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

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

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

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

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

1.2   Good and Poor Design

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

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

1.2.1 Voice-Mail System

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

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

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

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

What is problematic with this voice-mail system?

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

Now compare it to the phone answering machine shown in Figure 1.1 The illustration shows a small sketch of a phone answering machine. Incoming messages are represented using marbles. The number of marbles that have moved into the pinball-like chute indicates the number of messages. Placing one of these marbles into a dent on the machine causes the recorded message to play. Dropping the same marble into a different dent on the phone dials the caller who left the message.
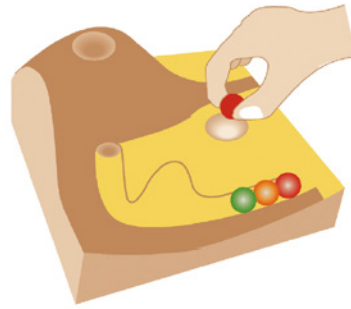
Figure 1.1 The marble answering machine
Source: Adapted from Crampton Smith (1995)

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

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

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

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

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

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

1.2.2   Remote Control

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

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

Figure 1.2 The TiVo remote control
Source: https://business.tivo.com/

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

DILEMMA

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

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

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

More recent remote controls, such as those provided by Apple TV, incorporate a touchpad to enable swiping akin to the control commonly found on laptops. While this form of touch control expedites skipping through a set of letters displayed on a TV screen, it does not make it any easier to type in an email address and password. Each letter, number, or special character still has to be selected. Swiping is also prone to overshooting when aiming for a target letter, number, or character. Instead of providing a grid, the Apple TV interface displays two single lines of letters, numbers, and special characters to swipe across (see Figure 1.3b). While this can make it quicker for someone to reach a character, it is still tedious to select a sequence of characters in this way. For example, if you select a Y and the next letter is an A, you have to swipe all the way back to the beginning of the alphabet.
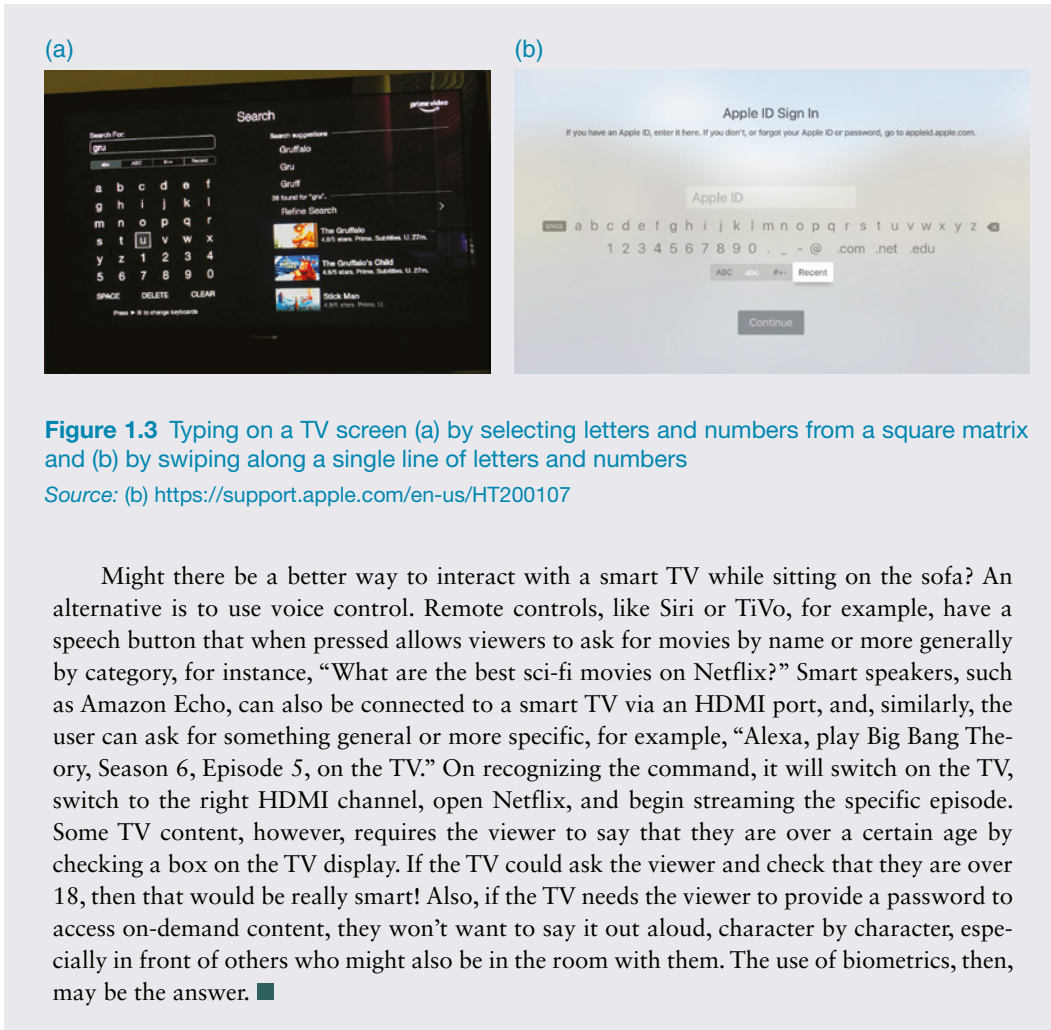
Figure 1.3 Typing on a TV screen (a) by selecting letters and numbers from a square matrix and (b) by swiping along a single line of letters and numbers
Source: (b) https://support.apple.com/en-us/HT200107

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

1.2.1   What to Design

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

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

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

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

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