Relations between the visibility of a character and the eye movement in the difference of font types

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Abstract: There are many font types today. These characters are important in order to acquire information and are needed more visible but relations between the shape of the character and visibility are ambiguous. In this paper describes a relation between a shape of number and visibility. We shown subjects the character of different font types and examined eye movements. An eye mark recorder was used for record of eye movements. The recorded result conducted eye movement paths and fixation frequency. In addition, the reaction time to the shown number was calculated. At the last of the experiment, we made the subjects to evaluate the visibility of each font type.

Key words: *eye mark recorder, eye movements, fixation, font, visibility*

1. Introduction

Using a computer, anyone has been able to create font types easily. It is said that people have received about 80 percent of information from vision. It is important to choice more visible font type. Although subjective evaluation is mainly used for evaluation of font types, it is difficult to explain the right and wrong of form concretely. So we suggest consider the evaluation method of the form of the character using the physiological reaction.

In this paper describes eye movements when perceiving a character of different shapes. We conducted an experiment to measure the eye movements when they see the characters. In addition we had subjects fill in a questionnaire about visibility of each font types.

2. Method

An eye mark recorder (EMR-8, Nac image technology) was used for record of eye movements. It was used a corneal reflex to measure eye movements.

In this experiment, three types of fonts, Verdana, Mistral AV, and PLUMP MT, were used. The shape of Verdana is common. The shape of Mistral AV likes handwriting. Also the shape of PLUMP MT is roundish and

the line weight is uniform. Stimulus used for the experiment is shown in a figure (see Fig. 1). The kind of stimulus was 30 (the number of 0-9, three types of fonts) and these heights were 540 mm. The stimulus was shown on the screen which was separated from a subject 2000 mm. The color of number was white and that of background was black (the mean luminance was 255 cd/m2). The size of screen was 600 * 800 mm.

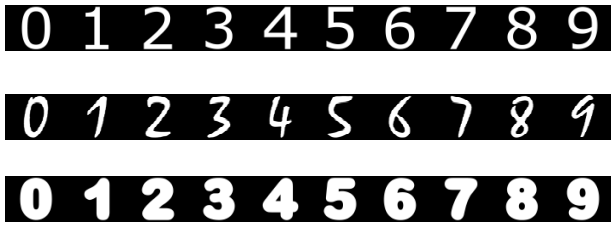

Figure 1:The number used as the stimulus (upper: Verdana, middle: Mistral AV, lower: PLUMP MT)

Subjects were eight college students (range of 18-22) with normal eyesight. The experiment was conducted in the darkroom; the mean illumination when the stimulus was showed was 6.6 lx. We made a subject's jaw fix by using a stand. Therefore, head movements were controlled and data processing became easy. The environment of experiment is shown in a figure (see Fig. 2).

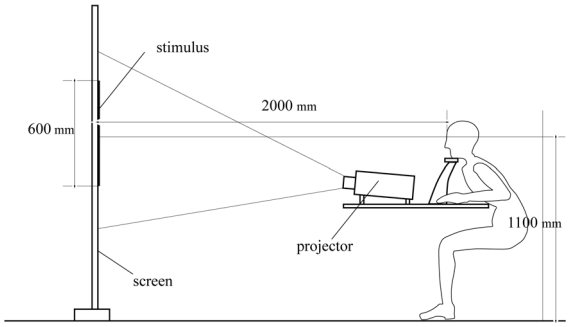

Figure 2: Environment of the experiment

First, we made the subject wear the eye mark recorder. Each stimulus was shown for two seconds at random and a fixation point for two seconds was inserted between them for proofreading. Before the stimulus was shown, a white point was projected in the center of the screen. The subject was instructed to gaze at the white point. We presented 30 kinds of stimulus at random. In consideration of subject's fatigue, we conducted a set which made 10 kinds of stimulus and break alternately. We made the subjects push a switch that was attached to the device when they understand what number was shown.

We recorded the view images which eye mark data superimposed. In addition, the coordinate value of eye mark (640 by 480 pixels) in every 1/60 second was acquired by using a network program which was made by Visual Basic 6.0. Furthermore, the reaction time was calculated by counting the number of frames from the frame when a stimulus was shown to the frame when the switch was pushed.

After the experiment, the subjects filled out the questionnaire about the visibility of each font types. The subject answered the ranking of visibility to each number and overall.

3. Results and Discussions

A fixation frequency was acquired from eye movements when the stimulus was shown. The paths of eye movements for each font were compared. An example is shown in a figure (refer to Fig. 3-5: by the same subject). In the figure of the Verdana, fixations focused on the center of the stimulus (Fig. 3). On the other hand, the eye movement paths of the Mistral AV and PLUMP MT were complex (Fig. 3 and Fig. 4). Information is acquired at the time of a gaze, so information acquisition seems to have difference by shapes. The difference in the number of the fixation was tested. The Kruskal-Wallis test of the fixation points revealed no significant different. As the one of the reasons, it seems that all stimulus were relatively easy to understand.

The reaction time to each stimulus was obtained. All the subjects were able to react to within a time when the

stimulus was presented. The ANOVAs of the reaction times of these three font reveled significant difference ($F(3.05) = 3.56$, $p < .05$). The Fisher's PLSD revealed significant difference between Verdana and Mistral AV (rejection region 0.35, level of significance 5%). Also the Mistral AV and PLUMP MT was significantly difference. However, the Verdana and PLUMP MT revealed no significant difference. The reaction time of Verdana and PLUMP MT was earlier than that of Mistral AV. That reaction time is early shows the easiness of processing. Consequently, the fonts those of Verdana or PLUMP MT were probably more visible.

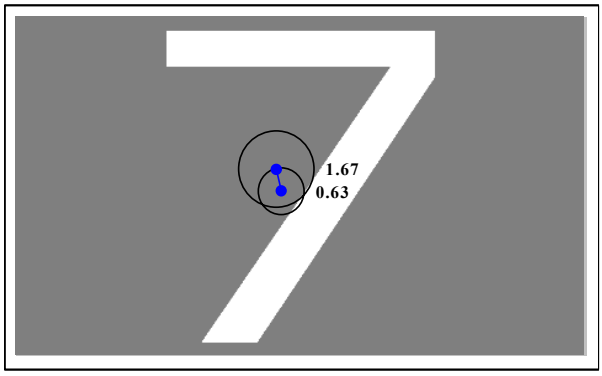

Figure 3: Eye movement paths in the Verdana 7 (Value indicates gaze time, The size of a circle is proportional to gaze time)

The Result of the questionnaire the rankings about the visibility of each font type based on subjective evaluation were obtained. The Kruskal-Wallis test of the rankings revealed significant difference ($H = 90.11$, $p < .01$). The Scheffé's multiple comparison test indicate significant difference between Verdana and Mistral AV (rejection region 0.25, level of significance 5%). The significant difference was similarly accepted to other two. From the result of a questionnaire the evaluation that Verdana was the most visible was obtained.

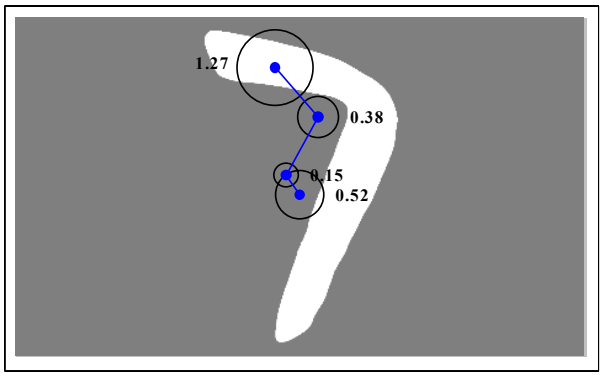

Figure 4: Eye movement paths in the Mistral AV 7 (Value indicates gaze time, The size of a circle is proportional to gaze time)

The above results showed that the Verdana was the most visibility font type among the three. From comparison of the results of the Verdana and the Mistral AV, it seems that the linear shape was more visible than the shape like handwriting. Although the clear difference was not seen from the results of comparing the Verdana with PLUMP MT, it is likely that too bold line isn't great important to visibility. Moving the eyes slightly while the Verdana presented, subjects probably perceived the number effectively.

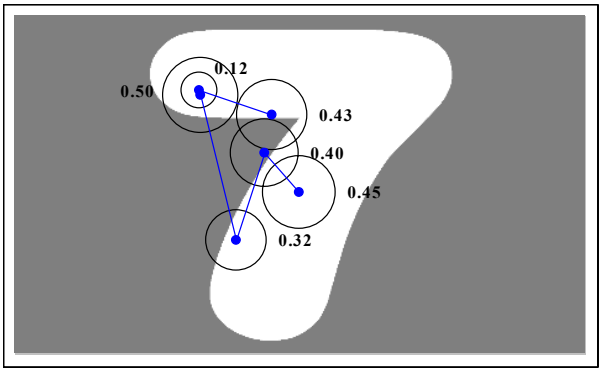

Figure 5: Eye movement paths in the PLUMP MT 7 (Value indicates gaze time, The size of a circle is proportional to gaze time)

4. Conclusions

The tendency of the difference in eye movement paths was found by the difference in font types. Visible font type seems to be effectively perceived by few fixations. In this experiment, since subjects' visions were clear and all the stimulus could be recognized, the great difference in eye movement paths were not shown. Therefore, it is necessary to conduct the experiment in more difficult condition in order to found the clear difference in eye movement.

References

1. A.L.Yarbus. Eye Movements and vision, PLENUM (1967).
2. Osaka.R, Nakamizo.Y, Koga.K. Gankyuuunndou-no-zittukensinrigaku, Nagoyadaigakusyuttupankai (1993).
3. Yamaoka.T. hard・softdesign-no-ningenkougakukougi, Musashinobizyutudaigakusyuttupankyoku (2002).
4. Yokomizo.Y, Komatsubara.A. Engineer-no-tameno-ningenkougaku –revision-, Nihon-syuttupan-service (1998).