TWO TYPES OF ANTICIPATION IN SENSORY-MOTOR COUPLING

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The anticipatory timing control in sensory-motor coupling is indispensable to generate coordinative movement among humans, however its cognitive mechanism still remains obscure. In this study we used synchronization tapping task as a model system, and negative asynchrony phenomenon where the tap onset precedes the stimulus onset was analyzed as an example of the anticipation. Especially, applying dual task method, the relationship between the anticipation mechanism and the higher brain function such as attention and working memory was investigated. The results revealed two types of anticipatory timing control (Fig.1). In the inter stimulus-onset interval (ISI) range of 450 to 1800ms, automatic anticipation that is not affected by attentional resources was observed and was based on feed forward dynamics. In the 2400 to 3600ms range, the anticipation showed trade-off relationship in the allocation of attentional resources. Magnitude of synchronization error (SE) between tap onset and stimulus onset in this region was scaled by the ISI and the feed back dynamics concerning ISI was suggested. Accordingly, anticipation in timing control was shown to be a dual processing between the attentional process and the embodied automatic process.
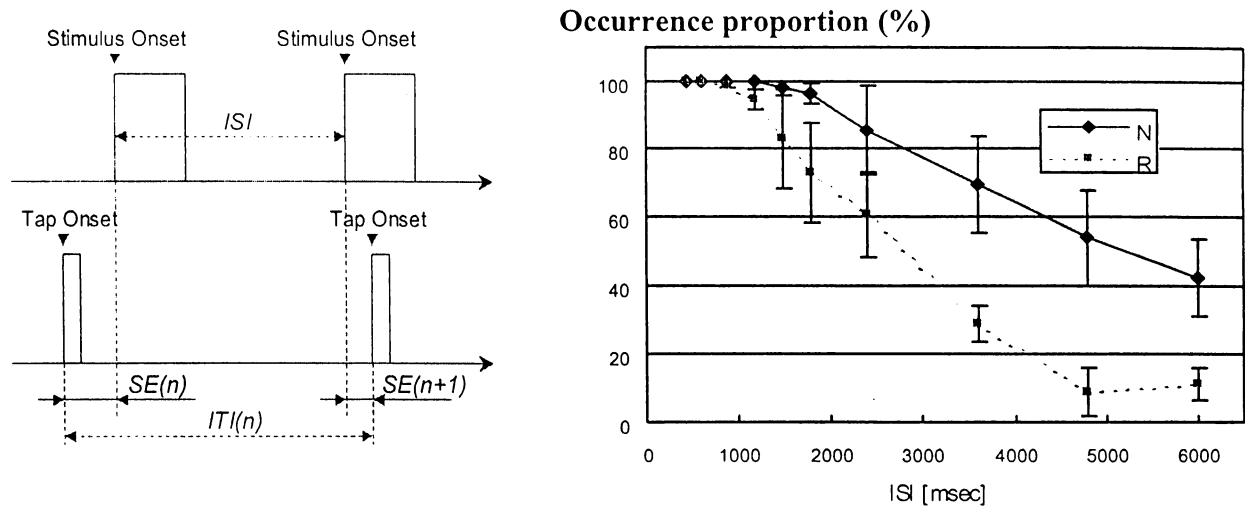
Occurrence proportion (%)

Fig. 1 Occurrence proportion of anticipatory tapping

The data measured during this experiment is stimulus onset and tap onset. The time difference between the stimulus onset and the tap onset was defined as the Synchronization Error (SE). Negative SE indicates that the tapping precedes to the stimulus onset and corresponds to the anticipatory tapping. The time difference between two successive stimulus onsets was defined as the Inter Stimulus-onset Interval (ISI). The duration time of each stimulus is 100ms. Occurrence proportion is defined as the ration of anticipatory tapping in all taps. "N" means normal tapping task and "R" means the normal tapping task + reading task. The difference between these two conditions corresponds to the influence from attentional resources. In the ISI of 1800ms and 2400ms, there was a large difference $(0.05 \leq p < 0.1)$, and significant difference $(p < 0.05)$ was observed in the ISI range more than 3600ms. Error bar shows the Standard Error of all subjects (n=6).