decreased. This indicates that the infraspinatus muscle was involved in the fatigue task. In addition, the shoulder position sense of internal and external rotation significantly decreased after the fatigue task. These results suggest that the fatigue reduced the accuracy of sensory input from muscle spindles. However, no significant difference was observed in shoulder position sense of abduction before and after the fatigue task. This may be due to the fact that infraspinatus muscle did not act as prime movers in shoulder abduction. These results suggest that muscle fatigue decreased position sense during movements in which the affected muscles acted as prime movers.

3-32

The effect of auditory stream segregation on synchronized tapping

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We can tap in synchrony with a simple sequence of auditory tones, but our taps generally precede it by several tens of milliseconds("negative mean asynchrony"). A simple sequence of sounds sometimes causes auditory perceptual organization different from the physical sequence. However little is known about interactions between the auditory perceptual organization and sensorimotor synchronization. The present study aimed at investigating effects of the auditory stream segregation (one stream or two) on the synchronized tapping. Participants listened to a sequence of two different auditory tones presented alternately, and were asked to tap in synchrony with one group of tones (i.e., high tones or low) with index fingers. After that, they were also asked whether the tones were perceived one or two streams. The results showed that negative mean asynchrony was caused both in perceived one stream and two. However, the amplitude of the asynchrony was smaller when they perceived the tones as one stream than as two. This indicates that auditory perceptual organization affects sensorimotor synchronization even if auditory tones were presented with the same timing. When we synchronize bodily with auditory tones as in the case of a motor rehabilitation, we have to take account of auditory perceptual organization.

3-33

Action-induced rubber hand illusion

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In the rubber hand illusion (RHI), when a rubber hand is observed while the real hand is occluded from view, and the two are stroked synchronously, several illusions can be induced: proprioceptive drift toward the rubber hand, sensation of touch on the rubber hand, and ownership for the rubber hand. RHI has often been demonstrated for hands that are passive. We modified the basic protocol, such that action is required—the pressing of a button. Our device has two buttons, allowing real and rubber hands to press, either synchronously or asynchronously. Participants start a stopwatch when action begins or when stroking begins; they are instructed to stop the stopwatch, as soon as they begin to experience the illusion. Results reveal a significant difference between synchronous and asynchronous conditions for the act of pressing, as measured both by questionnaire and reaction time. Difference in proprioceptive drift, however, is only exhibited in the passive condition. This difference might be due to awareness that we are doing something, and due to what we call, the "silencing" of a subject of experience. We are the first to demonstrate that RHI can be induced not only when hands remain passive, but also when they act.

3-34

The effects of body action and attentive anticipation on oculomotor fixation stability

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Tiny eye movements, such as micro-saccades, ocular tremor, and drifts, occur involuntarily during fixation. We found evidence that involvement of body action and anticipation of visual stimuli modulates them.
While eye movements were monitored, subjects performed the working memory task with a touch-screen display in two different conditions. In the passive condition, each number was shown for 400-ms and spaced in time by 500-ms automatically. In the active condition, touching action was required to trigger the appearance of each number. The delay between the touch and stimulus onset was constant within a block as 200, 500, or 800-ms. Subjects were prompted to type in the number sequence after five numbers were shown.
As a measure of fixation instability, deviation of eye position was analyzed by comparing eye positions with those during the reference interval (0~50ms time period after the number onset). We observed two results: first, the deviation was smaller in pre-reference time than in post-reference time. Second, the deviation was smaller in the active condition. These results show that micro eye movements are influenced by attentive anticipation of upcoming events, which becomes more pronounced with bodily interactions. These findings suggest a cross-modal interaction among visual, motor, and oculomotor systems.

3-35

PD patients with movement problem also showed the deficit of object representation in movable objects

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Parkinson's disease (PD) is a neurodegeneration disease that caused by neural loss in substantial nigra, leading to the neurotransmitter, dopamine, decreases in the mid- brain. Previous studies found that PD patients have deficits in identifying animate objects (Antal, et al., 2002; Righi, et al., 2007) and in naming actions (Cotelli et al., s2007). Since most animate objects are moveable and most inanimate ones are unmovable, the main purpose here is to investigate whether PD' s deficit in categorizing animate objects would be confounded with movable ones. We use the object decision task in which participants have to decide whether objects were real or not. Results showed that in comparison to age matched controls, (1) patients responded slower for animate objects than for inanimate ones; (2) they also responded slower for movable objects than for unmovable ones; (3) patients responded the worst, when animate and movable objects were presented compared to the conditions of animate or moveable objects only. We concluded that PD patients have deficit in object representation especially for the animate and movable concepts. We will discuss the relationship between PD patient's movement and the representation of movable concepts.