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Verification and Proposal of Information Processing Model Using EEG-Based Brain Activity Monitoring

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Abstract : Human beings perform a task by perceiving information from outside, recognizing them, and responding them. There have been various attempts to analyze and understand internal processes behind the reaction to a given stimulus by conducting psychological experiments and analysis from multiple perspectives. Among these, we focused on Model Human Processor (MHP). However, it was built based on psychological experiments and thus the relation with brain activity was unclear so far. To verify the validity of the MHP and propose our model from a viewpoint of neuroscience, EEG (Electroencephalography) measurements are performed during experiments in this study. More specifically, first, experiments were conducted where Latin alphabet characters were used as visual stimuli. In addition to response time, ERPs (event-related potentials) such as N100 and P300 were measured by using EEG. By comparing cycle time predicted by the MHP and latency of ERPs, it was found that N100, related to perception of stimuli, appeared at the end of the perceptual processor. Furthermore, by conducting an additional experiment, it was revealed that P300, related to decision making, appeared during the response decision process, not at the end. Second, by experiments using Japanese Hiragana characters, i.e. Japan's own phonetic symbols, those findings were confirmed. Finally, Japanese Kanji characters were used as more complicated visual stimuli. A Kanji character usually has several readings and several meanings. Despite the difference, a reading-related task and a meaning-related task exhibited similar results, meaning that they involved similar information processing processes of the brain. Based on those results, our model was proposed which reflects response time and ERP latency. It consists of three processors: the perception processor from an input of a stimulus to appearance of N100, the cognitive processor from N100 to P300, and the decision-action processor from P300 to response. Using our model, an application system which reflects brain activity can be established.

Keywords : brain activity, EEG, information processing model, model human processor
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