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Directed Questions for Structured Interviews in Requirements Determination

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Abstract

Requirements determination is a critical stage in systems development. Despite its importance, however, few studies have provided empirical tests of requirements determination issues (Vessey and Conger, 1994). The present study tested several questioning approaches in structured interviews: an Interrogatories technique (Couger, 1996), a Semantic questioning technique (Lauer, 1994), and a Task Characteristics technique developed as part of the current research. Experimental results showed that the Task Characteristics technique elicited a higher quantity of requirements and more detailed requirements from subjects in an application development task than did the other two approaches. Further, the three approaches elicited qualitatively similar requirements, indicating that the use of only the Task Characteristics tool is likely best for systems analysis practice.

Introduction

The difficulties encountered in developing information systems are well documented and arise for a number of reasons. A principal reason that systems do not meet user expectations is the failure of the development process to yield a complete and accurate set of requirements (Davis, 1982).

The elicitation of such requirements has been recognized as the most difficult phase of information systems development (Vessey and Conger, 1994; Watson and Frolick, 1993). Broadly speaking, requirements determination can be viewed as a three-step process: (1) elicitation, during which requirements are articulated by users; (2) representation, during which the evoked requirements are modeled in a physical form by the systems analyst; and (3) verification and validation, during which the analyst verifies with the user that the requirements modeled are indeed correct (Vitalari, 1992). The present research is concerned with the elicitation step of requirements determination and the problems that occur due to cognitive limitations of both users and analysts and the general complexity of system requirements. Specifically, the research tests whether theoretically-driven prompting tools can increase the quantity and quality of requirements elicited from system users.

Although a number of strategies exist for eliciting system requirements (Davis, 1982), the most popular strategy is for the analyst to interview the users of the proposed system (Byrd, Cossick, and Zmud, 1992). In the present research, context-independent directed questions were developed for use in a structured interview setting. Context-independent questions are a valuable resource for systems analysts because, since they are not tied to a particular application development, they can be re-used in numerous projects. To gauge the relative effectiveness of the tool in eliciting requirements, it was compared to two other context-independent questioning methodologies: (1) the Interrogatories technique, which involves asking "who," "what," "when," "where," "how," and "why" questions (Couger, 1996); and (2) the semantic questioning scheme developed by Lauer (1994), which involves asking questions based on a theoretical model of knowledge structures. The value of all three methods in requirements determination was previously untested.

The prompting tool developed in the present research is intended to improve the quantity and quality of requirements elicited from users. The tool was developed using a theoretical account of the requirements determination task. This theoretical account considered cognitive issues, problem structuring issues, and communication issues (Davis, 1982). The tool contains two types of prompts: substantive and procedural. Substantive prompts are aimed at eliciting various types of requirements, such as goals, processes, tasks, and data. Procedural prompts are designed to address the cognitive issues associated with the requirements determination task, such as overconfidence and ease of recall. Because the prompts are context-independent, the tool can be used in many different requirements determination settings.

Method

Forty-five subjects were utilized in a between-subjects design. Subjects were adults who had used computers as part of their job function and who had experience accessing databases. Fifteen subjects were randomly assigned to each of three groups: (1) a treatment group in which subjects received prompts to evoke information from the tool developed as part of the present research (Task Characteristics group); (2) a treatment group in which subjects received prompts adapted from the semantic

prompting approach developed by Lauer (1994) (Semantic group); or (3) a group in which subjects received "who," "what," etc., prompts; because such prompts offer no substantive help in evoking information, this group served as the control group in the current experiment (Interrogatories group). Each treatment group received approximately the same number of prompts.

Subjects evoked system requirements in response to a case involving development of an on-line grocery shopping application. This application was chosen because such systems were rare at the time of the experiment, and so it was unlikely that subjects would have thought about requirements for such a system before the experimental session. In responding to the case stimulus and prompts given by the interviewer (who was a person blind to the hypotheses of the study), subjects spoke aloud about the information requirements for the system. Their responses were tape recorded and later transcribed. A coding scheme (adapted from the work of Byrd, Cossick, and Zmud (1992)) developed prior to the experiment was used to code the transcripts. Coding was performed by another person blind to both the treatment groups and the hypotheses of the research. Inter-rater reliability with a second individual coding a sample of the data was 92%.

Measures

Dependent variables measured included: (1) the total number of different requirements evoked by subjects, as determined by the coding scheme; (2) the breadth of requirements elicited, as determined by the number of different requirements categories in the coding scheme (this is a measure of treatment quality, since a wider variety of requirements elicited is considered better from a theoretical standpoint); (3) the depth of requirements elicited, as determined by how many sub-surface (detailed) level categories within the hierarchical coding scheme the subject mentioned (this is also a quality measure, since evocation of such requirements provides a more detailed picture of the proposed system's needs).

Hypotheses

The hypotheses tested in the present experiment can be summarized as follows:

- H1: The total number of requirements elicited by the Task Characteristics prompting tool will be greater than the number elicited by either the Semantic tool or the Interrogatories technique.
- H2: The breadth of requirements elicited by the Task Characteristics prompting tool will be greater than the breadth elicited by either the Semantic tool or the Interrogatories technique.
- H3: The depth of requirements elicited by the Task Characteristics prompting tool will be greater than the depth elicited by either the Semantic tool or the Interrogatories technique.
- H4: Types of requirements elicited from subjects in the Task Characteristics group will be qualitatively different than those elicited from subjects in the Semantic and Interrogatories groups.

Results

For the total number of requirements evoked measure, the mean number of requirements per group was as follows: Interrogatories = 30.8, Semantic = 40.9, Task Characteristics = 66.3. An analysis of variance showed differences between the groups ($F(2,42) = 17.05$; $p < .0001$). Multiple comparisons showed that the Task Characteristics group evoked significantly more requirements than both of the other two groups. These results support Hypothesis 1.

For the breadth of requirements evoked, the mean number of categories utilized per subject by group was as follows: Interrogatories = 7.1, Semantic = 8.1, Task Characteristics = 9.1. These numbers were not significantly different ($F(2,42) = 2.47$; $p = .097$). Thus, Hypothesis 2 was not supported. Subjects appear likely to raise the same number of general requirements topics regardless of the treatment applied.

For the depth of requirements evoked, the mean number of categories evoked by group was as follows: Interrogatories = 3.1, Semantic = 6.2, Task Characteristics = 19.3. These means were significantly different ($F(2,42) = 29.61$; $p < .0001$). Multiple comparisons showed that the Task Characteristics group evoked more detailed-level categories than either of the other two treatments. These data support Hypothesis 3.

To test whether different requirements were evoked by subjects in the three groups, the requirements categories used by members of each group were first rank-ordered according to how often each category was mentioned. Spearman's test of ranks was then used (due to serious violations of normality in these distributions) to assess the correlation between the rank orders. If the rank orders were different, this would suggest that different categories were being emphasized by the three groups. Both comparisons made were insignificant: Task Characteristics vs. Interrogatories ($rs = .77$; $p < .01$); and Task Characteristics vs. Semantic ($rs = .79$; $p < .01$). Hence, Hypothesis 4 is not supported. There were no qualitative differences in the requirements elicited by the three tools according to this measure.

Discussion

The present research shows that theory-based prompts developed to help analysts overcome cognitive difficulties and task complexity improve the quantity and quality of requirements elicited from subjects in a requirements determination task. Subjects in the Task Characteristics treatment group evoked more requirements and more detailed requirement categories than subjects in the other two groups.

The failure to reject Hypothesis 4, which concerned qualitative differences in requirements evoked, is an important conclusion for both theory and practice. Since there were no qualitative differences between the groups, we can conclude that the use of more than one tool will not cause subjects to evoke different requirement categories. Because the Task Characteristics tool elicited more requirements (as shown in the test of Hypothesis 1), rejection of Hypothesis 4 implicates the use of this tool alone. Together, these results give researchers theoretical guidance as to how requirements elicitation tools should be constructed and deployed. For practice, the combined use of several tools is not appealing in any case. The practitioner charged with

gathering requirements is subject to time and cost constraints. In today's rapid application development environment, use of more than one requirements determination tool would be costly. The results of this study indicate that using more than one tool would be qualitatively redundant, and therefore unnecessary.

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