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Motion After Effect in Tactile Sensation

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Introduction

In vision, after prolonged seeing of motion in one direction, illusory motion in the opposite direction is observed in physical static pattern (known as "waterfall illusion"). This phenomenon is referred to as Motion After Effect (MAE) [1][2], (see also Fig. 1.).

Although some visual illusions have been observed also in tactile perception [3], obvious tactual MAE has not been reported [4]. We, however, found clear and robust MAE in tactile sensation by using dynamic vibration of ambiguous motion as the test stimulus of MAE [5].

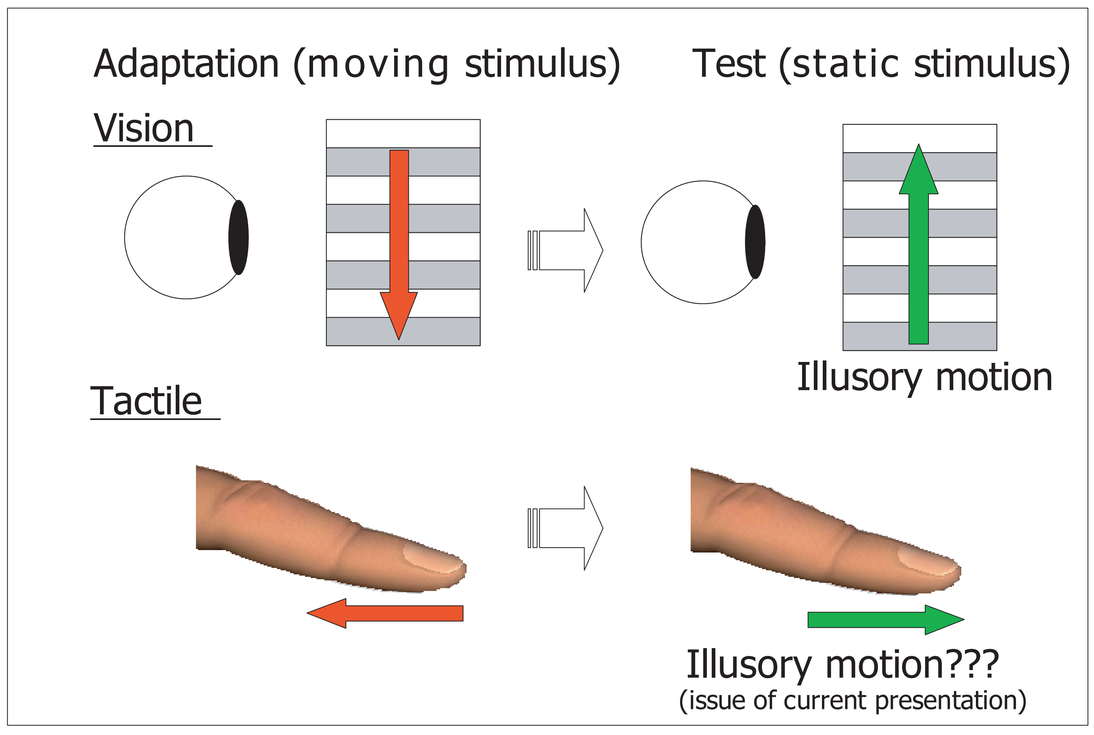
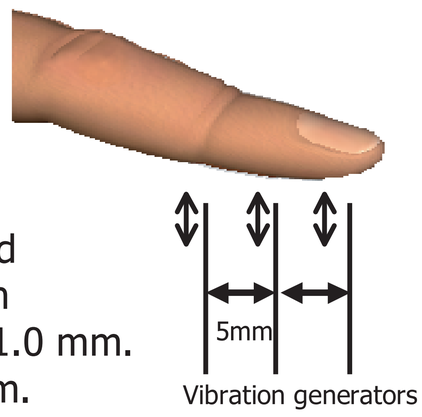


Fig. 1 Motion After Effect (MAE)

Experiment

Subject : 3 naïve subjects

Apparatus :



Finger pad of the forefinger was mounted on three pins, which vibrate vertically as in right figure. The diameter of the rod was 1.0 mm. The spatial intervals of the pins were 5 mm. The frequency of vibration was 60 Hz, and the amplitude of vibration was 0.06 mm.

Procedure :

Three 60 Hz vibrations (each has 200 ms duration) were sequentially presented from fingertip (downward condition in Fig. 2a) or to fingertip (upward condition in Fig. 2b). The inter-stimulus onset interval of the vibrations was 100 ms.

After 30 times adaptation, test stimulus was presented. In the test stimulus, middle stimulus was firstly presented, and then, both top and bottom stimuli were simultaneously presented after 133 ms. The amplitude of the middle and bottom stimuli were 0.06 mm, while that of top pin was varied from 0.02 mm through 0.15 mm.

Subjects answered whether upward or downward motion was perceived. The answer was 2 Alternative forced choice (AFC). 20 trials were performed for each amplitude.
3 conditions x 8 amplitude x 20 trials = total 480 trials for 1 subject.

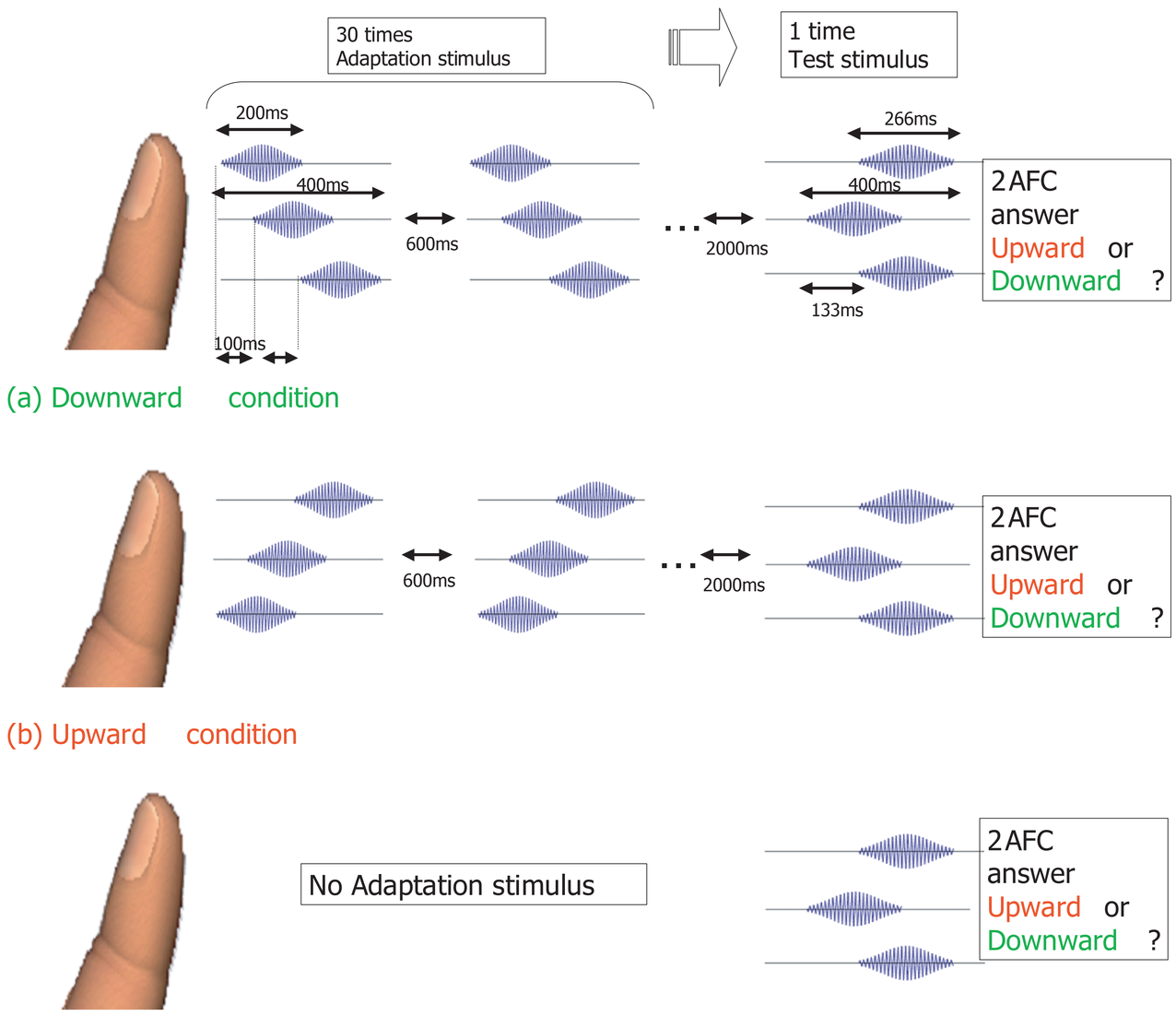


Fig.2 Experimental Time Charts

Result :

Figure 3 shows the rate of response "Upward". The horizontal axis represents vibration amplitude of the top pin. Blue, green and red lines indicates the average of each 20 trials in Downward adaptation, Upward adaptation and No adaptation condition, respectively.

In the data of No adaptation (Blue), when the vibration amplitude of the top pin was the same as the other pins, the rate of answer "Upward" is about 0.5. If downward vibration is presented in adaptation phase (Green), more "Upward" responses is obtained. On the other hand, in upward condition (Red), the rate of "Upward" decreases. These tendencies are observed for a wide range of top pin amplitude. This strongly suggests that perceived motion direction for the test stimulus is affected by the upward or downward motion adaptation, i.e. clear evidence of tactual motion after effect.

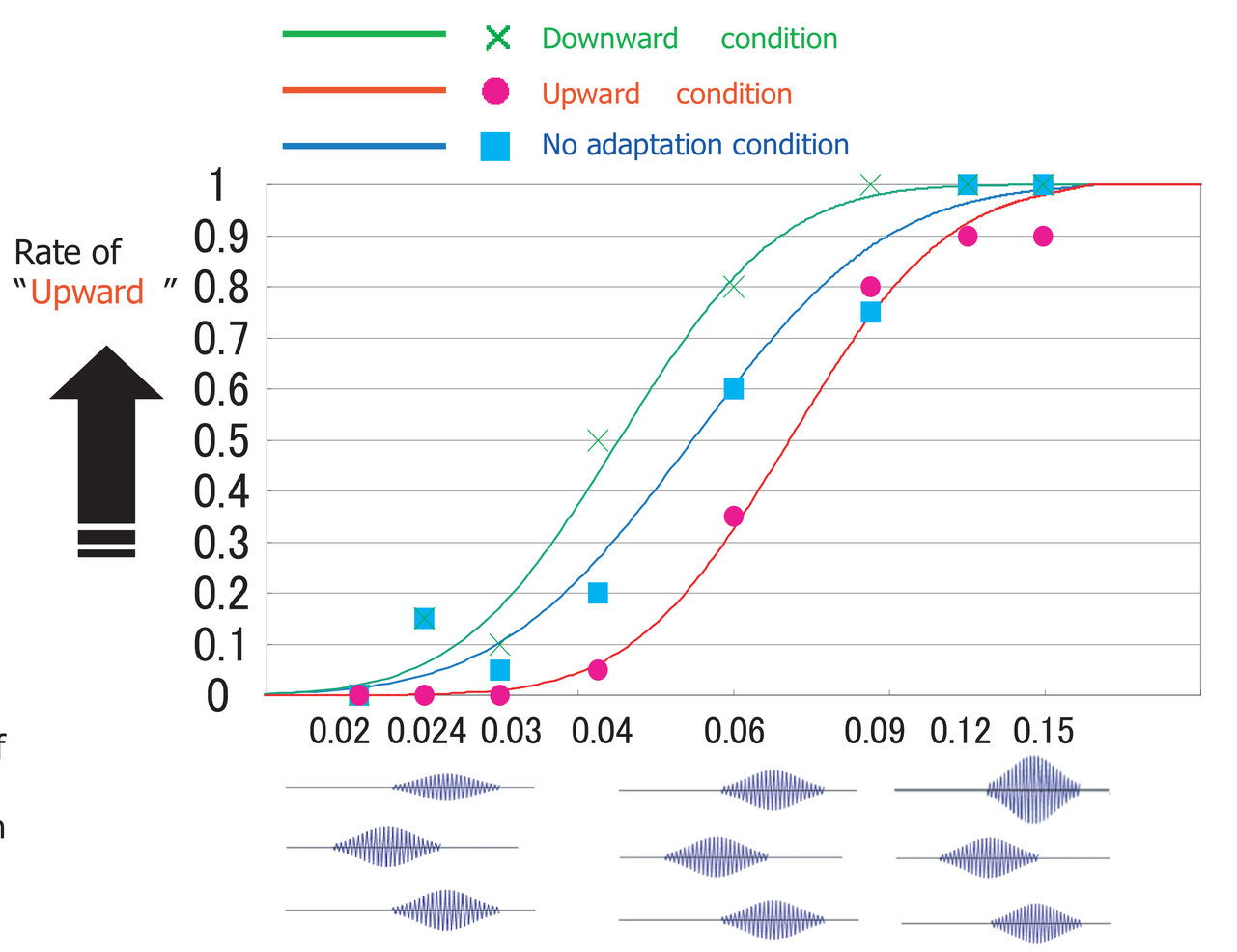


Fig. 3 Results of one subject
Horizontal axis: vibration amplitude of the top pin [mm].
Vertical axis: rate of response "Upward"

Conclusions

We found obvious Motion After Effect in tactile sensation, which occurs when tested by dynamic vibrations of ambiguous motion. Tactual MAE can help to investigate further insight in tactile information processing, as visual MAE has been useful probe to study human brain mechanism for visual motion perception.

References

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