Correlation between rat personality and learning ability, and possible involvement of NR1 subunit

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Background: The definition of individuality of small animals has not yet been clarified. Regarding the relationship between the individuality of small animals and brain functions, research has been done but no direct proof of individuality emergence has been made. Therefore, in this study, we carried out a rat individuality judgment based on the anxious insensitive behavior (resistance) and the anxious avoidance behavior (vulnerability) for acrophobia, and furthermore investigated the relationship with the learning ability and the expression level of glutamate receptors (GluRs) in the hippocampus.

Methods: Improved Elevated Beam Walking (IEBW) Test of the SD rats was performed for 3 minutes. The rats with a staying time of 90 seconds or less on the bridge were defined as short stay type (S-type), while the rats with a staying time on the bridge of 121 seconds or more were referred to as long stay type (L-type). After the IEBW test, the learning ability in the rat according to the individuality was judged by two-image discrimination task using a rat touch screen recognition learning device. After determining a learning ability, hippocampi were harvested from rat brain. RT-qPCR analysis using specific primer of GluRs and western blotting analysis using mGluR3, GluR7, NR1 specific antibody were performed in rat hippocampus samples.

Results: Based on the results of the two-image discrimination task, it was revealed that S-type rats with vulnerability at altitude had less erroneous touch and higher percentage of correct answers than L-type rats. In the L-type rat hippocampus, the GluR7 and mGluR3 mRNAs expression level in the right-brain was significantly decreased relative to the left-brain. In addition, the expression levels of NR1 mRNA in the right-brain hippocampus were significantly increased relative to the left-brain. It was revealed that the expression level of NR1 protein in the L-type hippocampus was significantly higher than that of S-type hippocampus.

Conclusions: It is observed that the learning ability of rats showing vulnerability to altitude stress is better than that of resistant rats, which was suggested to be due to the balance of the expression level of GluRs. This may be an important trigger determining the individuality emergence.