC and supplemented with video recordings for subsequent manual scoring. DVC-derived metrics and manual scoring were compared to assess the extent of correlation between the two approaches. Experiments were conducted at two independent research facilities, the IIT (Genoa, Italy) and the CNR (Rome, Italy), for cross-laboratory validation.

Results indicate that the interlinking is particularly promising for the LD and 3C tests. This is supported by a strong correlation between traditional manual video scoring and digital biomarkers derived from DVC data, such as activity levels and cage occupancy patterns. Furthermore, the data obtained from the two laboratories were consistent, supporting the reproducibility of the approach across different settings.

Overall, these findings highlight the potential of the DVC interlinking setup to support experimental designs for behavioral testing while reducing human interference and improving animal welfare. Also, this work underscores the value of integrating home-cage monitoring technologies with established behavioral paradigms to improve experimental reproducibility and robustness.

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Role of Neuronal growth regulator 1 (Negr1) in motor functions

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NEGR1 is a member of the immunoglobulin (IgLON) superfamily of cell adhesion molecules. Evidence-based on GWAS & OMICS studies indicate Negr1 gene loci as one of the significant risk factors for several neuropsychiatric disorders such as depression, autism, schizophrenia, etc. Around 80% of neuropsychiatric patients develop genuine motor abnormalities, including motor agitation, retardation, or disturbed gait patterns. Mice deficient with Negr1 (Negr1-/-) show several brain-behavior-related endophenotypes. So far, not much is known about Negr1 role in motor function. AIM: The study aims to investigate the impact of Negr1 in motor function. MATERIAL AND METHODS: Experiments were performed using male and female Negr1-/- and Wt mice in young (3-4 months old) and middle-aged (11-12 months old) groups (n=14-16; each). Behavioral experiments such as grip strength, grid hang, climbing, and gait analysis tests were used. Results were accessed using statistical parameters. RESULTS: In young cohort mice, Negr1-/- showed reduced muscle strength in both forepaws and all four paws compared to Wt mice. Middle-aged Negr1-/-males and females display reduced muscle strength. The grid hang test revealed decreased hanging duration for Negr1-/-mice in the young-age group. Muscle strength decline was observed in both genotypes with age. Negr1-/- mice showed poor motor coordination, and ladder-climbing tests showed slower climbing times for males in the middle-aged group. In addition, early gait disturbances were noted in both males and females of Negr1-/- from the young-age group, showing slow speed and reduced stride length. The middle-aged group showed reduced swing speed only in males. There is no significant difference in the other run characteristics and kinetic parameters in the middle-aged group, suggesting that the impact of the genotype fades as the mice advance in age. CONCLUSIONS: Negr1 deficiency leads to motor abnormality in male and female mice. Age-related variations in the progression of motor abnormalities are noted in both genotypes.

A hierarchical 3D-motion learning framework for mapping animal behavior in- and outside of the home-cage

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Animal behavior usually has a hierarchical structure and dynamics. To understand how the neural system coordinates with all the different types of behavior, a quantitative description of the hierarchical dynamics of different behavior is needed. However, the recent end-to end machine-learning-based methods for behavior analysis mostly focus on recognizing behavioral identities on a static timescale or based on limited observations. These approaches usually lose rich dynamic information on cross-scale behaviors. Inspired by the natural structure of animal behaviors in the home-cage, we address this challenge by proposing a parallel and multi-layered framework to learn the hierarchical dynamics and generate an objective metric to map the behavior. In addition, we characterize the animal 3D kinematics with our efficient multi-view 3D animal motion-capture and analysis system Behavioral Atlas. We demonstrate that this framework can monitor spontaneous behavior and automatically identify the behavioral phenotypes of transgenic animal disease model. Clearly this approach allows

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fully automated unsupervised investigation and analysis of animal behavior inside the home-cage and in any other arena of interest.

Disruption and recovery of vestibular and cognitive functions following hypergravity exposure in mice

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Among the numerous challenges of space research, adaptation and recovery of vestibular and cognitive functions during space flights and after returning to Earth remains a critical issue. One of the only ways to study this on Earth is to use artificial gravity change induced in a centrifuge. In this study, the long-term effects of 2G hypergravity (HG) were investigated in male and female C57BL6/J mice exposed for 24hours, 48hours or 15 days. The battery of behavioral tests comprised an assessment of vestibular function, a short-term memory test (spontaneous alternation in a Y-maze) and a long-term memory test with a spatial component (object location memory). For each experimental group, the behavioral analyses were carried out on the day of removal from the centrifuge and repeated after 1, 2, 7 and 15 days to assess the long-term recovery time. Whatever the sex, the results follow the same trend. The 2G exposure disturb vestibular functions and the recovery time was proportional to the duration of HG exposure. While short term memory was not affected, long-term object location memory was affected for up to 2 days in the 24hours and 48hours-exposed mice, and up to 7 days in the group exposed for 15 days to HG. Interestingly, these recovery times align with those of vestibular function impairment. The present study indicates the existence of a link between vestibular impairment resulting from hypergravity exposure and memory deficits involving the hippocampus. Indeed, long term memory with a spatial component involves the hippocampus more specifically than working memory, which involves more the prefrontal cortex. These alterations seemed to be compensated in the days following removal from the centrifuge proving recovery capacities and plasticity of the hippocampus.

Uncovering Animal Welfare Themes in Rodent Research Using Text Mining

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Background and Aim: Animal studies continue to be vital for the development of medical innovations and for gaining insights into biological processes in both humans and animals. They are also central to advancements in applied animal sciences and improving animal welfare. This study aims to explore how the concept of animal welfare has been addressed in scientific literature involving rodent models, particularly rats and mice by applying text mining techniques. Methods: A search protocol was done using PubMed. Text mining was conducted on a corpus to compare word frequency, examine inter word relationships, and perform sentiment analysis with R studio. Results: Document matrix was composed of 1818 words. According to the TM matrix, the most frequently repeated words include cell, mice, animal, rat, and Japan. These words include Asian countries such as Japan, Korea, Taiwan, and China. Among the words repeated more than 3000 times is reducing, which is in the 3Rs. Conclusion: Based on the results, mostly Asian countries cares animal welfare in first place according to others, we needed general discussion as to the cross-cultural findings, and then discuss key findings with these countries

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to make contributions to welfare perspective. Also based on 3R's rules (reducing, replacement, refinement) mostly worked area is reducing compared to rest. Reduction is often the most straightforward principle to apply in practice. In contrast, replacement and refinement often require more significant changes to experimental design or infrastructure. In future we need to think about how we increase the usage of replacement and refinement in animal welfare studies. Keywords: Text mining, animal welfare, rat, mice, 3R

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