Medical Xpress

Moving neuroscience into the fast lane

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At the RIKEN Brain Science Institute in Japan, a two-year project from Andrea Benucci's research group has culminated in the construction and deployment of a high-throughput system to study mouse behavior and physiology. The system aims to deliver larger, standardized datasets, a reduction in the number of experimental animals, and time-savings through complete automation.

Behavioral neuroscience—studying vision or cognition in mice, for example—always entails training animals to do experimental tasks, like pushing a button to indicate a preference or demonstrate a memory. Training can take months, a full-time job for one or multiple researchers. In addition, mice can get stressed from being handled by experimenters, and training and experiments vary from lab to lab. "It is hard to compare data across labs and even within the same lab, and we waste a lot of person-hours getting comparatively little data," says Benucci. His longstanding goal has been to comprehensively address these issues. Collaborating with Japanese laboratory equipment manufacturer O'hara & Co. Ltd., Benucci designed and built an automated experimental platform, details of which have been published in *Nature Communications* on October 30.

Without any human intervention, mice can engage in behavioral training tasks at-will, and a single system can operate around the clock, training four or more mice per day. With multiple setups and mouse cages stacked in what resembles a row of server racks, the system has already been used to safely train 100 mice. "Previously, training just one mouse took about 15 hours of a researcher's time," Benucci estimates. "Now, with twelve setups we are down to less than one-and-a-half hours." Mice enter the apparatus to receive liquid rewards for doing visual or auditory discrimination tasks. They rotate a small toy wheel with their front paws to indicate a decision, for example whether they can hear a tone or not. Crucially, mice learn to self-stabilize their heads, which gives the system a great deal of experimental versatility and represents a significant advance from existing attempts at automating rodent training.

Because mice learn to self-direct and become familiar with the system, and it is modular, the experimental possibilities extend beyond studying mouse behavior to real-time brain imaging and physiology. "Normally we see a decline in mouse performance or other incompatibilities when moving from highly-trained behaviors to different types of experiments for brain recordings, but that doesn't happen with our system," says Benucci. The self-learned head stabilization is key for collecting high-fidelity physiology data, and the paper also shows that two-photon microscopy of the brains of trained mice engaging in complex behavioral tasks is a seamless extension of the system.

The high-throughput neuroscience platform has been patented by RIKEN, one of Japan's national science institutes, and Benucci hopes it will be widely adopted nationally and internationally. "Standard hardware and training protocols across labs that do not require the experimenter's intervention can go a long way to addressing data reproducibility in science," says Benucci, "and in neuroscience in particular there is a pressing need for large, shareable datasets to validate findings and push the field forward."

More information: Ryo Aoki et al, An automated platform for high-throughput mouse behavior and physiology with voluntary head-fixation, *Nature Communications* (2017). DOI: 10.1038/s41467-017-01371-0

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