H. Ishii, A. Koumura, Y. Masuda, S. Miyagishima, A. Takanishi, N. Iida, H. Kimura. Proposal of novel experimental methodology for studies on Alzheimer's disease using rat and small mobile robot. Gerontechnology 2008; 7(2):131. In the aging society, many elderly people suffer from Alzheimer's disease (AD)[1]. WHO reports that more than 18 million people are suffering from AD in the world today. Glenner reported that amyloid had been deposited in the brain of AD patients[2], several researchers started to develop AD model animals by injecting amyloid into their brains or knocking out the gene associated with amyloid protein formation. These studies contribute to clarifying molecular biological mechanism of AD. Psychological factor such as stress or satisfaction obtained from interaction with other people plays important part in onset of AD as well as molecular biological factor. However, comparing to studies on AD in molecular biology, psychological factor is not well studied. We then propose a novel experimental methodology to study AD from psychological view point. Applying robotics to animal psychology, we developed an experimental setup to investigate rat's characteristic such as sociality, learning ability through the interaction experiment between a rat and a small mobile robot. **Method** The experimental setup consists of an 'open-field' and a small mobile robot, WM-6 (Waseda Mouse No.6)[3]. WM-6 has a microcontroller, a wireless communication module, two driving wheels, an omni-directional passive wheel, a battery and two levers. This robot is wirelessly controlled by the PC. The motion performance of this robot is almost equal to a mater rat. The interaction experiments between a rat and the robot are conducted in the open-field (1100 x 1100 [mm]). A food feeding machine and a water feeding machine are set in it. A battery exchanging machine for WM-6 is also set in it. A CCD camera is positioned above the open-field and constantly sends an image of the experiment to the PC every 30 milliseconds. The PC autonomously controls robot's motion and the three machines in the open-field using image processing technique. We performed an experiment using this setup to investigate differences in learning ability between young (15 weeks old) and old (75 weeks old) rat. In the experiment, we trained a task, pushing lever on WM-6 to obtain food, to each rat. To train rat, we developed a robot behavior pattern that enables the robot to autonomously teach a rat to push the lever to obtain food. This pattern is designed referring to the method of 'shaping' that is one of the techniques of 'operant conditioning'. **Results and discussion** In the experiment, young rat learned the task three times faster than old one. Interestingly, the learning curve shape of each rat is quite different. That of young rat looks stair like while that of old rat looks gentle slope. These results are consistent with the basic theory of learning ability in psychology. Concerning only this result, the experimental setup we developed has no novelty. However, each rat shows different kinds of interaction with the robot. For instance, young rat bit and pulled the robot several times before to learn to push the lever while old one had not exhibited that. Consequently, we believe proposed experimental setup can be a novel experimental paradigm to evaluate 'sociality' and 'learning ability' of rats. In future work, we will evaluate 'sociality' and 'learning ability' of AD model rats in this experimental paradigm. Thus we believe this work will contribute to clarify the mechanisms of AD in the future.

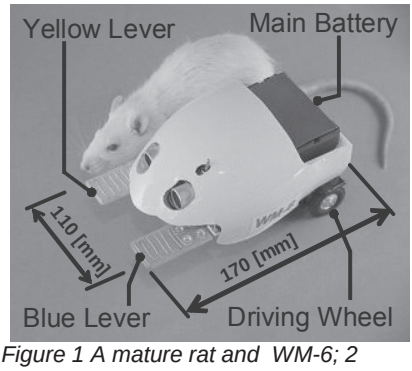

Figure 1 A mature rat and WM-6; 2 driving wheels are mounted on the rear end; an omni-directional wheel and 2 levers are mounted on the front end

References

1. Vas Chicot J, Rajkumar S, Tanyakitpisal P, Candra V. Regional Office for South-East Asia, WHO; 2001
2. Glenner GG, Wong CW. Biochemical and Biophysical Research Communications 1984;120:885-890
3. Ishii H, Nakasuji M, Ogura M, Miwa H, Takanishi A. Proceedings ICRA 2005; pp 3089-3094

Keywords: Alzheimer's disease, disease model animal, animal-robot interaction

Address: Waseda University, Japan; E: h-ishii@takanishi.mech.waseda.ac.jp