Objective evaluation of fatigue in macaque monkeys.

In order to access the neuronal mechanism of fatigue and sensing of fatigue, it is important to evaluate the state of fatigue objectively. However, a test that is suitable for the evaluation of the state of fatigue from the animal's behavioral performance has not been established yet. To evaluate fatigue, we analyzed the behavioral performance of the macaque monkeys during which is performing continuous repetition of a simple reaction task (SRT) that requires visual-guided lever pressing and/or simultaneous visual discrimination. After they had been skillful in performing the SRT by a long-term training and experiences, we measured the reaction time (RT) consist of the release latency (the time required to release the lever after the presentation of a targeted visual stimulus) and the movement time (the time required to press lever after release of the middle lever). We found that the RT was delayed gradually when the monkey repeated the SRT 100 times continuously. Though it delayed whenever the trial progressed to the end of session, after 5 min of resting from the end of the session (e.g. the 1st), this tendency of delay was consistently reappeared in the next (e.g. 2nd) session. The mean value of the RT in each trial strikingly indicates that, in this monkey, almost linear delay, 0.7-millisecond delay per trial, was occurred in this task when a large spot was used as a target (Fig. 1).

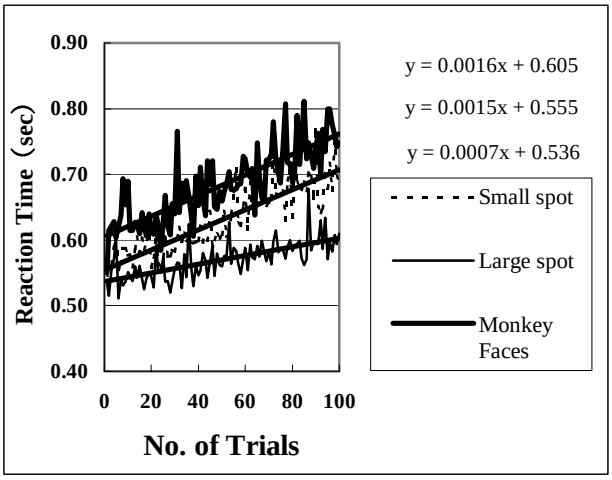

Fig. 1. Change in reaction time (RT) during continuous repetition of SRT in a monkey.

Alteration of the target stimulus for visual discrimination (small or large white spot, or photo pictures of monkey face) increased the slope of delay in RT in the order of faces, small and large spot (Fig. 1). In addition, it was increased by the one-night sleep deprivation and also affected by kinds of reward (e.g. water or juice) used in the task. Further, using this task paradigm, we also examined the effect of plant-derived odors on the behavioral performance of monkeys. Exposure of the green leaf odor (a mixture of 0.3% dilution of hexenol and 0.03% hexenal) to the subjective monkey throughout the task performing period resulted in the reduction of delay of RT during the task. The green leaf odor may have a biological action to prevent the accumulation of fatigue occurred during the continuous repetition of SRT. These results indicate that measurement of RT during continuous repetition of the SRT is useful for the evaluation of fatigue and/or sensing of fatigue in the monkey.

References

1. Onoe, H., Yokoyama, C., Aou, S., Tsukada, H., and Watanabe, Y. (2002) Evaluation of the fatigue monkeys. *J. Chronic Fatigue Synd.*, **11**, *in press.*