

TOWARD ICONIC-BASED INFORMATION TECHNOLOGY AND APPLICATION CONTROL EXCEPTION MESSAGES

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ABSTRACT

Information technology (IT) users commonly encounter exception messages during their interactions with application programs. Exception messages are similar in purpose to the warnings that appear on consumer products, in work environments, and on chemicals. This manuscript reviews the normative elements included in product, chemical, and environment warnings and proposes that these elements should be included in IT exception messages. Additionally, we report the results of an experiment carried out to determine if IT exception messages that include descriptive icons improves user interactions. The results confirm that user's behavioral compliance increases when interacting with a system that incorporates iconic-based exception messages.

Keywords: Application controls, exception messages, habituation, icons

INTRODUCTION

Users of information technology (IT) commonly encounter exception messages during their interactions with application programs. Exception messages, are similar in purpose to the warning messages that appear on consumer products and equipment (e.g., cigarettes, power tools, etc.), in various work environments (e.g., around machinery), and on chemicals. Warnings, like exception messages, are designed to inform people of problems or actions required to be taken. For example, warnings appear on household cleaners and ladders to inform the user of a problem if the item is used inappropriately. A significant amount of research examining the content of warnings has been carried out by human factors psychologists to determine the effect on human perceptions, judgment and decision making [8]. In addition, the American National Standards Institute (ANSI) and the International Standards Organization (ISO) have focused attention on the content of warning messages. A result of both research and the standard setting process is a set of normative guidelines specifying the elements and information that should be included in warning messages.

In contrast, very little guidance is offered in the academic and professional IT literature as to the form and content of exception messages [1] [2]. Accordingly, there are two objectives of the current research. First, to review the normative elements and information that are included in product, chemical, and environment warnings and to propose that these elements and information should also be included in IT exception messages. A second objective of this manuscript is to report the results of an experiment carried out to determine if IT exception messages including descriptive icons in the body of exception messages enhance user interactions. The results of the experiment confirm that when users interact with exception messages incorporating descriptive icons, their behavioral compliance with the exception message significantly increases.

WELL DESIGNED WARNINGS – AN APPLICATION TO IT EXCEPTION MESSAGES

An example of a product and environmental warning is shown in Figure 1. The warnings literature and standards suggests that a well-designed warning should contain two key sections or “panels:” a signal word panel and a message panel [9] [5]. The warning of Figure 1 possesses these two panels and each panel has a specific purpose or function. The purpose of the signal word in the upper panel is to draw attention of the user and to express a level of hazard or probability of injury associated with the environment or situation. The purpose of the lower, message panel is to convey specific information about the hazard or situation. This information can be expressed using written language, using icons or by using both language and icons.

FIGURE 1
Examples of Warnings used in Work Environments



Taken together, the elements of a well-designed warning would seem to be very appropriate for IT exception messages. An examination of the actual IT exception message of Figure 2 shows deficiencies relative to the prescriptions described above for warnings. Indeed, the message of Figure 2 is especially lacking in information content.

FIGURE 2
Example of IT Exception Message



Guidance in the IT Literature

It is not surprising that IT exception messages often lack information content given the paucity of guidance offered in the IT literature. Only one study on the academic side has investigated exception message content. Amer and Maris [1] measured the “arousal strength” (i.e., the perceived severity of hazard a warning communicates) of the common signal words and signal icons used in IT exception messages. They recommend that exception messages should contain signal words and/or signal icons and that the specific word or icon contained in the exception message should be a matched appropriately with the severity of the underlying computer problem.

The professional literature and researchers in human computer interaction (HCI) offer limited guidance as to the content of exception messages. Both Apple Corporation and Microsoft provide only cursory recommendations that lack a clear theoretical or experimental basis. Cooper and Reimann [3] and Shneidermann and Plaisant [4] note that exception messages should provide informative feedback. In addition, error messages should offer specific information about the nature of the problem, and indicate what the user needs to do. Error messages should also provide simple, constructive, and specific instructions for error recovery. The recommendations from authors in both the academic and professional literature aligns with that of the researchers in warnings.

Proposed Elements of Effective Exception Messages

Combining the guidelines established in the warnings literature with the recommendations provided by the IT authors leads to a set of normative elements that, arguably, should be possessed by IT exception messages: (1) Include a signal word and/or Icon, (2) Provide hazard information (illuminate the problem), (3) Offer instructions, (4) Note the consequences or alternatives, and (5) Offer a solution.

Consider mock ups of two exception messages illustrated in Figure 3. The first, an “edit-request” exception message, could be displayed when prompting a user to review the data just entered in a data input screen prior to submitting the data for processing. The second, a “network connection failure” exception message, could be used to communicate to a user that data may be lost due to a network connection failure. The format and contents of both exception messages comply with the proposal above. Of special note are the iconic representations in each exception message. Both icons provide a visual representation of the situation faced by the user.

FIGURE 3

Examples of Iconic-Based Exception Messages Compliant with the Proposed Informational Elements

a. Edit-Request Exception Message:

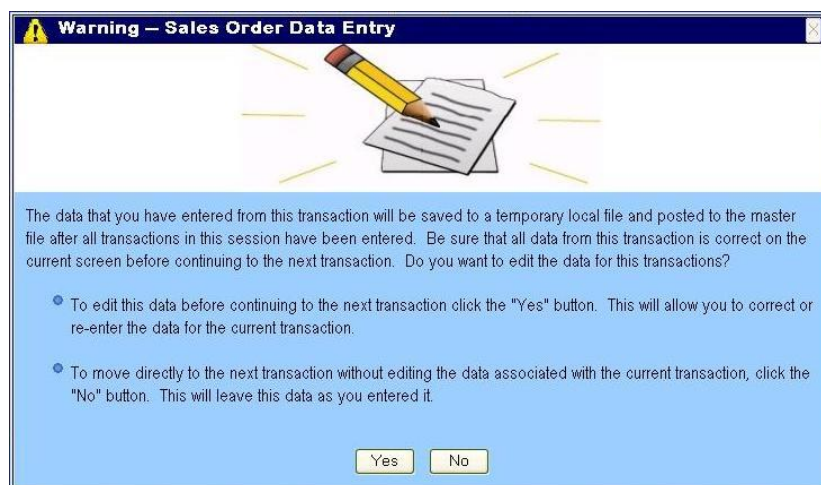
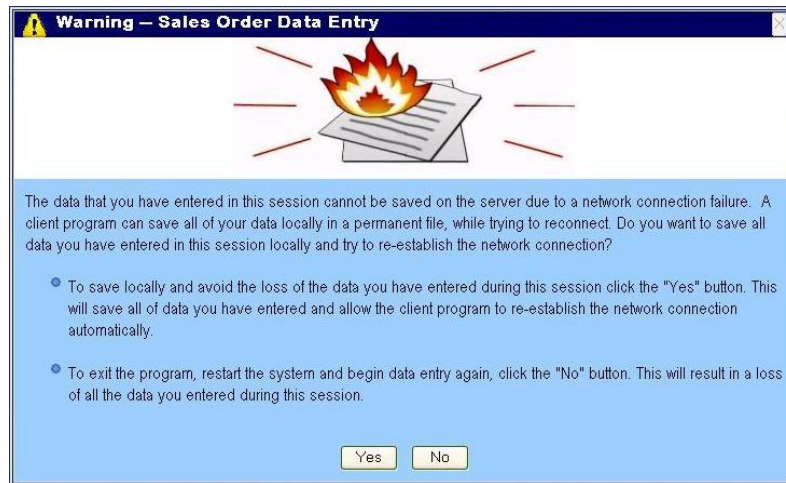


FIGURE 3 – Continued

b. Network Connection Failure Exception Message:



EMPIRICAL TEST OF EFFECTIVENESS – ICONIC REPRESENTATIONS

The use of icons in lieu of written words in warnings is prompted by the notion of their “alerting value” whereby they call attention to themselves better than textual material [6]. Because of visual differentiations of shape, size, and color, symbols may be more salient than text. Symbols typically have unique details and possess more differences in appearance than do the letters of the alphabet. Letters also tend to be highly familiar and are more similar to one another than most graphical symbols. Accordingly, using icons should result in better “attention maintenance” [7] whereby attention to the exception message is maintained long enough for the user to extract meaning from the information contained in the message and act on that information [1]:

H1: Behavioral compliance to IT exception messages will be higher with iconic-based exception messages than with text-based exception messages.

METHOD

An experiment was carried out to examine the effect of iconic-based exception messages as set forth in hypothesis **H1**. In this experiment, participants (upper division accounting students) were randomly assigned across treatment conditions to determine if exception messages containing icons resulted in a higher degree of behavioral compliance than exception messages containing text. Following Amer and Maris [1], the participants completed a simple yet relevant accounting data entry task that required the entry of sales order information using an on-line sales order data entry screen. The data entry task was intentionally designed to habituate the participants and thereby desensitize them to repeated exposure to similar exception messages. As noted by Amer and Maris [1] habituation leads to a lack of attention maintenance [7] whereby attention to the exception message is *not* maintained long enough for the user to extract meaning from the information contained in the message. The result is a significant decrease in compliance to the exception message.

Procedure and Task

The habituation task used by Amer and Maris [1] was administered using a Web-based computerized data collection program. The program was accessed individually by each participant through the internet

at their convenience. The participants completed the task in its entirety during one sitting. Each participant was randomly assigned to one of two treatment conditions in a between subject design. The first treatment condition, “iconic-based,” used the exception messages displayed in Figure 3. The second treatment condition, “text-based,” used the exception messages with text instead of the icons. All elements, (e.g., size, color, written content, etc.) of the messages in both Figures are identical *but* for the icons used in those of Figure 3.

To examine the behavioral compliance prediction of **H1**, a different hazardous situation with a different exception message was developed. The exception message was similar in appearance to the first but the context required a different action to be taken. After each participant entered the data for a ninth transaction and was habituated to the edit –request exception message, a simulated network connection failure occurred. The participants were informed of the connection failure by a network connection failure exception message that notified them that all data would be lost if they did not save it to a local file. The iconic-based exception messages utilized appear in Figure 3. The text-based exception messages were identical except the icons were replaced with textual phrases.

RESULTS

Table 1 presents the hit rate percentages associated with the iconic-based and text-based exception messages *after* habituation. That is, the participant’s responses to the network connection failure exception message after habituation to the edit-request exception message. In support of **H1** the percentages indicate that iconic-based exception message have a higher hit rate than the text-based message 48% to 30%. A binomial test reveals a statistically significant difference ($z = 1.79, p = .038$). These results support the notion that behavioral compliance increases with iconic-based exception messages.

TABLE 1
Hit Rate Percentages – Iconic-Based Versus Text-Based Exception Messages

Treatment Condition	Hit Rate
Iconic-Based (n = 46)	48%
Text-Based (n = 44)	30%

DISCUSSION AND CONCLUSIONS

This paper accomplishes two primary objectives. First, it proposes and sets forth standards for the form and content of IT and application control exception messages. Building upon the work in consumer product and environmental warnings and linking to the literature in IT, five elements of well-prepared exception messages are established. The second objective is to report the results of an experiment in which the effects of iconic-based exception messages on behavioral compliance are examined. The results indicate that behavioral compliance is increased by incorporating icons in exception messages.

This research contributes to both the professional and academic literature. First, if systems designers adopt the proposed standardized format and elements set forth in the first part of this paper, the informativeness and effectiveness of exception messages should be enhanced. Exception design itself can also become more efficient because a set of standards can be referenced during system programming thus eliminating ad-hoc exception message coding. The academic literature is also enhanced as this research provides a well-controlled test of the effects of habituation and how iconic-based exception messages improve behavioral compliance in this situation.

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