To Customize or Not to Customize? The Use of a Customization Tool to Augment Information Indexing in a Computer Desktop Environment

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We studied when and how people will use a customization tool that helps users offload information indexing to the external environment to augment finding and re-finding of information in a computer desktop environment. An experiment was conducted to study how the cost and benefit of customization may influence when and how participants customize, and how the customization may help them find and re-find information. Results showed that participants were sensitive to the cost and benefit of customization. In general, participants performed more customization when the cost was low and when the benefit was high. Customization was also found to influence their information indexing strategy. Implications to design of customization tools for information indexing were discussed.

INTRODUCTION

Imagine you are a psychologist who gives diagnoses to patients with a potential psychological disorder. You have a wide range of information concerning these disorders (e.g., dissociative disorders, mood episodes, and schizophrenia) filed on your computer desktop. How would you use your distributed information resources (e.g., electronic documents) to make diagnosis for different patients? It is likely that you may have to access a subset of information *repeatedly* to inform decisions, or to find and re-find relevant information when patients with similar symptoms appear at different intervals. Having a tool that helps you to index useful information so that you can easily re-find them when they are needed will greatly enhance your task efficiency.

Although a number of studies (Alvarado et al, 2003; Barreau & Nardi, 1995; Capra & Pérez-Quiñones, 2003; Dumais et al, 2003) looked at how people find and re-find information in different contexts, there have been relatively few studies on how people re-find information in a desktop environment, and how they will utilize customization tools to facilitate re-finding of information. Systematic understanding of how people utilize tools to index information in the external environment deserves more consideration as we become more and more reliant on repeatedly assessing information on our digital devices, practically using them as our external memory stores. A study on how people index information in the external environment for later access will therefore shed light on how we can design better tools that help us more effectively offload information to the external world and be able to re-find the information when it is needed.

In this paper, we studied how people would use customizable features to index information to help them re-find information across a set of tasks that required repeated accesses to the information. Specifically, we created tools that allowed participants to change the size of icons so that they could use different sizes as cues to help them to recall where to find certain information during the tasks. In particular, we were interested in knowing how the willingness to customize was sensitive to the cost and benefit of using the tool to create cues to help them re-find information.

RELATED WORK

Previous findings (Alvarado et al, 2003; Barreau & Nardi, 1995) showed that people make use of contextual cues concerning their searching target when looking for electronic information. This is especially obvious in the process of re-finding information (Capra & Pérez-Quiñones, 2003). In a typical Graphical User Interface (GUI) environment, besides being used to relate to information source, icons can also convey indicative meaning with slight alteration of their visual features (Ehret, 2002; Houde & Salomon, 1994). Thus, in a computer desktop environment, contextual cues can be represented as features of interface objects so that users can easily take advantage of these cues to guide them to find the right information. For example, if contextual cues such as the frequency and recency of accesses to icons are visually represented, users may find it easier to re-find the right information (Moon & Fu, 2009).

Although it is theoretically possible for people to fully evaluate and utilize possible customization options, the general observation is that many people choose not to customize (Mackay, 1991). People are busy and customizing takes time, so they only customize when they deem it worth the trouble (Mackay, 1991; McGrenere et al, 2002; Findlater & McGrenere, 2004).

One theoretical framework to systematically study how and why people customize is to cast the decision as a trade-off between a short-term investment and a longer-term potential benefit. In general, one can assume that it is desirable if the long-term benefits of customizing justify the short-term cost of doing so. Indeed, this kind

of tradeoff has been studied in previous human factors research. For example, Gray et al (2006) proposed the theory of soft constraint to characterize this tradeoff, which states that the decision on when to act is sensitive to the time costs of the alternative actions. They found that people might even adopt suboptimal actions, when they somehow perceive that the short-term costs are not justify by the long-term benefit; however, with experience, the perception of benefit may change and their decision on actions may tend to approach optimality across time (Fu & Gray, 2006; Gray et al, 2006). Therefore, although anecdotal evidence seems to suggest that people do not customize their desktop for re-finding of information, there seems to be other factors that may influence their willingness to do so, and one such important factor is the cost-benefit tradeoffs involved in customization (Fu & Gray, 2006). We therefore conducted a study and directly manipulated the cost and benefit of customization, and tested how they would influence the willingness to customize and whether it would influence information indexing strategies (i.e., how to re-access found information).

METHOD

Experiment Design

In this experiment, two kinds of icon edit tools: *track bar* (low cost, abbreviated as Lo) and *increase/decrease buttons* (high cost, abbreviated as Hi), and two kinds of organization of icons: *random* and *organized* (abbreviated as Org) were used. Therefore, there were four conditions: Lo-Random, Lo-Org, Hi-Random, and Hi-Org.

The size of each icon could be changed from 1x1 pixel to 60x60 pixel, and originally each icon had the size of 20x20 pixels. The track bar and increase/decrease buttons were used to change the size of the icons. We considered the track bar a low cost tool and increase/decrease buttons a high cost tool because when participants used the track bar to adjust the size of a particular icon, they only needed to drag its cursor on the scale (which usually took less than 1 second for this simple point-and-drag action); but for the increase/decrease buttons tool, participants had to click the increase (or decrease) buttons multiple times (each time increase (or decrease) the size by 1 pixel). Additionally, in both organized and random conditions, the locations of icons always stayed the same. However, in the organized condition, the adjacent icons shared similar contents and this could be location cues for searching; but in random condition, the icons with similar contents were not grouped together, thus no location cues could be used. Comparing these two conditions, we could find customization which left size cues could benefit the participants more in random than in organized condition.

We expected that in the high-cost conditions, participants were less willing to change the size of the icons compared to the low-cost conditions. Because there was a higher benefit for customizing the icon sizes in the random conditions, we expected that participants would be more likely to change the icon sizes in the random condition than in the organized condition.

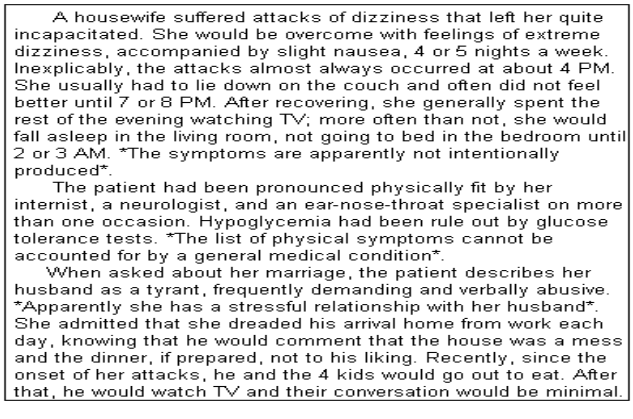
Participants

Forty native English speakers were recruited from a university community. They were randomly assigned to one condition in a 2x2 between participants design.

Interface, Task and Procedure

All participants were given the same set of 13 search tasks, one in practice session and 12 in experiment session. Each task, no matter in practice session or experiment session, had a maximum of 10 minutes for participants to answer the question. In each task, each participant was instructed to imagine that he or she was a doctor of abnormal psychological diseases, and was asked to give out the diagnosis results based on the symptom shown in the question area and the reference information shown in each icon file. Participants were required to use any information available in the icon files, and they were told to not only emphasize accuracy and search time, but also the edit and search strategies they used. We chose this task because we did not want the background knowledge of the participants to be a confounding variable, and during recruitment we ensured that they did not have a psychology background.

Search tasks (see Figure 1 for an example) were designed such that participants need to make multiple accesses to icons to find, re-find, and integrate information. For instance, several abnormal psychological diseases have similar symptoms, thus participants have to access and re-access icon files to get the useful information.


A housewife suffered attacks of dizziness that left her quite incapacitated. She would be overcome with feelings of extreme dizziness, accompanied by slight nausea, 4 or 5 nights a week. Inexplicably, the attacks almost always occurred at about 4 PM. She usually had to lie down on the couch and often did not feel better until 7 or 8 PM. After recovering, she generally spent the rest of the evening watching TV; more often than not, she would fall asleep in the living room, not going to bed in the bedroom until 2 or 3 AM. *The symptoms are apparently not intentionally produced*.

The patient had been pronounced physically fit by her internist, a neurologist, and an ear-nose-throat specialist on more than one occasion. Hypoglycemia had been rule out by glucose tolerance tests. *The list of physical symptoms cannot be accounted for by a general medical condition*.

When asked about her marriage, the patient describes her husband as a tyrant, frequently demanding and verbally abusive. *Apparently she has a stressful relationship with her husband*. She admitted that she dreaded his arrival home from work each day, knowing that he would comment that the house was a mess and the dinner, if prepared, not to his liking. Recently, since the onset of her attacks, he and the 4 kids would go out to eat. After that, he would watch TV and their conversation would be minimal.

Figure 1. Example of health information search task

The left-hand side of the interface (see Figure 2) simulated a computer desktop environment with 36 file icons (white squares in the green panel). Each search task was shown in the top left panel, and right below this panel was the answer box. Based on different conditions, an icon size edit tool (track bar or increase/decrease buttons) was shown in the edit tool area that was between the answer box and the area of 36 file icons.

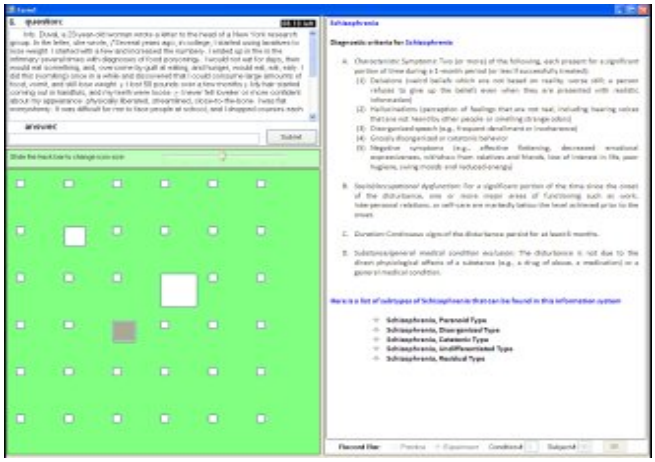


Figure 2. Interface of search task, answer box, icon size edit tool, 36 file icons, and reference information

The right-hand side of the interface was the reference information area. Each time one icon was clicked, it would be highlighted as grey color and at the same time a loading page would be shown in the right-hand side of the interface. The loading page was to simulate the time cost in accessing the information from a database, and it lasted for 1.5 seconds. The loading page would then be replaced by the reference information corresponding to the highlighted icon. Participants could then read the reference information, select another icon, and repeat until they could answer the question. At any time, participants could use the icon edit tool to change the icon size, making it bigger or smaller. Finally, participants could input the answer to the search task into the answer box, and then click submit button to finish the current task and go on to the next task. The whole experiment took about 2 hours.

RESULTS

Accuracy and Performance Time

Participants' responses and their completion time to each question were recorded. The answers were graded on a 0-4 grading scale and the total scores were computed. There was no between-group difference in the total scores. The completion time was averaged across all questions for each participant and also compared across groups. Perhaps because of the low number of questions, we did not find significant between-group difference. However, we did find significant differences in their customization behavior and their strategies of information indexing.

Icon Size Editing Behavior

Average number of icon size edits. We looked at how often participants made icon edits when they were performing the tasks. The number of times participants edited the size of each icon was recorded, and the average number of edits was computed for each participant. Two-way Analysis of Variance (ANOVA) with icon edit cost and icon organization as between-subject variables yielded a significant interaction between the two independent variables ($F_{1,\ 1418} = 20.47$, $p<.001$), suggesting that the effect of the ease of editing icon size varied based on whether the icons were organized or not (see Figure 3).

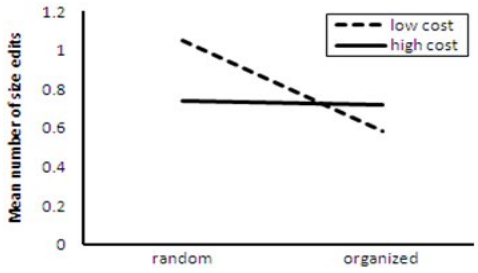


Figure 3. Mean number of size edits

Figure 3 showed the average number of icon edits for each group. Consistent with the theory of soft constraints, results showed that cost had a significant effect on how many times participants edited icons in the random condition. In the random condition, participants did not have consistent spatial cues to guide them to find the correct icon, and thus it would be more beneficial if they could change the sizes of icons to help them index information in the environment. However, the size edit tool was only highly used when it was easy to use (low-cost), whereas increase cost of changing icon sizes dampened participants' willingness of using of this feature. No significant effect of cost was found on number of edits in the organized condition. Apparently, participants in this condition were able to index information based on its location. Thus their use of the customization tools had a low benefit, and there were therefore fewer icon edits in the organized condition.

Final icon size. We further divided the 36 icons into two groups by identifying a number of icons as more relevant for participants to answer the questions and putting them into the useful group, and the rest into the less useful group. The content of each icon was used for at least one question throughout the experiment. However, for some icons, their contents were useful for answering more than three questions. Those icons were called *useful* icons. In contrast, the *less useful* icons were used to answer one question only throughout the experiment.

ANOVA showed different usage patterns for the two icon groups. A significant two-way interaction between cost and organization was found for the useful icons only ($F_{1,1100}$ = 20.135, p<.01). Consistent with the results on icon edits, participants in Lo-Random condition utilized the feature of size edit the most by making the useful icons larger compared to participants in other conditions. It was not surprising that random icon location and low edit cost made participants make more use of the icon size edit tools by changing them into larger sizes (see Figure 4).

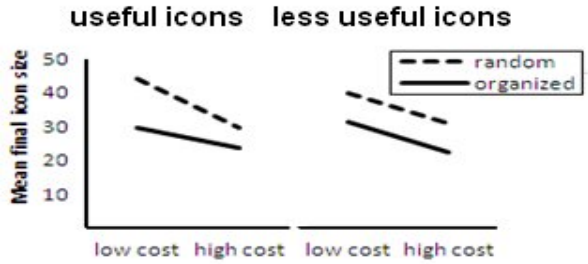


Figure 4. Mean final icon size

In summary, the manipulations of the two independent variables did have an effect on how often participants made changes to icon sizes and on the final sizes of the icons. Randomization of icon location increased the participants' need to make use of customization cues other than location to facilitate searching while cost in editing icon size increased the barrier of utilizing the feature. A combination of the two effects made the Lo-Random condition provided the largest motivation for participants to customize the sizes of icons.

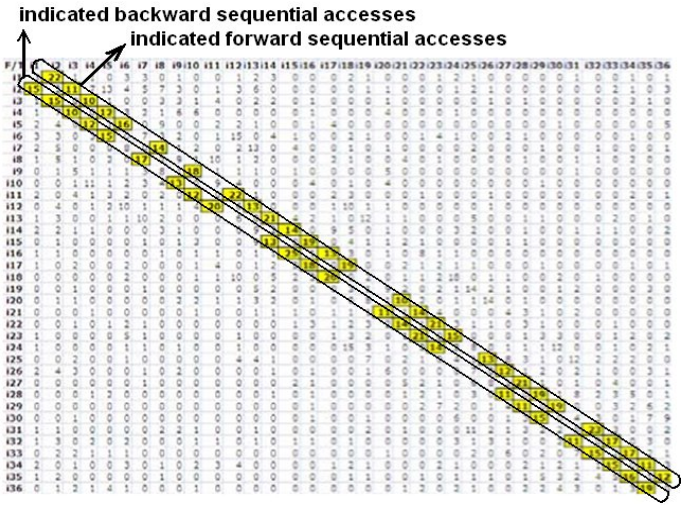


Table 1. Transition table of the Lo-Random condition. The highlighted cells indicated forward and backward sequential accesses, which had the highest frequencies.

Icon Access Patterns

In addition to the above findings, there were interesting patterns from the analysis of icon access transitions that informed the use of search strategies. The transition table shows how the frequency of one icon access to the next icon access. For instance, in the transition table of the Lo-Random condition (see Table 1), the number 16 which is in the cell of the fifth row and the sixth column means there were 16 instances in which the participants accessed icon6 right after accessing icon5. In this experiment, four transition tables which correspond to the four experimental conditions (Lo-Random, Lo-Org, Hi-Random, and Hi-Org) were obtained when access frequencies were aggregated for all participants in each condition. A couple of interesting things in the transition tables were observed.

Forward sequential accesses. The upper right diagonal in each transition table corresponds to the forward sequential accesses (see Table 1). In all of the four conditions we found an obvious pattern of these diagonals, that is, cells on these diagonals have relatively larger numbers (marked in yellow in Table 1) which are equal to or greater than 10. ANOVA with between-subject variables showed a significant main effect of icon edit cost on forward sequential accesses ($F_{1, 136}$=7.245, p<.01) as well as a significant main effect of icon organization ($F_{1, 136}$=66.861, p<.001). However, the interaction between the icon edit cost and the icon organization was not significant.

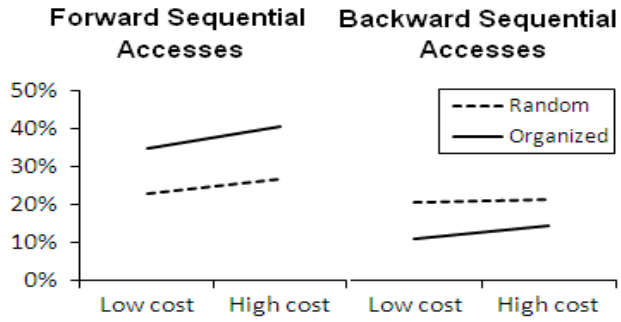


Figure 5. Forward Sequential Accesses (left) and Backward Sequential Accesses (right)

Forward sequential accesses took a higher percentage of total accesses in the organized conditions than in the random conditions and in the high cost conditions than in the low cost conditions (see Figure 5 left). Consistent with previous results, participants in organized conditions knew the icons were grouped together according to their contents, thus they clicked sequentially to retrieve the most exact answer. But for random conditions, participants had less location cues; therefore they had to make more random attempts that led to the fact that forward sequential accesses took a lower percentage of total accesses. Compared with low cost conditions, in high cost conditions, participants made fewer total

accesses to icons, hence the forward sequential accesses had higher percentage of the total accesses.

Backward sequential accesses. The lower left diagonal in each transition table stands for the backward sequential accesses (see Table 1). In random conditions, we found relatively larger numbers (equal to or greater than 10) in most of these diagonal cells. But in organized conditions, we had no similar findings. ANOVA with between-subject variables showed a significant main effect of icon organization on backward sequential accesses ($F_{1, 136}$=35.859, p<.001). The icon edit cost has a marginal effect (p=.094). However, the interaction between cost and organization is not significant.

We found that backward sequential accesses had a higher percentage of total accesses in the random conditions than in the organized conditions (see Figure 5 right). This was probably because in random condition participants had less location cues then in organized condition, thus they tended to be less likely to sequentially search for information; but when they did, they were equally likely to search it either direction (i.e. either the icon on the left or on the right). However, in the organized condition, the locations of icons stayed the same, and an intuitive strategy was to start from the top-left corner and sequentially clicked on each icon to find the relevant content. Results suggested that in the organized condition, information indexing tended to rely more on the location cues, which guided them to search sequentially; however, in the random condition, participants would more likely start their search by clicking on a specific icon by, for example, recognizing their sizes, then searched for icons nearby. While the exact strategy used could vary across individuals, apparently the differences in the benefit of customization had led to a difference in the information indexing strategies.

DISCUSSION AND CONCLUSIONS

Consistent with the theory of soft constraints, participants in random conditions tended to make more icon edits when the cost of editing was low. Different usage patterns for the useful and less useful icons were found. For the useful icons, participants in Lo-Random condition utilized the feature of size editing the most by making the useful icons larger compared to participants in other conditions. This finding could also be explained by cost-benefit tradeoff considering that in this condition the cost of editing is low and the benefit of editing was high. A couple of interesting things were observed in the icon access transition tables that informed the use of search strategies. Due to different reasons, forward sequential accesses took a higher percentage of total accesses in the organized conditions than in the random conditions and in the high cost conditions than in the low cost conditions; backward sequential accesses took a higher percentage of total accesses in the random conditions than in the organized conditions.

Future studies should further decrease the cost of icon edits and increase the benefit in order to encourage the participants to make more edits on the icon sizes. Derived from the finding of Mackay (1991) that users would more likely customize when they discovered that they would do something repeatedly, in future studies we plan to design more questions to increase the frequency of using each icon, hoping to make participants easily realize that each icon will be accessed again in the future to increase their motivation to customize. By increasing the number of questions (and their difficulty), we also hope to find out how increase in customization may lead to differences in information indexing strategies, which in turn may help people to improve their performance in finding and re-finding information.

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