Chapter 1

WHAT IS INTERACTION DESIGN?

Objectives

The main goals of this chapter are to accomplish the following:

- Explain the difference between good and poor interaction design.
- Describe what interaction design is and how it relates to human-computer interaction and other fields.
- Explain the relationship between the user experience and usability.
- Introduce what is meant by accessibility and inclusiveness in relation to human-computer interaction.
- Describe what and who is involved in the process of interaction design.
- Outline the different forms of guidance used in interaction design.
- Enable you to evaluate an interactive product and explain what is good and bad about it in terms of the goals and core principles of interaction design.

1.1 Introduction

How many interactive products are there in everyday use? Think for a minute about what you use in a typical day: a smartphone, tablet, computer, laptop, remote control, coffee machine, ticket machine, printer, GPS, smoothie maker, e-reader, smart TV, alarm clock, electric toothbrush, watch, radio, bathroom scales, fitness tracker, game console . . . the list is endless. Now think for a minute about how usable they are. How many are actually easy, effortless, and

enjoyable to use? Some, like the iPad, are a joy to use, where tapping an app and flicking through photos is simple, smooth, and enjoyable. Others, like working out how to buy the cheapest train ticket from a ticket machine that does not recognize your credit card after completing a number of steps and then makes you start again from scratch, can be very frustrating. Why is there a difference?

Many products that require users to interact with them, such as smartphones and fitness trackers, have been designed primarily with the user in mind. They are generally easy and enjoyable to use. Others have not necessarily been designed with the users in mind; rather, they have been engineered primarily as software systems to perform set functions. An example is setting the time on a stove that requires a combination of button presses that are not obvious as to which ones to press together or separately. While they may work effectively, it can be at the expense of how easily they will be learned and therefore used in a real-world context.

Alan Cooper (2018), a well-known user experience (UX) guru, bemoans the fact that much of today's software suffers from the same interaction errors that were around 20 years ago. Why is this still the case, given that interaction design has been in existence for more than 25 years and that there are far more UX designers now in industry than ever before? He points out how many interfaces of new products do not adhere to the interaction design principles validated in the 1990s. For example, he notes that many apps do not follow even the most basic of UX principles, such as offering an "undo" option. He exclaims that it is "inexplicable and unforgivable that these violations continue to resurface in new products today."

How can we rectify this situation so that the norm is that all new products are designed to provide good user experiences? To achieve this, we need to be able to understand how to reduce the negative aspects (such as frustration and annoyance) of the user experience while enhancing the positive ones (for example, enjoyment and efficacy). This entails developing interactive products that are easy, effective, and pleasurable to use from the users' perspective.

In this chapter, we begin by examining the basics of interaction design. We look at the difference between good and poor design, highlighting how products can differ radically in how usable and enjoyable they are. We then describe what and who is involved in the process of interaction design. The user experience, which is a central concern of interaction design, is then introduced. Finally, we outline how to characterize the user experience in terms of usability goals, user experience goals, and design principles. An in-depth activity is presented at the end of the chapter in which you have the opportunity to put into practice what you have read by evaluating the design of an interactive product.

1.2 Good and Poor Design

A central concern of interaction design is to develop interactive products that are usable. By this we mean products that are generally easy to learn, effective to use, and provide an enjoyable user experience. A good place to start thinking about how to design usable interactive products is to compare examples of well-designed and poorly designed ones. Through identifying the specific weaknesses and strengths of different interactive products, we can begin to

understand what it means for something to be usable or not. Here, we describe two examples of poorly designed products that have persisted over the years—a voice-mail system used in hotels and the ubiquitous remote control—and contrast these with two well-designed examples of the same products that perform the same function.

1.2.1 Voice-Mail System

Imagine the following scenario. You are staying at a hotel for a week while on a business trip. You see a blinking red light on the landline phone beside the bed. You are not sure what this means, so you pick up the handset. You listen to the tone and it goes "beep, beep, beep." Maybe this means that there is a message for you. To find out how to access the message, you have to read a set of instructions next to the phone. You read and follow the first step:

> 1. Touch 41.
> The system responds: "You have reached the Sunny Hotel voice message center. Please enter the room number for which you would like to leave a message."
> You wait to hear how to listen to a recorded message. But there are no further instructions from the phone. You look down at the instruction sheet again and read:
> 2. Touch*, your room number, and #.
> You do so and the system replies: "You have reached the mailbox for room 106. To leave a message, type in your password."

You type in the room number again, and the system replies: "Please enter room number again and then your password."

You don't know what your password is. You thought it was the same as your room number, but clearly it is not. At this point, you give up and call the front desk for help. The person at the desk explains the correct procedure for listening to messages. This involves typing in, at the appropriate times, the room number and the extension number of the phone (the latter is the password, which is different from the room number). Moreover, it takes six steps to access a message. You give up.

What is problematic with this voice-mail system?

- It is infuriating.
- It is confusing.
- It is inefficient, requiring you to carry out a number of steps for basic tasks.
- It is difficult to use.
- It has no means of letting you know at a glance whether any messages have been left or how many there are. You have to pick up the handset to find out and then go through a series of steps to listen to them.
- It is not obvious what to do: The instructions are provided partially by the system and partially by a card beside the phone.

Now compare it to the phone answering machine shown in Figure 1.1 The illustration shows a small sketch of a phone answering machine. Incoming messages are represented using marbles. The number of marbles that have moved into the pinball-like chute indicates the number of messages. Placing one of these marbles into a dent on the machine causes the recorded message to play. Dropping the same marble into a different dent on the phone dials the caller who left the message.

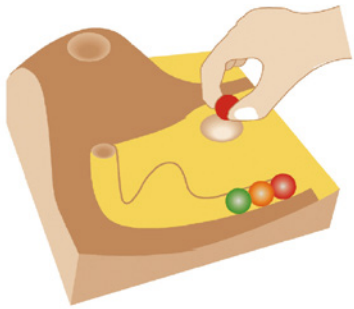


Figure 1.1 The marble answering machine
Source: Adapted from Crampton Smith (1995)

How does the marble answering machine differ from the voice-mail system?

- It uses familiar physical objects that indicate visually at a glance how many messages have been left.
- It is aesthetically pleasing and enjoyable to use.
- It requires only one-step actions to perform core tasks.
- It is a simple but elegant design.
- It offers less functionality and allows anyone to listen to any of the messages.

The marble answering machine is considered a design classic. It was created by Durrell Bishop while he was a student at the Royal College of Art in London (described by Crampton Smith, 1995). One of his goals was to design a messaging system that represented its basic functionality in terms of the behavior of everyday objects. To do this, he capitalized on people's everyday knowledge of how the physical world works. In particular, he made use of the ubiquitous everyday action of picking up a physical object and putting it down in another place.

This is an example of an interactive product designed with the users in mind. The focus is on providing them with a pleasurable experience but one that also makes efficient the activity of receiving messages. However, it is important to note that although the marble answering machine is an elegant and usable design, it would not be practical in a hotel setting. One of the main reasons is that it is not robust enough to be used in public places; for instance, the marbles could easily get lost or be taken as souvenirs. Also, the need to identify the user before allowing the messages to be played is essential in a hotel setting.

Therefore, when considering the design of an interactive product, it is important to consider where it is going to be used and who is going to use it. The marble answering machine would be more suitable in a home setting—provided that there were no children around who might be tempted to play with the marbles!

Video Durrell Bishop's answering machine: **http://vimeo.com/19930744.**

1.2.2 Remote Control

Every home entertainment system, be it the smart TV, set-top box, stereo system, and so forth, comes with its own remote control. Each one is different in terms of how it looks and works. Many have been designed with a dizzying array of small, multicolored, and double-labeled buttons (one on the button and one above or below it) that often seem arbitrarily positioned in relation to one another. Many viewers, especially when sitting in their living rooms, find it difficult to locate the right ones, even for the simplest of tasks, such as pausing or finding the main menu. It can be especially frustrating for those who need to put on their reading glasses each time to read the buttons. The remote control appears to have been put together very much as an afterthought.

In contrast, much effort and thought went into the design of the classic TiVo remote control with the user in mind (see Figure 1.2). TiVo is a digital video recorder that was originally developed to enable the viewer to record TV shows. The remote control was designed with large buttons that were clearly labeled and logically arranged, making them easy to locate and use in conjunction with the menu interface that appeared on the TV screen. In terms of its physical form, the remote device was designed to fit into the palm of a hand, having a peanut shape. It also has a playful look and feel about it: colorful buttons and cartoon icons are used that are distinctive, making it easy to identify them.

Figure 1.2 The TiVo remote control

Source: https://business.tivo.com/

How was it possible to create such a usable and appealing remote device where so many others have failed? The answer is simple: TiVo invested the time and effort to follow a user-centered design process. Specifically, TiVo's director of product design at the time involved potential users in the design process, getting their feedback on everything from the feel of the device in the hand to where best to place the batteries, making them easy to replace but not prone to falling out. He and his design team also resisted the trap of "buttonitis" to which so many other remote controls have fallen victim; that is one where buttons breed like rabbits—a button for every new function. They did this by restricting the number of control buttons embedded in the device to the essential ones. Other functions were then represented as part of the menu options and dialog boxes displayed on the TV screen, which could then be selected via the core set of physical control buttons. The result was a highly usable and pleasing device that has received much praise and numerous design awards.

DILEMMA

What Is the Best Way to Interact with a Smart TV?

A challenge facing smart TV providers is how to enable users to interact with online content. Viewers can select a whole range of content via their TV screens, but it involves scrolling through lots of menus and screens. In many ways, the TV interface has become more like a computer interface. This raises the question of whether the remote control is the best input device to use for someone who sits on a sofa or chair that is some distance from the wide TV screen. Smart TV developers have addressed this challenge in a number of ways.

An early approach was to provide an on-screen keyboard and numeric keypad that presented a grid of alphanumeric characters (see Figure 1.3a), which were selected by pressing a button repeatedly on a remote control. However, entering the name of a movie or an email address and password using this method can be painstakingly slow; it is also easy to overshoot and select the wrong letter or number when holding a button down on the remote to reach a target character.

More recent remote controls, such as those provided by Apple TV, incorporate a touchpad to enable swiping akin to the control commonly found on laptops. While this form of touch control expedites skipping through a set of letters displayed on a TV screen, it does not make it any easier to type in an email address and password. Each letter, number, or special character still has to be selected. Swiping is also prone to overshooting when aiming for a target letter, number, or character. Instead of providing a grid, the Apple TV interface displays two single lines of letters, numbers, and special characters to swipe across (see Figure 1.3b). While this can make it quicker for someone to reach a character, it is still tedious to select a sequence of characters in this way. For example, if you select a Y and the next letter is an A, you have to swipe all the way back to the beginning of the alphabet.

(a) (b)

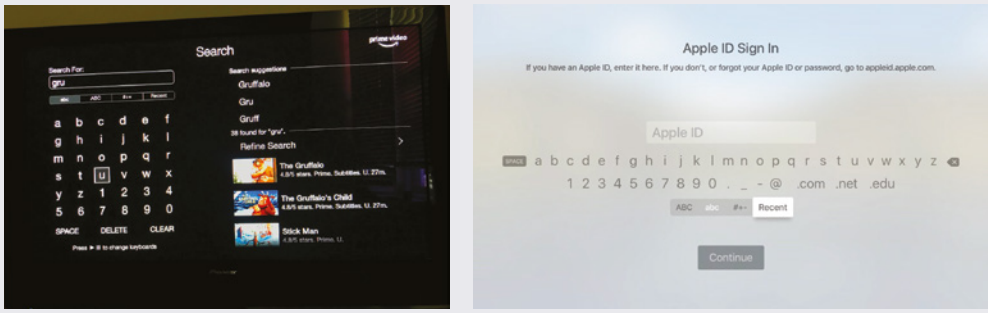


Figure 1.3 Typing on a TV screen (a) by selecting letters and numbers from a square matrix and (b) by swiping along a single line of letters and numbers

Source: (b) https://support.apple.com/en-us/HT200107

Might there be a better way to interact with a smart TV while sitting on the sofa? An alternative is to use voice control. Remote controls, like Siri or TiVo, for example, have a speech button that when pressed allows viewers to ask for movies by name or more generally by category, for instance, "What are the best sci-fi movies on Netflix?" Smart speakers, such as Amazon Echo, can also be connected to a smart TV via an HDMI port, and, similarly, the user can ask for something general or more specific, for example, "Alexa, play Big Bang Theory, Season 6, Episode 5, on the TV." On recognizing the command, it will switch on the TV, switch to the right HDMI channel, open Netflix, and begin streaming the specific episode. Some TV content, however, requires the viewer to say that they are over a certain age by checking a box on the TV display. If the TV could ask the viewer and check that they are over 18, then that would be really smart! Also, if the TV needs the viewer to provide a password to access on-demand content, they won't want to say it out aloud, character by character, especially in front of others who might also be in the room with them. The use of biometrics, then, may be the answer. ■

1.2.1 What to Design

Designing interactive products requires considering who is going to be using them, how they are going to be used, and where they are going to be used. Another key concern is to understand the kind of activities people are doing when interacting with these products. The appropriateness of different kinds of interfaces and arrangements of input and output devices depends on what kinds of activities are to be supported. For example, if the activity is to enable people to bank online, then an interface that is secure, trustworthy, and easy to navigate is essential. In addition, an interface that allows the user to find out information about new services offered by the bank without it being intrusive would be useful.

The world is becoming suffused with technologies that support increasingly diverse activities. Just think for a minute about what you can currently do using digital technology: send messages, gather information, write essays, control power plants, program, draw, plan, calculate, monitor others, and play games—just to name but a few. Now think about the types of interfaces and interactive devices that are available. They too are equally diverse: multitouch displays, speech-based systems, handheld devices, wearables, and large interactive displays—again, to name but a few. There are also many ways of designing how users can interact with a system, for instance, via the use of menus, commands, forms, icons, gestures, and so on. Furthermore, ever more innovative everyday artifacts are being created using novel materials, such as e-textiles and wearables (see Figure 1.4).

Figure 1.4 Turn signal biking jacket using e-textiles developed by Leah Beuchley
Source: Used courtesy of Leah Buechley

The Internet of Things (IoT) now means that many products and sensors can be connected to each other via the Internet, which enables them to talk to each other. Popular household IoT-enabled products include smart heating and lighting and home security systems where users can change the controls from an app on their phone or check out who is knocking on their door via a doorbell webcam. Other apps that are being developed are meant to make life easier for people, like finding a car parking space in busy areas.

The interfaces for everyday consumer items, such as cameras, microwave ovens, toasters, and washing machines, which used to be physical and the realm of product design, are now predominantly digitally based, requiring interaction design (called consumer electronics). The move toward transforming human-human transactions into solely interface-based ones has also introduced a new kind of customer interaction. Self-checkouts at grocery stores and libraries are now the norm where it is commonplace for customers to check out their own goods or books themselves, and at airports, where passengers check in their own luggage. While more cost-effective and efficient, it is impersonal and puts the onus on the person to interact with the system. Furthermore, accidentally pressing the wrong button or standing in the wrong place at a self-service checkout can result in a frustrating, and sometimes mortifying, experience.

What this all amounts to is a multitude of choices and decisions that interaction designers have to make for an ever-increasing range of products. A key question for interaction design is this: "How do you optimize the users' interactions with a system, environment, or product so that they support the users' activities in effective, useful, usable and pleasurable ways?" One could use intuition and hope for the best. Alternatively, one can be more principled in deciding which choices to make by basing them on an understanding of the users. This involves the following:

- Considering what people are good and bad at
- Considering what might help people with the way they currently do things
- Thinking through what might provide quality user experiences
- Listening to what people want and getting them involved in the design
- Using user-centered techniques during the design process

The aim of this book is to cover these aspects with the goal of showing you how to carry out interaction design. In particular, it focuses on how to identify users' needs and the context of their activities. From this understanding, we move on to consider how to design usable, useful, and pleasurable interactive products.

1.3 What Is Interaction Design?

By interaction design, we mean the following:

Designing interactive products to support the way people communicate and interact in their everyday and working lives

Put another way, it is about creating user experiences that enhance and augment the way people work, communicate, and interact. More generally, Terry Winograd originally described it as "designing spaces for human communication and interaction" (1997, p. 160). John Thackara viewed it as "the why as well as the how of our daily interactions using computers" (2001, p. 50), while Dan Saffer emphasized its artistic aspects: "the art of facilitating interactions between humans through products and services" (2010, p. 4).

A number of terms have been used since to emphasize different aspects of what is being designed, including user interface design (UI), software design, user-centered design, product design, web design, user experience design, and interactive system design. Interaction design is generally used as the overarching term to describe the field, including its methods, theories, and approaches. UX is used more widely in industry to refer to the profession. However, the terms can be used interchangeably. Also, it depends on their ethos and brand.

1.3.1 The Components of Interaction Design

We view interaction design as fundamental to many disciplines, fields, and approaches that are concerned with researching and designing computer-based systems for people. Figure 1.5 presents the core ones along with interdisciplinary fields that comprise one or more of these, such as cognitive ergonomics. It can be confusing to try to work out the differences between them as many overlap. The main differences between interaction design and the other approaches referred to in the figure come largely down to which methods, philosophies, and lenses they use to study, analyze, and design products. Another way they vary is in terms of

the scope and problems they address. For example, information systems is concerned with the application of computing technology in domains such as business, health, and education, whereas ubiquitous computing is concerned with the design, development, and deployment of pervasive computing technologies (for example, IoT) and how they facilitate social interactions and human experiences.

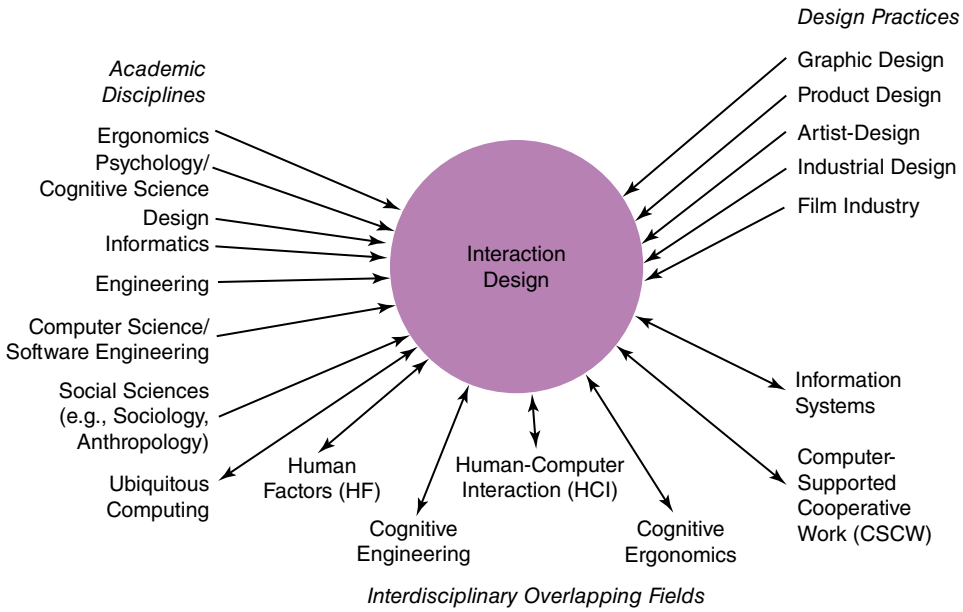


Figure 1.5 Relationship among contributing academic disciplines, design practices, and interdisciplinary fields concerned with interaction design (double-headed arrows mean overlapping)

BOX 1.1

Is Interaction Design Beyond HCI?

We see the main difference between interaction design (ID) and human-computer interaction (HCI) as one of scope. Historically, HCI had a narrow focus on the design and usability of computing systems, while ID was seen as being broader, concerned with the theory, research, and practice of designing user experiences for all manner of technologies, systems, and products. That is one of the reasons why we chose to call our book *Interaction Design: beyond human-computer interaction*, to reflect this wider range. However, nowadays, HCI has greatly expanded in its scope (Churchill et al., 2013), so much so that it overlaps much more with ID (see Figure 1.6). ■

Figure 1.6 HCI out of the box: broadening its reach to cover more areas

1.3.2 Who Is Involved in Interaction Design?

Figure 1.5 also shows that many people are involved in performing interaction design, ranging from social scientists to movie-makers. This is not surprising given that technology has become such a pervasive part of our lives. But it can all seem rather bewildering to the onlooker. How does the mix of players work together?

Designers need to know many different things about users, technologies, and the interactions among them to create effective user experiences. At the least, they need to understand how people act and react to events and how they communicate and interact with each other. To be able to create engaging user experiences, they also need to understand how emotions work, what is meant by aesthetics, desirability, and the role of narrative in human experience. They also need to understand the business side, technical side, manufacturing side, and marketing side. Clearly, it is difficult for one person to be well versed in all of these diverse areas and also know how to apply the different forms of knowledge to the process of interaction design.

Interaction design is ideally carried out by multidisciplinary teams, where the skill sets of engineers, designers, programmers, psychologists, anthropologists, sociologists, marketing people, artists, toy makers, product managers, and others are drawn upon. It is rarely the case,

however, that a design team would have all of these professionals working together. Who to include in a team will depend on a number of factors, including a company's design philosophy, size, purpose, and product line.

One of the benefits of bringing together people with different backgrounds and training is the potential of many more ideas being generated, new methods developed, and more creative and original designs being produced. However, the downside is the costs involved. The more people there are with different backgrounds in a design team, the more difficult it can be to communicate and make progress with the designs being generated. Why? People with different backgrounds have different perspectives and ways of seeing and talking about the world. What one person values as important others may not even see (Kim, 1990). Similarly, a computer scientist's understanding of the term *representation* is often very different from that of a graphic designer or psychologist.

What this means in practice is that confusion, misunderstanding, and communication breakdowns can surface in a team. The various team members may have different ways of talking about design and may use the same terms to mean quite different things. Other problems can arise when a group of people who have not previously worked as a team are thrown together. For example, Aruna Balakrishnan et al. (2011) found that integration across different disciplines and expertise is difficult in many projects, especially when it comes to agreeing on and sharing tasks. The more disparate the team members—in terms of culture, background, and organizational structures—the more complex this is likely to be.

ACTIVITY 1.1

In practice, the makeup of a given design team depends on the kind of interactive product being built. Who do you think should be involved in developing

- A public kiosk providing information about the exhibits available in a science museum?
- An interactive educational website to accompany a TV series?

Comment

Ideally, each team will have a number of different people with different skill sets. For example, the first interactive product would include the following individuals:

- Graphic and interaction designers, museum curators, educational advisers, software engineers, software designers, and ergonomists

The second project would include these types of individuals:

- TV producers, graphic and interaction designers, teachers, video experts, software engineers, and software designers

In addition, as both systems are being developed for use by the general public, representative users, such as school children and parents, should be involved.

In practice, design teams often end up being quite large, especially if they are working on a big project to meet a fixed deadline. For example, it is common to find teams of 15 or more people working on a new product like a health app. This means that a number of people from each area of expertise are likely to be working as part of the project team. ■

1.3.3 Interaction Design Consultancies

Interaction design is now widespread in product and services development. In particular, website consultants and the computing industries have realized its pivotal role in successful interactive products. But it is not just IT companies that are realizing the benefits of having UXers on board. Financial services, retail, governments, and the public sector have realized too the value of interaction design. The presence or absence of good interaction design can make or break a company. Getting noticed in the highly competitive field of web products requires standing out. Being able to demonstrate that your product is easy, effective, and engaging to use is seen as central to this. Marketing departments are also realizing how branding, the number of hits, the customer return rate, and customer satisfaction are greatly affected by the usability of a website.

There are many interaction design consultancies now. These include established companies, such as Cooper, NielsenNorman Group, and IDEO, and more recent ones that specialize in a particular area, such as job board software (for example, Madgex), digital media (think of Cogapp), or mobile design (such as CXpartners). Smaller consultancies, such as Bunnyfoot and Dovetailed, promote diversity, interdisciplinarity, and scientific user research, having psychologists, researchers, interaction designers, usability, and customer experience specialists on board.

Many UX consultancies have impressive websites, providing case studies, tools, and blogs. For example, Holition publishes an annual glossy booklet as part of its UX Series (Javornik et al., 2017) to disseminate the outcomes of their in-house research to the wider community, with a focus on the implications for commercial and cultural aspects. This sharing of UX knowledge enables them to contribute to the discussion about the role of technology in the user experience.

1.4 The User Experience

The user experience refers to how a product behaves and is used by people in the real world. Jakob Nielsen and Don Norman (2014) define it as encompassing "all aspects of the end-user's interaction with the company, its services, and its products." As stressed by Jesse Garrett (2010, p. 10), "Every product that is used by someone has a user experience: newspapers, ketchup bottles, reclining armchairs, cardigan sweaters." More specifically, it is about how people feel about a product and their pleasure and satisfaction when using it, looking at it, holding it, and opening or closing it. It includes their overall impression of how good it is to use, right down to the sensual effect small details have on them, such as how smoothly a switch rotates or the sound of a click and the touch of a button when pressing it. An important aspect is the quality of the experience someone has, be it a quick one, such as taking a photo; a leisurely one, such as playing with an interactive toy; or an integrated one, such as visiting a museum (Law et al., 2009).

It is important to point out that one cannot design a user experience, only design *for* a user experience. In particular, one cannot design a sensual experience, but only create the design features that can evoke it. For example, the outside case of a smartphone can be designed to be smooth, silky, and fit in the palm of a hand; when held, touched, looked at, and interacted with, that can provoke a sensual and satisfying user experience. Conversely, if it is designed to be heavy and awkward to hold, it is much more likely to end up providing a poor user experience—one that is uncomfortable and unpleasant.

Designers sometimes refer to UX as UXD. The addition of the *D* to UX is meant to encourage design thinking that focuses on the quality of the user experience rather than on the set of design methods to use (Allanwood and Beare, 2014). As Don Norman (2004) has stressed for many years, "It is not enough that we build products that function, that are understandable and usable, we also need to build joy and excitement, pleasure and fun, and yes, beauty to people's lives."

ACTIVITY 1.2

The iPod Phenomenon

Apple's classic (and subsequent) generations of portable music players, called iPods, including the iPod Touch, Nano, and Shuffle, released during the early 2000s were a phenomenal success. Why do you think this occurred? Has there been any other product that has matched this quality of experience? With the exception of the iPod Touch, Apple stopped production of them in 2017. Playing music via a smartphone became the norm, superseding the need for a separate device.

Comment

Apple realized early on that successful interaction design involves creating interactive products that have a quality user experience. The sleek appearance of the iPod music player (see Figure 1.7), its simplicity of use, its elegance in style, its distinct family of rainbow colors, a novel interaction style that many people discovered was a sheer pleasure to learn and use, and the catchy naming of its product and content (iTunes, iPod), among many other design features, led to it becoming one of the greatest products of its kind and a must-have fashion item for teenagers, students, and adults alike. While there were many competing players on the market at the time—some with more powerful functionality, others that were cheaper and easier to use, or still others with bigger screens, more memory, and so forth—the quality of the overall user experience paled in comparison to that provided by the iPod.

Figure 1.7 The iPod Nano
Source: David Paul Morris / Getty Images

The nearest overall user experience that has all of the above is not so much for a product but for a physical store. The design of the Apple Store as a completely new customer experience for buying technology has been very successful in how it draws people in and what they do when browsing, discovering, and purchasing goods in the store. The products are laid out in a way to encourage interaction. ■

There are many aspects of the user experience that can be considered and many ways of taking them into account when designing interactive products. Of central importance are the usability, functionality, aesthetics, content, look and feel, and emotional appeal. In addition, Jack Carroll (2004) stresses other wide-reaching aspects, including fun, health, social capital (the social resources that develop and are maintained through social networks, shared values, goals, and norms), and cultural identity, such as age, ethnicity, race, disability, family status, occupation, and education.

Several researchers have attempted to describe the experiential aspect of a user experience. Kasper Hornbæk and Morten Hertzum (2017) note how it is often described in terms of the way that users perceive a product, such as whether a smartwatch is seen as sleek or chunky, and their emotional reaction to it, such as whether people have a positive experience when using it. Marc Hassenzahl's (2010) model of the user experience is the most well-known, where he conceptualizes it in terms of pragmatic and hedonic aspects. By pragmatic, it is meant how simple, practical, and obvious it is for the user to achieve their goals. By hedonic, it is meant how evocative and stimulating the interaction is to them. In addition to a person's perceptions of a product, John McCarthy and Peter Wright (2004) discuss the importance of their expectations and the way they make sense of their experiences when using technology. Their *Technology as Experience* framework accounts for the user experience largely in terms of how it is felt by the user. They recognize that defining experience is incredibly difficult because it is so nebulous and ever-present to us, just as swimming in water is to a fish. Nevertheless, they have tried to capture the essence of human experience by describing it in both holistic and metaphorical terms. These comprise a balance of sensual, cerebral, and emotional threads.

How does one go about producing quality user experiences? There is no secret sauce or magical formula that can be readily applied by interaction designers. However, there are numerous conceptual frameworks, tried and tested design methods, guidelines, and relevant research findings, which are described throughout the book.

1.5 Understanding Users

A main reason for having a better understanding of people in the contexts in which they live, work, and learn is that it can help designers understand how to design interactive products that provide good user experiences or match a user's needs. A collaborative planning tool for a space mission, intended to be used by teams of scientists working in different parts of the world, will have quite different needs from one targeted at customer and sales agents, to be used in a furniture store to draw up kitchen layout plans. Understanding individual

differences can also help designers appreciate that one size does not fit all; what works for one user group may be totally inappropriate for another. For example, children have different expectations than adults about how they want to learn or play. They may find having interactive quizzes and cartoon characters helping them along to be highly motivating, whereas most adults find them annoying. Conversely, adults often like talking-head discussions about topics, but children find them boring. Just as everyday objects like clothes, food, and games are designed differently for children, teenagers, and adults, so too should interactive products be designed for different kinds of users.

Learning more about people and what they do can also reveal incorrect assumptions that designers may have about particular user groups and what they need. For example, it is often assumed that because of deteriorating vision and dexterity, old people want things to be big—be it text or graphical elements appearing on a screen or the physical controls, like dials and switches, used to control devices. This may be true for some elderly people, but studies have shown that many people in their 70s, 80s, and older are perfectly capable of interacting with standard-size information and even small interfaces, for example, smartphones, just as well as those in their teens and 20s, even though, initially, some might think they will find it difficult (Siek et al., 2005). It is increasingly the case that as people get older, they do not like to consider themselves as lacking in cognitive and manual skills. Being aware of people's sensitivities, such as aging, is as important as knowing how to design for their capabilities (Johnson and Finn, 2017). In particular, while many older adults now feel comfortable with and use a range of technologies (for instance, email, online shopping, online games, or social media), they may resist adopting new technologies. This is not because they don't perceive them as being useful to their lives but because they don't want to waste their time getting caught up by the distractions that digital life brings (Knowles and Hanson, 2018), for example, not wanting to be "glued to one's mobile phone" like younger generations.

Being aware of cultural differences is also an important concern for interaction design, particularly for products intended for a diverse range of user groups from different countries. An example of a cultural difference is the dates and times used in different countries. In the United States, for example, the date is written as month, day, year (05/21/20), whereas in other countries, it is written in the sequence of day, month, year (21/05/20). This can cause problems for designers when deciding on the format of online forms, especially if intended for global use. It is also a concern for products that have time as a function, such as operating systems, digital clocks, or car dashboards. To which cultural group do they give preference? How do they alert users to the format that is set as default? This raises the question of how easily an interface designed for one user group can be used and accepted by another. Why is it that certain products, like a fitness tracker, are universally accepted by people from all parts of the world, whereas websites are designed differently and reacted to differently by people from different cultures?

To understand more about users, we have included three chapters (Chapters 4–6) that explain in detail how people act and interact with one another, with information, and with various technologies, together with describing their abilities, emotions, needs, desires, and what causes them to get annoyed, frustrated, lose patience, and get bored. We draw upon relevant psychological theory and social science research. Such knowledge enables designers to determine which solutions to choose from the many design alternatives available and how to develop and test these further.

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

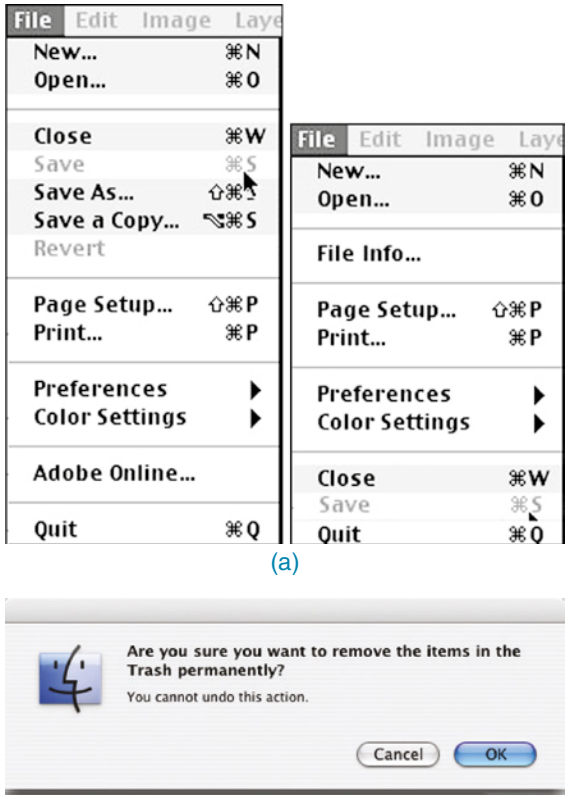


Figure 1.9 (a) A safe and unsafe menu. Which is which and why? (b) A warning dialog box for Mac OS X

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

Many of these are subjective qualities and are concerned with how a system feels to a user. They differ from the more objective usability goals in that they are concerned with how users experience an interactive product from their perspective, rather than assessing how useful or productive a system is from its own perspective. Whereas the terms used to describe usability goals comprise a small distinct set, many more terms are used to describe the multifaceted nature of the user experience. They also overlap with what they are referring to. In so doing, they offer subtly different options for expressing the way an experience varies for the same activity over time, technology, and place. For example, we may describe listening to music in the shower as highly pleasurable, but consider it more apt to describe listening to music in the car as enjoyable. Similarly, listening to music on a high-end powerful music system may invoke exciting and emotionally fulfilling feelings, while listening to it on a smartphone that has a shuffle mode may be serendipitously enjoyable, especially not knowing what tune is next. The process of selecting terms that best convey a user's feelings, state of being, emotions, sensations, and so forth when using or interacting with a product at a given time and place can help designers understand the multifaceted and changing nature of the user experience.

The concepts can be further defined in terms of elements that contribute to making a user experience pleasurable, fun, exciting, and so on. They include attention, pace, play, interactivity, conscious and unconscious control, style of narrative, and flow. The concept of flow (Csikszentmihalyi, 1997) is popular in interaction design for informing the design of user experiences for websites, video games, and other interactive products. It refers to a state of intense emotional involvement that comes from being completely involved in an activity, like playing music, and where time flies. Instead of designing web interfaces to cater to visitors who know what they want, they can be designed to induce a state of flow, leading the visitor to some unexpected place, where they become completely absorbed. In an interview with *Wired* magazine, Mihaly Csikszentmihalyi (1996) uses the analogy of a gourmet meal to describe how a user experience can be designed to be engrossing, "starting off with the appetizers, moving on to the salads and entrées, and building toward dessert and not knowing what will follow."

The quality of the user experience may also be affected by single actions performed at an interface. For example, people can get much pleasure from turning a knob that has the perfect level of gliding resistance; they may enjoy flicking their finger from the bottom of a smartphone screen to reveal a new menu, with the effect that it appears by magic, or enjoy the sound of trash being emptied from the trashcan on a screen. These one-off actions can be performed infrequently or several times a day—which the user never tires of doing. Dan Saffer (2014) has described these as *micro-interactions* and argues that designing these moments of interaction at the interface—despite being small—can have a big impact on the user experience.

ACTIVITY 1.3

There are more desirable than undesirable aspects of the user experience listed in Table 1.1. Why do you think this is so? Should you consider all of these when designing a product?

(*Continued*)

Comment

The two lists we have come up with are not meant to be exhaustive. There are likely to be more—both desirable and undesirable—as new products surface. The reason for there being more of the former is that a primary goal of interaction design is to create positive experiences. There are many ways of achieving this.

Not all usability and user experience goals will be relevant to the design and evaluation of an interactive product being developed. Some combinations will also be incompatible. For example, it may not be possible or desirable to design a process control system that is both safe and fun. Recognizing and understanding the nature of the relationship between usability and user experience goals is central to interaction design. It enables designers to become aware of the consequences of pursuing different combinations when designing products and highlighting potential trade-offs and conflicts. As suggested by Jack Carroll (2004), articulating the interactions of the various components of the user's experience can lead to a deeper and more significant interpretation of the role of each component. ■

BOX 1.3

Beyond Usability: Designing to Persuade

Eric Schaffer (2009) argues that we should be focusing more on the user experience and less on usability. He points out how many websites are designed to persuade or influence rather than enable users to perform their tasks in an efficient manner. For example, many online shopping sites are in the business of selling services and products, where a core strategy is to entice people to buy what they might not have thought they needed. Online shopping experiences are increasingly about persuading people to buy rather than being designed to make shopping easy. This involves designing for persuasion, emotion, and trust, which may or may not be compatible with usability goals.

This entails determining what customers will do, whether it is to buy a product or renew a membership, and it involves encouraging, suggesting, or reminding the user of things that they might like or need. Many online travel sites try to lure visitors to purchase additional items (such as hotels, insurance, car rental, car parking, or day trips) besides the flight they originally wanted to book, and they will add a list full of tempting graphics to the visitor's booking form, which then has to be scrolled through before being able to complete the transaction. These opportunities need to be designed to be eye-catching and enjoyable, in the same way that an array of products are attractively laid out in the aisles of a grocery store that one is required to walk past before reaching one's desired product.

Some online sites, however, have gone too far, for example, adding items to the customer's shopping basket (for example, insurance, special delivery, and care and handling) that the shopper has to deselect if not desired or start all over again. This sneaky add-on approach can often result in a negative experience. More generally, this deceptive approach

to UX has been described by Harry Brignull as *dark patterns* (see http://darkpatterns.org/). Shoppers often become annoyed if they notice decisions that add cost to their purchase have been made on their behalf without even being asked. For example, on clicking the unsubscribe button on the website of a car rental company, as indicated in Figure 1.10, the user is taken to another page where they have to uncheck additional boxes and then Update. They are then taken to yet another page where they are asked for their reason. The next screen says "Your email preferences have been updated. Do you need to hire a vehicle?" without letting the user know whether they have been unsubscribed from their mailing list.

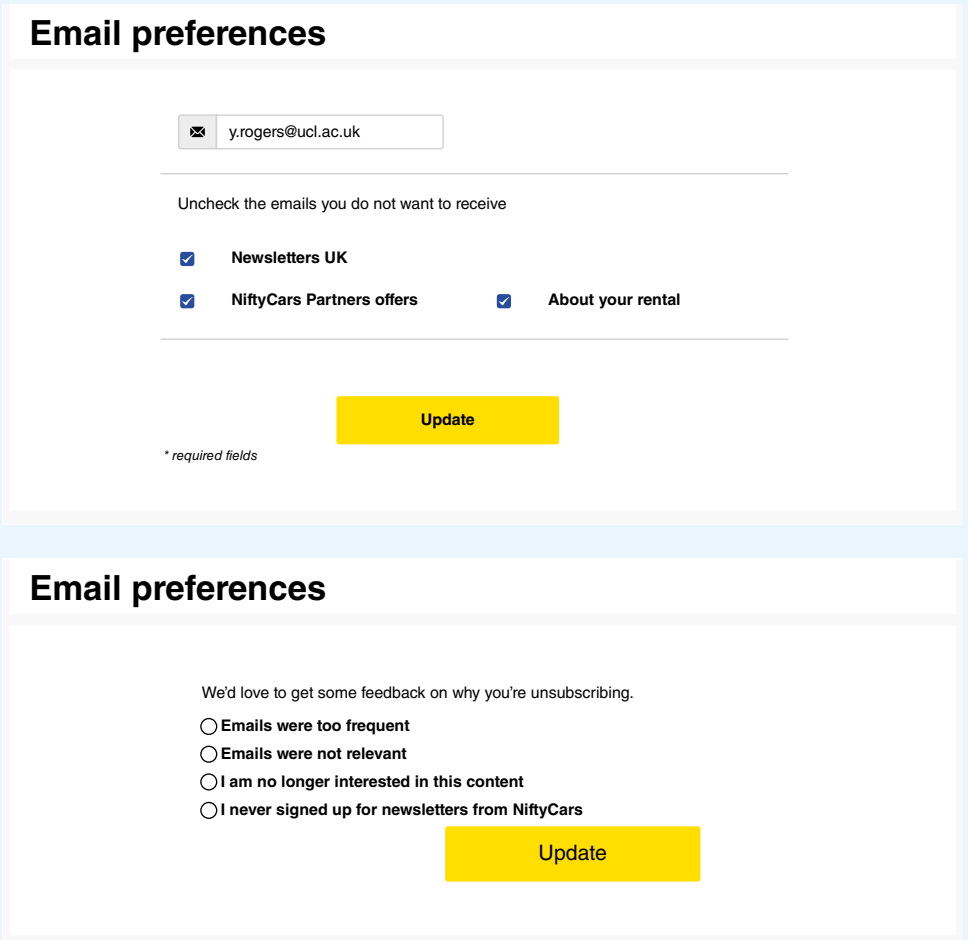


Figure 1.10 Dark pattern for a car rental company

(*Continued*)

The key is to nudge people in subtle and pleasant ways with which they can trust and feel comfortable. Natasha Loma (2018) points out how dark pattern design is "deception and dishonesty by design." She describes in a TechCrunch article the many kinds of dark patterns that are now used to deceive users. A well-known example that most of us have experienced is unsubscribing from a marketing mailing list. Many sites go to great lengths to make it difficult for you to leave; you think you have unsubscribed, but then you discover that you need to type in your email address and click several more buttons to reaffirm that you really want to quit. Then, just when you think you are safe, they post a survey asking you to answer a few questions about why you want to leave. Like Harry Brignull, she argues that companies should adopt fair and ethical design where users have to opt in to any actions that benefit the company at the expense of the users' interests. ■

1.7.3 Design Principles

Design principles are used by interaction designers to aid their thinking when designing for the user experience. These are generalizable abstractions intended to orient designers toward thinking about different aspects of their designs. A well-known example is feedback: Products should be designed to provide adequate feedback to the users that informs them about what has already been done so that they know what to do next in the interface. Another one that is important is findability (Morville, 2005). This refers to the degree to which a particular object is easy to discover or locate—be it navigating a website, moving through a building, or finding the delete image option on a digital camera. Related to this is the principle of navigability: Is it obvious what to do and where to go in an interface; are the menus structured in a way that allows the user to move smoothly through them to reach the option they want?

Design principles are derived from a mix of theory-based knowledge, experience, and common sense. They tend to be written in a prescriptive manner, suggesting to designers what to provide and what to avoid at the interface—if you like, the dos and don'ts of interaction design. More specifically, they are intended to help designers explain and improve their designs (Thimbleby, 1990). However, they are not intended to specify how to design an actual interface, for instance, telling the designer how to design a particular icon or how to structure a web portal, but to act more like triggers for designers, ensuring that they provide certain features in an interface.

A number of design principles have been promoted. The best known are concerned with how to determine what users should see and do when carrying out their tasks using an interactive product. Here we briefly describe the most common ones: visibility, feedback, constraints, consistency, and affordance.

Visibility

The importance of visibility is exemplified by our contrasting examples at the beginning of the chapter. The voice-mail system made the presence and number of waiting messages invisible, while the answering machine made both aspects highly visible. The more visible functions are, the more likely it is that users will be able to know what to do next. Don Norman (1988) describes the controls of a car to emphasize this point. The controls for different operations are clearly visible, such as indicators, headlights, horn, and hazard warning lights, indicating what

can be done. The relationship between the way the controls have been positioned in the car and what they do makes it easy for the driver to find the appropriate control for the task at hand.

In contrast, when functions are out of sight, it makes them more difficult to find and to know how to use. For example, devices and environments that have become automated through the use of sensor technology (usually for hygiene and energy-saving reasons)—like faucets, elevators, and lights—can sometimes be more difficult for people to know how to control, especially how to activate or deactivate them. This can result in people getting caught short and frustrated. Figure 1.11 shows a sign that explains how to use the automatically controlled faucet for what is normally an everyday and well-learned activity. It also states that the faucets cannot be operated if wearing black clothing. It does not explain, however, what to do if you are wearing black clothing! Increasingly, highly visible controlling devices, like knobs, buttons, and switches, which are intuitive to use, have been replaced by invisible and ambiguous activating zones where people have to guess where to move their hands, bodies, or feet—on, into, or in front of—to make them work.

Figure 1.11 A sign in the restrooms at the Cincinnati airport
Source: http://www.baddesigns.com

Feedback

Related to the concept of visibility is feedback. This is best illustrated by an analogy to what everyday life would be like without it. Imagine trying to play a guitar, slice bread using a knife, or write using a pen if none of the actions produced any effect for several seconds.

There would be an unbearable delay before the music was produced, the bread was cut, or the words appeared on the paper, making it almost impossible for the person to continue with the next strum, cut, or stroke.

Feedback involves sending back information about what action has been done and what has been accomplished, allowing the person to continue with the activity. Various kinds of feedback are available for interaction design—audio, tactile, verbal, visual, and combinations of these. Deciding which combinations are appropriate for different types of activities and interactivities is central. Using feedback in the right way can also provide the necessary visibility for user interaction.

Constraints

The design concept of *constraining* refers to determining ways of restricting the kinds of user interaction that can take place at a given moment. There are various ways that this can be achieved. A common design practice in graphical user interfaces is to deactivate certain menu options by shading them gray, thereby restricting the user only to actions permissible at that stage of the activity (see Figure 1.12). One of the advantages of this form of constraining is that it prevents the user from selecting incorrect options and thereby reduces the chance of making a mistake.

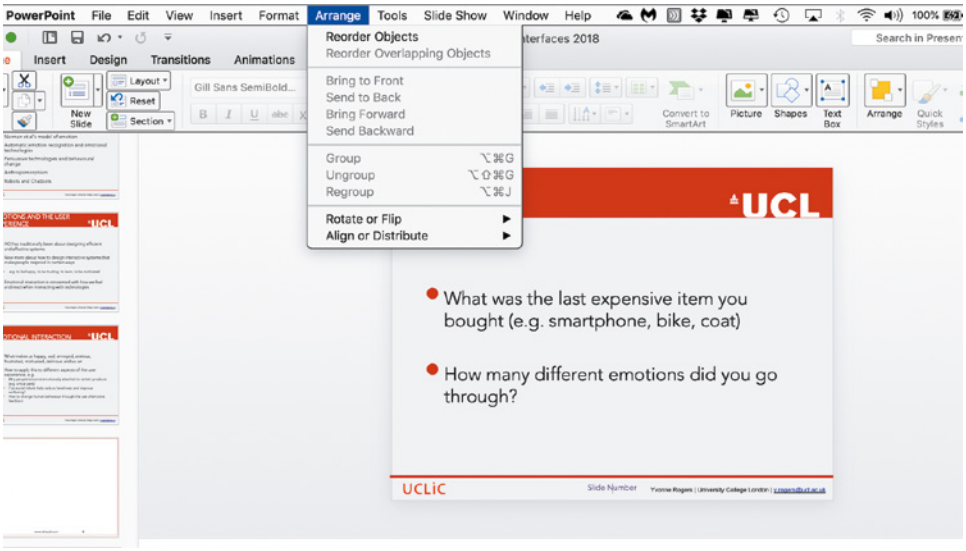


Figure 1.12 A menu showing restricted availability of options as an example of logical constraining. Gray text indicates deactivated options.

Source: https://www.ucl.ac.uk

The use of different kinds of graphical representations can also constrain a person's interpretation of a problem or information space. For example, flow chart diagrams show which objects are related to which, thereby constraining the way that the information can be perceived. The physical design of a device can also constrain how it is used; for example, the

external slots in a computer have been designed to allow a cable or card to be inserted in a certain way only. Sometimes, however, the physical constraint is ambiguous, as shown in Figure 1.13. The figure shows part of the back of a computer. There are two sets of connectors; the two on the right are for a mouse and a keyboard. They look identical and are physically constrained in the same way. How do you know which is which? Do the labels help?

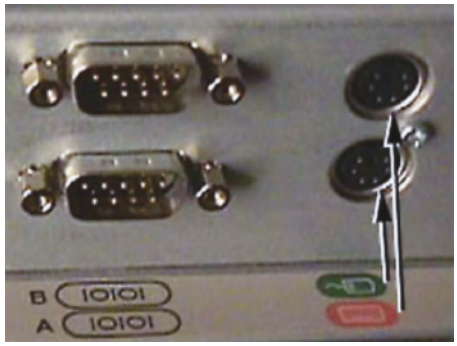


Figure 1.13 Ambiguous constraints on the back of a computer
Source: http://www.baddesigns.com

Consistency

This refers to designing interfaces to have similar operations and use similar elements for achieving similar tasks. In particular, a consistent interface is one that follows rules, such as using the same operation to select all objects. For example, a consistent operation is using the same input action to highlight any graphical object on the interface, such as always clicking the left mouse button. Inconsistent interfaces, on the other hand, allow exceptions to a rule. An example is where certain graphical objects (for example, email messages presented in a table) can be highlighted only by using the right mouse button, while all other operations are highlighted using the left mouse button. The problem with this kind of inconsistency is that it is quite arbitrary, making it difficult for users to remember and making its use more prone to mistakes.

One of the benefits of consistent interfaces, therefore, is that they are easier to learn and use. Users have to learn only a single mode of operation that is applicable to all objects. This principle works well for simple interfaces with limited operations, such as a portable radio with a small number of operations mapped onto separate buttons. Here, all the user has to do is to learn what each button represents and select accordingly. However, it can be more problematic to apply the concept of consistency to more complex interfaces, especially when many different operations need to be designed. For example, consider how to design an interface for an application that offers hundreds of operations, such as a word-processing application. There is simply not enough space for a thousand buttons, each of which maps to an individual operation. Even if there were, it would be extremely difficult and time-consuming for the user to search through all of them to find the desired operation. A much more effective design solution is to create categories of commands that can be mapped into subsets of operations that can be displayed at the interface, for instance, via menus.

Affordance

This is a term used to refer to an attribute of an object that allows people to know how to use it. For example, a mouse button invites pushing (in so doing, activating clicking) by the way it is physically constrained in its plastic shell. At a simple level, to afford means "to give a clue"' (Norman, 1988). When the affordances of a physical object are perceptually obvious, it is easy to know how to interact with it. For example, a door handle affords pulling, a cup handle affords grasping, and a mouse button affords pushing. The term has since been much popularized in interaction design, being used to describe how interfaces should make it obvious as to what can be done when using them. For example, graphical elements like buttons, icons, links, and scrollbars are discussed with respect to how to make it appear obvious how they should be used: icons should be designed to afford clicking, scrollbars to afford moving up and down, and buttons to afford pushing.

Don Norman (1999) suggests that there are two kinds of affordance: perceived and real. Physical objects are said to have real affordances, like grasping, that are perceptually obvious and do not have to be learned. In contrast, user interfaces that are screen-based are virtual and do not have these kinds of real affordances. Using this distinction, he argues that it does not make sense to try to design for real affordances at the interface, except when designing physical devices, like control consoles, where affordances like pulling and pressing are helpful in guiding the user to know what to do. Alternatively, screen-based interfaces are better conceptualized as perceived affordances, which are essentially learned conventions. However, watching a one-year-old swiping smartphone screens, zooming in and out on images with their finger and thumb, and touching menu options suggests that kind of learning comes naturally.

Applying Design Principles in Practice

One of the challenges of applying more than one of the design principles in interaction design is that trade-offs can arise among them. For example, the more you try to constrain an interface, the less visible information becomes. The same can also happen when trying to apply a single design principle. For example, the more an interface is designed to afford through trying to resemble the way physical objects look, the more it can become cluttered and difficult to use. It can also be the case that the more an interface is designed to be aesthetic, the less usable it becomes. Consistency can be a problematic design principle; trying to design an interface to be consistent with something can make it inconsistent with something else. Furthermore, sometimes inconsistent interfaces are actually easier to use than consistent interfaces. This is illustrated by Jonathan Grudin's classic (1989) use of the analogy of where knives are stored in a house. Knives come in a variety of forms, including butter knives, steak knives, table knives, and fish knives. An easy place to put them all and subsequently locate them is in the top drawer by the sink. This makes it easy for everyone to find them and follows a simple consistent rule. But what about the knives that don't fit or are too sharp to put in the drawer, like carving knives and bread knives? They are placed in a wooden block. And what about the best knives kept only for special occasions? They are placed in the cabinet in another room for safekeeping. And what about other knives like putty knives and paint-scraping knives used in home improvement projects (kept in the garage) and jack-knives (kept in one's pockets or backpack)? Very quickly, the consistency rule begins to break down.

Jonathan Grudin notes how, in extending the number of places where knives are kept, inconsistency is introduced, which in turn increases the time needed to learn where they are all stored. However, the placement of the knives in different places often makes it easier to find them because they are at hand for the context in which they are used and are also next to the other objects used for a specific task; for instance, all of the home improvement project tools are stored together in a box in the garage. The same is true when designing interfaces: introducing inconsistency can make it more difficult to learn an interface, but in the long run it can make it easier to use.

ACTIVITY 1.4

One of the main design principles for website design is simplicity. Jakob Nielsen (1999) proposed that designers go through all of their design elements and remove them one by one. If a design works just as well without an element, then remove it. Do you think this is a good design principle? If you have your own website, try doing this and seeing what happens. At what point does the interaction break down?

Comment

Simplicity is certainly an important design principle. Many designers try to cram too much into a screenful of space, making it unwieldy for people to find the element in which they are interested. Removing design elements to see what can be discarded without affecting the overall function of the website can be a salutary lesson. Unnecessary icons, buttons, boxes, lines, graphics, shading, and text can be stripped, leaving a cleaner, crisper, and easier-to-navigate website. However, graphics, shading, coloring, and formatting can make a site aesthetically pleasing and enjoyable to use. Plain vanilla sites consisting solely of lists of text and a few links may not be as appealing and may put certain visitors off, never to return. Good interaction design involves getting the right balance between aesthetic appeal and the optimal amount and kind of information per page. ■

In-Depth Activity

This activity is intended for you to put into practice what you have studied in this chapter. Specifically, the objective is to enable you to define usability and user experience goals and to transform these and other design principles into specific questions to help evaluate an interactive product.

Find an everyday handheld device, for example, a remote control, digital camera, or smartphone and examine how it has been designed, paying particular attention to how the user is meant to interact with it.

(*Continued*)

(a) From your first impressions, write down what is good and bad about the way the device works.
(b) Give a description of the user experience resulting from interacting with it.
(c) Outline some of the core micro-interactions that are supported by it. Are they pleasurable, easy, and obvious?
(d) Based on your reading of this chapter and any other material you have come across about interaction design, compile a set of usability and user experience goals that you think will be most relevant in evaluating the device. Decide which are the most important ones and explain why.
(e) Translate each of your sets of usability and user experience goals into two or three specific questions. Then use them to assess how well your device fares.
(f) Repeat steps (c) and (d), but this time use the design principles outlined in the chapter.
(g) Finally, discuss possible improvements to the interface based on the answers obtained in steps (d) and (e).

Summary

In this chapter, we have looked at what interaction design is and its importance when developing apps, products, services, and systems. To begin, a number of good and bad designs were presented to illustrate how interaction design can make a difference. We described who and what is involved in interaction design and the need to understand accessibility and inclusiveness. We explained in detail what usability and user experience are, how they have been characterized, and how to operationalize them to assess the quality of a user experience resulting from interacting with an interactive product. The increasing emphasis on designing for the user experience and not just products that are usable was stressed. A number of core design principles were also introduced that provide guidance for helping to inform the interaction design process.

Key Points

- Interaction design is concerned with designing interactive products to support the way people communicate and interact in their everyday and working lives.
- Interaction design is multidisciplinary, involving many inputs from wide-ranging disciplines and fields.
- The notion of the user experience is central to interaction design.
- Optimizing the interaction between users and interactive products requires consideration of a number of interdependent factors, including context of use, types of activity, UX goals, accessibility, cultural differences, and user groups.
- Identifying and specifying relevant usability and user experience goals can help lead to the design of good interactive products.
- Design principles, such as feedback and simplicity, are useful heuristics for informing, analyzing, and evaluating aspects of an interactive product.

Further Reading

Here we recommend a few seminal readings on interaction design and the user experience (in alphabetical order).

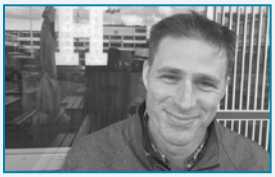
COOPER, A., REIMANN, R., CRONIN, D. AND NOESSEL, C. (2014) *About Face: The Essentials of Interaction Design* (4th ed.). John Wiley & Sons Inc. This fourth edition of *About Face* provides an updated overview of what is involved in interaction design, and it is written in a personable style that appeals to practitioners and students alike.

GARRETT, J. J. (2010) *The Elements of User Experience: User-Centered Design for the Web and Beyond* (2nd ed.). New Riders Press. This is the second edition of the popular coffee-table introductory book to interaction design. It focuses on how to ask the right questions when designing for a user experience. It emphasizes the importance of understanding how products work on the outside, that is, when a person comes into contact with those products and tries to work with them. It also considers a business perspective.

LIDWELL, W., HOLDEN, K. AND BUTLER, J. (2010) *Revised and Updated: 125 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions and Teach Through Design*. Rockport Publishers, Inc. This book presents classic design principles such as consistency, accessibility, and visibility in addition to some lesser-known ones, such as constancy, chunking, and symmetry. They are alphabetically ordered (for easy reference) with a diversity of examples to illustrate how they work and can be used.

NORMAN, D.A. (2013) *The Design of Everyday Things: Revised and Expanded Edition*. MIT Press. This book was first published in 1988 and became an international best seller, introducing the world of technology to the importance of design and psychology. It covers the design of everyday things, such as refrigerators and thermostats, providing much food for thought in relation to how to design interfaces. This latest edition is comprehensively revised showing how principles from psychology apply to a diversity of old and new technologies. The book is highly accessible with many illustrative examples.

SAFFER, D. (2014) *Microinteractions: Designing with Details*. O'Reilly. This highly accessible book provides many examples of the small things in interaction design that make a big difference between a pleasant experience and a nightmare one. Dan Saffer describes how to design them to be efficient, understandable, and enjoyable user actions. He goes into detail about their structure and the different kinds, including many examples with lots of illustrations. The book is a joy to dip into and enables you to understand right away why and how it is important to get the micro-interactions right.



INTERVIEW with Harry Brignull

Harry Brignull is a user experience consultant based in the United Kingdom. He has a PhD in cognitive science, and his work involves building better experiences by blending user research and interaction design. In his work, Harry has consulted for companies including Spotify, Smart Pension, The Telegraph, British Airways, Vodafone, and many others. In his spare time, Harry also runs a blog on interaction design that has attracted a lot of eyeballs. It is called 90percentofeverything.com, and it is well worth checking out.

What are the characteristics of a good interaction designer?
I think of interaction design, user experience design, service design, and user research as a combined group of disciplines that are tricky to tease apart. Every company has slightly different terminology, processes, and approaches. I'll let you into a secret, though. They're all making it up as they go along. When you see any organization portraying its design and research publicly, they're showing you a fictionalized view of it for recruitment and marketing purposes. The reality of the work is usually very different. Research and design is naturally messy. There's a lot of waste, false assumptions, and blind alleys you have to go down before you can define and understand a problem well enough to solve it. If an employer doesn't understand this and they don't give you the space and time you need, then you won't be able to do a good job, regardless of your skills and training.

A good interaction designer has skills that work like expanding foam. You expand to fill the skill gaps in your team. If you don't have a writer present, you need to be able to step up and do it yourself, at least to the level of a credible draft. If you don't have a researcher, you'll need to step up and do it yourself. The same goes for developing code-based prototypes, planning the user journeys, and so on. You'll soon learn to become used to working outside of your comfort zone and relish the new challenges that each project brings.

How has interaction design changed in the past few years?
In-housing of design teams is a big trend at the moment. When I started my consultancy career in the mid-2000s, the main route to getting a career in industry was to get a role at an agency, like a UX consultancy, a research agency, or a full-service agency. Big organizations didn't even know where to start with hiring and building their own teams, so they paid enormous sums to agencies to design and build their products. This turned out to be a pretty ineffective model—when the agencies finish a project, they take all the acquired expertise away with them to their next clients.

These days, digital organizations have wised up, and they've started building their own in-house teams. This means that a big theme in design these days is organizational change. You can't do good design in an organization that isn't set up for it. In fact, in old, large organizations, the political

structure often seems to be set up to sabotage good design and development practices. It sounds crazy, but it's very common to walk into an organization to find a project manager brandishing a waterfall Gantt chart while ranting obsessively about Agile (which is a contradiction in terms) or to find a product owner saying in one breath they value user research yet in the next breath getting angry with researchers for bringing them bad news. As well as "legacy technology," organizations naturally end up with "legacy thinking." It's really tricky to change it. Design used to be just a department. Nowadays it's understood that good design requires the entire organization to work together in a cohesive way.

What projects are you working on now?
I'm currently head of UX at a FinTech startup called Smart Pension in London. Pensions pose a really fascinating user-centered design challenge. Consumers hate thinking about pensions, but they desperately need them. In a recent research session, one of the participants said something that really stuck with me: "Planning your pension is like planning for your own funeral." Humans are pretty terrible at long-term planning over multiple decades. Nobody likes to think about their own mortality. But this is exactly what you need to do if you want to have a happy retirement.

The pension industry is full of jargon and off-putting technical complexity. Even fundamental financial concepts like *risk* aren't well understood by many consumers. In some recent research, one of our participants got really tongue-tied trying to understand the idea that since they were young, it would be "high risk" (in the loose nontechnical definition of the word) to put their money into a "low-risk" fund (in the technical definition of the word) since they'd probably end up with lower returns when they got older. Investment is confusing unless you've had training. Then, there's the problem that "a little knowledge can hurt." Some consumers who think they know what they're doing can end up suffering when they think they can beat the market by moving their money around between funds every week.

Self-service online pension (retirement plans) platforms don't do anything to help people make the right decisions because that would count as advice, which they're not able to give because of the way it's regulated. Giving an average person a self-service platform and telling them to go sort out their pension is like giving them a Unix terminal and telling them to sort out their own web server. A few PDF fact sheets just aren't going to help. If consumers want advice, they have to go to a financial advisor, which can be expensive and doesn't make financial sense unless you have a lot of money in the first place. There's a gap in the market, and we're working these sorts of challenges in my team at Smart Pension.

What would you say are the biggest challenges facing you and other consultants doing interaction design these days?
A career in interaction design is one of continual education and training. The biggest challenge is to keep this going. Even if you feel that you're at the peak of your skills, the technology landscape will be shifting under your feet, and you need to keep an eye on what's coming next so you don't get left behind. In fact, things move so quickly in interaction design that by the time you read this interview, it will already be dated.

If you ever find yourself in a "comfortable" role doing the same thing every

(*Continued*)

day, then beware—you're doing yourself a disservice. Get out there, stretch yourself, and make sure you spend some time every week outside your comfort zone.

If you're asked to evaluate a prototype service or product and you discover it is really bad, how do you break the news?
It depends what your goal is. If you want to just deliver the bad news and leave, then by all means be totally brutal and don't pull any punches. But if you want to build a relationship with the client, you're going to need to help them work out how to move forward.

Remember, when you deliver bad news to a client, you're basically explaining to them that they're in a dark place and it's their fault. It can be quite embarrassing and depressing. It can drive stakeholders apart when really you need to bring them together and give them a shared vision to work toward. Discovering bad design is an opportunity for improvement. Always pair the bad news with a recommendation of what to do next.

NOTE
We use the term *interactive products* generically to refer to all classes of interactive systems, technologies, environments, tools, applications, services, and devices.