A Case for Iconic Icons

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Abstract

User interface designers still have to rely on personal creativity and skill when designing computer icons for program functions that have no existing conventional representation. Further, designers often stumble upon usable icons by trial and error. We designed an Icon Intuitiveness Test to gain better insight into how users interpret icons. Our hypothesis was that users would interpret icons they do not know the functionality of as iconic signs¹ by assuming that the icon looks like the functionality it represents. Our study suggests that participants do indeed base their guesses on the visual clues they can see and interpret the unknown icon as having the functionality they think it resembles.

Keywords: icon, semiotics, user interface design, usability

1 Introduction

Since the first use of icons in the visual programming environment *Pygmalion* in 1975 (Smith 1993), studies have shown that icons are faster and easier to recognise than text (Collins & Lerner 1982), can support the learnability and rememberability (Constantine & Lockwood 1999) of the user interface and can reduce the complexity of an application (Preece, Rogers, Sharp, Benyon, Holland & Carey 1994), however, badly designed icons can actually hamper usability.

We designed an Icon Intuitiveness Test (IIT) to gain better insight into how users interpret icons. Our results indicate that participants may attribute functionality to a computer icon based on what they see, and this may not agree with the functionality the user interface designer had attributed to the icon. Clearly then, computer icons that are designed to graphically resemble their underlying functionality, are better recognised by participants, and may be better recognised by users as well. Goguen claims that all else being equal, "icons are better than indices, and indices are better than symbols" (1993). The results of our IIT do support the notion that iconic signs are better than symbolic signs, however, icon evaluation is a very difficult task and there are many factors and limitations that have to be taken into account, such as the medium in which the icons are presented and tested, as well as the background of the participants, which can result in things not being equal.

In section 2 we give a short introduction to semiotics and explain Peirce's three sign divisions. We then show how icons can be evaluated as successful or unsuccessful. Section 3 discusses our own Icon Intuitiveness Test and its results, which are summarised in section 4. Finally, we conclude in section 5.

2 Background

Charles Sanders Peirce was one of the founders of the theory of *semiotics*, or the study of *signs*. Peirce defined a sign as "something which stands to somebody for something in some respect or capacity." (1931–58) Given this definition, it is clear that anything can be interpreted as a sign. Consequently, semiotics has been widely used in the analysis of the user interface as sign system (Nadin 1988), (Ferreira, Barr & Noble 2005), (Leite 2002), (de Souza, Prates, Barbosa & Edmonds 2000), (Marcus 1994), (Barr, Biddle & Noble 2002), (Scalisi 2001), (Goguen 2003) and is particularly useful for comparing design intentions with perceived meanings (de Souza, Barbosa & Prates 2001). We can make these comparisons by using Peirce's triadic model of the sign, which consists of the *representamen*, the *object* and the *interpretant*. According to Peirce:

The representamen stands to somebody for something in some repect or capacity. It addresses somebody and creates in the mind of that person an equivalent, or perhaps more developed sign. The object is the actual thing the sign stands for. (Peirce 1931–58)

The interpretant is therefore the sign created in the mind of the perceiver, or the reaction caused by the object in the perceiver (Andersen & Nowack 2002). Figure 1 illustrates how the Peircean triad can be applied to the icon conventionally used to represent the functionality of saving data in a computer application. The representamen is the picture of a disk, with which the user interface designer intends to convey the program's 'save' functionality to the user. The object is the program's 'save' functionality, and the interpretant is the user's understanding of the icon when perceiving the representamen.

Central to the discussion in this paper is Peirce's classification of signs based on the relationship between the object and representamen. The three fundamental sign categories Peirce described are *iconic* signs, *indexical* signs and *symbolic* signs. If the representamen resembles, or in some way imitates the object then the sign can be seen as an iconic sign. Peirce noted that these sign categories are not mutually exclusive — most signs contain elements of iconicity, indexicality and symbolism in varying measures. It is very rare, and some argue impossible, to find signs that belong solely to one category. Yet some relationship between the object and representamen usually tends to dominate in the sign and then it can be said that the sign type is of that relationship that dominates.

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¹Throughout the paper, in order to make a clear distinction between icons in the user interface and the Peircean notion of iconic sign, we will use the word 'icon' to refer to a computer icon, and 'iconic sign' to refer to the Peircean concept.

Barr, Biddle and Noble (2002) define an icon to be *successful* if the interpretant of the user matches the object that the designer had intended with that sign, and as *unsuccessful* otherwise. One way to determine whether the user's interpretant matches the designer's intention is by performing icon intuitiveness or icon usability tests, asking test participants to guess the functionality of icons in a set. The number of correct guesses for each icon can be tallied and compared to the ISO² 9186 recommended benchmark of 66%, to determine whether an icon successfully conveys its functionality to users. The type of relationship between the icon's object and representamen, i.e., iconic, indexical or symbolic, could affect the success of the icon.



Figure 1: The Peircean triad as applied to the 'save' icon

3 Icon Intuitiveness Test (IIT)

For our study we selected a set of 20 icons that would not be too familiar to experienced computer users and icons with accepted conventional representations, such as icons for copying, pasting and cutting text, were excluded. Some icons selected had different representamens but had the same underlying functionality, or object. These icons were chosen so that one representation was an iconic sign and the other a symbolic sign — these are discussed in section 3.2.1. All icons were presented in colour.

3.1 Organisation

The IIT was a paper based questionnaire in which icons were presented in three tables according to the contexts they were obtained from. The first group was called the 'Word processing and Spreadsheet icons' and consisted of icons from Acrobat Reader 6.0, Schaffer and Sorflaten (1996), Microsoft Excel and KSpread (see figure 2). The second group was called 'Maths/Statistics software and Graphics icons' and consisted of icons from Maple 9.5, Maple Worksheet 9.5, SAS/GRAPH v8.2 and KView (see figure 3). The last group was called 'Telecommunications software icons' and consisted of icons from a Telecommunications study (Salasoo 1990) (see figure 4). One column contained the icons and the other was left blank so the participant could fill in their interpretations. The icons within the tables had no special ordering. Each table was headed by the context, i.e., the type of application the icons were obtained from, since a program embodies stable properties that constrain user activities (Andersen 2001). There were eight participants, two of which were computer science students and the rest

could be classified as using the computer for work or for university assignments. They were all aware that some icons had the same functionality, but were not told which.

3.2 Results

From our results it was obvious that a given picture definitely does not convey the same thousand words to all viewers! In this study, we computed the recognition rate by taking the number of correct/almost correct guesses as a percentage of the total number of guesses.

According to the ISO benchmark of 66% the most successful icons were: icons 8 and 16, both with a recognition rate of 100%, and icons 15 and 20, both with a recognition rate of 75%. The least successful icons were those with a recognition rate of zero: icons 3, 4, 6, 11, 14 and 19.

3.2.1 Iconic versus Symbolic Signs

In this ection we discuss the icons that had the same object but different representamens.

Resize to Fit Window



Icons 2 and 11 both represent expanding the object to fit the window, however, icon 2 is the iconic representation and icon 11 is the symbolic representation. None of the participants could guess the symbolic icon 11 correctly, whereas icon 2 performed better with a recognition rate of 50%. One reason for this result could be that on many desktops the mouse pointer changes to look like icon 11 when it is possible to move an object around, and indeed, almost all guesses referred to the action of moving an object.

Insert Graph



Icons 8 and 9 both represent the action of inserting a graph or starting a graph wizard to help create a graph. Icon 8 is the iconic representation and had a higher recognition rate (100%) than the symbolic icon 9 (62.5%). In this case icon 8 was taken from a more popular application — Microsoft Excel —than icon 9 from KSpread. Additionally, the size of icon 9 makes it appear incomprehensible, but at a higher resolution and in the colour version it would be much clearer to see that the icon consists of a pie chart and bar graph on a yellow and blue background. If the higher resolution form of the icon had been used in the ITT, it would have been a stronger iconic sign, however, the lower resolution image was used, as this is closer to the way it appears in the actual application.

Rotate Image



Icons 13 and 16 both represent the functionality of rotating an image clockwise. Icon 13 is the iconic representation, however, only one participant correctly

²International Organisation for Standardisation



Figure 2: Word Processing and Spreadsheet icons.



Figure 3: Maths/Statistics software and Graphics icons.

guessed the functionality. While participants understood that the arrow in icon 13 indicated direction, they were confused as to what the arrow was indicating. One interpretation was influenced by the fact that the before state of the object is indicated in blue and the after state in grey. Hence, they focused on the fact that the colour of the before state appeared differently to the after state, and concluded that this icon converts the object to black and white. All participants understood icon 16's functionality even though this is the symbolic representation.

Resize Graph



The symbolic icon 14 is a tentative icon that would have been used in SAS/GRAPH v8.1, but a usability study (Wimmer 2001) showed that this image did not represent the graph resizing functionality to the participants, as the designers had intended. The designers then changed this icon to a more iconic representation, icon 15, but did not report whether the participants did indeed find this icon easier to understand. If the results of our IIT is to be believed, then the results here do support icon 15 as a better icon for the graph resizing functionality. All participants guessed that the magnifying glass represented some zoom functionality, but gave no indication that it could be used to resize an object, i.e., change its actual size. Many applications (Acrobat and Konqueror, for example) use the magnifying glass to represent the zoom action and this result may hint at participants accepting the magnifying glass as the conventional representation for the zoom action.

Answer Ringing Call



Recognition rate: 12.5%

Icons 17 and 18 both represent the functionality of answering a call indicated by ringing. Icon 18 can be seen as a more iconic sign than icon 17 due to the hand on the phone that is supposed to look like the action of someone answering a phone. However, the participants all agreed that icon 18 could represent the functionality of ending a call. One participant specified that it could mean either answering or ending a call. Although the iconic sign was not interpreted correctly it is notable that the participants' guesses were quite similar and consistent in their interpretation of this icon. For icon 17 the participants were more divided about whether it represented the tone of the call or making a call. Only

two participants guessed the correct functionality of this icon. The reason participants guessed icon 17 to be the icon for answering or placing a call and icon 18 to be the icon for ending a call is not very clear. The guesses could be attributed to the order in which the icons appeared, or due to the three black lines appearing under the phone in icon 18 that could signal movement of the phone, which the participants interpreted as a downward movement. Another reason could be that the grip of the fingers of the hand is rather loose. This may have been interpreted as a 'letting go' action rather than a 'picking up' action.





Icons 19 and 20 indicate that there is a message to be read. Icon 19 is the symbolic sign and also the only icon with unique interpretations supplied by each participant. Again the iconic representation of the message (icon 20) resulted in fairly consistent interpretations, i.e., unread/unopened mail message, by most participants.

4 Discussion

Although the difference in recognition rate for iconic and symbolic signs was found not to be statistically significant,³ out of the set of the four icons with a recognition rate above the ISO-proposed 66%, mentioned in section 3.2, three are iconic signs (icons 8, 15 and 20).

Participants tended to base their guesses of icons on the visual clues available. This was most clearly illustrated by the participants' guesses for icon 4. As already mentioned in section 3.2, icon 4 was the most problematic for participants and only two guesses were at all related to the given context. The other participants either could not guess at all or simply ignored the given context and made a guess based on the appearance of the image — 'set up camp on either side of the river' is a particularly iconic interpretation of the icon, since the diagonal line through the image is not even recognised as a symbolic sign for prohibiting something.

There are some issues worth noting about the design of the IIT. First, it became clear during conversation with the participants, that their experience with computer applications affected how easily they could guess the correct functionality of the icon, refering to their knowledge of what functionalities are available in certain types of computer applications. The IIT made no distinctions between computer users.

³The null hypothesis (H_0 : The recognition rate for iconic signs is equal to the recognition rate for symbolic signs) could not be rejected at a 5% level of significance, using a Mann-Whitney U test.



Figure 4: Telecommunications software icons from Salasoo (1990).

Second, cultural aspects were not taken into account in devising the test or interpreting the results. Icon 5 could be problematic for cultures that read based on a right-left orientation. For Western cultures, that read from left to right, the pages appear in numerical order from left to right and the arrow indicates that the functionality of this icon (printing in this case) will be applied to the pages in the opposite direction. This design could be problematic for a person who reads right to left, since the arrow will be pointing in the logical direction but the page numbers will be in reverse order. The IIT could not produce results to determine the difference in recognition rates due to the reading directions of different cultures.

Finally, the icons were presented on paper. Therefore the participants could not compare them to any other icons in the same application in order to make a guess at their functionality. This is not a reflection of reality, where users of an application may be in a better position to guess the icon correctly because there are others to compare and contrast it with.

In future we hope to repeat the study with more participants and perform the test using a computer.

5 Conclusion

Even though the number of test participants were small, the IIT did highlight a couple of important observations: Icons that have recognition rates higher than the ISOproposed 66%, are mostly represented as iconic signs and the test participants interpreted icons they could not make sense of as iconic signs.

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