1.6 Accessibility and Inclusiveness

Accessibility refers to the extent to which an interactive product is accessible by as many people as possible. Companies like Google and Apple provide tools for their developers to promote this. The focus is on people with disabilities. For example, Android OS provides a range of tools for those with disabilities, such as hearing aid compatibility to a built-in screen reader, while Apple VoiceOver lets the user know what's happening on its devices, so they can easily navigate and even know who is in a selfie just taken, by listening to the phone. Inclusiveness means being fair, open, and equal to everyone. Inclusive design is an overarching approach where designers strive to make their products and services accommodate the widest possible number of people. An example is ensuring that smartphones are being designed for all and made available to everyone—regardless of their disability, education, age, or income.

Whether or not a person is considered to be disabled changes over time with age, or as recovery from an accident progresses throughout their life. In addition, the severity and impact of an impairment can vary over the course of a day or in different environmental conditions. Disability can result because technologies are often designed in such a way as to necessitate a certain type of interaction that is impossible for someone with an impairment. Disability in this context is viewed as the result of poor interaction design between a user and the technology, not the impairment alone. Accessibility, on the other hand, opens up experiences so that they are accessible to all. Technologies that are now mainstream once started out as solutions to accessibility challenges. For example, SMS was designed for hearing-impaired people before it became a mainstream technology. Furthermore, designing for accessibility inherently results in inclusive design for all.

Accessibility can be achieved in two ways: first, through the inclusive design of technology, and second, through the design of assistive technology. When designing for accessibility, it is essential to understand the types of impairments that can lead to disability as they come in many forms. They are often classified by the type of impairment, for example:

- Sensory impairment (such as loss of vision or hearing)
- Physical impairment (having loss of functions to one or more parts of the body, for example, after a stroke or spinal cord injury)
- Cognitive (for instance, learning impairment or loss of memory/cognitive function due to old age or a condition such as Alzheimer's disease)

Within each type is a complex mix of people and capabilities. For example, a person might have only peripheral vision, be color blind, or have no light perception (and be registered blind). All are forms of visual impairment, and all require different design approaches. Color blindness can be overcome by an inclusive design approach. Designers can choose colors that will appear as separate colors to everyone. However, peripheral vision loss or complete blindness will often need an assistive technology to be designed.

Impairment can also be categorized as follows:

- Permanent (for example, long-term wheelchair user)
- Temporary (such as after an accident or illness)
- Situational (for instance, a noisy environment means a person can't hear)

The number of people living with permanent disability increases with age. Fewer than 20 percent of people are born with a disability, whereas 80 percent of people will have a disability once they reach 85. As people age, their functional abilities diminish. For example, people older than 50 often find it difficult to hear conversations in rooms with hard surfaces and lots of background noise. This is a disability that will come to most of us at some point.

People with permanent disabilities often use assistive technology in their everyday life, which they consider to be life-essential and an extension of their self (Holloway and Dawes, 2016). Examples include wheelchairs (people now refer to "wearing their wheels," rather than "using a wheelchair") and augmented and alternative communication aids. Much current HCI research into disability explores how new technologies, such as IoT, wearables, and virtual reality, can be used to improve upon existing assistive technologies.

Aimee Mullens is an athlete, actor, and fashion model who has shown how prosthetics can be designed to move beyond being purely functional (and often ugly) to being desirable and highly fashionable. She became a bilateral amputee when her legs were amputated below the knee as a one-year-old. She has done much to blur the boundary between disabled and nondisabled people, and she uses fashion as a tool to achieve this. Several prosthetic companies now incorporate fashion design into their products, including striking leg covers that are affordable by all (see Figure 1.8).

Figure 1.8 Fashionable leg cover designed by Alleles Design Studio
Source: https://alleles.ca/. Used courtesy of Alison Andersen

1.7 Usability and User Experience Goals

Part of the process of understanding users is to be clear about the primary objective of developing an interactive product for them. Is it to design an efficient system that will allow them to be highly productive in their work? Is it to design a learning tool that will be challenging and motivating? Or, is it something else? To help identify the objectives, we suggest classifying them in terms of usability and user experience goals. Traditionally, usability goals are concerned with meeting specific usability criteria, such as efficiency, whereas user experience goals are concerned with explicating the nature of the user experience, for instance, to be aesthetically pleasing. It is important to note, however, that the distinction between the two types of goals is not clear-cut since usability is often fundamental to the quality of the user experience and, conversely, aspects of the user experience, such as how it feels and looks, are inextricably linked with how usable the product is. We distinguish between them here to help clarify their roles but stress the importance of considering them together when designing for a user experience. Also, historically HCI was concerned primarily with usability, but it has since become concerned with understanding, designing for, and evaluating a wider range of user experience aspects.

1.7.1 Usability Goals

Usability refers to ensuring that interactive products are easy to learn, effective to use, and enjoyable from the user's perspective. It involves optimizing the interactions people have with interactive products to enable them to carry out their activities at work, at school, and in their everyday lives. More specifically, usability is broken down into the following six goals:

- Effective to use (effectiveness)
- Efficient to use (efficiency)
- Safe to use (safety)
- Having good utility (utility)
- Easy to learn (learnability)
- Easy to remember how to use (memorability)

Usability goals are typically operationalized as questions. The purpose is to provide the interaction designer with a concrete means of assessing various aspects of an interactive product and the user experience. Through answering the questions, designers can be alerted very early on in the design process to potential design problems and conflicts that they might not have considered. However, simply asking "Is the system easy to learn?" is not going to be very helpful. Asking about the usability of a product in a more detailed way—for example, "How long will it take a user to figure out how to use the most basic functions for a new smartwatch; how much can they capitalize on from their prior experience; and how long would it take the user to learn the whole set of functions?"—will elicit far more information.

The following are descriptions of the usability goals and a question for each one:

(i) *Effectiveness* is a general goal, and it refers to how good a product is at doing what it is supposed to do.
Question: Is the product capable of allowing people to learn, carry out their work efficiently, access the information that they need, or buy the goods that they want?

(ii) *Efficiency* refers to the way a product supports users in carrying out their tasks. The marble answering machine described earlier in this chapter was considered efficient in that it let the user carry out common tasks, for example, listening to messages, through a minimal number of steps. In contrast, the voice-mail system was considered inefficient because it required the user to carry out many steps and learn an arbitrary set of sequences for the same common task. This implies that an efficient way of supporting common tasks is to let the user use single button or key presses. An example of where this kind of efficiency mechanism has been employed effectively is in online shopping. Once users have entered all of the necessary personal details in an online form to make a purchase, they can let the website save all of their personal details. Then, if they want to make another purchase at that site, they don't have to re-enter all of their personal details. A highly successful mechanism patented by Amazon.com is the one-click option, which requires users to click only a single button when they want to make another purchase.
Question: Once users have learned how to use a product to carry out their tasks, can they sustain a high level of productivity?

(iii) *Safety* involves protecting the user from dangerous conditions and undesirable situations. In relation to the first ergonomic aspect, it refers to the external conditions where people work. For example, where there are hazardous conditions—such as X-ray machines or toxic chemicals—operators should be able to interact with and control computer-based systems remotely. The second aspect refers to helping any kind of user in any kind of situation to avoid the dangers of carrying out unwanted actions accidentally. It also refers to the perceived fears that users might have of the consequences of making errors and how this affects their behavior. Making interactive products safer in this sense involves (1) preventing the user from making serious errors by reducing the risk of wrong keys/buttons being mistakenly activated (an example is not placing the quit or delete-file command right next to the save command on a menu) and (2) providing users with various means of recovery should they make errors, such as an undo function. Safe interactive systems should engender confidence and allow the user the opportunity to explore the interface to try new operations (see Figure 1.9a). Another safety mechanism is confirming dialog boxes that give users another chance to consider their intentions (a well-known example is the appearance of a dialog box after issuing the command to delete everything in the trash, saying: "Are you sure you want to remove the items in the Trash permanently?") (see Figure 1.9b).
Question: What is the range of errors that are possible using the product, and what measures are there to permit users to recover easily from them?

(iv) *Utility* refers to the extent to which the product provides the right kind of functionality so that users can do what they need or want to do. An example of a product with high utility is an accounting software package that provides a powerful computational tool that accountants can use to work out tax returns. An example of a product with low utility is a software drawing tool that does not allow users to draw freehand but forces them to use a mouse to create their drawings, using only polygon shapes.
Question: Does the product provide an appropriate set of functions that will enable users to carry out all of their tasks in the way they want to do them?

(v) Learnability refers to how easy a system is to learn to use. It is well known that people don't like spending a long time learning how to use a system. They want to get started right away and become competent at carrying out tasks without too much effort. This is

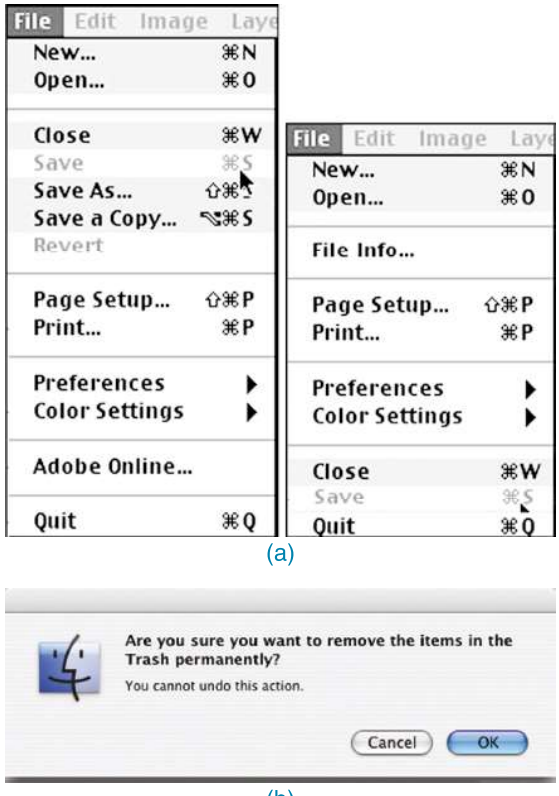

Figure 1.9 (a) A safe and unsafe menu. Which is which and why? (b) A warning dialog box for Mac OS X

especially true for interactive products intended for everyday use (for example social media, email, or a GPS) and those used only infrequently (for instance, online tax forms). To a certain extent, people are prepared to spend a longer time learning more complex systems that provide a wider range of functionality, such as web authoring tools. In these situations, pop-up tutorials can help by providing contextualized step-by-step material with hands-on exercises. A key concern is determining how much time users are prepared to spend learning a product. It seems like a waste if a product provides a range of functionality that the majority of users are unable or unprepared to spend the time learning how to use.

Question: Is it possible for the user to work out how to use the product by exploring the interface and trying certain actions? How hard will it be to learn the whole set of functions in this way?

(vi) *Memorability* refers to how easy a product is to remember how to use, once learned. This is especially important for interactive products that are used infrequently. If users haven't used an operation for a few months or longer, they should be able to remember or at least rapidly be reminded how to use it. Users shouldn't have to keep relearning how to carry

out tasks. Unfortunately, this tends to happen when the operations required to be learned are obscure, illogical, or poorly sequenced. Users need to be helped to remember how to do tasks. There are many ways of designing the interaction to support this. For example, users can be helped to remember the sequence of operations at different stages of a task through contextualized icons, meaningful command names, and menu options. Also, structuring options and icons so that they are placed in relevant categories of options, for example, placing all of the drawing tools in the same place on the screen, can help the user remember where to look to find a particular tool at a given stage of a task.

Question: What types of interface support have been provided to help users remember how to carry out tasks, especially for products and operations they use infrequently?

In addition to couching usability goals in terms of specific questions, they are turned into usability criteria. These are specific objectives that enable the usability of a product to be assessed in terms of how it can improve (or not improve) a user's performance. Examples of commonly used usability criteria are time to complete a task (efficiency), time to learn a task (learnability), and the number of errors made when carrying out a given task over time (memorability). These can provide quantitative indicators of the extent to which productivity has increased, or how work, training, or learning have been improved. They are also useful for measuring the extent to which personal, public, and home-based products support leisure and information gathering activities. However, they do not address the overall quality of the user experience, which is where user experience goals come into play.

1.7.2 User Experience Goals

A diversity of user experience goals has been articulated in interaction design, which covers a range of emotions and felt experiences. These include desirable and undesirable ones, as shown in Table 1.1.

Desirable aspects		
Satisfying	Helpful	Fun
Enjoyable	Motivating	Provocative
Engaging	Challenging	Surprising
Pleasurable	Enhancing sociability	Rewarding
Exciting	Supporting creativity	Emotionally fulfilling
Entertaining	Cognitively stimulating	Experiencing flow
Undesirable aspects		
Boring	Unpleasant	
Frustrating	Patronizing	
Making one feel guilty	Making one feel stupid	
Annoying	Cutesy	
Childish	Gimmicky	

Table 1.1 Desirable and undesirable aspects of the user experience