A Study on System Dialog Message Design by Age Considering Interruption in Task-Switching

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ABSTRACT

Due to the wide use of smart devices, users are often exposed to system dialog messages during interaction. These messages are mainly interruptive, since what they say is not relevant to the intention of the user and to the existing task. The interruption requires extra work to be done in a different context from the existing task, which needs additional cognitive effort. In particular, this cognitive task-switching process may have a negative impact on the performance of the old users, whose cognitive abilities decline. In this study, the interrupting task was designed to handle several smartphone system dialog messages in order to infer which terminological properties make them interruptive by age. 24 subjects of two age groups (twenties and sixties) followed text reading tasks which contain dialog messages with two terminological attributes (the number of technical jargons, the length of message), observing the timeline of three task switching process (main task, interruption task, resumption) as subtasks. Considering these conditions, task performance time, comprehension rate, and subjective workload were measured. As a result of the experiment, it was shown that the task performance time of sixties was significantly longer than those of twenties. Correlation analysis for the partial time of the task switching revealed that for old users, the time spent for the resumption was positively correlated with the time cost for interruption. In addition, the old subjects experienced higher subjective workloads by the messages with many jargons, and this load tended to continue in the following process, the resumption. While previous message studies only considered the complexity of the dialog messages themselves, this study tried to consider them in the total work condition discussing behavioral characteristics of processing the interruption by age during the task-switching simulation. In addition to the design guideline for the practical message construction, we also suggest cognitive considerations to maintain the performance of the old user at the appropriate level in such a task-switching condition.

Keywords: ESK-JES Joint Session, Smartphone system dialog message, Interruption, Task-switching, Aging

1. Introduction

Users of smart devices experience various and continuous interruption from the system. The frequency of interruption is increasing due to the spread of smartphones with various notifications such as phone calls, mails, and messages, etc. (Shirazi et al., 2014). When an interruption occurs in the system, the user processes tasks in the order of (1) main task, (2) interruption appearance and processing, (3) task resumption after the interruption processing (Mcfarlane and Latorella, 2002; Trafton et al., 2003). As an example of such interruption, task instructions through text reading could aggravate disruption by requiring the additional use of declarative memory (Iqbal and Bailey, 2006). Therefore, it is necessary to analyze the interruption in the context of the task switching since the interruption can probably affect the performance of the main task.

Among various types of interruption in HCI, dialog messages are mainly used to convey security and function related issues, but many users fail to comprehend the dialog message (Bravo-Lillo et al., 2011). In order to analyze the cause of this failure, Harbach et al. (2013) observed the comprehension rate and subjective workload of dialog messages related to web browser. Their results showed that the complexity of the dialog message led to a declined attention for comprehension, which results in failure of information transmission. Also, they raised the necessity of in-depth discussion for the use of technical jargons and the length of messages as elements related to the linguistic complexity of the dialog messages. The result was similar with the research for the application installation messages of the Android operating system (Felt et al., 2012). They pointed out that
those interfaces are usually difficult for general users since their subjects showed only 3% of comprehension rate for the experimental dialog messages.

The IT-related phrases included in the dialog message can be more difficult, especially for old users. In 2015, the percentage of smartphone users aged 65 and over in Korea was largely grown than a year ago (In 2015: 25.3, In 2014: 15.6%) (MSIP, 2016). However, unlike this social trend, the cognitive abilities decline with aging. In particular, the inhibitory mechanism of selective attention could be weakened (Hasher and Zacks, 1988).

In addition to this decline in cognitive abilities, the understanding for IT terminology of old smartphone users is also generally low level (Chung and Kim, 2014). This lack of understanding can negatively affect the technology acceptance by old users (Wilkovska and Zieffe, 2009). To make the information technology sustainable in the current aged society, it has been discussed that the interface design for old users should receive more attention (Melenhorst et al., 2006).

The objective of this study is to analyze the changes of task performance caused by interruption which is a main characteristic of the dialog messages, and to provide guidelines for designing the dialog message so that smartphones can be used easily by age.

2. Method

2.1 Subject

In the present study, a total of 24 subjects participated. Twelve of them aged between 22 and 29 (mean: 24.75) and the other aged between 60 and 68 (mean: 63.75). All subjects were using the smartphone for more than 2 years and confirmed by the preliminary vision test that there was no problem in carrying out the experiment.

2.2 Apparatus

The smartphone Samsung Galaxy S4 was used for the experiment and Java-based application program was developed to conduct experiments in the mobile condition.

2.3 Experimental design

The main task used in this experiment is the reading four types of 200-character weather articles in Korean. The experimental program was designed so that when a subject finished reading the first half of primary task (100 characters), a dialog message popped up. The main task could be resumed just after processing this dialog message.

Four system dialogue messages were used in the current experiment. Out of 28 system dialog messages from the latest products of the three smartphone manufacturers, the final four dialog messages were extracted based on the standards of the use of technical jargon and the length of messages.

As shown in Figure 1, 2×3×4 mixed-factor design was used in this study. Age (young, old) was selected as a first factor to confirm the task performance by age. Second factor was three stages of Task Switching process containing interruption (main task, interruption, resumption). Even if it was designed as a within-subject factor, and the order was not randomized by counterbalancing; the sequential order by time was fixed. The last factor was the four Types of text reading task, which comprises the four types of experimental system dialog messages in the middle. This factor was completely counterbalanced.

Task performance time, comprehension rate, and subjective workload were used as dependent variables. The task performance time was measured by completing each stage of Task Switching, and the task comprehension rate utilized the correct answer rate for the questionnaires about each text in the Task Switching process. Subjective workload was measured using the three dimensions of Nasa-TLX subscale (mental demand, effort, and frustration).

The times spent to cognitive task switching around interruption were also measured in this experiment: The interruption lag from the appearance of interruption to the start of the actual process of interruption, and the resumption lag from the completion of interruption to the point of actual resumption of the task. In order to discuss this cognitive process, correlation analysis was performed for the relevant elements in the task switching process.
3. Results and discussion

3.1 Task performance time

The results of Analysis of Variance (ANOVA) for task performance time showed that the main effects of Age, Task Switching, and Type of task were statistically different at each significance level of 1%. The post-hoc test (Bonferroni’s method) on Type of task showed that it took a considerable amount of time in the task type 4 where it had system dialog message with long length containing many technical jargons, while task type 1 where it had the dialog message with short length containing a few jargon showed the smallest task performance time. There was no significant difference between the task type 2 where it had the dialog message of short length with many jargons, and the task type 3 where it had the dialog message of long length with a few jargons in its middle.

The result of simple effect F-test for two-way interaction Age × Task Switching showed that there was a significant difference of task performance time between age group at the levels of interruption and the resumption (Figure 2) in Task Switching. Therefore, while the young subjects performed the interruptions (identical to system dialog messages) relatively fast, the old subjects performed the interruptions slowly. This tendency was continued to the followed resumption. In addition, we found that old subjects showed some delay of performance on the types of task which contained the dialog messages with many jargons from a significant interaction between Age and Type of task.

3.2 Comprehension rate

The results of the comprehension rate showed that all main effects were statistically significant at 1% significance level. The followed t-test showed the comprehension rate of the interruption level in Task Switching was significantly lower than the other levels. Also, task type 2 and 4 were poorly comprehended than the others. No significant interactions were found for comprehension rate. Therefore, it was confirmed that interruption was insufficiently comprehended by either age group. The comprehension for technical jargons was found to be at low level.

3.3 Subjective workload

As a result of the analysis of mental demand, all main effects were statistically significant within the significance level of 0.05. The two-way interaction between Age and Task Switching was significant at p=0.05, and corresponding post-hoc test revealed that there were no significant differences for the mental demand among young subjects according to Task Switching process, while old subjects required mental demand in the order of interruption, resumption, and main task. Another significant interaction between Age and Type of task (p<0.05) showed that old subjects rated higher mental demand for task type 2 and 4 than young subjects (Figure 2). The results for the effort and the frustration were quite similar to the result of mental demand.

3.4 Correlation analysis

The result of correlation analysis for the task
Performance time between the interruption and the resumption lag revealed a positive correlation for both age groups (young: r=0.460, p<0.01; old: r=0.518, p<0.01). Therefore, we reaffirmed the results of previous studies that the longer the time required for interruption, the longer the resumption lag time arose. On the other hand, we also analyzed the temporal correlation between the interruption excluding the time spent to interruption lag and the resumption excluding the time spent to resumption lag. The result demonstrated that only old subjects showed a significant positive correlation (r = 0.395, p <0.01).

4. Conclusion

This study newly set up the time factor of the Task Switching and the social factor of the old users in the existing studies for the dialogue message. In the case of young subjects, the reading tasks for the dialog message and the followed resumption were processed quickly than old subjects. The subjective workload did not show any significant difference according to the task switching process.

In the case of old subjects, the time spent to resumption was longer with the increasing time for interruption. It is considered that the information transfer did not proceed smoothly during the cognitive lag. Also, they showed higher subjective workload and significant delay of task performance time on the task which contained dialog messages with many technical jargons. This implies that old users experience workload and congestion when they try to process many technical terms.

Therefore, it is recommended to minimize the use of IT terminology in system dialog messages for smooth task switching and resumption of old users. Also, it is necessary to consider sensory cues to effectively reactivate the information of main task in resumption.

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