## RESULTS

Perhaps surprisingly, the more visual information contained in the icons, the worse user performance was:

| | Icon type | | |
|---|---|---|---|
| | Blank | Picture | Prototype |
| Mean Search time | 7.48s | 10.51s | 12.46s |
| Standard deviation | 4.28s | 6.98s | 11.61s |

The difference in means is statistically significant ($F[2,6]=5.75$, $p=.018$).

## DISCUSSION

Icons do not seem to function well as either individuators or prototypes. One interpretation this hints at is that when presented with icons that contain pictures, users may make use of a two-pass approach. The first pass over the icons is used to locate those icons that are relevant. The second pass is a search of the filenames of the relevant icons to determine which one is the target. However, when users are presented with blank icons, only one pass is made across the filenames. This suggests that blank icons force the user to focus on filenames, which contain more task-relevant information.

What is important to realize is that the single pass over the filenames is faster than the two-pass method. The user has less items to search in the second pass, but this is more than made up for by the additional time spent on the first pass.

One possible reason for this is suggested by the difference in variability exhibited. This suggests that some users are quick to interpret the visual information, while others flounder with it. This is hardly surprising when the nature of the information is considered. It is very difficult to guarantee that a picture will mean the same thing to different people, whereas word meaning is more universal; "automobile" means roughly the same thing to all of us, thus text may be a "safer" representation.

One should be careful not to over-generalize these results. Icons may well be the best way to represent other things, such as commands in a painting program or maintaining a metaphor. What is clear is that more work needs to be done in the area of icons. Specifically, the cognitive and perceptual mechanisms involved in icon recognition need to be better understood and more formally modeled so that user behavior can be better predicted and interface design can be more scientific.

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# THE EFFECTS OF WARNINGS AND DISPLAY SIMILARITY ON INTERRUPTION IN MULTITASKING ENVIRONMENTS

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Operators are often required to perform concurrent tasks, as well as attend to additional information (e.g., emergencies, changes of plans). This additional information has a tendency to interrupt the human operator's primary duties, requiring the operator to delay completion of these duties until a later time. Two experiments examined the effects of display similarity and the presence or absence of a warning on an operator's ability to remember information from (and hence, resume) multiple primary tasks. It was hypothesized that subjects' performance would be worse when interrupted by a task that was more similar to the primary task. It was also hypothesized that subjects would benefit from a warning prior to the interruption. In experiment 1, subjects monitored information from 4 different space station systems. After 4 minutes, an interrupting task replaced the information on the computer screen. Subjects were either warned or not warned of the upcoming interruption 30 seconds prior to its onset. The interruption task was either similar or dissimilar in display format to the primary task.

Results indicated significantly better recall of the primary tasks' values when the interruption was dissimilar in format to the primary tasks. Experiment 2 replicated the first study, and extended it. In this study, subjects were explicitly told that they would have to recall the primary tasks' parameters at the end of the experimental session. When subjects' performance was analyzed according to whether or not subjects recalled the correct state of the system (i.e., nominal, off-nominal), recall performance was again significantly better when interruptions were in a format dissimilar to the primary tasks, replicating experiment 1. However, when subjects' performance was analyzed as to whether or not they recalled the exact values of each system's status, the similarity effect observed in experiment 1 was not significant. (Either way of analyzing subjects' performance resulted in a significant similarity effect in experiment 1). This change in results from experiment 1 to experiment 2 suggests that subjects' encoding and memory strategies changed when explicitly told that they would have to recall as much information as they could. Results also revealed that subjects recalled significantly more of the primary tasks' values when a warning was provided.

Implications for user interface design in multitasking environments hinge on whether or not the human operator knows she must recall specific multi-system parameters in the case of interruptions. Experiment 1 suggests that information in an unanticipated interruption should be

displayed in a format that is dissimilar to the tasks being interrupted. On the other hand, experiment 2 suggests that the similarity of the interruption to the interrupted tasks may have less of an effect on performance when the operator is aware that she must recall several multi-system parameters after the interruption. The results from the second experiment also suggest that it would be best to warn the operator of an imminent interruption in this scenario.

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## AN EVALUATION OF ALTERNATIVE DESIGNS FOR VARIABLE SELECTION LISTS

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Alternative designs for the selection of items from a list were evaluated using a Thurstone scaling technique. When making choices among alternative designs, the software designer often wants to know the magnitude of the differences among the designs. This poster demonstrated the use of this technique to help software designers make more informed decisions.

The data were obtained from a usability study of methods to extend list (menu) selection in the IBM*CUA Panel Design and User Interaction book (1987). Various methods for making single and multiple selections from lists were proposed and evaluated. Users learned how to select items from a menu for each method using either a pencil and paper survey (Experiment 1) or an online prototype (Experiment 2). In both experiments, participants were asked to choose the better set of designs from a pair. A Thurstone scaling procedure (Emory, 1976) was applied to the paired comparison data.

The Thurstone scaling helped to quantify the differences between the selection methods tested. This technique gives the designer the ability to consider the effects of design tradeoffs because the relative size of the differences among designs is uncovered. For example, in Experiment I, the most preferred single selection method, paired with one type of multiple selection (ms) method, was rated approximately twice as good as when it was paired with another ms method.

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## DECIDING THROUGH DOING: THE ROLE OF SKETCHING IN TYPOGRAPHIC DESIGN

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#### INTRODUCTION

Current computer-based tools for document creation do not yet support and enhance the full range of traditional skills possessed by professional typographic designers. These tools' strengths lie in the latter stages of the process, that is, in the production aspects, but they provide only limited support for the early, design stages. Traditionally, the early, decision-making part of the design process has been executed through sketching using paper and pencil. Observations of contemporary professional designers indicate that even those who fluently use computer-based systems for implementing designs nevertheless use paper and pencil to sketch their initial exploration of design ideas. That designers choose the traditional medium for sketching strongly suggests that they are engaging in an activity that