7

Interface Metaphors and Conceptual Models

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Aims and objectives

The aim of this chapter is to describe how the cognitive principle of metaphorical reasoning – that we use prior knowledge to understand new situations – has been applied to user interface design. After working through this chapter you should be able to:

- describe the difference between verbal and virtual interface metaphors,
- explain why the development of composite interface metaphors has been necessary,
- discuss the problems and advantages of using metaphors at the interface,
- decide whether you think the interfaces that you use or develop should model some aspect of the world [that is, metaphor-based] or that it be invisible to the user (that is, ubiquitous computing),
- understand the different ways in which the term ‘conceptual model’ is used in HCJ.
Overview

The term ‘metaphor’ is traditionally associated with language use. When we want to convey an abstract concept in a more familiar and accessible form we frequently resort to using metaphoric expressions. For example, we tend to talk about time, which is a very abstract concept, in terms of money (Lakoff and Johnson, 1980). We save it, spend it, waste it, give someone our time, live on borrowed time and so on. In fact, the whole of language is based on these types of metaphorical abstractions.

When we consider how system interfaces have been designed, we can also see how metaphors play an important role. The objects on the screen, the types of user interactions we perform, the way the system responds, the names given to command names, tend to be based on familiar terms. Desktops, icons, menus, windows, cutting, pasting, copying are either system objects or actions that are part of a virtual interface metaphor. In fact, it is difficult to think of a system that is not based on some form of metaphor. We need to ask ourselves, therefore, to what extent and how they help users interact with computer systems.

7.1 Verbal metaphors

When confronted with a new piece of technology, such as a computer, for the first time people will often compare it to a machine with which they are familiar in a metaphorical way. The classic example is of people who use a word processor for the first time; it occurs to them how similar it is to a typewriter. Having activated the typewriter schema (see Chapter 6) they are then able to interpret and predict more readily how the word processor functions. On seeing that the computer has a keyboard the obvious inference is that it behaves like the qwerty keyboard on a typewriter. Hence, an obvious assumption is that the character keys should act in the same way as they do for the typewriter.

These links provide the basic foundation from which users develop their mental models of computer systems. Knowledge about a familiar domain in terms of elements and their relation to each other is mapped on to elements and their relations in the unfamiliar domain. Elements include the keyboard, the spacebar and the return key. Relations between the elements include ‘only one character key can be hit at any one time’ and ‘hitting a character key will result in a letter being displayed on a visible medium’. By drawing on this prior knowledge a learner can develop an understanding of the new domain more readily.
As well as similarities between a new and familiar domain, however, there are obviously going to be many dissimilarities. Two examples are the spacebar and backspace key, which are both present on the typewriter and word processor keyboards but which perform different functions. Whereas the backspace key on the typewriter physically moves the carriage (this is the mechanism that holds the paper feed rollers and travels across the top of the machine) one space back and the spacebar moves the carriage one space forward, the backspace key on the word processor deletes the character marked by the cursor on the screen while the spacebar inserts a blank character. Moreover, if users want to move backwards or forwards, as they would do when using a typewriter, then they have to use another set of cursor control keys (or move the cursor on the screen via a mouse). The effect of changing the function played by the spacebar and return key, together with introducing a different way of doing spacing, often causes problems for learners because it contravenes their expectations about how the elements and their relations should behave. However, it should also be noted that once users become aware of the discrepancies and differences between the old and new systems, they can develop a new mental model, accordingly.

**EXERCISE**

Can you think of any other similarities or mismatches between the typewriter and the word processor domains?

**COMMENT**

Other similarities include the tab key, which moves the carriage/cursor to a pre-set point and the shift key, which when used in combination with a character key has the effect of changing the character to upper case or to one of the expressions displayed on the ‘dual character’ keys (for example, the & symbol on the ‘7’ key). A mismatch is the lock key. On the typewriter keyboard the shift key can be locked to enable continuous typing of upper case and the upper expressions on dual keys whereas on most word processor keyboards there is a ‘caps’ lock key which allows the continuous typing of upper case but not the upper expressions on the dual keys.

A number of studies have been carried out that have investigated the effects of providing verbal metaphors in the form of written or spoken instructions. For example, Foss et al. (1982) looked at the effects of providing an ‘advance organizer’ on learning to use a word processor. The advance organizer described how files were created, stored and retrieved in terms of a filing cabinet metaphor. The results showed that subjects who had been presented with the verbal metaphor before using the word processor showed better performance in terms of making fewer errors and
faster times to complete the tasks. Other studies have also shown similar improvements (e.g. Borgman, 1986).

In general, the results suggest that verbal metaphors can be useful tools to help users begin to understand the new system. However, it must be remembered that computer systems are much more complex and have different ways of doing things. For example, in the typewriter analogy there are clearly a number of properties about the word processing domain that do not map on to existing features in the typewriter domain. The most obvious include the ability to save text and manipulate it in a number of ways (such as copying sections and formatting). Here there are no obvious links with the typewriter domain, so users have to develop a new understanding. In addition, it is important that users understand how the new system works as a computer system. Accordingly, instructions and descriptions of the system need to be developed that also describe aspects of the structure and function of the system (see Halasz and Moran, 1982).

**Question 7.1**

*What knowledge types are mapped between the familiar and unfamiliar domains of metaphors?*
Figure 7.1 The desktop metaphor as it originally appeared on the Star screen (Smith et al., 1982).

### 7.2 Virtual interface metaphors

One of the first computer companies to realize the enormous potential of designing interfaces to be more like the physical concrete world that people are familiar with was Xerox (see Box 1.4). Instead of developing verbal metaphors as ways of helping users to understand the interface, they went one step further and designed an interface metaphor that was based on the physical office. The outcome was the ‘Star user interface’ (Smith et al., 1982) discussed in Chapter 1. The core aspect of the interface metaphor was to create electronic counterparts to the physical objects in an office. This involved representing office objects as icons on the screen. These included paper, folders, filing cabinets and in and out trays, as shown in Figure 7.1. The overall organizing metaphor that was presented on the screen was of a desktop, resembling the top of a typical office desk.

Instead of being abstract entities, having arbitrary names, files were transformed into pictorial representations, which everyone could easily identify and understand (see Chapter 5 for more on icons). Moreover, having this basic understanding would provide the basis from which users would know how to interact with the icons. Just as
one opens, closes, copies and trashes paper files in the physical world, the interface was designed so that equivalent actions could be done on the electronic versions. The trick was to design an input device that enabled such electronic actions to be performed intuitively. And so the 'mouse' was developed to enable actions equivalent to physically handling documents, which were achieved by 'clicking', 'pointing', 'selecting', 'moving' and 'dragging'.

EXERCISE
What are the physical equivalent actions for (i) clicking, (ii) pointing, (iii) selecting and (iv) dragging?

COMMENT
The physical actions are not directly analogous to the electronic counterparts but consist of (i) placing one's hand on the object and grasping it, (ii) scanning the office, locating the object and making physical movements towards the object, (iii) picking up the object and (iv) holding the object and moving it to another location.

A difference between virtual interface metaphors and verbal metaphors is that the former are part of the interface. Whereas verbal metaphors invite the user to 'see' the similarities and dissimilarities between the system and the familiar domain, interface metaphors combine the system and familiar domains into one entity. Instead of imagining parts of the computer system to be like a typewriter, the interface metaphor conflates the familiar domain and the new system domain into one model. In other words, the desktop metaphor is like an office desktop but it is also the system interface. The effect is that users will develop mental models of the system that are more like the metaphor world rather than how the underlying system works. When they place an icon of a file into an icon of a folder they will assume that the system is doing just that (rather than it changing the pointer to the file).

Hence, instead of using the metaphor as a basis from which to develop a new mental model of the new domain, the metaphor is the model that is learned. This means that users will tend to develop functional-based mental models of the system and be largely unaware of the structural aspects of the system (see Chapter 6 on the difference between structural and functional models).

Question 7.2
What is the difference between a verbal metaphor and a virtual interface metaphor?

A design problem with the 'metaphor as model' approach is working out ways in which to incorporate additional functionality, which is not part of the interface
metaphor, but which enables the computer application to be more powerful than non-electronic means. For example, how has it been possible to represent in familiar terms the manipulation of documents, like copying, moving, formatting and so on that could not have be done with the older technology?

Composite metaphors and multiple mental models

Designers have got round this problem by developing composite metaphors at the interface (Carroll, et al., 1988a). The desktop metaphor has been combined with other metaphors to allow users the flexibility of carrying out a range of computer-based actions. One example is the scroll bar. Such objects do not exist in real life but they are metaphorical in the sense that they have been designed to capitalize on the main feature of the concept of a scroll — that is, a rolled-up document that has to be unrolled to be read. In the same way, files can be ‘unrolled’ by moving a box up and down a bar adjacent to the text file.

Other examples of interface metaphors based on objects that have been combined with the desktop metaphor are menus and windows. Both have their own metaphorical basis that is distinct from the concept of an office or a desk. Another type of metaphor that has been used is based on a prototypical activity associated with a professional practice. For example, the ‘cut’ and ‘paste’ actions used for moving and copying text is based on the process used in page layout in the printing profession.

From a cognitive perspective, it might be assumed that people would have difficulties with interpreting composite metaphors. In most instances, though, it seems that people can readily assimilate differing concepts and develop multiple mental models. The idea of moving around in a file, by scrolling through a window and selecting items from a menu attached to the top of the window by a bar, appears to create few conceptual problems. In fact, most people do not actually think about what they’re doing in terms of the various metaphors (Tognazzini, 1992). Instead, they just interact with the system, thinking in terms of windows, menus, icons, scroll bars and so on as if they were everyday terms.

Needless to say, there are some poorly designed composite metaphors that can cause conceptual problems to their users. One of the main problems is the mismatch between the user’s expectation of what an interface object should and should not do, based on their previous knowledge, and what the interface object actually does.

**Question 7.3**

What is a composite metaphor?

**EXERCISE**

As part of the desktop metaphor it is common practice to have an icon of a waste basket that serves other functions besides those for which it is conventionally used