Audio-visual interactions during motion adaptation modulate the perceived duration of the motion aftereffect and the brain activity in hMT+

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The perceptual system forms a unified, coherent percept by integrating sensory inputs from multiple modalities each of which is processed through a distinct neural pathway. In our previous psychophysical study exploiting the motion aftereffect (MAE; an illusory motion caused by adaptation to physical motion), adaptation to visual motion accompanied by auditory motion with the congruent direction enhanced the intensity of the subsequent visual MAE, suggesting audio-visual interactions relatively early in the visual pathway. In the present study, we used functional magnetic resonance imaging (fMRI) to examine the neural mechanisms underlying such audiovisual congruence effect. Specifically, we focused on the motion sensitive area hMT+ since neural adaptation arising from direction-selective neurons in hMT+ has been considered as the neural basis of the MAE. During the 30-sec initial adaptation and the 12-sec top-up adaptation phases, MAE was induced by the 100%-coherence random-dot kinematograms (RDKs) moving either leftward or rightward. Leftward or rightward moving sound was simulated by cross-fading the intensity of the white noise presented between binaural channels of noise-cancelling headphones. According to the audio-visual direction congruence, there were congruent and incongruent sound conditions along with stationary, and no-sound conditions. During the 4-sec test phase, participants reported the duration and the direction of the MAE experienced on a stationary RDK. Behavioral results from the three participants clearly replicated our previous findings that the duration of visual MAE was longer in the congruent condition and was shorter in the incongruent condition than in other conditions. fMRI results from the univariate analysis showed the greater activation in hMT+ in the congruent condition than in the incongruent condition, echoing the behavioral results. Results from the multivariate pattern analysis (MVPA) showed the difference in decoding accuracies between the congruent and incongruent conditions when a classifier discriminated the direction of the MAE after being trained to discriminate leftward versus rightward direction of physical motion. These results indicate that audio-visual interactions based on the

direction congruence during adaptation lengthened the duration of the MAE, which was subserved by modulation of the intensity and the activity patterns of hMT+.

Supported by NRF-2017M3C7A1029659