Visual Apparent Motion Influences Audiovisual Synchrony Perception

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Abstract Relation between visual motion information and temporal perception is important in dynamic environment. We investigated the relationship between temporal order perception and motion perception on audiovisual processing. Participants performed audiovisual temporal order judgment (TOJ) task in the apparent motion condition and the single flash condition. The perceived order and temporal resolution on audiovisual processing are different between the apparent motion condition and the single flash condition. Our result shows that motion information differs from non-motion information on temporal processing in multisensory integration.

Keyword: Motion Perception, Time Perception, Multisensory Integration

1 Introduction

We perceive and interpret external sensory stimuli to establish flexible interaction with the environment. In particular, the relation between visual motion information and temporal perception is an important key for flexible human behavior in a dynamic environment. However, the characteristics of temporal perception under motion perception are not fully elucidated. The purpose of the present study is to investigate the temporal order perception of external sensory stimuli under apparent motion perception on audiovisual integration. To investigate the temporal order perception of external sensory stimuli on motion perception, we examined the temporal order judgment (TOJ) task experiment. Participants performed audiovisual TOJ task between the apparent motion condition and the single flash condition to examine whether visual apparent motion affect audiovisual temporal order.

2 Method

Sixteen participants participated in the Experiment. The audiovisual TOJ tasks were performed over two sessions with visual stimuli: in the apparent motion condition and in the single flash condition. We conducted logistic regressions using a generalized linear model with the ratio data of the experiment [1]. Point of subjective simultaneity (PSS) and just noticeable difference (JND) are used as the methods of measurement. The following equation was applied to the regression analysis:

$$y = \frac{1}{1+e^{\frac{(\alpha - x)}{\beta}}} \quad (1)$$

where α represents the estimated PSS and β is related to JND, x denotes stimulus onset asynchrony (SOA). y indicates the responses of visual first or auditory first. JND is defined as shown in the following:

$$JND = \frac{X_{75} - X_{25}}{2} = \beta \log 3 \quad (2)$$

where X_p represents the SOA with p percent of 'auditory first' responses.

3 Results

Fig. 1 presents the results of the experiment. The PSS in the single flash condition had a visual-lead value, 12.47 ms (SE = 6.45), but the PSS in the apparent motion condition shifted to a sound-lead value, –4.90 ms (SE = 5.84). A paired t-test of PSSs indicated significant difference between the two conditions ($t(15) = -2.33$, $P < 0.05$). In addition, the JND in the apparent motion condition was smaller than that in the single flash condition (see Table 1), and the JND values were 35.72 ms (SE = 3.96) and 48.23 ms (SE = 5.17), respectively. A significant difference between the JNDs was observed in the paired t-test ($t(15) = -3.57$, $P < 0.01$).

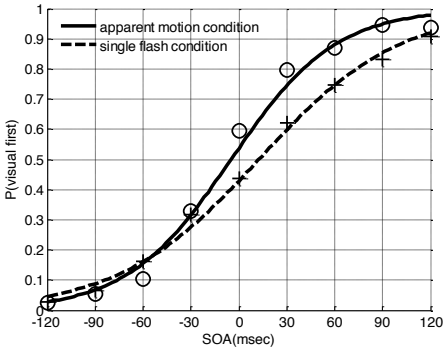

Fig. 1: The results of the experiment.

4 Discussion and conclusion

Previous studies have reported that the PSS usually shifts toward a visual-lead stimulus within a range of 20-40ms, and therefore simultaneity is maximally perceived if light comes slightly before sound [2]. However, the PSS in apparent motion condition was shifted to a sound-lead stimulus and closer to zero. With respect to JND, it is known that the JND is within a range of 30-60 ms in audiovisual TOJ tasks [2]. We however found that visual apparent motion resulted in the smaller JND, which indicates higher temporal discrimination. These results suggest that motion information differs from non-motion information on temporal processing in multisensory integration.

Reference

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2) J. Vroomen and M. Keetels : Perception of intersensory synchrony: A tutorial review, Attention, Perception, & Psychophysics 72 (4), pp. 871–884, (2010)

* This study was published in SICE Annual Conference 2014 September 9-12, 2014, Hokkaido University, Sapporo, Japan.