■講演要旨 (VISION Vol. 12, No. 4, 209-212, 2000)

Poggendorf Illusion without Physical Interaction between Inducing Rectangle and Line Segments

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1. Introduction

As shown in Fig. 1a, two collinear segments abutting obliquely on the rectangle appear to be not collinear. This discrepancy between appearance and physical reality is called as the Poggendorf illusion[1].

In the present study, we investigated the misalignment effect in the Poggendof illusion from the viewpoint of depth difference between the line element and the rectangle element; then we considered this illusion in relation to the perceptual sequence in the visual mechanism.

Firstly, we observed the Poggendorf configuration and its variants stereoscopically by giving the depth difference between two elements according to binocular disparity[2]. In the conventional Poggendorf configuration, we found that the illusion could be perceived when the line segments was placed farther or equal depth excepting nearer depth than that of the rectangle. We found that the same phenomenon occurred in its variants: they were without physical interaction between the rectangle and the line elements and the case using illusory surface[3] for the rectangle and/or the line element.

Secondly, for obtaining the information relating to processing stage in visual mechanism, we investigated the perception of this illusion by changing the displaying time sequence and displaying interval of line elements and rectangle element; both the real and illusory rectangle elements were investigated in this experiment.

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2. Experiments

In order to compare the perception in different configurations and to study this illusion in relation to the perceptual sequence, we conducted the following two experimental series. The first involved the real configuration with and without physical interaction and the illusory configuration. The second involved the configuration formed with real line and illusory rectangle. Configurations used in the experimental series are shown in Fig. 1.

2.1 Experimental Method in general

In the experiments, the visual stimuli for the left eye and the right eye were presented alternately on a 21 inch CRT display screen of a graphics computer in red color (Fig. 2). The observation position was at a distance of 50cm from the screen. The subjects wore the liquid-crystal shutter glasses controlled synchronizing to the depicted views to obtain stereopsis easily. Conceptual figure showing the experimental arrangement is shown in Fig. 3.

Each configuration included the test version and two additional camouflaging versions: the test

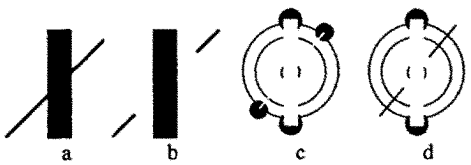

Fig. 1 Configurations used in two experimental series. The first involved the real configuration with (a) and without (b) interaction between the line element and the rectangle element; the illusory configuration (c). The second used the configuration of real line and illusory rectangle without spatial interaction between them (d).

version consisted of the rectangle and two physically collinear segments of the line, and was presented ten times; two additional camouflaging versions formed with the rectangle and two physically noncollinear segments of the line: the right segment of line element is higher or lower with comparing continuous of the left segment. Both of them were presented three times. For each of the various versions, three kinds of line depth, farther, equidepth and nearer than rectangle, were prepared; and they were presented stereoscopically in random order. The subject was asked to answer his or her perception of the right line segment with comparing continuous of the left line segment by clicking mouse switches. That is one of perceptions at collinear, higher or lower.

2.2 Investigation of the perception in different Poggendorf configurations

2.2.1 Investigation of the perception in real configuration with physical interaction

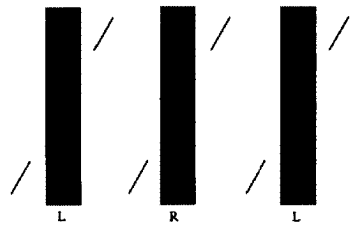

Fig. 2 An example of Poggendorf stereogram without physical interaction. Observing by the uncrossed or crossed fusing method, the line segments can be perceived at father depth than the rectangle in the normal fusion and nearer depth than the rectangle in the opposite fusion (L: left eye view, R: right eye view) .

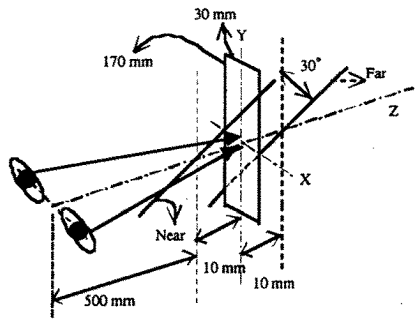

Fig. 3 Conceptual configuration of the depth relation between the line element and the rectangle element.

2.2.1.1 Method

In this experiment, each versions of real configuration shown in Fig. 1a was presented stereoscopically for 600 ms.

2.2.1.2 Results

Figure 4 represents the change of perception according the depth relation between the line and the rectangle element. These results suggest that this illusion might be due to the depth relation between the line element and the rectangle element. This illusion almost could not be perceived when the line was nearer than rectangle and could be perceived when the line was farther or equal depth than rectangle. It should be noted that the illusion became weaker as the line was placed farther beyond the rectangle. We inferred the reason that the occluded part of line becomes shorter as the line depth farther.

2.2.2 Investigation of the perception in real configuration without physical interaction

2.2.2.1 Method

In this experiment, the line segments were located in two side of the rectangle separately as shown in Fig. 1b, and there was no physical interaction between the line and the rectangle.

2.2.2.2 Results

The results (Fig. 6) looked to be same as in the case of the real configuration with interation. Then, we inferred that the depth component is a major determinant of the Poggendorf illusion.

In this experiment, however, the illusion was the same when the line is far and equidepth. This was quite different from the results for with

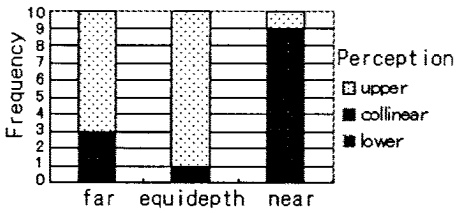

Fig. 4 Results of the perception in real configuration with physical interaction.

physical interaction. It means that the occlusion condition influence to this illusion when the physical interaction was exist but do not affect in the case without interaction. Although, it might to be considered that since a virtual rectangle shown as dashed lines in Fig. 4 seemed to be perceived as an illusory rectangle then the illusion became stronger; however, the virtual rectangle could not be perceived actually.

2.2.3. Investigation of perceptions in illusory Configuration without Physical Interaction

2.2.3.1 Method

In this experiment, illusory surface and illusory line were used instead of the real rectangle element and the real line element as shown in Fig. 1c. Each stimulus was presented simultaneously for 4000 ms.

2.2.3.2 Results

The results showed that there was the similar phenomenon as in the real figures. That is misalignment could not be perceived when the line element was placed nearer than the rectangle and could be perceived when the line element was placed farther than the rectangle. However, perception of the illusion becomes ambiguous comparing with the case of real figures especially when the line was at equidepth. It could be thought that the depth perceived for each element becomes ambiguous in the case of illusory elements.

2.3 Investigation of the illusion in relation to the perceptual sequence

The aim of experiment was to investigate the Poggendorf phenomenon in relation to the displaying time sequence of the rectangle element and the line element. In this experiment, the illusory surface was used for the rectangle; the line element was real line segments without the interaction between with the illusory surface throughout the experiment (Fig.1d). There were two different tasks called synchronous display and delayed display. (Experiment 4A and Experiment 4B). In the synchronous display (a), the illusory rectangle and the real line segments were displayed at the same time. On the other hand, in the delayed display (b), the line segments were displayed overlaying to the previously displayed illusory rectangle with time delay.

2.3.1 Experiment 4A

In the experiment 4A, frame A, B, C in Fig. 8 were presented for 600, 600, 1500 ms, and there was no interval between frames. The experimental procedure is shown in Fig. 8.

Results of Experiment 4A were shown in Fig. 10. Neither in synchronous display nor in delayed display, the Poggendorf illusion could be perceived. We thought that after image of the real line could be exist after the visual stimuli were disappeared, on the other hand, illusory rectangle could not be perceived very well.

2.3.2 Experiment 4B

In the experiment 4B, after the figure including real line and illusory rectangle was presented for 600 ms, the illusory rectangle was displayed additionally for 800 ms. Frame A, B, C, D was

Fig. 5 Conceptual diagram of the virtual rectangle expected to be perceived.

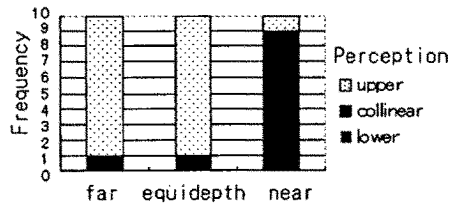

Fig. 6 Results of the perception in the real configuration without physical interaction.

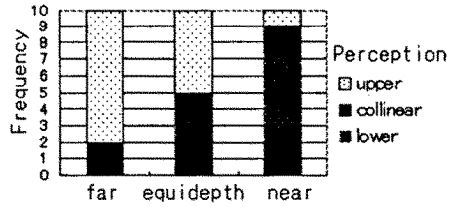

Fig. 7 The result of the perception in illusory configuration.

presented for 600, 600, 1500, 800 ms, there was no interval between frames. The experimental procedure is shown in Fig. 9.

Results of Experiment 4B were shown in Fig. 11. Either in synchronous display or in delayed display, the Poggendorf illusion could be perceived. We also did this experiment by changing the displaying time duration of the frame D, and we found that when the frame D was displayed for less than or equal 600 ms Poggendorf illusion could not be perceived. The displaying time of frame D probably reflecting some characteristics human visual mechanism.

3. Conclusions

In this paper, we observed the Poggendorf illusion stereoscopically by changing depth difference between line element and rectangle element. It was confirmed that the illusion could be perceived only when the line element was placed farther or equidepth than the rectangle element; it is expected that the depth difference between the line element and the rectangle element is the main issue of this illusion. Experimental results observed by using the illusory rectangle element are suggesting that it takes bit more time to perceive illusory surface than real surface and illusory surface and real surface are treated in different stage of visual systems. It is expected that the further investigation can provide a new clew to reveal human visual mechanism.

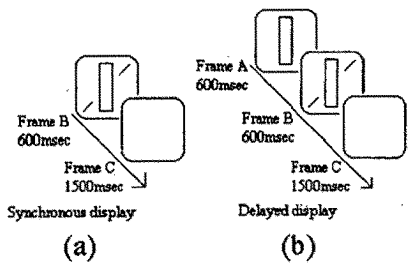

Fig. 8 The experimental procedure was used in the Experiment 4A without delay. (a): Both elements appeared simultaneously. (b): Illusory rectangle appeared leadingly.

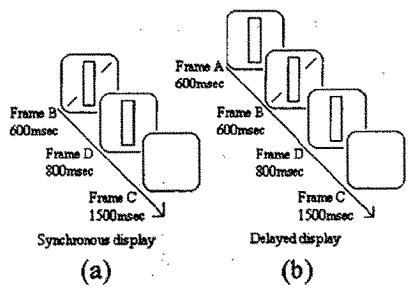

Fig. 9 Experimental procedure used in Experiment 4B delayed display. (a): Both elements appeared simultaneously. (b): Illusory rectangle appeared leadingly.

References

1) J. Ninio: Characterisation of the misalignment and misangulation components in the Poggendorff and corner-Poggendorff illusions. *Perception*, 28, 949-964, 1999.
2) T. Yamatsuka: A study on geometrical visual illusion with binocular viewing (in Japanese) . Thesis for Master degree, Graduate school of Information Systems, The University of Electro-Communications, 1995.
3) M. Idesawa: Perception of 3D illusory surface with binocular viewing. *Japanese Journal of Applied Physics*, 3D-4B, L751-L754, 1991.
4) R. Gregory: Cognitive contours. *Nature*, 238, 51-52, 1972.

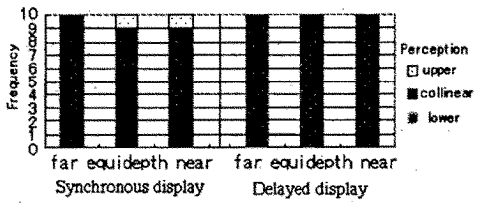

Fig. 10 Results of Experiment 4A:real line and illusory rectangle without delay. (a): Both elements appeared simultaneously. (b): Illusory rectangle appeared leadingly.

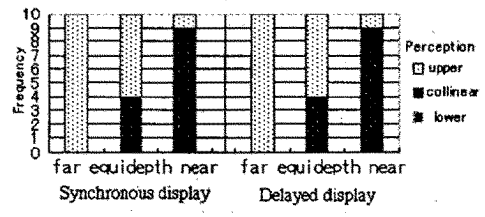

Fig. 11 Results of Experiment 4B:real line and illusory rectangle with delay. (a): Both elements appeared simultaneously. (b): Illusory rectangle appeared leadingly.