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Article / Book Information

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Title(English)	The Effect of Motion Information on Simultaneity Perception
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（博士課程）
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論 文 要 旨

THESIS SUMMARY

専攻： Department of	知能システム科学　専攻	申請学位（専攻分野）： Academic Degree Requested	博士　（　理学　） Doctor of
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Motion perception is a fundamental tool for interaction with a dynamic environment. When considering real-time interaction, temporal information of moving object is a significant factor for smooth interaction. In particular, simultaneity perception is an important key for flexible human behavior with the dynamic environment. In other words, real time interaction with the dynamic environment is generated by the relationship between motion perception and simultaneity perception. This dissertation addresses the influence of visual motion information on simultaneity perception. The main aims of this dissertation were (1) to examine how visual apparent motion affects audiovisual simultaneity perception, (2) to investigate what mechanisms contribute to the findings that visual apparent motion affects simultaneity perception, (3) to examine the influence of visual motion on simultaneity perception in human communication. These aspects are described in more detail in Chapter 1.

In Chapter 2, the purpose was to investigate how visual apparent motion affects audiovisual simultaneity perception. Two types of temporal order judgment (TOJ) tasks were examined to confirm the effect of visual apparent motion. Participants conducted audiovisual TOJ tasks in the apparent motion condition with two flashes, and in the normal condition with a single flash, which is the conventional condition of a TOJ task. The results of the experiments showed that point of subjective simultaneity (PSS) in the apparent motion condition was shifted toward a sound-lead stimulus, which is closer to physical simultaneity (i.e., zero) and just noticeable difference (JND) in the apparent motion condition was smaller than that in the normal condition. This means that audiovisual simultaneity perception is closer to physical simultaneity from the PSS's result and showed greater temporal resolution from the JND's result during apparent motion perception. This results suggest that visual apparent motion contributes to very precise perceptions of temporal simultaneity in audiovisual integration.

In Chapter 3, the goal was to investigate what mechanisms contribute to the finding obtained in Chapter 2. Three possible mechanisms were considered and they were examined in three sections, respectively. In Section 1, the purpose was to examine the influence of amount of visual stimulation as the first possible mechanism, because it remained unclear whether the results obtained in Chapter 2 were influenced by differences in the amount of visual stimulation. As a result, the PSS and JND obtained in the apparent motion condition differed from those obtained in the successive condition as non-motion perception, which included the same amount of visual stimulation of the apparent motion condition. This means that the amount of visual stimulation made no difference in the apparent motion condition.

In Section 2, the purpose was to investigate the influence of prediction (a higher-order brain function) as the second possible mechanism, because apparent motion was produced by a constant interval between two flashes. Therefore, it was necessary to eliminate the influence of prediction by randomizing the intervals between the two visual stimuli. As a result, the results obtained in Section 2 did not differ from those obtained in the apparent motion condition in Chapter 2. This means that apparent motion was equivalently processed regardless of prediction.

In Section 3, the purpose was to confirm whether motion binding property as the third possible mechanism influences audiovisual simultaneity perception. Visual apparent motion is achieved by binding property that stimuli are perceived as a moving object with spatiotemporal continuity, and a single bounded object. Therefore, there is a need to examine the influence of motion binding property. As a result, the PSS shifted toward a sound-lead stimulus and especially became closer to physical simultaneity in the motion binding condition, and the JND in the motion binding condition was smaller than those in the non-motion binding condition. This shows that motion binding property shifted simultaneity toward physical simultaneity, and reduces the temporal window in audiovisual integration. Therefore, it is revealed that motion binding property contributes to the accurate perceptions of temporal events in audiovisual processing.

In Chapter 4, the purpose was to investigate the influence of visual motion on simultaneity perception in human communication. To confirm the influence of visual motion, body movement synchronization is detected in face-to-face (visual interaction) and remote communication (unidirectional visual perception) settings using a new definition through phase difference because body movement synchronization is achieved by simultaneity perception. As a result, although the mean phase differences in head nods did not differ significantly between the face-to-face communication and remote communication conditions, there were significant differences in the densities, standard deviations and kurtoses in the phase difference distributions between the two conditions. This means that visual interaction resulted in higher synchronization activity and strength by accurate simultaneity perception.

This dissertation addresses the influence of visual motion information on simultaneity perception. The findings showed that visual motion information contributes to higher accuracy on simultaneity perceptions of temporal events in the dynamic environment. Therefore, motion perception allows flexible interaction with the dynamic environment in real time.