Information Space

David Benyon
Napier University, UK

INTRODUCTION

Human-Computer Interaction (HCI) in the 21st century needs to look very different from its 20th-century origins. Computers are becoming ubiquitous; they are disappearing into everyday objects. They are becoming wearable. They are able to communicate with each other autonomously, and they are becoming self-adaptive. Even with something as ubiquitous as the mobile phone, we see a system that actively searches out a stronger signal and autonomously switches transmitters. Predictive techniques allow phones to adapt (e.g., anticipate long telephone numbers). These changes in technologies require us to change our view of what HCI is.

The typical view of how people interact with computers has been based primarily on a cognitive psychological analysis (Norman & Draper, 1986) of a single user using a single computer. This view sees the user as outside the computer. People have to translate their intentions into the language of the computer and interpret the computer's response in terms of how successful they were in achieving their aims. This view of HCI leads to the famous gulfs of execution (the difficulty of translating human intentions into computer speak) and evaluation (trying to interpret the computer's response).

With the ubiquity of information appliances (Norman, 1999) or information artifacts (Benyon et al. 1999), the single-person, single-computer view of HCI becomes inadequate. We need to design for people surrounded by information artefacts. People no longer are simply interacting with a computer; they are interacting with people using various combinations of computers and media. As computing devices become increasingly pervasive, adaptive, embedded in other systems, and able to communicate autonomously, the human moves from outside to inside an information space. In the near future, the standard graphical user interface will disappear for many applications, the desktop will disappear, and the keyboard and mouse will disappear. Information artefacts will be embedded both in the physical environment and carried or worn by people as they move through that environment.

This change in the nature of computing demands a change in the way we view HCI. We want to move people from outside a computer, looking in to the world of information, to seeing people as inside information space. When we think of having a meeting or having a meal, we do not see people as outside these activities. People are involved *in* the activity. They are engaged in the interactions. In an analogous fashion, we need to see people as inside the activities of information creation and exchange, as inside information space.

BACKGROUND

The notion that we can see people as existing in and navigating through an information space (or multiple information spaces) has been suggested as an alternative conceptualization of HCI (Benyon & Höök, 1997). Looking at HCI in this way means looking at HCI design as the creation of information spaces (Benyon, 1998). Information architects design information spaces. Navigation of information space is not a metaphor for HCI. It is a paradigm shift that changes the way that we look at HCI. The conception has influenced and been influenced by new approaches to systems design (McCall & Benyon, 2002), usability (Benyon, 2001), and information gathering (Macaulay et al., 2000).

The key concepts have developed over the years through experiences of developing databases and other information systems and through studying the difficulties and contradictions in traditional HCI. Within the literature, the closest ideas are those of writers on distributed cognition (Hutchins, 1995). A related set of ides can be found in notions of resources that aid action (Wright et al., 2000). In both of these, we see the recognition that cognition simply

does not take place in a person's head. Cognition makes use of things in the world—cognitive artefacts, in Hutchins' terms. If you think about moving through an urban landscape, you may have a reasonable plan in mind. You have a reasonable representation of the environment in terms of a cognitive map (Tversky, 1993). But you constantly will be using cues and reacting to events. You may plan to cross the road at a particular place, but exactly where and when you cross the road depends on the traffic. Plans and mental models constantly are being reworked to take account of ongoing events. Navigation of information space seeks to make explicit the ways in which people move among sources of information and manage their activities in the world.

MAIN FOCUS OF THE ARTICLE

Navigation of information space is a new paradigm for thinking about HCI, just as direct manipulation was a new paradigm in the 1980s. Navigation of information space suggests that people are navigators and encourages us to look to approaches from physical geography, urban studies, gardening, and architecture in order to inspire designs. Navigation of information space requires us to explore the concept of an information space, which, in turn, requires us to look at something that is not an information space. We conceptualize the situation as follows. The activity space is the space of real-world activities. The activity space is the space of physical action and physical experiences. In order to undertake activities in the activity space, people need access to information. At one level of description, all our multifarious interactions with the experienced world are effected through the discovery, exchange, organization, and manipulation of information. Information spaces are not the province of computers. They are central to our everyday experiences and go from something as simple, for example, as a sign for a coffee machine, a public information kiosk, or a conversation with another person.

Information spaces often are created explicitly to provide certain data and certain functions to facilitate some activity—to help people plan, control, and monitor their undertakings. Information system designers create information artefacts by conceptualizing some aspect of an activity space and then selecting and structuring some signs in order to make the conceptualization available to other people. Users of the information artefact engage in activities by performing various processes on the signs. They might select items of interest, scan for some general patterns, search for a specific sign, calculate something, and so forth.

Both the conceptualization of the activity space and the presentation of the signs are crucial to the effectiveness of an information artefact to support some activity. Green and Benyon (1996) and Benyon, et al. (1999) provide many examples of both paper-based and computer-based information artefacts and the impact that the structuring and presentation have on the activities that can be supported with different conceptualizations of activity spaces and different presentations or interfaces on those conceptualizations. For example, they discuss the different activities that are supported by different reference styles used in academic publications, such as the Harvard style (the author's name and date of publication, as used as in this article) and the Numeric style (when a reference is presented in a numbered list). Another example is the difference between a paper train timetable and a talking timetable, or the activities that are supported by the dictionary facility in a word processor.

All information artefacts employ various signs structured in some fashion and provide functions to manipulate those signs (conceptually and physically). I can physically manipulate a paper timetable by marking it with a pen, which is something I cannot do with a talking timetable. I can conceptually manipulate it by scanning for arrival times, which is something I cannot do with a talking timetable. So, every information artefact constrains and defines an information space. This may be defined as the signs, structure, and functions that enable people to store, retrieve, and transform information. Information artefacts define information spaces, and information spaces include information artefacts. Information artefacts also are built on top of one another. Since an information artefact consists of a conceptualization of some aspect of the activity space and an interface that provides access to that conceptualization whenever a perceptual display (an interface) is created, it then becomes an object in the activity space. Consequently, it may have its own