

STUDY ON THE VISUAL COGNITIVE CHARACTERISTICS BY THE FIXATION POINT ANALYSIS USING THE EYE MARK RECORDER

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In recent years, the concern about a user center design is increasing, and it's needed to take a user's visual cognitive characteristics for information presentation. Then this study aims to grasp user's cognitive characteristics about the information presentation by analyzing the fixation points. In the experiment, actually subject operated a copy machine. Recorded the fixation point movement on the operation panel by the eye mark recorder. Analysis examined the screen interface of the operation panel from the field of a fixation point trace. The top down type fixation order by experience or the context became clear as a result. Furthermore, the difference of the fixation order by skill level was also examined. In this study, it was assumed that to grasp the visual cognitive characteristics becomes the key of efficient information.

Keyword: fixation point, visual cognitive characteristics, fixation trace, fixation order,

1. Introduction

Human acquires information through vision, when human operates apparatus. Therefore it is necessary that to evaluated objective the visibility about visual information and the visual cognitive characteristics and to consider the interface in many scenes.

In recent years, the concern about a user center design is increasing, such as a user interface design and usability. In such a current, it is necessary to consider user's visual cognitive characteristics for efficient information presentation. Then, in this research, it aimed at grasping a user's visual cognitive characteristics by fixation point analysis. If these things can be clarified, it will become the key, which solves the cognitive process over visual information.

It aims at examining a cognitive process to visual information in this research. Therefore, it is

necessary to experiment on the conditions same as much as possible as usual operation.

Then, limitation of experiment conditions, such as head fixation and time limitation were removed by the fixation point analysis using the eye mark recorder. It is thought that the real cognitive characteristics of the user at the time of this operating apparatus can be examined.

2. Materials and Methods

2-1. Fixation point analysis

The eye camera was used as an objective measuring method of eye movement in this research. By this method, a fixation point position, fixation time, fixation point order, etc can be measured, and it is suitable for analyzing the fixation situation to visual information. The main parameters, which specify the object to see by the eye camera, are

fixation point. Fixation point is defined in the fixation range and fixation time of an eye mark. In this research, the case where there were the fixation range of less than 2 degrees in the visual angle and fixation time for 0.2 seconds or more was considered as the definition of a fixation point.

The eye mark recorder (EMR-8, product made from nac) was used for detection of look position. Eye mark is superimposed and outputted on a view image. Eye mark was recorded with VTR. The coordinates data of the eye mark outputted was recorded in the personal computer by RS-232C connection. Date is measured every 1/60 second.

2-2. Experiment 1

A copy machine was used, and experiment 1 measures and considers fixation activities of the user at the time of actual operation. It aims at this grasping the visual cognitive characteristics of the user to the visual information on the apparatus used daily.

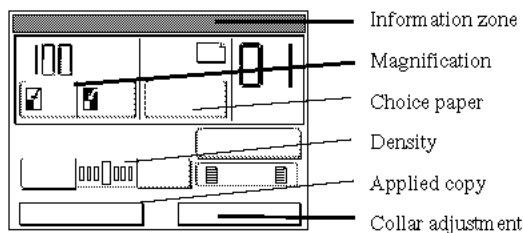


Fig.1 operation screen

The subject used 20 persons in sum total. The questionnaire of "whether to use apparatus, such as a copy machine and ATM, daily" was performed to the subject. Marks were given about each item from the result, and four higher ranks in the sum total of mark were selected as a skilled person. It is considered a satisfactory thing even if it sees from the degree of task achievement of an experiment.



Fig.2 experiment situation

2-3. Experiment 2

The experiment 2 considered skill of visual information retrieval of a user. And it aimed to analyze and examine the process about efficiency of fixation activities. Specifically, visual information is shown to a subject two or more times, and cognitive process about the process about efficiency of information retrieval is clarified.

The subject used 12 persons. There were seven subjects whom the coordinates data of the fixation movement has measured normally in the experiment. This data of seven persons was used as analytical data.

In the experiment 2, the screen supposing the vending machine was created and it used as a stimulus. The touch-panel display was used in the experiment.

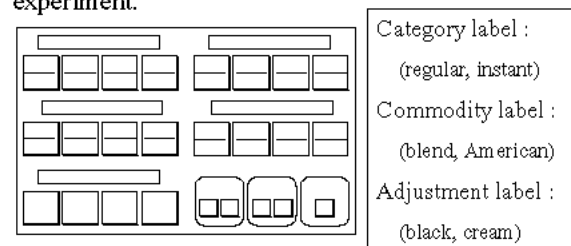


Fig.3 presentation information

3. Results

3-1. Experiment 1

The figure of fixation point order has shown look movement, which plotted only the fixation point. The small black dot expresses the fixation point for 0.2 - 0.5 seconds, and the black dot of the larger one expresses the fixation point for 0.5 seconds or more. The line, which connects each fixation point, is connected by serial change of a gazing point

Fig.4 is the fixation point trace of the subject at the first sight. Fundamental fixation movement at the time of operation gazes optionally at the button of the selection item. It did not fixation at the display portion, which shows the item. In this experiment, 12 subjects followed the gazing point trace of fig.4. This pattern is searched for the selection item from the upper part of a screen to clockwise. Moreover it is searching for the selection item with a near position in order also in each item.

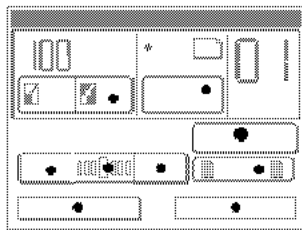


Fig.4 fixation point trace

Fig.5-1 is selection screen and has displayed the selection item by the blink display. In this task, which requires a magnification setup, and also paper selections are needed. If a setup, which is one side, previously here is performed another selection screen will be displayed automatically and a selection item will be displayed by blink display.

This subject confused by blink display, and was not able to choose a paper smoothly. The subject gazed at the blink part and gazed to each part of a screen after that. Moreover, fixation time is comparatively shortened in each fixation point, and the fixation for 0.5 seconds or more was not seen. Fig.5-2 is a figure, which plotted only the fixation point. The time in each fixation point was near 0.2 second. By the comment to a blink display, it was the comment of "I thought whether any errors happened", "having thought whether to have wrong operation", etc.

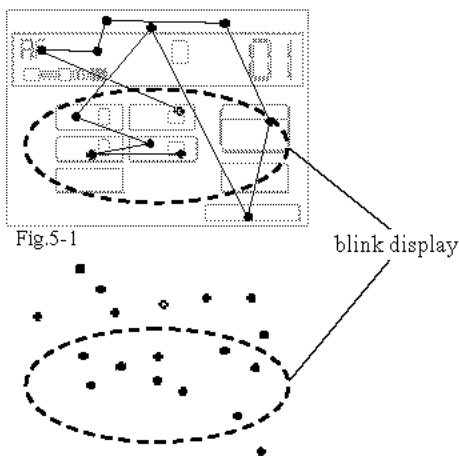


Fig.5-1

Fig.5-2

Fig.5 fixation point trace

Fig. 6 is a figure of the gazing point course of a beginner and a skilled at the time of a blink display. Fig. 6-1 is the situation of fixation movement of a beginner. Here, as same the tendency was seen.

On the other hand, Fig. 6-2 is the situation of fixation movement of a skilled person. In this subject, it gazed at the selection item of a blink display first similarly. Then, it gazed at the information zone, gazed at the selection item again, and [B5] button was chosen. Moreover, the fixation time to information zone was 0.5 seconds or more. By the comment to a blink display, even if it was a skilled person, it was the comment of "having thought whether any errors happened" similarly.

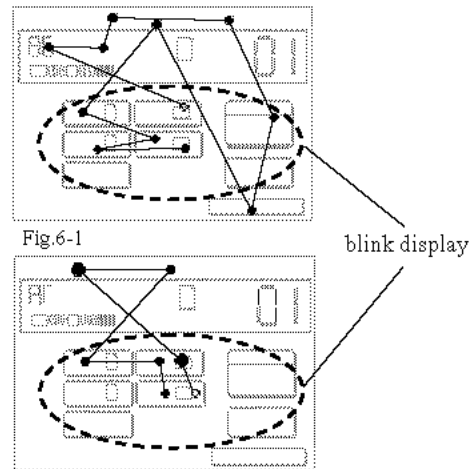


Fig.6-1

Fig.6-2

Fig.6 fixation point trace

3-2. Experiment 2

Although the layout of a screen was eternal, in order to prevent the study effect, six kinds of visual information that arrangement was changed was prepared. The example of presentation information is shown in Fig. 7. Arrangement of each group was changed, having used the item in an ellipse as one group. Display parts, such as [regular coffee], are called category label, and a square item button is called selection button. A display of the upper part in a selection button such as [American, standard] is called goods label, and lower part such as [black, cream] is called adjustment label.

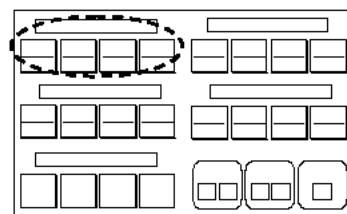


Fig.7 presentation information

task

It directed to choose a favorite thing as a subject like [when buying juice with a vending machine usually], and to touch a screen as first task. It pointed by "choose what to drink next" after that, and the stimulus was shown 3 times in order. The presentation information of a set was shown and the measurement person directed the item made to choose henceforth. It made to show six kinds of visual information one by one by a unit of 1 time into one set. All subjects repeated two sets. The order of the stimulus in one set is the same, and presentation of six kinds of visual information is performed continuously.

It considered as the object of analysis of the first task, 1st task and 6th task of 1st set, and 1st task and 6th task of 2nd, fixation tendency for seeing skill process. Fig.8 illustrates the flow of a task.

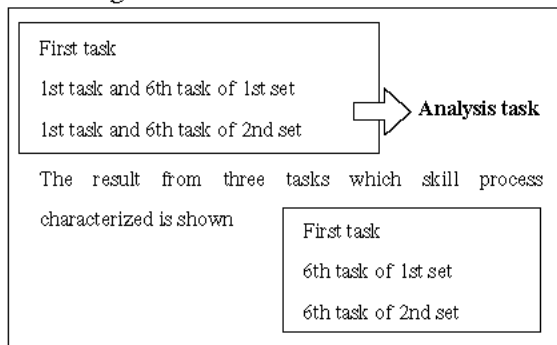


Fig.8 The flow of a task

definition of fixation point

In the experiment 2, the definition about fixation time was considered as the case where it is 0.17 seconds or more. A subject's feelings were not suited when a definition of a fixation point was 0.2 seconds or more. By showing the same information two or more times, the amount of information acquired from on a screen decreases, and it is considered because the contents can fully be checked also in short time. The fixation point of this definition was the result of following on a subject's feelings.

move speed of eye mark

The move speed of an eye mark is used as a parameter about the speed of fixation activities. An eye mark is sampled every 1/60 second. It is necessary to observe the situation of the real fixation

activities under task operation. Move speed of an eye mark was serially graph-ized so that a fixation state could be observed visually, and it considered as the key of the analysis of a gaze situation.

First task

Subject's fixation points were scattered all over each item of a screen. The tendency, which repeats the long jump of distance and a short jump, was seen. Near the target item, the case where the short jump of distance and the display of an item were being read increased.

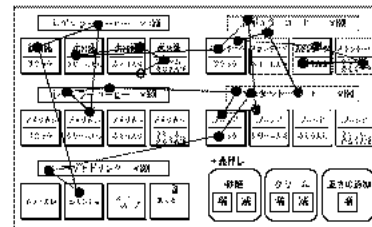


Fig.9-1 fixation point trace

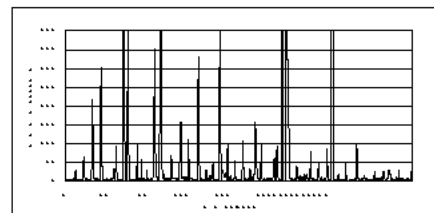


Fig.9-2 move speed of eye mark

6th task of 1st set

Here, fixation to a category label increased. The tendency to choose from a category label and to start reference of the selection item in a group from there was seen.

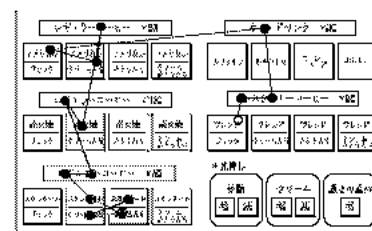


Fig10-1 fixation point trace

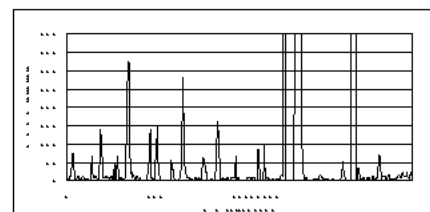


Fig10-2 move speed of eye mark

6th task of 2nd set

Here, the tendency directly searched from the commodity label of a selection item, without fixation at a category label was seen. Reference within the target group also decreased. Reading an adjustment label also decreased.

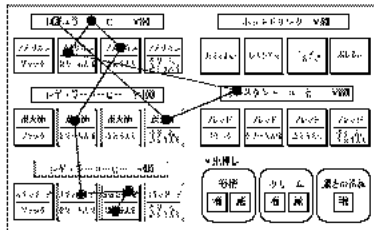


Fig.11-1 fixation point trace

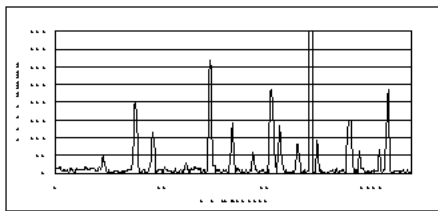


Fig.11-2 move speed of eye mark

4. Conclusions

4-1. Experiment 1

optional fixation procedure

In the example of Fig. 4, the order of fixation point is right-handed rotation, and fixation at the item near in position in order. It is guessed that this is the fixation order of a bottom-up process that a fixation order is determined by the layout of each selection item. Moreover, the result said that a subject does not fixation at display parts, such as [A4] and [100 %], etc, was obtained. From this result, when a user performs a screen operation task, it can say fixation at the selection item, which he can operate optionally. This is guessed that the top down fixation method is performed from context factors, such as expectation and a task. The display method related with the item, which a user needs for displaying information showing a user, is needed. Construction of the screen layout, which had the correlation to such users' cognitive characteristics rather than layout-arrangement, is needed.

Active fixation activities

On the problem, which gets confused to operation by blink display, followings are assumed as a cause. They are things when the disagreement with a user's cognition and navigation of an information zone are inadequate for urging operation.

An effective view becomes narrow although cautions become high as how as which man regards deeply under a complicated condition. Moreover, fixation time becomes short and each fixation point is distributed the large range. That is, the time efficiency of processing at a gazing point is gathered. And the active information acquisition and the processing characteristics that it will search for much information are shown. It was shown that active information search and the processing characteristics appear under the condition also with complicated operation of a copy machine.

A difference of the fixation procedure by skill

In Fig. 6, the difference in the fixation move trace by skill level was seen. The skilled person was imagined to be able to maintain an efficient fixation order at the complicated situation. This is considered to excel in a skilled person grasping the contents of vision information. A skilled person relates the seen contents with knowledge, and was imagined to be able to recognize as a known pattern.

4-2. Experiment 2

About scatter of the fixation point in task a, it is assumed as a factor that it is going to grasp all the contents of the information shown the subject. In the state of not being skilled, it is imagined as what the active fixation method that contents information would be grasped in this way was regarded as.

When set to 6th task of 1st set, reduction of the amount of movements of a look was seen. This is considered that a subject came to search with reference to informational memory. From the field of a fixation trace, the tendency to judge and gaze at the information on a point was seen. This can be called expression of the increase in efficiency of fixation movement by skill.

In 6th task of 2nd set, fixation movement, which was conscious of the regularity about how to locate

in a line the adjustment label in a selection button, became remarkable.

The fixation method which was the point conscious of the category label in reference first as process of mastery is seen. Next, it becomes the fixation method, which was conscious of how to locate each item in a line. Finally, the tendency, that grasping information, fixation at a commodity label, and searching directly was seen. In skilled person, information can be caught now as a known pattern. Thus, an efficient fixation order can be maintained according to a top down gaze form based on knowledge.

The difference of eye mark move speed was examined about change of the rate of jump speed between each task. However, the big change to change of the rate of each jump speed below 50deg/sec and 51-150 deg/sec and 151 deg/sec was not seen. Since the average was taken about all the jumps of a task, it is thought that the difference between tasks is not seen. It is thought that there is a difference in the eye mark move speed in the time of reference start and the second half by each task. However, since it was difficult to define the boundary line, which divides a task when the individual difference of reference time is taken into consideration, comparison examination could not be carried out. However, it was significant to have become the key, which analyzes a gaze tendency visually by graph-izing move speed of eye mark.

5. References

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