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.
- Consider the pros and cons of transforming activities to become digital.
- 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, smartwatch, laptop, remote control, coffee machine, printer, smoothie maker, e-reader, smart TV, alarm clock, electric toothbrush, radio, bathroom

scales, fitness tracker, game console. Then think of which apps and social media you use…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 a tablet, are a joy to use, where tapping an app and flicking through photos is simple, smooth, and enjoyable. Others, like buying a 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 users' needs in mind. They are generally easy and enjoyable to use. Others have not necessarily been designed with the person in mind; rather, they have been engineered primarily as software systems to perform set functions. An example is setting the time of day on a stove, such as when setting it up or after a power failure, 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 remembered and therefore used in a real-world context.

Alan Cooper (2018), a well-known user experience guru, bemoans the fact that much of today's software suffers from the same interaction errors that were around 25 years ago. Why is this still the case, given that interaction design has been in existence for more than 30 years and given that there are far more 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 user experience design 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) while enhancing the positive ones (for example, enjoyment and efficacy). This entails developing interactive products that are easy to learn, effective, and pleasurable to use from a user's 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 consider what is gained and lost from transforming activities to be digital when previously they were done through using physical artifacts. 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 this 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.

BOX 1.1

What's in a name? User, people, human, or customer?

Several terms have been used to emphasize different aspects of what is being designed, including user interface design (UI), software design, user-centered design, human-centered design, people-centered design, product design, web design, user experience (UX) design, customer

experience (CX) design, and interactive system design. Interaction design (IxD) is generally used as the overarching term to describe the field, including its methods, theories, and approaches. Since about 2010, UX design has been the most widely used term in industry to refer to the profession. However, the terms have been used interchangeably. Also, it depends on each company's ethos and brand.

As the field has matured, Don Norman (2018) has argued for using the more encompassing term *people-centered design* and referring to *people* instead of *users* where it seems more appropriate. Sometimes, continuing to use the term *user* makes sense, however, if it is specifically about how a technology is to be used for or by someone. Likewise, continuing to refer to *user's needs* and the *user experience* can be preferable when considering how to design a specific product. More generally, however, much of what interaction design is about is understanding and augmenting people. In this context, using the term *people* is better, because it is broader, being able to refer to a single person, a group of people, or even whole societies, which is appropriate when describing large social media systems. Here, in the new edition of our textbook, we have changed primarily to using *people-centered* design but have continued to use the term *user-centered* when referring specifically to using an interface.

Customer experience (CX), on the other hand, refers to all of the interactions someone has with a company's offering, including the overall experience, the probability they will continue to use it, and the likelihood they will recommend it to others. In this sense, the UX is part of the wider CX, but the CX covers other aspects that the UX has traditionally not covered (Lowden, 2014). ■

Video Don Norman explains why adopting a people-centered approach is the way forward: **interaction-design.org/literature/topics/people-centered-design.**

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 experience for the intended people. 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 an example of a poorly designed product that has persisted over the years—the ubiquitous remote control—and contrast this with a well-designed example of the same product that performs the same function.

Every home entertainment system, be it the smart TV, streaming video player, home theater 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 buttons, 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 viewer in mind (see Figure 1.1). 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 1.1 The TiVo remote control
Source: 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 people-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 people 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, which once consisted of simply choosing from among a few channels, 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 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 1.2a), 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. Other systems have tried alternatives, such as different arrangements of the alphanumeric characters on-screen; using the numeral keys with their telephone-style associated letters; and sliding a small, physical keyboard from the underside of the remote control. None of these has proven perfect.

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 1.2b). 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.

(*Continued*)

(a) (b)

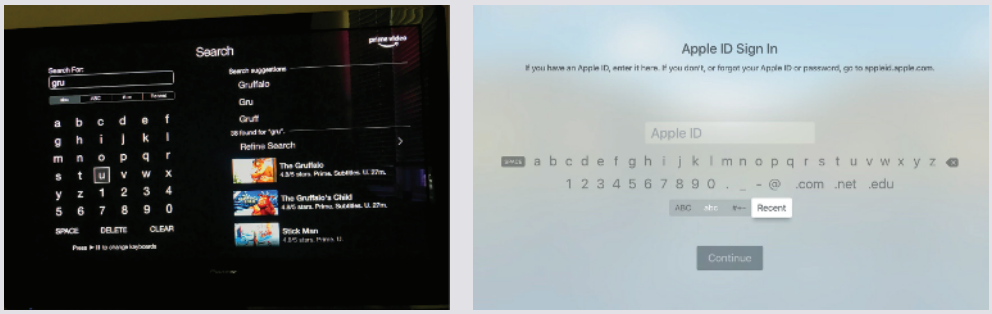

Figure 1.2 Typing on a TV screen (a) by selecting letters and numbers from a square matrix and (b) by swiping along a single line of letters and numbers

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

Might there be a better way to interact with a smart TV while sitting on the sofa? Firestick TV has pared down the number of buttons on its remote controllers to a core set of basic navigation ones (e.g., up, down) needed to interact with its streaming media players. An alternative is to use voice control. Most remote controls 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, a person 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, the Echo will switch on the TV, switch to the right HDMI channel, open Netflix, and begin streaming the specific episode. A recent survey found voice input is becoming ever more popular; one in five TV users now use voice input to find movies, shows, or videos; change the channels; change the volume; or turn the TV on or off (Roettgers, 2019). Some TV content, however, requires the viewer to say that they are older than a certain age by checking a box on the TV display. If the TV could ask the viewer and check that they are 18 or older, 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 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. ■

1.3 Switching to Digital

Many activities that used to be done via a physical artifact have gone digital. Instead of walking up to a machine and buying a ticket or an ATM to withdraw cash, many of us now do such transactions digitally using an app on our smartphone or tablet. Mostly, this has made the tasks easier, quicker, and more convenient. An example is being able to pay for parking via a mobile phone app. Twentieth-century parking meters required drivers to insert coins to rent a parking

space, which meant drivers who didn't have the correct coins couldn't legally park. Now, instead of fumbling around trying to find the right change for the time wanted and slotting this into a physical meter, we can fill in an online form in advance with our details and then pay each time we want to park using a credit card or digital pay app. Our details can then be stored ready for the next time we need to pay for parking, meaning even fewer steps to complete subsequently (see Figure 1.3). It just needs us to type in the parking location number where we plan to park, and the rest is filled in for us by the app. Some apps will even notify us on our phone when the time we have paid for is nearly up, asking if we would like to add time. All we need to do is press a button from our phone. Not only does this form of digital prompting prevent us from risking a fine if we exceed the time limit, but it also provides more revenue for the parking company!

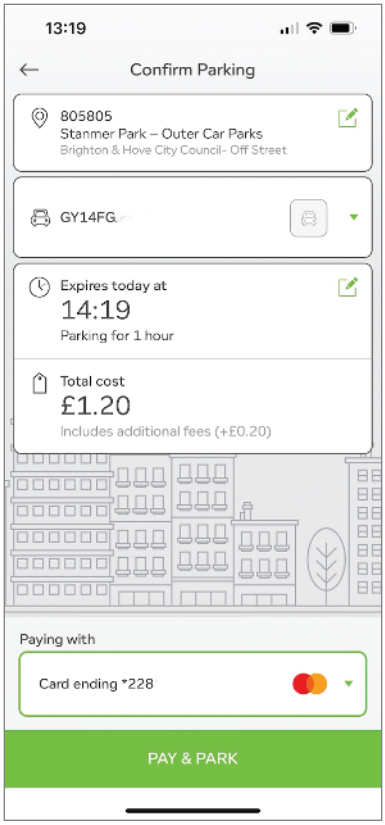

Figure 1.3 The form used for a parking app in the United Kingdom. It takes five seconds to complete and can be done while sitting in the car.

Many previous physical transactions have been digitalized like this. Other examples include buying tickets from an entertainment site (e.g., a movie, a concert, a play) or booking a ticket to go somewhere (e.g., a train, a bus, an airline). An added benefit is not having to wait in line before being able to buy a physical ticket. The customer can also check various

preferences for which kind of ticket they want, which can all be stored and accessed again at a later date. Furthermore, a QR or barcode is usually part of the digital ticket, making it easy to gain entrance through the ticket barrier by swiping their smartphone or watch across it. Another advantage of booking tickets online is having the option of choosing where to sit and, in some situations, ordering food or drinks in advance. Digital tickets can also be stored in digital wallets, which keep a record of all the digital tickets someone has bought.

There are, however, disadvantages of switching over to digital. First, it requires a person to possess a smartphone that is capable of downloading and storing the digital tickets. Second, some people still prefer to use older phones, which the apps won't work on, while others prefer to have paper-based tickets. Third, it can also be stressful and cumbersome to some people—especially if they do not have much battery power left on their phone or they need to fumble around trying to find their glasses to see the apps on their phone. There is of course the option of printing out a digital ticket onto paper, but that assumes someone has access to a printer. A further problem is if the person is entitled to a discount (e.g., student, senior, disabled), it may require them to show a card in person to the ticket collector, which can mean having to switch between apps, which can be cumbersome. People who are disabled using certain assistive technologies might be unable to use a digital ticket, which could lead to legal and ethical issues as well as emotional distress. Another disadvantage is that some people don't like to divulge their personal details online and would prefer to buy a ticket anonymously and pay by cash.

1.4 What to Design

Designing interactive products requires considering who is going to be using them, how they are going to be used, and when 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 a customer to find out information about new services offered by their bank without it being intrusive would be useful.

There are many types of interfaces and interactive devices available now, including multitouch displays, speech-based systems, mobile devices, and wearables. There are also many ways of designing how people can interact with them, for instance, via the use of menus, commands, forms, icons, gestures, and so on. Ever more innovative everyday artifacts are being created using novel materials, such as e-textiles. Wearable glasses that look like fashionable shades have also started to appear, such as Snap Spectacles, that let the wearer experience augmented reality (see Figure 1.4).

The interfaces for everyday consumer items, such as cameras, microwave ovens, toasters, and washing machines, have become predominantly digitally-based. Self-checkouts at grocery stores and libraries have become the norm, where customers check out their own goods or books themselves, and at airports, where passengers check in their own luggage. More recently, smart supermarkets have appeared that do not require the shopper to even have to check out the goods they want to purchase. A sophisticated network of AI-enabled cameras in the ceiling, together with shelves embedded with weight sensors, can determine what a customer picks up and puts in their bag/pocket, billing them as soon as they leave the store.

The smarts are in how the computer vision, sensor fusion, and deep learning are combined to track customers and what they took from or replaced on a shelf. Amazon Go pioneered this type of store, with other supermarkets now testing their own versions.

Figure 1.4 The digital world overlaying the physical experienced when wearing Snap AR Spectacles

Source: www.techeblog.com/new-snapchat-spectacles-augmented-reality

The advent of the Internet of Things (IoT), where data is collected from sensors and travels via the Internet to other devices, has been embedded into several of our household products. For example, a popular household IoT-enabled product is home security, where people can keep an eye on their home from the data relayed to their smartphone via a combination of sensors placed in their home. These include motion detectors, glass breaking detectors, and smart object detectors. A video camera can be attached to someone's doorbell and relayed to a smartphone app so the owner can check up on who has rung it—even though they may be on vacation. Some home-based security cameras also use machine learning that recognizes whether an intruder is trying to break into the house through using facial recognition. Machine learning is also being used in a range of other home-based products, such as automated thermostats like the Nest, which optimizes the temperature settings for a household where the algorithms analyze its energy consumption over time.

A key question for interaction design is this: "How do you optimize a person's interactions with a system, environment, or product so that they support their activities in effective, useful, usable, and pleasurable ways?" Another question that is of growing concern to interaction design is how safe and private is the data being collected? Many decisions need to be made based on an understanding of people including 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 experiences

- Considering a person's privacy concerns if data is being collected about them
- Listening to what people want and getting them involved in the design
- Using people-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 a user's needs and the context of their activities. From this understanding, we move on to consider how to design usable, useful, safe, and pleasurable interactive products.

1.5 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 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).

BOX 1.2

Is Interaction Design Beyond HCI?

We see the main difference between interaction design (ID) and human-computer interaction 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. ■

1.5.1 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.

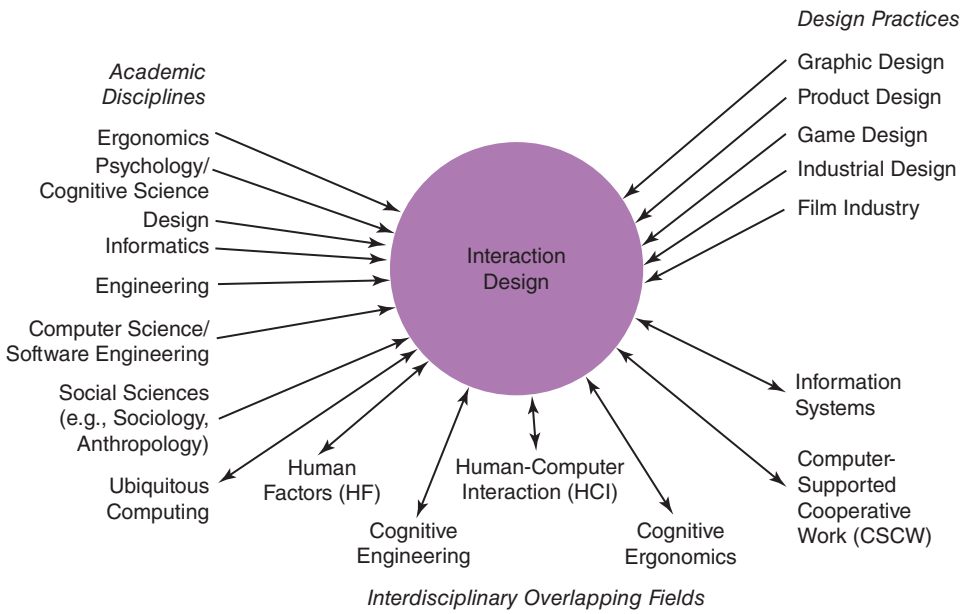

Figure 1.5 Relationship among contributing academic disciplines, design practices, and interdisciplinary fields concerned with interaction design (double-headed arrows mean overlapping)

ACTIVITY 1.1

Since we first created Figure 1.5, many other computer-related fields have emerged where the user is considered central. These include cybersecurity, digital humanities, data science, and digital healthcare. For some fields, there has also been a shift toward being more people-oriented, for example, human-centered AI. Would it make sense to add these, and, if so, how?

Comment

We could add a further section that identifies where interaction design has informed other fields, for example, those where software tools have been developed for scientists/researchers/clinicians to use as part of their methodology. These include the built environment, bioinformatics, medicine, marketing, computational biology, and computational design. We could also try to add a number of other fields and practices that have begun to inform interaction design, including behavioral economics, ethics, accessibility, and AI. Feminism, critical theory, queer theory, post-colonial and political activism have also come to the fore providing alternative lenses by which to examine and explore societal challenges within the scope of interaction design. However, rather than try to add all of these to the diagram—which would make it unwieldy—we have decided to keep it as is, comprising the core disciplines, practices, and overlapping fields. ■

1.5.2 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 people, technologies, and the interactions among them to create effective 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 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. Recently, there has been more emphasis on understanding the ethical aspects, especially for technologies that are collecting ever-increasing amounts of personal data, such as smart speakers and personal healthcare devices. Questions raised include how do we ensure the new technology or product is safe, secure, perceived to be trustworthy and valued, and understandable by the general public?

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, media specialist, 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 1.2

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, screenwriters, information architects, UX researchers, 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. ■

1.5.3 Interaction Design Consultancies

Interaction design is now widespread in product and services development. In particular, UX 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 interaction designers. Financial services, retail, governments, marketing, video and film producers, and the public sector have realized its value, too. The presence or absence of good interaction design can make or break a company. Getting noticed in the highly competitive field of smartphone apps 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 focus on how the branding, the number of engagements, the customer return rate, and customer satisfaction are greatly affected by the usability of a website. Many now have their own toolkits for testing the different aspects of a website, for example, using A/B testing to determine the effect of different UI designs on metrics such as sales or the number of repeat visitors.

There are many interaction design consultancies now. These include established companies, such as Nielsen Norman Group and IDEO, and more recent ones that specialize in

a particular area, such as job board software (for example, Madgex), digital media (e.g., Cogapp), or mobile design (such as CXpartners). Smaller consultancies, such as Bunnyfoot and Dovetailed, promote diversity, interdisciplinarity, and scientific research, having psychologists, researchers, interaction designers, usability, and customer experience specialists on board.

Many consultancies have impressive websites, providing case studies, tools, and blogs. For example, Holition publishes highly engaging case studies and tantalizing videos of their in-house research, intended for the wider community, with a focus on the implications for commercial and cultural aspects. This sharing of knowledge enables them to contribute to the discussion about the role of technology in human experience.

1.6 People-Centered Design

People-centered design involves understanding 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). As Don Norman (2004) stressed earlier, "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 1.3

The Classic 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. They were very popular at the time. Then the smartphone came into being in 2007, which enabled music to be played on it. Playing music via a smartphone became the norm, superseding the need for a separate device. Apple stopped production of their last remaining iPod—the iPod Touch—in 2022. Why do you think the iPod was such a huge success when it came into being? What other products have since been received with so much acclaim?

Comment

Apple realized early on that successful interaction design involves creating interactive products that provide not just usable but also enjoyable experiences. The sleek appearance of the iPod music player (see Figure 1.6), 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 experience paled in comparison to that provided by the iPod. In addition, Apple provided a whole ecosystem to accompany the iPod, including the iTunes store app where millions of licensed music tracks could be bought for less than a dollar each.

Figure 1.6 The iPod Nano
Source: Paul Sakuma / AP Photo

Apple has continued to design products that are both beautiful and usable, most notable are the iPad and the range of iPhones. It even designed what was at the time a completely new customer experience for buying technology in the form of the Apple Store, from how it draws people in and what they do when browsing, discovering, and purchasing goods in the store. There are no checkouts to pay for goods—just roaming Apple employees holding mobile devices that they interact with to make an order for a customer, take payment, and email them a receipt. Apple now has a new kind of retail space, akin to being more like a town square, where everyone is welcome, and various community activities take place weekly, like learning to code. ■

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 people-centered design. Kasper Hornbæk and Morten Hertzum (2017) note how the user experience is often described in terms of the way that people perceive a product, such as whether a smartwatch is seen as sleek, cool, or chunky, and their emotional reaction to it, such as whether people have a positive experience when using it. Marc Hassenzahl, Michael Burmester, and Frank Keller (2021) reflect on the way the user experience has evolved over the last 20 years, noting how there has been a growing interest in designing for hedonic aspects in relation to well-being. 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 someone's expectations and the way they make sense of their experiences when using technology. Their *Technology as Experience* framework accounts for the experience largely in terms of how it feels to someone. Kia Höök (2018) has extended the idea of the felt experience even further, proposing *Soma Design*, which considers how technology can make people more aware of the experience of their felt bodily sensations and movements.

How does one go about designing quality experiences for people? 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.

1.7 Understanding People

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 augment humans and match their needs at the time and place of use. 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 group of people 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. Teenagers enjoy short videos such as the ones they watch and upload to TikTok and YouTube. Conversely, adults often like podcast discussions about topics, which children and teenagers may find 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 people.

Learning more about people and what they do can also reveal incorrect assumptions that designers may have about particular groups and what they need. For example, it is often assumed that because of deteriorating vision and dexterity, older 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 older 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 getting older, associated with 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 (Knowles et al, 2021). 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 groups from different countries. A seemingly trivial but important 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 (05/21/23), whereas in other countries, it is written in the sequence of day, month, year (21/05/23). 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 someone to the format that is set as default? This raises the question of how easily an interface designed for one 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? How does the design and use of social media platforms differ across cultures, such as Weibo and Twitter? The former is used primarily in China by more than 500 million people, whereas the latter is used worldwide by more than 200 million people. A number of cross-cultural studies have been conducted showing significant differences in the microblogging behaviors across these two platforms. For example, a recent analysis by Shi Chen et al. (2021) during the COVID-19 pandemic found that Weibo users were more likely to focus on the disease itself and other health aspects, whereas Twitter users talked more about policy, politics, and other societal issues.

To understand more about people, 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.

1.8 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 and a built-in screen reader, while Apple VoiceOver lets the person 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.

The degree to which a person is considered to be disabled can change over time, for example decreasing as recovery from an accident progresses. In addition, the severity and impact of an impairment can vary over the course of a day or in different environmental conditions. Inability to use a product 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 a disability. Such an inability is viewed as the result of poor interaction design between a person 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 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, as people get older, they find it more difficult to hear conversations in rooms with hard surfaces and lots of background noise.

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. A recent approach is to consider disability interactions (DIX) that combines cross-disciplinary methods from HCI and disability studies to co-create new technologies, experiences, and ways of working with disabled people (Holloway and Barbareschi, 2022). There has also been a push toward designing accessible technology in the developing world (Stein and Lazar, 2022).

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 1.7).

Figure 1.7 Fashionable leg cover designed by Alleles Design Studio
Source: alleles.ca. Used courtesy of Alison Andersen

1.9 Usability and User Experience Goals

Part of the process of understanding people 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 an 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.

1.9.1 Usability Goals

Usability refers to ensuring that interactive products are easy to learn, effective to use, and enjoyable from the person'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 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)
- Enjoyable to use (satisfaction)

Usability goals are typically stated 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 someone 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 them to learn the whole set of functions?"—will elicit far more useful information.

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

(1) *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 carry out their work efficiently, access the information that they need, or buy the goods that they want?

(2) *Efficiency* refers to the way a product supports people in carrying out their tasks. The example mentioned earlier of buying tickets online using stored personal details on the app is considered efficient. Once people have entered all of the necessary personal details in an online form to make a purchase, they can let the website/app 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 is the one-click option, which requires people to click only a single button when they want to make another purchase.

Question: How many steps does it take to complete a task? How does storing a person's personal details make it more efficient?

(3) *Safety* involves protecting a person 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 anyone in any kind of situation to avoid the dangers of carrying out unwanted actions accidentally. It also refers to the perceived fears that someone 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 people with various means of recovery should they make errors, such as an undo function. Safe interactive systems should engender confidence and give people the opportunity to explore the interface to try new operations (see Figure 1.8a). 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 1.8b).

Question: What is the range of errors that are possible using the product, and what measures are there to permit someone to recover easily from them?

(4) *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 them to carry out all of their tasks in the way they want to do them?

(5) *Learnability* refers to how easy a product is to learn to use. Generally, people want to get started right away and become competent at carrying out basic tasks without too much effort. This is true for both interactive products intended for everyday use (for example, social media) and those used only infrequently (for instance, online tax forms). Learning may continue over the lifetime of someone's interaction with a product so that basic use eventually becomes mastery. 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 someone is prepared to spend learning a product.

Question: Is it possible for someone to work out basic use of the product by exploring the interface and trying certain actions? How hard will it be to master the product in this way? Are additional learning tools needed?

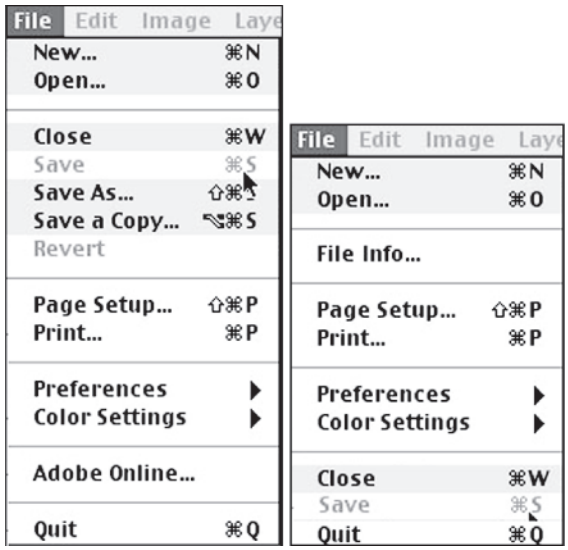

Figure 1.8 (a) A safe and unsafe menu. Which is which and why? (b) A warning dialog box on macOS

(6) *Memorability* refers to how easy a product is to remember how to use, once learned. This is especially important for tasks and interactive products that are used infrequently. If someone hasn'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. They 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. People 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 a 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 someone remember how to carry out tasks, especially for ones they use infrequently?

(7) *Satisfaction* generally refers to how acceptable a product is when being used. It is most often used to measure a customer's experience. Various satisfaction scales have been developed for this purpose, for example, asking customers to give a score from 1–5 to indicate how satisfied they are after using a product. The most well-known one is called the Customer Satisfaction Score (CSAT).

Question: What are the mean, median, and mode values on the CSAT scale? What proportion of users say they are highly satisfied with the product? How many people are still satisfied after using the product for six months?

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) human 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 can be compared with target values to determine whether a product under development is usable enough to be released. However, they do not address the overall quality of the user experience, which is where user experience goals come into play.

1.9.2 User Experience Goals

A diversity of user experience goals have been articulated in interaction design, which covers a range of emotions and felt experiences. These include desirable and undesirable aspects, 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	Creepy
Frustrating	Patronizing	Intrusive
Making one feel guilty	Making one feel stupid	Invasive
Annoying	Cutesy	Deceptive
Childish	Gimmicky	Annoying

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 someone. They differ from the more objective usability goals in that they are concerned with how people 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 person'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) continues to be 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 websites 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.

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 person never tires of doing. Dan Saffer (2014) has described these as *microinteractions* and argues that designing these moments of interaction at the interface—despite being small—can have a big impact on the user experience.

ACTIVITY 1.4

There are many aspects of the user experience listed in Table 1.1. Should you consider all of these when designing a product? What other ones might you include?

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.

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 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) argued that we should be focusing more on the user experience and less on usability. He pointed out how many websites are designed to persuade or influence rather than enable people 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 them 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 is known as *dark patterns*, a term first coined by Harry Brignull (see 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 1.9, the user is taken to another page where they have to uncheck additional boxes and then Update. They are then taken to

(*Continued*)

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 that mailing list.

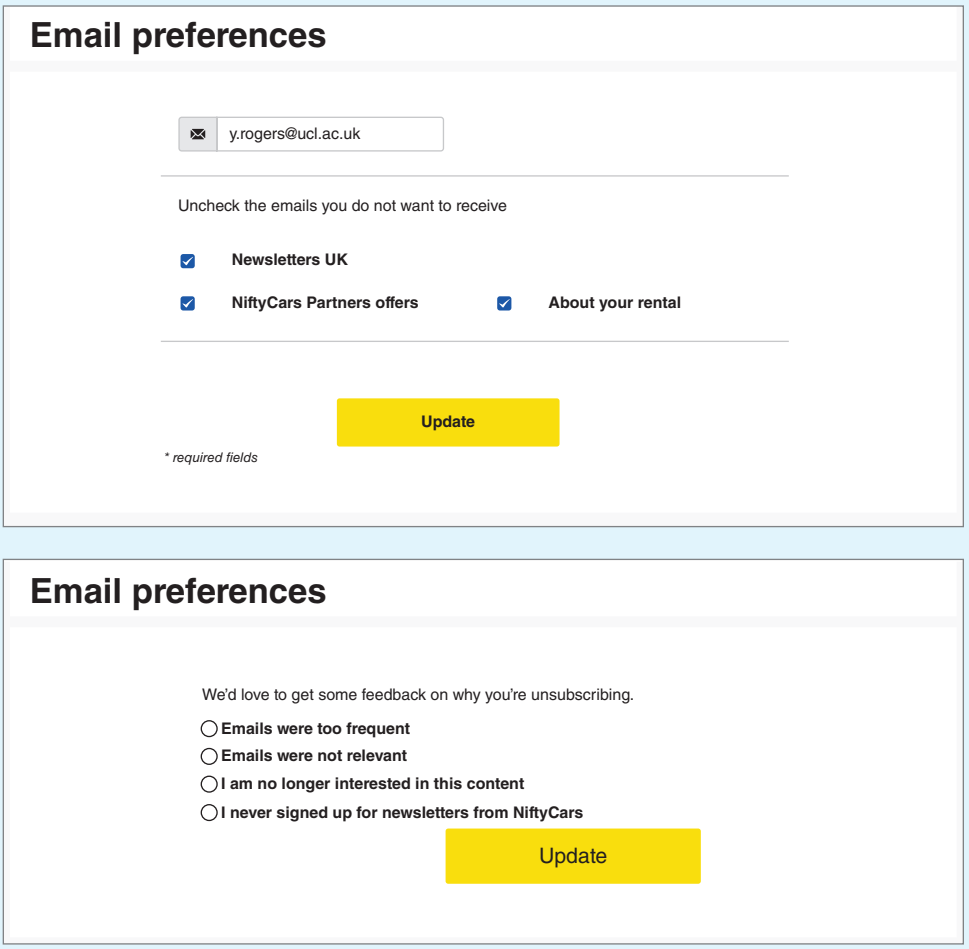

Figure 1.9 Dark pattern for a car rental company

Nudging people can be an acceptable mechanism to use at the interface if it is transparent and users are able to understand and feel comfortable with it. An example is encouraging people to exercise more through using emoji nudges, like badges and hands cheering. However, the use of nudging at the interface can also be insidious. Natasha Loma (2018) points out how it can take on the form of a dark pattern, encompassing "deception and dishonesty by design." She mentions how many kinds of dark patterns are now used to deceive people. 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. Similar to Harry Brignull, she argues that companies should adopt fair and ethical design where people have to opt in to any actions that benefit the company at the expense of their interests.

Another technique that is often used is asking users to rate products by clicking Like or 1–5 stars and adding comments about the product. These can then nudge others to buy a particular product. How many times have you chosen a product over another one, based on it having been mainly rated with five stars versus having more one-to-three star ratings? Do you think this practice is OK? ■

Video Watch Alita Joyce explain the difference between dark patterns and persuasive techniques: **nngroup.com/videos/what-makes-a-dark-ui-pattern**.

1.9.3 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 about what has already been done so that users 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 a 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.

Several design principles have been promoted. The best known are concerned with how to determine what people 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

Visibility refers to how an interface is designed to show what someone needs to do next to progress with their task. 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 made it easy for the driver to find the appropriate control for the task at hand. Newer electric cars, however, have been designed so that the controls are activated from a touchscreen next to the steering wheel. While easier to design and update from an engineering perspective, it can make it harder for the driver to know where to find them.

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 1.10 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, such as 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 1.10 A sign in the restrooms at the Cincinnati airport
Source: Yvonne Rogers

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 which actions are permissible at that stage of the activity (see Figure 1.11). One of the advantages of this form of constraining is that it prevents incorrect options being selected and thereby reduces the chance of making a mistake.

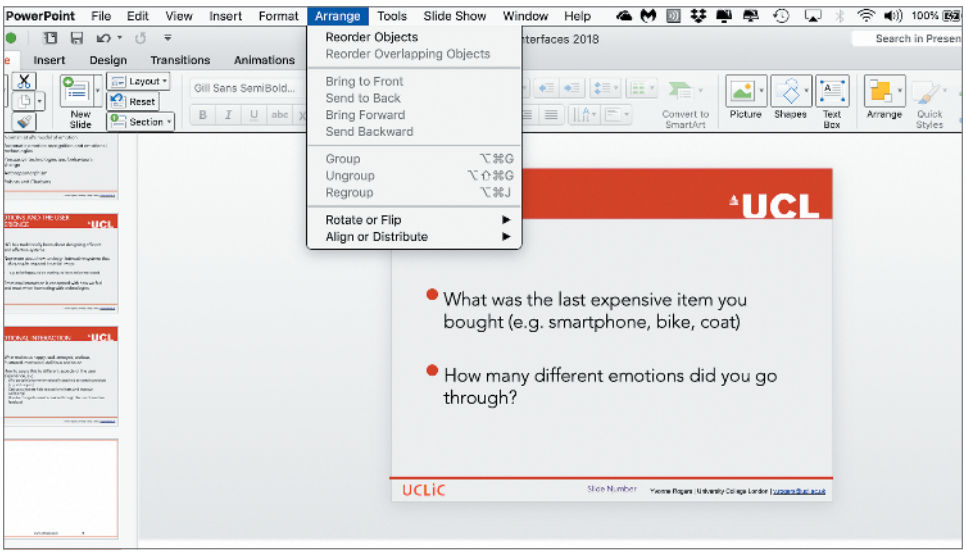

Figure 1.11 A menu showing restricted availability of options as an example of logical constraining. Gray text indicates deactivated options.

Source: Yvonne Rogers

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, most door locks are designed to allow keys to be inserted one way only.

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, requiring learning about 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 that is needed 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 someone 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. This solution is both consistent and highly learnable.

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.

ACTIVITY 1.5

One of the main design principles for website design is simplicity. Jakob Nielsen (1999) originally 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 these days? 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 information 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, branding and formatting can make a site aesthetically pleasing and enjoyable to use. Good interaction design involves getting the right balance between aesthetic appeal and the optimal amount and kind of information. ■

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 or smartwatch, and examine how it has been designed, paying particular attention to how a user is meant to interact with it.

1. From your first impressions, write down what is good and bad about the way the device works.
2. Give a description of the user experience resulting from interacting with it.
3. Outline some of the core microinteractions that are supported by it. Are they pleasurable, easy, and obvious?
4. 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.
5. 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.
6. Repeat steps (3) and (4), but this time use the design principles outlined in the chapter.
7. Finally, discuss possible improvements to the interface based on the answers obtained in steps (4) and (5).

Summary

In this chapter, we have looked at what interaction design is and its importance when developing apps, products, services, and systems. To begin, good and bad designs were contrasted for a device to illustrate how interaction design can make a difference. The pros and cons of transforming everyday activities into being digital was discussed. We described who and what is involved in interaction design and the need to understand accessibility and inclusiveness. We noted how there has been a shift toward embracing people-centered design in place of user-centered design and referring to *people* as a term of reference rather than the user where it seems more appropriate. 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. 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.
- There is a growing shift toward replacing the term *user-centered design* with *people-centered design*.
- Optimizing the interaction between people and interactive products requires consideration of a number of interdependent factors, including context of use, types of activity, design 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 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. Even though this second edition is more than 10 years old, it is still highly relevant to the challenges facing interaction design today. It focuses on how to ask the right questions when designing for a human 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.

HOLLOWAY, C. AND BARBARESCHI, G. (2022) *Disability Interactions: Creating Inclusive Innovations*. Morgan & Claypool Publishers. This lecture series book outlines a new approach to co-creating new technologies, experiences, and ways of working with disabled people, illustrated with many illuminating case studies written by those who have conducted the research.

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 microinteractions right.

STEIN, M.A., and LAZAR, J. (2022) *Accessible Technology and the Developing World*. Oxford University Press. This book is concerned with accessible technology in the developing world. It sits at the intersection of human-computer interaction, policy, law, and development, and is concerned primarily with the accessibility innovations taking place in the Global South and the need to ensure that technology and legal infrastructures in the Global South that are currently being built do not present barriers to people with disabilities.

Source: Harry Brignull

INTERVIEW with Harry Brignull

Harry Brignull is a design director and a user experience expert. He has a PhD in cognitive science, and his work involves helping companies deliver better experiences for users by blending 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 runs darkpatterns.org and is an expert witness—campaigning against deceptive design and working on class action lawsuits and other legal cases to help stamp it 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 a company 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 are 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. Accepting that is a key part of being good at your job. Don't be reluctant to change your mind or throw things away.

A good interaction designer has skills that work like expanding foam. You need to fill the gaps and glue together all the work from your team members. If you don't have a writer present, you need to be able to step up and do it yourself. If you don't have a researcher, you'll need to step up and do that too sometimes. The same goes for developing 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. A lot of your work also involves helping people understand your perspective regarding user needs, problem definition, and the strategy you're trying to use to solve the problem.

You can't expect all of your stakeholders to understand the basics of interaction design—you'll need to teach them on the job.

How has interaction design changed in the past few years?
If I think back to the early days of my career around 2000–2005, there was a lot of techno-optimism with the rise of the web, smartphones, and social media. They all seemed such wonderful enabling things. Most of us didn't realize that there would be downsides too, nor that it would become our jobs to fight against those downsides.

If we think specifically about interaction design practice in industry, what's changed most is how much employers now understand the relationship between design decisions and profit. If you make the sign-up journey easier, revenue goes up. Great—everyone's happy! But what about hiding pricing information until the last step? Everyone hates that—apart from the business owners and shareholders, who like the extra revenue it delivers.

Don't believe me? In 2020, some researchers worked with a large-ticket sales website to look at the effect of hidden fees versus upfront fees ("Price Salience and Product Choice" by Blake et al., 2020). The experiment included several million users. It's the largest test of dark patterns that's ever been published.

The users who weren't shown the ticket fees up front spent about 21 percent more money and were 14 percent more likely to complete a purchase. That is a huge impact. Imagine if you ran a business, and you could press a button to get your customers to spend 21 percent more. This is what we're up against as interaction designers. In some companies, it will be seen as your job to enable cold, hard profit seeking at any cost. Be careful where you end up working—over the years it will change who you are.

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.

I really like working in finance because it's a regulated environment. This is something that most people moan about, but hear me out—a lot of the regulations are about protecting end users from unscrupulous service providers. Our regulatory compliance officers spend their time thinking about user needs and stopping misleading or confusing design. That's like an interaction designer, but with added clout because if the business doesn't listen to them, they're at risk of getting fined! Take my advice, make friends with your compliance team if you have one. They're on your side.

"Master Trust" pension schemes also have a board of trustees. They have a number of responsibilities, but part of their job is to make sure the scheme members (i.e., the end users) get looked after properly. Lots of the things that my team designs have to get approved by the trustees and the compliance officers before they go live. It slows things down a bit, but in finance you

(*Continued*)

really don't want to "move fast and break things." It's a bit like healthcare. These are people's lives we're talking about. I sometimes wonder if we should have similar structures in tech and social media.

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 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 bad 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.