Basic study of the intuitive feel for user interface using the serial reaction time task.

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Abstract: In recent years, attention has been drawn to the intuitive user interface. Some previous experimental studies have suggested that familiarity indicating the knowledge acquired from other kinds of product effected intuitive manipulation of the appropriate user interface. Therefore we considered the process of acquiring the familiarity as implicit learning. Familiarity may increases accompanying the progress of implicit learning, resulting in intuitive manipulation of user interface. Present study examined the relationship between familiarity of user interface and intuitive manipulation using serial reaction time task. It was hypothesized that the decrease of reaction time with progress of implicit learning causes the increase of self-rating score of intuitive feel. Mean reaction time was gradually decreased from nearly 300 ms to 200 ms with task block progress. Self-rating score of intuitive feel on task response was increased along with change of reaction time. This implied participants felt the task response got more intuitive accompanied with progress of implicit learning. It was considered that knowledge gained from learning underlie the intuitive manipulation of product. Additionally there was a possibility that data of reaction time recorded in this study was able to use as one of standard to evaluate the intuitive manipulation of user interface design.

Key words: Intuitive feel, interface design, implicit learning, serial reaction time task

1. Introduction

Development of multifunctional products like an electronic information device enhanced the convenience of using the products in our life. However, vexatious complication in the operation and too many options brought "the hard to use". To solve this problem, various researches have been conducted in interface design field [1]. In recent years, attention has been drawn to the intuitive user interface. The intuitive user interface has not been defined clearly while there is thought to be "the easy to use" and/or natural in operation and procedure. Some studies have suggested that familiarity indicating the use of knowledge acquired from other kinds of product effected the intuitive manipulation of user interface [2]. Although there are many discussions for the concept of intuition on user interface in intuitive design study [3], experimental study of intuitive user interface is very limited. Blakers et al [4-5] reported that the participants who had higher familiarity to technology showed faster and more intuitive use of unfamiliar product, then relevant past experience has contributed to that.

Therefore we considered the process of gain the familiarity as implicit learning. The familiarity may increases accompanying the progress of implicit learning, resulting in intuitive manipulation of user interface. It is widely known that serial reaction time task (SRTT) is one of the tasks for implicit learning [6]. Present study examined

the relationship between familiarity of user interface and intuitive manipulation using SRTT. It was hypothesized that the decrease of reaction time (RT) with progress of implicit learning causes the increase of self-rating score of intuitive feel. Same experiment was repeated for interval of one week or more to confirm whether the acquired intuitive feel was maintained or not. SRTT used in this study was a typical type. Participants pressed the button corresponding to the position of the visual stimulus.

2. Method

2.1 Participants

Twenty university students and graduate students participated in the experiment. They were all right handed and took part in both first and second sessions. Second session was executed after a week of first session.

2.2 Task and Procedures

The experiment was run on PC and display. Figure 1 illustrates the relationships between stimulus presentation and a participant's response. The display consisted of four asterisks arranged in a horizontal square on the computer's screen and separated by intervals of 1 cm. Asterisk indicated the target stimulus. Back color is black and asterisk and square were white. Asterisk was presented one at a time in the square sequentially. The squares starting from the left were termed A, B, C and D. The sequences which indicated the order of presentation of asterisk was B-C-A-D-B-C-A . This was the one of the sequence used in previous study [7].

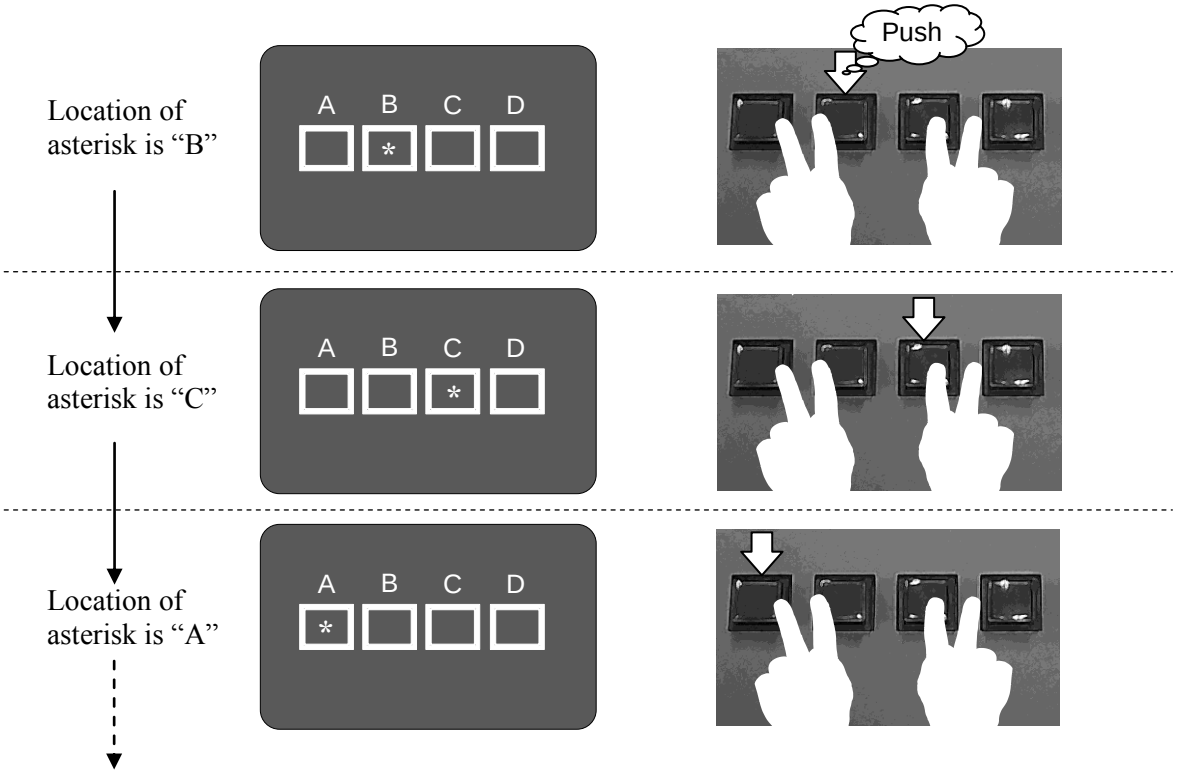

Figure.1 Example for stimulus presentation and participant's response. Asterisk was target and changed the location in four square in following sequence (B→C→A→⋯). Participants pushed the button according the location of asterisk.

Participants were instructed to respond as fast and as accurately as possible by pressing on the corresponding button. Response buttons were lined from side to side corresponding the position of presentation of target. The target was presented at the position of two left-handed square was responded by index or middle finger of the left hand respectively. In same way, the target at right hand was responded by the right hand finger. The target was removed as soon as a button had been pressed, and the next stimulus appeared after a 600 ms interval (response to nest stimulus interval = 600ms).

The experiment consisted of 15 experimental blocks and 2 random sequence blocks. In experimental block, each block consisted of 42 trial (7 elements in sequence × 6 time repeats). Starting position of the sequence was randomly selected in every experimental block. After 16 experimental blocks, random blocks followed. In random block, there was no sequence and target position was randomly selected.

In each trial, reaction time from target presentation to button press was measured. After each block participants rated the intuitive feel about the cognitive aspect of response on 9 points Likert-type scale. They were instructed "Rate the intuitive feel about response, for example, I anticipate the position of next target". Stimulus presentation and measurements were controlled by experimental psychology software. Participants were not told that the sequence exist in experimental blocks. After experimental session, participants were subsequently asked whether they noticed some about sequence. The same experiment was executed over one week interval as second session.

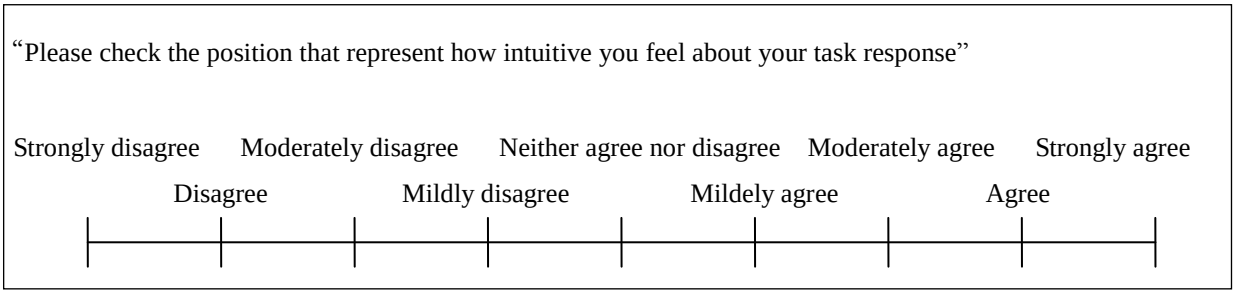

Figure.2 Self-rating scale of the intuitive feel about the task response on 9 points Likert-type scale.

3. Results and Discussion

Intuitive means having the ability to understand or know something without any direct evidence or reasoning process. Therefore RT has to be shorter in intuitive decision. In present experiment, RT was shorten while participants did not aware the position of target. Figure 2 shows mean RT and mean rating score for each block. Mean reaction time was gradually decreased from nearly 300ms to 200ms with task block progress. Mean standard deviations (SDs) of RTs were not change among blocks. Self-rating score of intuitive feel on task response was increased at the beginning of block progress. In a similar way to figure 2, figures3 also shows the mean RT and mean rating score for one week later second session. Mean RT was shorter and Mean rating score was higher at the beginning of block in the second session

RT data was analyzed by a two-way repeated-measures analysis of variance (rANOVA) (blocks × sessions). It revealed a significant main effect of block ($F(1, 19)= 15.48$, $p<.01$) and session ($F(17, 323)= 46.20$, $\varepsilon=.24$, $p<.01$). Furthermore, interaction effect (blocks × sessions) was significant ($F(17, 323)=2.68$, $\varepsilon=.36$, $p<.05$). Post hoc analysis indicated that RTs after middle blocks were shorter than the RT in the last two random blocks in both first and second sessions. This indicates that the sequential learning took place in both sessions. In first session, RT was significantly different between second block and the blocks after fourth block and between third block and the blocks after tenth block. These differences indicate that RTs after middle bock were shorter than that of first few blocks. These differences were not found in the second session. Difference of RT between first and second session was confirmed from first to sixth bock. RTs in second session were shorter than that of first session.

Score on intuitive feel was analyzed by a two-way repeated-measures analysis of variance (rANOVA) (blocks × sessions). It revealed a significant main effect of block ($F(17, 323)= 17.51$, $\varepsilon=.22$, $p<.01$) and significant interaction effect (blocks × sessions) ($F(17, 323)=3.21$, $\varepsilon=.32$, $p<.01$). Post hoc analysis revealed that score was significantly different between second block and the blocks after sixth block and between third block and the blocks after ninth block in first session. These differences indicate that intuitive feel was raised until the middle of session. There, however, were no differences in score of second session. Then, differences between first and second session were found. Since scores from first to third bock were higher in second session than that of first block, intuitive feel for responding the task was enhanced from starting block in second session. It considered the results of learning was remained after one week or later.

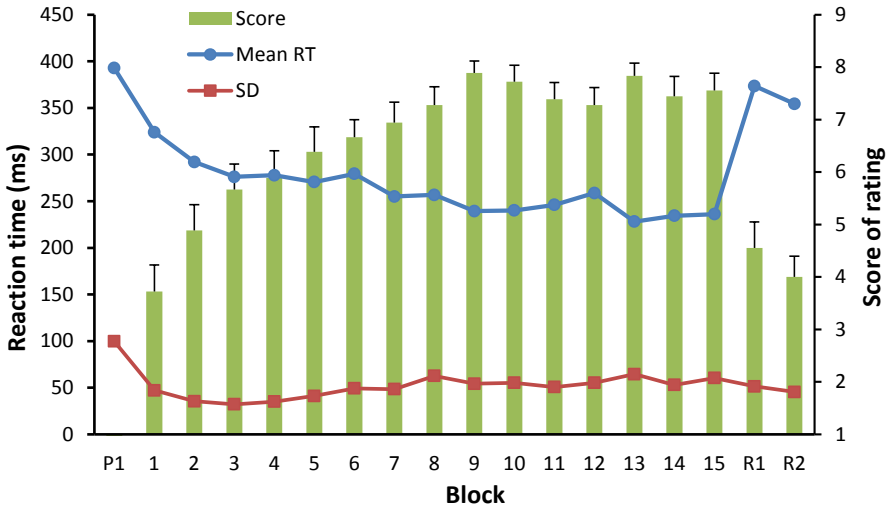

Figure.2 Mean RT, Mean standard deviation and score of intuitive feel in each block in session 1

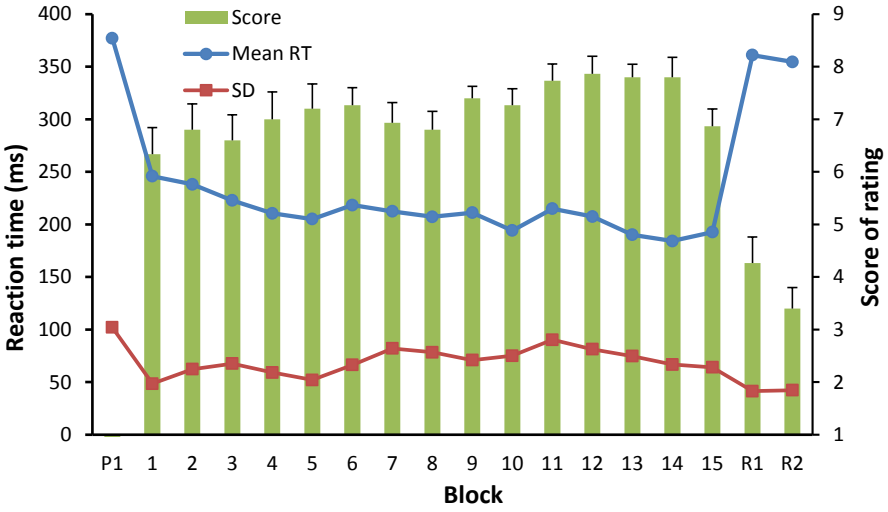

Figure.3 Mean RT, Mean standard deviation and score of intuitive feel in each block in session 2

These results implied participants felt the task response got more intuitive accompanied with progress of implicit learning, in particular first session. To examine this, correlation between RT and score of intuitive feel for every participant was analyzed. Twenty participants for two sessions, for a total of 40 correlation coefficients were calculated, of which 25 data were significant ($r(18)=-0.55\sim-0.91$, $p<0.05$). This means score of intuitive feel correlated with RT in individual data. Furthermore, mean RTs were calculated for every score of intuitive feel (1-9 point). Figure 4 shows mean RT for every score of intuitive feel. Mean RT for score of 2 was approximately 350 ms while mean RT for score of 9 was approximately 200 ms. It was considered that participants might feel the intuitive manipulation for the task when they came to be able to press the button about 200 ms. Moreover, figure 4 indicated there was a direct proportional relationship between RT and score of intuitive feel. This means that RT has possibility to become an index for intuitive feel.

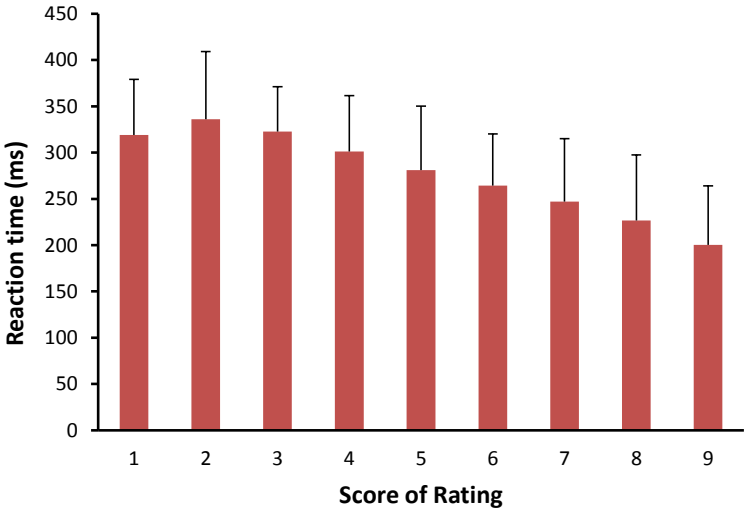

Figure.4 Mean RT for every score of intuitive feel

4. Conclusions

Mean reaction time was gradually decreased from nearly 300ms to 230ms with task block progress. Self-rating score of intuitive feel on task response was increased along with change of reaction time. This implied participants felt the task response got more intuitive accompanied with progress of implicit learning. Based on these results, it was considered that knowledge gained from learning underlie the intuitive manipulation of product. Preset study documented that familiarity facilitate the intuitive manipulation.

Regarding RT data, recorded RT data has possibility to become an index for intuitive feel for developing the interface design Reaction time which is less than 250ms is found in simple reaction time task. It means the response could be made without question when the stimulus was presented. From the aspect of reaction time, intuitive interface might be defined as the action without question.

On the other hand, repeated experiment after one week indicated reaction time was shorter from the beginning of task block and self-rating score of intuitive feel also relatively higher. This suggested that intuitive manipulation was maintained once it has been acquired and became a basis of intuitive manipulation.

5. References

[1] Stephanidis, C. (ed.) (2009) *The Universal Access Handbook*, CRC Press, Boca Raton, Florida.

[2] Raskin, J. (1994). *Intuitive equals familiar*. Communications of the ACM, vol.37, no.9, pp.2.

[3] Turnerar, P (2008) *Towards an account of intuitivenesss.* Behaviour & Information Technology, vol .27, no. 6, pp.475-482.

[4] Blackler, A., Popovic, V., and Mahar D. (2003) *The nature of intuitive use of products*: *An experimental approach*. Design Studies, vol. 24, no.6, pp.491-506.

[5] Blackler, A., Popovica, V., Maharb, D. (2010) *Investigating users' intuitive interaction with complex artefacts*. Applied Ergonomics, vol. 41, no. 1, pp. 72–92.

[6] Nissen, M., & Bullemer, P. (1987) *Attentional requirements of learning: Evidence from performance measures*. Cognitive Psychology, vo.19, no.1, pp. 1–32.

[7] Stadler, M. A. (1995) *Role of attention in implicit learning*. Journal of Experimental Psychology: Learning, Memory, and Cognition, vol. 21, no. 3, pp 674–685.