Recognition of animated icons by elementary-aged children

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Abstract

This paper describes a study to investigate the recognizability of and preference for animated icons by elementary-aged aged children. Fourteen typical computer-related tasks (e.g., copy, move) were viewed by 60 school-children in two iconic formats: animated and static. The content of the icons and the computer process or action they mimicked were drawn from a previous study in which a similar group of children was asked to depict gesturally their interpretation of the 14 tasks. Results indicated that the animated version of the icons was more recognizable and that the children greatly preferred the animated icons over the static icons. Implications for the design of enhanced user-interfaces for children are noted.

Introduction

Two advancements in the microcomputer industry – direct-manipulation user interface (DMUI) and multimedia – have opened the door for the provision of enhanced computer interaction. The former has received a great deal of attention and has resulted in a proliferation of such interfaces running on many different platforms. The latter is also causing a stir in the industry and promises to allow for the integration and manipulation of text, graphics and sounds (voice and music).

From the perspective of a direct-manipulation interface, however, children in educational settings have benefited little from these advancements. Presently, they have access to microcomputers which have been designed for general-purpose and adult use (IBM, Apple II series, Apple Macintosh, Amiga). Some work has been carried out by the designers of the Ontario Government-supported microcomputer (ICON), a system targeted solely for educational use (McLean, 1983) and by researchers at the Children's Television Workshop (Strommen, 1990), but there still exists a wide gap between the features of existing interfaces and features which reflect a sensitivity to developmental change. The expectation is that children will be able to interpret and to make productive and efficient use of an interface that was designed for another class of users, i.e. adults. In the classroom, children are provided with 'out-of-package' software (MacWrite, PCPaint or the like) and the assumption is made that either that the children will intuit how many of the functions of these programs are accessed and executed or that they will become productive users after some minimal instruction. Given that there are great differences – both qualitative and quantitative – between children and adults, it follows that the nature of child-computer interaction will be quite different from adult-computer interaction and that a starting point for a closer look at child-computer interaction might be the features inherent in the DMUI.

To investigate one of these features, I carried out a study[1] which focused on the recognizability of and preference for animated icons by young children. Building on previous work which attempted to determine the pictorial content of the icons (Jones, 1990), elementary-aged school children were asked to describe what computer-related action or message was being depicted by a moving image (animated icon) or by a static image, and to indicate which of the two formats they preferred. Results are reported here, together with a discussion of future directions.

Animated icons

Given that graphical icons (as part of a more general metaphor) comprise one half of a direct-manipulation interface (Gittins, 1986), one might ask: What should constitute the features of these icons with which children will interact in a 'seeing and pointing' – i.e. direct-manipulation – interface? Townsend (1986) recommends that icons which are designed for use by children should "clearly depict, indicate and distinguish a program's commands and operations" and "should suggest and indicate a command intention rather than just duplicate or represent a particular pictorial form." The goal of educational software developers, then, is to incorporate icons which are realistic and meaningful for children and which leave little room for misinterpretation. For the most part, the iconic component in existing interfaces for children's use merely mirrors what is available in the commercial marketplace and does not respond to the developmental world of the child.

One possibility is to consider the utility of animated icons as a feature in a DMUI. A similar approach has been successfully used in the area of pre-reading – Bridge Reading program (Dewsbury, 1983) – in which the instructor employs sounds, logographs (drawings) and physical gestures to teach young children how to read. In this program, the physical gestures by both instructors and students are viewed as a temporary event in the instructional process and are meant, at the outset, to provide additional cues to the beginning reader. Eventually the gestures are dropped as the child moves toward a word-recognition capability. The gestural component, which is heavily used at the outset of the instruction, is considered pivotal in that the instructional process is, at that beginning stage, drawing on the child's knowledge of commonplace movements. Thus, the children are exposed to not only a static series of letters in a book or on a card, but also are provided with additional information by means of the accompanying gesture.

In a previous study (Jones, 1990), an attempt was made to determine how children would indicate to a second party by gesture their notion of computer tasks or operations (e.g. cut, move, copy). The 14 operations selected involved actions and were provided to the subjects during the experiment as verbs (Table 1). The goal was to solicit from the population of interest their ideas on how best to indicate overtly (but without words) these actions, and to use this information in the design of the content of the computer icons. During a 40-minute testing session, 40 children (6, 8 and 10 year-olds) were asked to put themselves in a situation in which they could see a friend but could not verbally communicate with that friend. The subjects were asked to look at a drawing of a child who was standing behind a window and to move their hands or body in such a way as to communicate to the friend behind the window what it was that they wanted the friend to do. For example, in order to indicate to the friend that the subject wanted something moved, the majority of the subjects moved their two hands in tandem from left to right or right to left in an arc-like fashion.

Task
1. put away
2. get
3. send
4. open
5. close
6. write
7. draw
8. point
9. move
10. erase
11. drag
12. copy
13. cut
14. paste

Table 1: Operators presented to three age groups

Although there was disparity across age levels for some of the 14 tasks, the content of the responses and the percentage of subjects who exhibited similar responses resulted in obvious trends. To produce animated icons for testing, each operator in Table 1 for each of the three age levels was scripted in a storyboard fashion; a model posed for each step in the scripts and these steps were then digitized using a video camera and a screen-capture program (MacVision). Each image was subsequently cleaned up or 'outlined' and the images or steps were then cut and pasted to an animation program (VideoWorks II) as cast-members, and assembled into an animated icon. One example of these animated icons is presented in Figure 1.

In order to determine if the icon content generated during the previous study (Jones, 1990) had the same connotation for other children of the same age, the icons were presented to a similar sample of elementary-aged students in two formats: animated and static. The goals were two-fold:

- to see if these children attributed the same meaning to – i.e. recognized – the actions generated by the previous subjects
- to solicit from them their preference as to an animated or static version of the icon for the computer task.

Method

Subjects

Sixty children from an elementary school in Calgary (20 from each of three age groups – 6, 8 and 10) were tested. There were an equal number of males and females. The primary criterion for subject selection was that the child had not previously used a Macintosh computer or a computer with a similar interface.

Procedure

Each subject was tested in two phases. For the first phase, the subjects were randomly assigned to the animated or static icon condition and were asked to describe the action that they saw depicted on the monitor for all 14 computer-like tasks. For the second phase, they were told what each of the 14 icons (animated or static) stood for, and were then asked which of the two formats they preferred. For both phases, the 14 items were randomly presented to the subjects.

Analysis

Frequency counts were carried out for both experimental phases and chi-square tests were run.

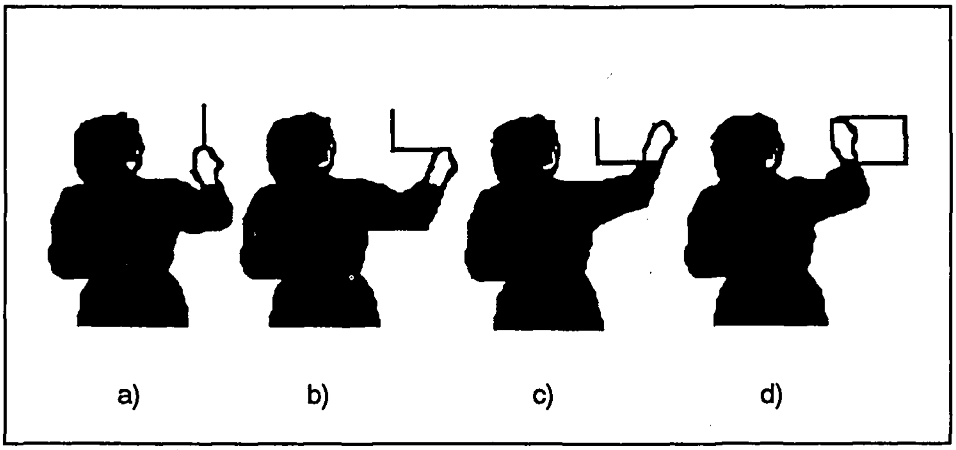

Figure 1: Example of an animated sequence for 'draw'

Results

For the first phase of the testing ("What does this picture [animated or static] mean?"), the results are contained in Table 2.

For 13 of the 14 computer tasks listed in Table 2, the percentage of subjects who were asked to describe the computer task depicted by the animated icons was higher than those who were exposed to the static icon condition. However, in many instances, the spread between the two percentage scores was not high. For four of the animated tasks and six of the static tasks, less than 50% of the subjects correctly indicated the action involved. This is not surprising given that the subjects in this study were simply asked to state in one or two words what the moving or static drawing on the computer screen represented; that is, they were not provided a context in which to respond.

Analysis of the age and gender factors did not result in marked differences. The sex-by-animated-icon analysis showed no differences, while the age-by-animated-icon results indicated that there were differences for the 'draw' and 'copy' tasks. For the former, the 8 and 10 year-olds correctly

Operation	Animated	Static
1. put away	16.7	6.7
2. get	3.3	6.7
3. send	66.7	60.0
4. open	43.3	30.0
5. close	20.0	16.7
6. write	96.7	90.0
7. draw	83.3	60.0
8. point	80.0	76.7
9. move	70.0	20.0
10. erase	40.0	20.0
11. drag	60.0	56.7
12. copy	83.7	76.7
13. cut	80.0	66.7
14. paste	63.7	63.3

Table 2: Correct response for animated versus static condition (%)

Operation	Animated	Static
1. put away	75.0	25.0
2. get	65.0	35.0
3. send	81.7	18.3
4. open	51.7	48.3
5. close	51.7	48.3
6. write	78.3	21.7
7. draw	78.3	21.7
8. point	51.7	48.3
9. move	85.0	15.0
10. erase	91.7	8.3
11. drag	76.7	23.3
12. copy	70.0	30.0
13. cut	86.7	13.3
14. paste	78.3	21.7

Table 3: Preferences for icon format (%)

identified the animated 'draw' icon more often than the 6 year-olds (χ^2 (2,$\underline{N}$=60) = 6.24, p <.05) and the same result held for the animated 'copy' icon (χ^2 (2,$\underline{N}$=60) = 12.0, p <.05). With respect to the static icons, the age-by-static-icon analysis showed no differences, while the sex-by-static-icon comparison showed the male subjects incorrectly identified the 'open' icon more often than the female subjects (χ^2 (1,$\underline{N}$=60) = 14.36, p <.05). The results for which format the subjects preferred were more clear-cut. In each instance, more than 50% of the subjects selected the animated icon as the one which best captured the designated action. Table 3 lists the results across all subjects.

What should be noted here is that, for this treatment, the subjects were aware of what each icon stood for in that the stimulus consisted of the animated icon, the static icon, and the operator word which described the action. The subjects were asked to pick the icon format (animated or static) which they thought best described the operation.

Conclusion

It appears that the use of animated icons as a feature in a child-computer interface has merit. In addition to the fact that children are better able to decipher the meaning of animated icons over static icons, they also show a marked preference for the moving icons. Given that one of the tenets of a DMUI is that the user should spend less time processing (and eventually deciding) what a system's options are, if the system itself is to be transparent to the user (Shneiderman, 1987), then the incorporation of animated icons which provide children with meaningful information should be seriously considered. This would fit with the goal of designing an interface for children which puts as little demand as possible on their short-term or working memory.

Not surprisingly, there were no age or sex differences for either of the two icon formats or for the preferences. What warrants further study is the content (animated or otherwise) of the icon itself. With respect to the results reported here, a number of the icons presented a problem to all three age groups in that the icons either did not contain enough information or contained ambiguous information and, as a result, were not correctly identified by the majority of the subjects. The reasons for this might range from a simple mis-reading by the subjects, to the gap between the pictorial content of the icon and the lack of an overall context – or, in DMUI terms, the metaphor – in which the recognition task was presented. The more-encompassing matter of a metaphor for classroom use is deserving of more detailed analysis.

A possible next step is to generate a series of prototypical interfaces for children and to test them for effectiveness and for children's reactions to them. A number of questions should be addressed:

- What other features should be built into an interface designed for use by children?
- If animated icons are an effective way to provide information to children about the functionalities of a system, how might the child proceed once the animated icon is selected? Would the child select the object upon which he or she wishes to carry out some operation first, and then select the animated icon which represents the desired operation, or vice-versa?
- How many levels of options should be made available to the child? Should the system or application program contain options that can be crossed with each and every other option, or should there be some measure of a hierarchical structure?

All of these questions (and many others) call for a comprehensive analysis of generalizable interface for child-computer interaction. It seems only fair that if children in schools are going to be using these technologies for learning, and if large expenditures are going to be required to provide these tools, a rigorous and child-centred approach must be taken to the design and implementation of this interface.

Note

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