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Influence of saccade on geometrical illusion

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In this study, we examine how geometric illusions are related to saccade in terms of psychological experiments and computer simulations of a saccade model.

There are common features in geometrical illusions such as Muller-Lyer and Poggendorf illusions. That is to present figures with deformed proportion of lines and shapes. Although various explanations and theories about these illusions have been proposed, most of them provide not a mechanism of the illusion but just explanations of the phenomena. Moreover, they do not give us an unified understanding of the geometrical illusions. In this study, our attitude toward geometrical illusion is that eye movement called saccade plays an important role. In order to propose a model to explain the whole geometrical illusion, study of saccade on Muller-Lyer illusion using a psychological experiment. Furthermore, we examine the relation between the geometrical illusion and saccade using a computational saccade model which describes a part of brain function.

Binsted and Elliott[2] find that there is an error between target and viewpoint, that stops temporally, on Muller-Lyer illusion. Accepting this result, we support in this study, the eye movement hypothesis 80 geometrical illusions. We propose a hypothesis the saccade produces errors within the process of the element of the geometrical illusion around the target and the error cause illusion.

In our psychological experiment, we investigate the features of Muller-Lyer illusion in order to verify the relation between the eye movement and the perceptual error. Concretely speaking, we measure difference of the error with or without saccade and that for the size and form of figure. Consequently, we find that the eye movement enlarges the perceptual error. Moreover, we find the error depends on the form and the circumference of target.

While the experiment reveals the features of the illusion, we does not clarify the mechanism of the phenomenon. Then, we consider influence of geometrical illusion on motor command of saccade using a computational saccade model.

The model proposed in this study is an extended model based on Arai et al.[1] to be able to deal with stimulus during saccade. This extension allows us to input geometrical illusion as visual stimulus and to investigate eye movement command during the visual stimulus of the validity of our model. After evaluation between data by comparing with experiment using apes, we employed figures of geometrical illusion which corresponds to figures used in the psychological experiment. The result of computer simulation is found to have strong correlation to the psychological experiment. Simply put, it shows qualitatively same result as the psychological experiment. Considering results of the psychological experiment and the simulation, saccade causes failure of length perception by emphasizing figures composing the geometrical illusion and deforming the position of the target.

Finally, we discussed the figure of geometrical illusion at large in order to treat the relation of illusional theories other than a eye movement theory and brain functions other than the eye movement command said that it relates illusion, as a computational model.

Reference

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