

# 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 with dynamical environment, however its cognitive mechanism still remains obscure. In this study we used synchronization tapping task as a model system, and negative asynchrony phenomenon [1-4] where the tap onset precedes the stimulus onset was analyzed as an example of the anticipation. Especially, applying dual task method [5], the relationship between the anticipation mechanism and the higher brain function such as attention [6] and working memory [7] was investigated.

The results revealed two types of anticipatory timing control [8]. 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 process. 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 process concerning ISI was suggested.

Furthermore, we used time-series analysis to clarify it in frequency response characteristics. As a result, it was shown that anticipatory behavior in sensory-motor coupling is composed of two different dynamics corresponding to the above two types of anticipatory timing control [9]. The former is characterized by the  $1/f$  fluctuation between the power and the frequency, suggesting non-stationary process in unbounded variation [10]. The latter is characterized by the superimposition between white noise and the significant peak of periodic stimulus, suggesting stationary process in bounded variation.

Accordingly, anticipation dynamics in timing control was shown to be a dual processing between the attentional processing based on completeness and the embodied processing based on incompleteness. Not only psychophysical analysis but also some applications in the field of human-interface are mentioned in the lecture [11].

## References

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