Digital ventilated cage (DVC®) in Phenotyping: Identify how unexpected environmental factors (cage change, light conditions...) heavily impact basal locomotor activity.

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Introduction

Behavioral phenotyping in mice involves systematically evaluating behaviors relevant to an individual mouse's phenotype. Two widely utilized phenotyping methods are traditional laboratory-based and home cage systems.

Methods

Traditional laboratory-based systems typically entail assessing specific behaviors, such as memory, anxiety, or motor function, in a controlled environment, such as a maze or an open field. These tests offer precise and controlled measurements of behavior but may not accurately reflect the mouse's natural behavior in its environment.

Results & Brief Discussion

With the increasing focus on translational research, there has been a growing interest in home cage monitoring systems, which allow for long-term behavior monitoring in a more natural and unrestricted setting. These systems are often integrated with automation and artificial intelligence and provide a more comprehensive understanding of mouse behavior.

Additionally, spontaneous locomotion is a crucial factor in out-of-cage behavioral testing. Establishing a baseline 24/7 activity can indicate hypo/hyperactivity (see example below), particularly in mouse models with genetic mutations or undergoing drug treatments of unknown effects.

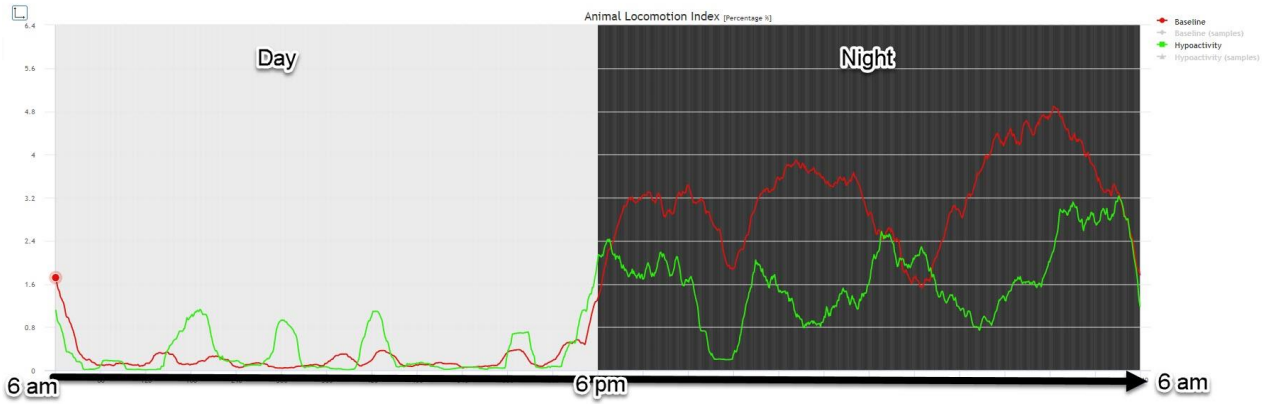

Figure 1: Example of hypoactivity of the cage (green line) detected as compared to its week baseline (in red).

A recent study investigated activity patterns in male and female C57BL/6J mice across three test sites using DVC®. The results showed an increase in activity around lights-on and a substantial increase at lights-off. Standard animal handling procedures were found to be stressors that impacted in-cage activity. The study also revealed differences in activity between the test sites, between weeks, and between male and female mice, with males showing differences in response to cage change and lights-on and females showing a more significant tendency for week-to-week variance in activity. These findings demonstrate that home

cage monitoring is scalable and provides valuable information for animal welfare, experimental design, and phenotypic characterization (*1*).

Another recent study by Charles River and CNR Rome researchers established baseline locomotor patterns in commonly used mouse strains, including C57BL6N, BALB/C, and CD1,
using DVC® technologies. The results showed that outbred mice displayed more activity than inbred mouse strains and that female mice were more active than male mice. These findings demonstrate the feasibility of simultaneous 24/7 behavioral characterization in both genders at a scale for behavioral core labs or facilities (*2*).

Conclusion

Such findings demonstrate the ability to phenotype at large-scale novel mouse models or evaluate a treatment response across several days of evaluation. Such application can be extended into behavioral core labs, large animal facilities, or large genetic/phenotypic consortia.

References

1. K. Pernold *et al.*, Towards large scale automated cage monitoring - Diurnal rhythm and impact of interventions on in-cage activity of C57BL/6J mice recorded 24/7 with a non-disrupting capacitive-based technique. *PLoS One* 14, e0211063 (2019).

2. S. Fuochi *et al.*, Phenotyping spontaneous locomotor activity in inbred and outbred mouse strains by using Digital Ventilated Cages. *Lab Anim (NY)* 50, 215-223 (2021).