



Chapter 6

EMOTIONAL INTERACTION

- 6.1 Introduction
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- 6.3 Expressive Interfaces and Emotional Design
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Objectives

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

- Explain how our emotions relate to behavior and the user experience.
- Explain what are expressive and annoying interfaces and the effects they can have on people.
- Introduce the area of emotion recognition and how it is used.
- Describe how technologies can be designed to change people's behavior.
- Provide an overview on how anthropomorphism has been applied in interaction design.

6.1 Introduction

When you receive some bad news, how does it affect you? Do you feel upset, sad, angry, or annoyed—or all of these? Does it put you in a bad mood for the rest of the day? How might technology help? Imagine a wearable technology that could detect how you were feeling and provide a certain kind of information and suggestions geared toward helping to improve your mood, especially if it detected that you were having a real downer of a day. Would you find such a device helpful, or would you find it unnerving that a machine was trying to cheer you up? Designing technology to detect and recognize someone's emotions automatically from sensing aspects of their facial expressions, body movements, gestures, and so forth,

is a growing area of research often called *emotional AI* or *affective computing*. There are many potential applications for using automatic emotion sensing, other than those intended to cheer someone up, including health, retail, driving, and education. These can be used to determine if someone is happy, angry, bored, frustrated, and so on, in order to trigger an appropriate technology intervention, such as making a suggestion to them to stop and reflect or recommending a particular activity for them to do.

In addition, *emotional design* is a growing area relating to the design of technology that can engender desired emotional states, for example, apps that enable people to reflect on their emotions, moods, and feelings. The focus is on how to design interactive products to evoke certain kinds of emotional responses in people. It also examines why people become emotionally attached to certain products (for instance, virtual pets), how social robots might help reduce loneliness, and how to change human behavior through the use of emotive feedback.

In this chapter, we include emotional design and affective computing using the broader term, *emotional interaction*, to cover both aspects. We begin by explaining what emotions are and how they shape behavior and everyday experiences. We then consider how and whether an interface's appearance affects usability and the user experience. In particular, we look at how expressive and persuasive interfaces can change people's emotions or behaviors. How technology can detect human emotions using voice and facial recognition is then covered. Finally, the way anthropomorphism has been used in interaction design is discussed.

6.2 Emotions and the User Experience

Consider the different emotions one experiences throughout a common everyday activity—shopping online for a product, such as a new laptop, a sofa, or a vacation. First, there is the realization of needing or wanting one and then the desire and anticipation of purchasing it. This is followed by the joy or frustration of finding out more about what products are available and deciding which to choose from potentially hundreds or even thousands of them by visiting numerous websites, such as comparison sites, reviews, recommendations, and social media sites. This entails matching what is available with what you like or need and whether you can afford it. The thrill of deciding on a purchase may be quickly followed by the shock of how much it costs and the disappointment that it is too expensive. The process of having to revise your decision may be accompanied by annoyance if you discover that nothing is as good as the first choice. It can become frustrating to keep looking and revisiting sites. Finally, when you make your decision, a sense of relief is often experienced. Then there is the process of clicking through the various options (such as color, size, warranty, and so forth) until the online payment form pops up. This can be tedious, and the requirement to fill in the many details raises the possibility of making a mistake. Finally, when the order is complete, you can let out a big sigh. However, doubts can start to creep in—maybe the other one was better after all... .

This rollercoaster set of emotions is what many of us experience when shopping online, especially for big-ticket items where there is a myriad of options from which to choose and where you want to be sure that you make the right choice.

ACTIVITY 6.1

Have you seen one of the terminals shown in Figure 6.1 at an airport after you have gone through security? Were you drawn toward it, and did you respond? If so, which smiley button did you press?



Figure 6.1 A Happyornot terminal located after security at Heathrow Airport

Source: <https://www.rsrresearch.com/research/why-metrics-matter>. Used courtesy of Retail Systems Research

Comment

The act of pressing one of the buttons can be very satisfying—providing a moment for you to reflect upon your experience. It can even be pleasurable to express how you feel in this physical manner. Happyornot designed the feedback terminals that are now used in many airports throughout the world. The affordances of the large, colorful, slightly raised buttons laid out in a semicircle, with distinct smileys, makes it easy to know what is being asked of the passerby, enabling them to select among feeling happy, angry, or something in between.

The data collected from the button presses provides statistics for an airport as to when and where people are happiest and angriest after going through security. Happyornot has found that it also makes travelers feel valued. The happiest times to travel, from the data they have collected at various airports, are at 8 a.m. and 9 a.m. The unhappiest times recorded are in the early hours of the morning, presumably because people are tired and grumpier. ■

Emotional interaction is concerned with what makes people feel happy, sad, annoyed, anxious, frustrated, motivated, delirious, and so on, and then using this knowledge to inform the design of different aspects of the user experience. However, it is not straightforward. Should an interface be designed to try to keep a person happy when it detects that they are smiling, or should it try to change them from being in a negative mood to a positive one when it detects that they are scowling? Having detected an emotional state, a decision has to

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be made as to what or how to present information to the user. Should it try to “smile” back through using various interface elements, such as emojis, feedback, and icons? How expressive should it be? It depends on whether a given emotional state is viewed as desirable for the user experience or the task at hand. A happy state of mind might be considered optimal for when someone goes to shop online if it is assumed that this will make them more willing to make a purchase.

Advertising agencies have developed a number of techniques to influence people’s emotions. Examples include showing a picture of a cute animal or a child with hungry, big eyes on a website that “pulls at the heartstrings.” The goal is to make people feel sad or upset at what they observe and make them want to do something to help, such as by making a donation. Figure 6.2, for example, shows a web page that has been designed to trigger a strong emotional response in the viewer.



Figure 6.2 A webpage from Crisis (a UK homelessness charity)

Source: <https://www.crisis.org.uk>

Our moods and feelings are also continuously changing, making it more difficult to predict how we feel at different times. Sometimes, an emotion can descend upon us but disappear shortly afterward. For example, we can become startled by a sudden, unexpected loud noise. At other times, an emotion can stay with us for a long time; for example, we can remain annoyed for hours when staying in a hotel room that has a noisy air conditioning unit. An emotion like jealousy can keep simmering for a long period of time, manifesting itself on seeing or hearing something about the person or thing that triggered it.

In a series of short videos, Kia Höök talks about affective computing, explaining how emotion is formed and why it is important to consider when designing user experiences with technology. See www.interaction-design.org/encyclopedia/affective_computing.html.

A good place to start understanding how emotions affect behavior and how behavior affects emotions is to examine how people express themselves and read each other's expressions. This includes understanding the relationship between facial expressions, body language, gestures, and tone of voice. For example, when people are happy, they typically smile, laugh, and relax their body posture. When they are angry, they might shout, gesticulate, tense their hands, and screw up their face. A person's expressions can trigger emotional responses in others. When someone smiles, it can cause others to feel good and smile back.

Emotional skills, especially the ability to express and recognize emotions, are central to human communication. Most people are highly skilled at detecting when someone is angry, happy, sad, or bored by recognizing their facial expressions, way of speaking, and other body signals. They also usually know what emotions to express in a given situation. For example, when someone has just heard they have failed an exam, it is not a good time to smile and be happy for them. Instead, people try to empathize and show that they feel sad, too.

There is an ongoing debate about whether and how emotion causes certain behaviors. For example, does being angry make us concentrate better? Or does being happy make us take more risks, such as spending too much money or vice versa or neither? It could be that we can just feel happy, sad, or angry, and that this does not affect our behavior. Roy Baumeister et al. (2007) argue that the role of emotion is more complicated than a simple cause-and-effect model.

Many theorists, however, argue that emotions cause behavior, for example that fear brings about flight and that anger initiates the fight perspective. A widely accepted explanation, derived from evolutionary psychology, is that when something makes someone frightened or angry, their emotional response is to focus on the problem at hand and try to overcome or resolve the perceived danger. The physiological responses that accompany this state usually include a rush of adrenalin through the body and the tensing of muscles. While the physiological changes prepare people to fight or flee, they also give rise to unpleasant experiences, such as sweating, butterflies in the stomach, quick breathing, heart pounding, and even feelings of nausea.

Nervousness is a state of being that is often accompanied by several emotions, including apprehension and fear. For example, many people get worried and some feel terrified before speaking at a public event or a live performance. There is even a name for this kind of nervousness—*stage fright*. Andreas Komninos (2017) suggests that it is the autonomous system “telling” people to avoid these kinds of potentially humiliating or embarrassing experiences. But performers or professors can’t simply run away. They have to cope with the negative emotions associated with having to be in front of an audience. Some are able to turn their nervous state to their advantage, using the increase in adrenalin to help them focus on their performance. Others are only too glad when the performance is over and they can relax again.

As mentioned earlier, emotions can be simple and short-lived or complex and long-lasting. To distinguish between the two types of emotion, researchers have described them in terms of being either automatic or conscious. *Automatic emotions* (also known as *affect*) happen rapidly, typically within a fraction of a second and, likewise, may dissipate just as quickly. *Conscious emotions*, on the other hand, tend to be slow to develop and equally slow to dissipate, and they are often the result of a conscious cognitive behavior, such as weighing the odds, reflection, or contemplation.

BOX 6.1**How Does Emotion Affect Driving Behavior?**

Research investigating the influence of emotions on driving behavior has been extensively reviewed (Pêcher et al., 2011; Zhang and Chan, 2016). One major finding is that when drivers are angry, their driving becomes more aggressive, they take more risks such as dangerous overtaking, and they are prone to making more errors. Driving performance has also been found to be negatively affected when drivers are anxious. People who are depressed are also more prone to accidents.

What are the effects of listening to music while driving? A study by Christelle Pêcher et al. (2009) found that people slowed down while driving in a car simulator when they listened to either happy or sad music, as compared to neutral music. This effect is thought to be due to the drivers focusing their attention on the emotions and lyrics of the music. Listening to happy music was also found not only to slow drivers down, but to distract them more by reducing their ability to stay in their lane. This did not happen with the sad music. ■



"it's a very user-friendly model."

Source: Jonny Hawkins / Cartoon Stock

Understanding how emotions work provides a way of considering how to design for user experiences that can trigger affect or reflection. For example, Don Norman (2005) suggests that being in a positive state of mind can enable people to be more creative as they are less focused. When someone is in a good mood, it is thought to help them make decisions more quickly. He also suggests that when people are happy, they are more likely to overlook and cope with minor problems that they are experiencing with a device or interface. In contrast, when someone is anxious or angry, they are more likely to be less tolerant. He also suggests that designers pay special attention to the information required to do the task at hand, but especially in the case when designing apps or devices for serious tasks, such as monitoring a process control plant or driving a car. The interface needs to be clearly visible with

unambiguous feedback. The bottom line is “things intended to be used under stressful situations require a lot more care, with much more attention to detail” (Norman, 2005, p. 26).

Don Norman and his colleagues (Ortony et al., 2005) have also developed a model of emotion and behavior. It is couched in terms of different “levels” of the brain. At the lowest level are parts of the brain that are prewired to respond automatically to events happening in the physical world. This is called the *visceral level*. At the next level are the brain processes that control everyday behavior. This is called the *behavioral level*. At the highest level are brain processes involved in contemplating. This is called the *reflective level* (see Figure 6.3). The visceral level responds rapidly, making judgments about what is good or bad, safe or dangerous, pleasurable or abhorrent. It also triggers the emotional responses to stimuli (for instance fear, joy, anger, and sadness) that are expressed through a combination of physiological and behavioral responses. For example, many people will experience fear on seeing a very large hairy spider running across the floor of the bathroom, causing them to scream and run away. The behavioral level is where most human activities occur. Examples include well-learned routine operations such as talking, typing, and swimming. The reflective level entails conscious thought where people generalize across events or step back from their daily routines. An example is switching between thinking about the narrative structure and special effects used in a horror movie and becoming scared at the visceral level when watching the movie.

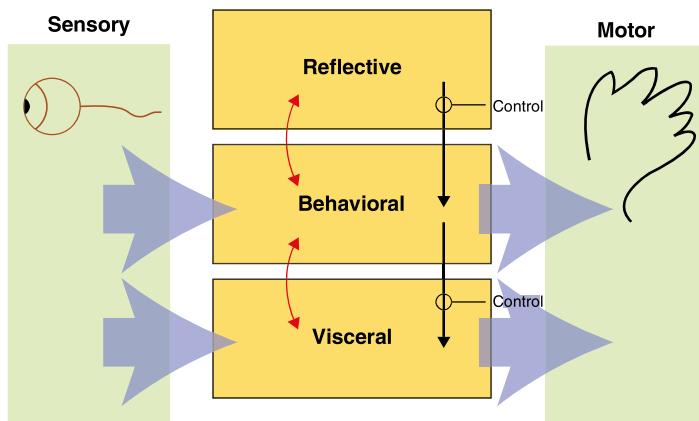


Figure 6.3 Anthony Ortony et al.’s (2005) model of emotional design showing three levels: visceral, behavioral, and reflective

Source: Adapted from Norman (2005), Figure 1.1

One way of using the model is to think about how to design products in terms of the three levels. Visceral design refers to making products look, feel, and sound good. Behavioral design is about use and equates to the traditional values of usability. Reflective design is about considering the meaning and personal value of a product in a particular culture. For example, the design of a Swatch watch (see Figure 6.4) can be viewed in terms of the three levels. The use of cultural images and graphical elements is designed to appeal to users



Figure 6.4 A Swatch watch called Dip in Color

Source: <http://store.swatch.com/suop103-dip-in-color.html>

at the reflective level; its affordances of use at the behavioral level, and the brilliant colors, wild designs, and art attract users' attention at the visceral level. They are combined to create the distinctive Swatch trademark, and they are what draw people to buy and wear their watches.

6.3 Expressive Interfaces and Emotional Design

Designers use a number of features to make an interface expressive. Emojis, sounds, colors, shapes, icons, and virtual agents are used to (1) create an emotional connection or feeling with the user (for instance, warmth or sadness) and/or (2) elicit certain kinds of emotional responses in users, such as feeling at ease, comfort, and happiness. In the early days, emotional icons were used to indicate the current state of a computer or a phone, notably when it was waking up or being rebooted. A classic from the 1980s was the happy Mac icon that appeared on the screen of the Apple computer whenever the machine was booted (see Figure 6.5a). The smiling icon conveyed a sense of friendliness, inviting the user to feel at ease and even smile back. The appearance of the icon on the screen was also meant to be

reassuring, indicating that the computer was working. After being in use for nearly 20 years, the happy and sad Mac icons were laid to rest. Apple now uses more impersonal but aesthetically pleasing forms of feedback to indicate a process for which the user needs to wait, such as “starting up,” “busy,” “not working,” or “downloading.” These include a spinning colorful beach ball (see Figure 6.5b) and a moving clock indicator. Similarly, Android uses a spinning circle to show when a process is loading.

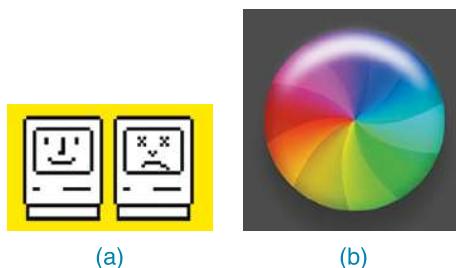


Figure 6.5 (a) Smiling and sad Apple icons depicted on the classic Mac and (b) the spinning beach ball shown when an app freezes

Source: (b) <https://www.macobserver.com/tmo/article/frozen-how-to-force-quit-an-os-x-app-showing-a-spinningbeachball-of-death>

Other ways of conveying expressivity include the following:

- Animated icons (for example, a recycle bin expanding when a file is placed in it and paper disappearing in a puff of smoke when emptied)
- Sonifications indicating actions and events (such as whoosh for a window closing, “schlook” for a file being dragged, or ding for a new email arriving)
- Vibrotactile feedback, such as distinct smartphone buzzes that represent specific messages from friends or family

The style or brand conveyed by an interface, in terms of the shapes, fonts, colors, and graphical elements used, and the way they are combined, also influence its emotional impact. Use of imagery at the interface can result in more engaging and enjoyable experiences (Mullet and Sano, 1995). A designer can also use a number of aesthetic techniques such as clean lines, balance, simplicity, white space, and texture.

The benefits of having aesthetically pleasing interfaces have become more acknowledged in interaction design. Noam Tractinsky (2013) has repeatedly shown how the aesthetics of an interface can have a positive effect on people’s perception of the system’s usability. When the look and feel of an interface is pleasing and pleasurable—for example through beautiful graphics or a nice feel or the way that the elements have been put together—people are likely to be more tolerant and prepared to wait a few more seconds for a website to download. Furthermore, good-looking interfaces are generally more satisfying and pleasurable to use.

BOX 6.2**The Design of the Nest Thermostat Interface**

The popular Nest thermostat provides an automatic way of controlling home heating that is personalized to the habits and needs of the occupants. Where possible, it also works out how to save money by reducing energy consumption when not needed. The wall-mounted device does this by learning what temperature the occupants prefer and when to turn the heating on and off in each room by learning their routines.

The Nest thermostat is more than just a smart meter, however. It was also designed to have a minimalist and aesthetically pleasing interface (see Figure 6.6a). It elegantly shows the temperature currently on its round face and to which temperature it has been set. This is very different from earlier generations of automatic thermostats, which were utilitarian box-shaped designs with lots of complicated buttons and a dull screen that provided feedback about the setting and temperature (see Figure 6.6b). It is little wonder that the Nest thermostat has been a success. ■



Figure 6.6 (a) The Nest thermostat and (b) A traditional thermostat

Source: Nest

For more information about the design of other Nest products, see
<https://www.wired.com/story/inside-the-second-coming-of-nest/>.

6.4 Annoying Interfaces

In many situations, interfaces may inadvertently elicit negative emotional responses, such as anger. This typically happens when something that should be simple to use or set turns out to be complex. The most common examples are remote controls, printers, digital alarm clocks, and digital TV systems. Getting a printer to work with a new digital camera, trying to switch from watching a DVD to a TV channel, and changing the time on a digital alarm clock in

a hotel can be very trying. Also, complex actions such as attaching the ends of cables between smartphones and laptops, or inserting a SIM card into a smartphone, can be irksome, especially if it is not easy to see which way is correct to insert them.

This does not mean that developers are unaware of such usability problems. Several methods have been devised to help the novice user get set up and become familiarized with a technology. These methods include pop-up help boxes and contextual videos. Another approach to helping users has been to make an interface appear friendlier as a way of reassuring users—especially those who were new to computers or online banking. One technique that was first popularized in the 1990s was the use of cartoon-like companions. The assumption was that novices would feel more at ease with a “friend” appearing on the screen and would be encouraged to try things out after listening, watching, following, and interacting with it. For example, Microsoft pioneered a class of agent-based software, Bob, aimed at new computer users (many of whom were viewed as computer-phobic). The agents were presented as friendly characters, including a pet dog and a cute bunny. An interface metaphor of a warm, cozy living room, replete with fire and furniture, was also provided (see Figure 6.7), again intended to convey a comfortable feeling. However, Bob never became a commercial product. Why do you think that was?



Figure 6.7 “At home with Bob” software developed for Windows 95

Source: Microsoft Corporation

Contrary to the designers’ expectations, many people did not like the idea of Bob, finding the interface too cute and childish. However, Microsoft did not give up on the idea of making its interfaces friendlier and developed other kinds of agents, including the infamous Clippy (a paper clip that had human-like qualities), as part of their Windows 98 operating environment. Clippy typically appeared at the bottom of a user’s screen whenever the system thought the user needed help carrying out a particular task (see Figure 6.8a). It, too, was depicted as a cartoon character, with a warm personality. This time, Clippy was released as a commercial product, but it was not a success. Many Microsoft users found it too intrusive, distracting them from their work.



Figure 6.8 Defunct virtual agents: (a) Microsoft's Clippy and (b) IKEA's Anna

Source: Microsoft Corporation

A number of online stores and travel agencies also began including automated virtual agents in the form of cartoon characters who acted as sales agents on their websites. The agents appeared above or next to a textbox where the user could type in their query. To make them appear as if they were listening to the user, they were animated in a semi human-like way. An example of this was Anna from IKEA (see Figure 6.8b) who occasionally nodded, blinked her eyes, and opened her mouth. These virtual agents, however, have now largely disappeared from our screens, being replaced by virtual assistants who talk in speech bubbles that have no physical appearance, or static images of real agents who the user can talk to via LiveChat.

Interfaces, if designed poorly, can make people sometimes feel insulted, stupid, or threatened. The effect can be to annoy them to the point of losing their temper. There are many situations that cause such negative emotional responses. These include the following:

- When an application doesn't work properly or crashes
- When a system doesn't do what the user wants it to do
- When a user's expectations are not met
- When a system does not provide sufficient information to let the user know what to do
- When error messages pop up that are vague or obtuse
- When the appearance of an interface is too noisy, garish, gimmicky, or patronizing

- When a system requires users to carry out too many steps to perform a task, only to discover a mistake was made somewhere along the line and they need to start all over again
- Websites that are overloaded with text and graphics, making it difficult to locate desired information and resulting in sluggish performance
- Flashing animations, especially flashing banner ads and pop-up ads that cover the user view and which require them to click in order to close them
- The overuse or automatic playing of sound effects and music, especially when selecting options, carrying out actions, running tutorials, or watching website demos
- Featuritis—an excessive number of operations, such as an array of buttons on remote controls
- Poorly laid-out keyboards, touchpads, control panels, and other input devices that cause users to press the wrong keys or buttons persistently

ACTIVITY 6.2

Most people are familiar with the “404 error” message that pops up now and again when a web page does not upload for the link they have clicked or when they have typed or pasted an incorrect URL into a browser. What does it mean and why the number 404? Is there a better way of letting users know when a link to a website is not working? Might it be better for the web browser to say that it was sorry rather than presenting an error message?

Comment

The number 404 comes from the HTML language. The first 4 indicates a client error. The server is telling the user that they have done something wrong, such as misspelling the URL or requesting a page that no longer exists. The middle 0 refers to a general syntax error, such as a spelling mistake. The last 4 indicates the specific nature of the error. For the user, however, it is an arbitrary number. It might even suggest that there are 403 other errors they could make!

Early research by Byron Reeves and Clifford Nass (1996) suggested that computers should be courteous to users in the same way that people are to one another. They found that people are more forgiving and understanding when a computer says that it’s sorry after making a mistake. A number of companies now provide alternative and more humorous “error” landing pages that are intended to make light of the embarrassing situation and to take the blame away from the user (see Figure 6.9). ■

(Continued)



Figure 6.9 An alternative 404 error message

Source: <https://www.creativebloq.com/web-design/best-404-pages-812505>

DILEMMA

Should Voice Assistants Teach Kids Good Manners?

Many families now own a smart speaker, such as an Amazon Echo, with a voice assistant like Alexa running on it. One observation is that young children will often talk to Alexa as if she was their friend, asking her all sorts of personal questions, such as “Are you my friend?” and “What is your favorite music?” and “What is your middle name?” They also learn that is not necessary to say “please” when asking their questions or “thank you” on receiving a response, similar to how they talk to other display-based voice assistants, such as Siri or Cortana. Some parents, however, are worried that this lack of etiquette could develop into a new social norm that could transfer over to how they talk to real human beings. Imagine the scenario where Aunt Emma and Uncle Liam come over to visit their young niece for her 5th birthday, and the first thing that they hear is, “Aunty Emma, get me my drink” or “Uncle Liam, where is my birthday present?” with nary a “please” uttered. How would you feel if you were treated like that?

One would hope that parents would continue to teach their children good manners and the difference between a real human and a voice assistant. However, it is also possible to configure Alexa and other voice assistants to reward children when they are polite to them,

for example, by saying “By the way, thanks for asking so nicely.” Voice assistants could also be programmed to be much more forceful in how they teach good manners, for example, saying, “I won’t answer you unless you say ‘please’ each time you ask me a question.” Would this be taking the role of parenting too far? Mike Elgon (2018) cogently argues why voice assistants should not do this. He questions whether by extending human social norms to voice assistants, we are teaching children that technology can have sensibilities and hence should be thought about in the same way that we consider human feelings. In particular, he wonders whether by being polite to a voice assistant, children might begin to think that they are capable of feeling appreciated or unappreciated and that they have rights just like humans. Do you agree with him, or do you think that there is no harm in developing virtual assistants to teach children good manners and that children will learn? Or, do you believe that children will instinctively know voice assistants don’t have rights or feelings?

6.5 Affective Computing and Emotional AI

Affective computing is concerned with how to use computers to recognize and express emotions in the same way as humans do (Picard, 1998). It involves designing ways for people to communicate their emotional states, through using novel, wearable sensors and creating new techniques to evaluate frustration, stress, and moods by analyzing people’s expressions and conversations. It also explores how affect influences personal health (Jacques et al., 2017). More recently, *emotional AI* has emerged as a research area that seeks to automate the measurement of feelings and behaviors by using AI technologies that can analyze facial expressions and voice in order to infer emotions. A number of sensing technologies can be used to achieve this and, from the data collected, predict aspects of a user’s behavior, for example, forecasting what someone is most likely to buy online when feeling sad, bored, or happy. The main techniques and technologies that have been used to do this are as follows:

- Cameras for measuring facial expressions
- Biosensors placed on fingers or palms to measure galvanic skin response (which is used to infer how anxious or nervous someone is as indicated by an increase in their sweat)
- Affective expression in speech (voice quality, intonation, pitch, loudness, and rhythm)
- Body movement and gestures, as detected by motion capture systems or accelerometer sensors placed on various parts of the body

The use of automated facial coding is gaining popularity in commercial settings, especially in marketing and e-commerce. For example, Affdex emotion analytics software from Affectiva (www.affectiva.com) employs advanced computer vision and machine learning algorithms to catalog a user’s emotional reactions to digital content, as captured through a webcam, to analyze how engaged the user is with digital online content, such as movies, online shopping sites, and advertisements.

Six fundamental emotions are classified based on the facial expressions that Affdex collects.

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- Anger
- Contempt
- Disgust
- Fear
- Joy
- Sadness

These emotions are indicated as a percentage of what was detected beside the emotion labels above the person's face appearing on a display. For example, Figure 6.10 shows a label of 100 percent happiness and 0 percent for all the other categories above the woman's head on the smartphone display. The white dots overlaying her face are the markers used by the app when modeling a face. They provide the data that determines the type of facial expression being shown, in terms of detecting the presence or absence of the following:

- Smiling
- Eye widening
- Brow raising
- Brow furrowing
- Raising a cheek
- Mouth opening
- Upper-lip raising
- Wrinkling of the nose

If a user screws up their face when an ad pops up, this suggests that they feel disgust, whereas if they start smiling, it suggests that they are feeling happy. The website can then adapt its ad, movie storyline, or content to what it perceives the person needs at that point in their emotional state.



Figure 6.10 Facial coding using Affdex software

Source: Affectiva, Inc.

Affectiva has also started to analyze drivers' facial expressions when on the road with the goal of improving driver safety. The emotional AI software perceives if a driver is angry and then suggests an intervention. For example, a virtual agent in the car might suggest to the driver to take a deep breath and play soothing music to help relax them. In addition to identifying particular emotions through facial expressions (for example, joy, anger, and surprise), Affectiva uses particular markers to detect drowsiness. These are eye closure, yawning, and blinking rate. Again, upon detecting when a threshold has been reached for these facial expressions, the software might trigger an action, such as getting a virtual agent to suggest to the driver that they pull over where it is safe to do so.

Other indirect methods that are used to reveal the emotional state of someone include eye-tracking, finger pulse, speech, and the words/phrases they use when tweeting, chatting online, or posting to Facebook (van den Broek, 2013). The level of affect expressed by users, the language they use, and the frequency with which they express themselves when using social media can all indicate their mental state, well-being, and aspects of their personality (for instance, whether they are an extrovert or introvert, neurotic or calm, and so on). Some companies may try to use a combination of these measures, such as facial expressions and the language that people use when online, while others may focus on just one aspect, such as the tone of their voice when answering questions over the phone. This type of indirect emotion detection is beginning to be used to help infer or predict someone's behavior, for example, determining their suitability for a job or how they will vote in an election.

Another application of biometric data is being used in streaming video games where spectators watch players, known as *streamers*, play video games. The most popular site is Twitch; millions of viewers visit it each day to watch others compete in games, such as *Fortnite*. The biggest streamers have become a new breed of celebrity, like YouTubers. Some even have millions of dedicated fans. Various tools have been developed to enhance the viewers' experience. One is called All the Feels, which provides an overlay of biometric and webcam-derived data of a streamer onto the screen interface (Robinson et al., 2017). A dashboard provides a visualization of the streamer's heart rate, skin conductance, and emotions. This additional layer of data has been found to enhance the spectator experience and improve the connection between the streamer and spectators. Figure 6.11 shows the emotional state of a streamer using the All the Feels interface.

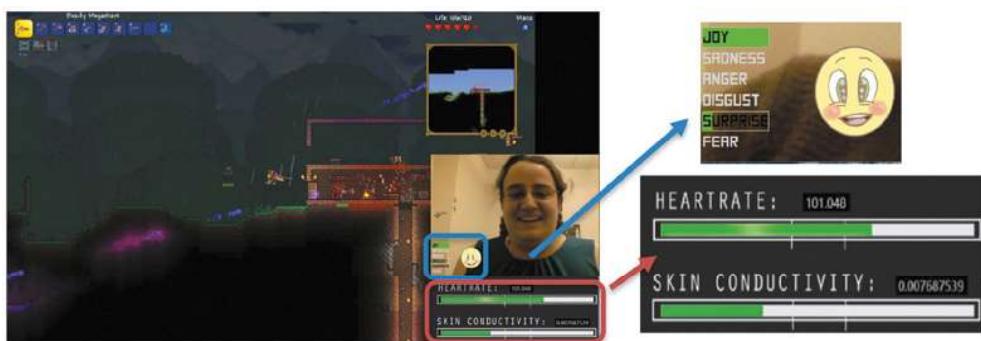


Figure 6.11 All the Feels app showing the biometric data of a streamer playing a videogame

Source: Used courtesy of Katherine Isbister

BOX 6.3**Is It OK for Technology to Work Out How You Are Feeling?**

Do you think it is ethical that technology is trying to read your emotions from your facial expressions or from what you write in your tweets and, based on its analysis, filter the online content that you are browsing, such as ads, news, or a movie to match your mood? Might some people think it is an invasion of their privacy?

Human beings will suggest things to each other, often based on what they think the other is feeling. For example, they might suggest a walk in the park to cheer them up. They might also suggest a book to read or a movie to watch. However, some people may not like the idea that an app can do the same, for example, suggesting what you should eat, watch, or do based on how it analyzes your facial expressions. ■

6.6 Persuasive Technologies and Behavioral Change

A diversity of techniques has been used at the interface level to draw people's attention to certain kinds of information in an attempt to change what they do or think. Pop-up ads, warning messages, reminders, prompts, personalized messages, and recommendations are some of the methods that are being deployed on a computer or smartphone interface. Examples include Amazon's one-click mechanism that makes it easy to buy something on its online store and recommender systems that suggest specific books, hotels, restaurants, and so forth, that a reader might want to try based on their previous purchases, choices, and taste. The various techniques that have been developed have been referred to as *persuasive design* (Fogg, 2009). They include enticing, cajoling, or nudging someone into doing something through the use of persuasive technology.

Technology interventions have also been developed to change people's behaviors in other domains besides commerce, including safety, preventative healthcare, fitness, personal relationships, energy consumption, and learning. Here the emphasis is on changing someone's habits or doing something that will improve an individual's well-being through monitoring their behavior. An early example was Nintendo's PokéMon Pikachu device (see Figure 6.12) that was designed to motivate children into being more physically active on a consistent basis. The owner of the digital pet that lives in the device was required to walk, run, or jump each day to keep it alive. The wearer received credits for each step taken—the currency being watts that could be used to buy Pikachu presents. Twenty steps on the pedometer rewarded the player with 1 watt. If the owner did not exercise for a week, the virtual pet became angry and refused to play anymore. This use of positive rewarding and sulking can be a powerful means of persuasion, given that children often become emotionally attached to their virtual pets, especially when they start to care for them.



Figure 6.12 Nintendo's PokéMon Pikachu device

Source: [http://nintendo.wikia.com/wiki/File:Pok%C3%A9mon_Pikachu_2_GS_\(Device\).png](http://nintendo.wikia.com/wiki/File:Pok%C3%A9mon_Pikachu_2_GS_(Device).png)

ACTIVITY 6.3

Watch these two videos:

The Piano Staircase: <http://youtu.be/2lXh2n0aPyw>

The Outdoor Bin: <http://youtu.be/cbEKAwCoCKw>

Do you think that such playful methods are effective at changing people's behavior?

Comment

Volkswagen sponsored an open competition, called *the fun theory*, asking people to transform mundane artifacts into novel enjoyable user experiences in an attempt to change people's behavior for the better. The idea was to encourage a desired behavior by making it more fun. The Piano Staircase and the Outdoor Bin are the most well-known examples; the stairs sounded like piano keys being played as they were climbed, while the bin sounded like a well echoing when something was thrown into it. Research has shown that using these kinds of playful methods is very engaging, and they can help people overcome their social inhibition of taking part in an activity in a public place (Rogers et al., 2010a).

HAPIfork is a device that was developed to help someone monitor and track their eating habits (see Figure 6.13). If it detects that they are eating too quickly, it will vibrate (similar to the way a smartphone does when on silent mode), and an ambient light will appear at the end of the fork, providing the eater with real-time feedback intended to slow them down. The assumption is that eating too fast results in poor digestion and poor weight control and that making people aware that they are gobbling their food down can help them think about



Figure 6.13 Someone using the HAPIfork in a restaurant

Source: Helen Sharp

how to eat more slowly at a conscious level. Other data is collected about how long it took them to finish their meal, the number of fork servings per minute, and the time between them. These are turned into a dashboard of graphs and statistics so that the user can see each week whether their fork behavior is improving.

Nowadays, there are many kinds of mobile apps and personal tracking devices available that are intended to help people monitor various behaviors and change them based on the data collected and displayed back to them. These devices include fitness trackers, for example, Fitbit, and weight trackers, such as smart scales. Similar to HAPIfork, these devices are designed to encourage people to change their behavior by displaying dashboards of graphs showing how much exercise they have done or weight they have lost over a day, week, or longer period, compared with what they have done in the previous day, week, or month. These results can also be compared, through online leaderboards and charts, with how well they have done versus their peers and friends. Other techniques employed to encourage people to exercise more or to move when sedentary include goal setting, reminders, and rewards for good behavior. A survey of how people use such devices in their everyday lives revealed that people often bought them simply to try them or were given one as a present, rather than specifically trying to change a particular behavior (Rooksby et al., 2014). How, what, and when they tracked depended on their interests and lifestyles; some used them as a way of showing how fast they could run during a marathon or cycle on a course or how they could change their lifestyle to sleep or eat better.

An alternative approach to collecting quantified data about a behavior automatically is to ask people to write down manually how they are feeling now or to rate their mood and for them to reflect upon how they felt about themselves in the past. A mobile app called Echo, for example, asked people to write a subject line, rate their happiness at that moment, and add a description, photos, and/or videos if they wanted to (Isaacs et al., 2013). Sporadically, the app then asked them to reflect on previous entries. An assumption was that this type

of technology-mediated reflection could increase well-being and happiness. Each reflection was shown as a stacked card with the time and a smiley happiness rating. People who used the Echo app reported on the many positive effects of doing so, including reliving positive experiences and overcoming negative experiences by writing them down. The double act of recording and reflecting enabled them to generalize from the positive experiences and draw positive lessons from them.

The global concern about climate change has also led a number of HCI researchers to design and evaluate various energy-sensing devices that display real-time feedback. One goal is to find ways of helping people reduce their energy consumption, and it is part of a larger research agenda called *sustainable HCI*: see Mankoff et al., 2008; DiSalvo et al., 2010; Hazas et al., 2012. The focus is to persuade people to change their everyday habits with respect to environmental concerns, such as reducing their own carbon footprint, their community's footprint (for example, a school or workplace), or an even larger organization's carbon footprint (such as a street, town, or country).

Extensive research has shown that domestic energy use can be reduced by providing households with feedback on their consumption (Froehlich et al., 2010). The frequency of feedback is considered important; continuous or daily feedback on energy consumption has been found to yield higher savings results than monthly feedback. The type of graphical representation also has an effect. If the image used is too obvious and explicit (for instance, a finger pointing at the user), it may be perceived as too personal, blunt, or “in your face,” resulting in people objecting to it. In contrast, simple images (for example, an infographic or emoticon) that are more anonymous but striking and whose function is to get people’s attention may be more effective. They may encourage people to reflect more on their energy use and even promote public debate about what is represented and how it affects them. However, if the image used is too abstract and implicit, other meanings may be attributed to it, such as simply being an art piece (such as an abstract painting with colored stripes that change in response to the amount of energy used), resulting in people ignoring it. The ideal may be somewhere in between. Peer pressure can also be effective, where peers, parents, or children chide or encourage one another to turn lights off, take a shower instead of a bath, and so on.

Another influencing factor is *social norms*. In a classic study by P. Wesley Schultz et al., (2007), households were shown how their energy consumption compared with their neighborhood average. Households above the average tended to decrease their consumption, but those using less electricity than average tended to increase their consumption. The study found that this “boomerang” effect could be counteracted by providing households with an emoticon along with the numerical information about their energy usage: households using less energy than average continued to do so if they received a smiley icon; households using more than average decreased their consumption even more if they were given a sad icon.

In contrast to the Schultz study, where each household’s energy consumption was kept private, the Tidy Street project (Bird and Rogers, 2010) that was run in Brighton in the United Kingdom created a large-scale visualization of the street’s electricity usage by spraying a stenciled display on the road surface using chalk (see Figure 6.14). The public display was updated each day to represent how the average electricity usage of the street compared to the city of Brighton’s average. The goal was to provide real-time feedback that all of the homeowner’s and the general public could see change each day over a period of three weeks. The street graph also proved to be very effective in getting people who lived on Tidy Street

to talk to each other about their electricity consumption and habits. It also encouraged them to talk with the many passersby who walked up and down the street. The outcome was to reduce electricity consumption in the street by 15 percent, which was considerably more than other projects in this area have been able to achieve.



Figure 6.14 Aerial view of the Tidy Street public electricity graph

Source: Helen Sharp

BOX 6.4

The Darker Side: Deceptive Technology

Technology is increasingly being used to deceive people into parting with their personal details, which allows Internet fraudsters to access their bank accounts and draw money from them. Authentic-looking letters, appearing to be sent from eBay, PayPal, and various leading banks, are spammed across the world, ending up in people's email in-boxes with messages such as "During our regular verification of accounts, we couldn't confirm your information. Please click here to update and verify your information." Given that many people have an account with one of these corporations, there is a good chance that they will be misled and unwittingly believe what is being asked of them, only to discover a few days later that they are several thousand dollars worse off. Similarly, letters from supposedly super-rich individuals in far-away countries, offering a share of their assets if the email recipient provides them with their bank details, have persistently been spammed worldwide. While many people are becoming increasingly wary of what are known as *phishing scams*, there are still many vulnerable individuals who are gullible to such tactics. ■

The term *phishing* is a play on the term *fishing*, which refers to the sophisticated way of luring users' financial information and passwords. Internet fraudsters are becoming smarter and are constantly changing their tactics. While the art of deception is centuries old, the increasing, pervasive, and often ingenious use of the web to trick people into divulging personal information can have catastrophic effects on society as a whole.

6.7 Anthropomorphism

Anthropomorphism is the propensity people have to attribute human qualities to animals and objects. For example, people sometimes talk to their computers as if they were humans, treat their robot cleaners as if they were their pets, and give all manner of cute names to their mobile devices, routers, and so on. Advertisers are well aware of this phenomenon and often create human-like and animal-like characters out of inanimate objects to promote their products. For example, breakfast cereals, butter, and fruit drinks have all been transmogrified into characters with human qualities (they move, talk, have personalities, and show emotions), enticing the viewer to buy them. Children are especially susceptible to this kind of magic, as witnessed by their love of cartoons where all manner of inanimate objects are brought to life with human-like qualities.

The finding that people, especially children, have a propensity to accept and enjoy objects that have been given human-like qualities has led many designers to capitalize on it, most notably in the design of virtual agents and interactive dolls, robots, and cuddly toys. Early commercial products like ActiMates were designed to encourage children to learn by playing with them. One of the first—Barney (a dinosaur)—attempted to motivate play in children by using human-based speech and movement (Strommen, 1998). The toys were programmed to react to the child and make comments while watching TV or working together on a computer-based task. In particular, Barney was programmed to congratulate the child whenever they produced a right answer and also to react to the content on-screen with appropriate emotions, for instance, cheering at good news and expressing concern at bad news. Interactive dolls have also been designed to talk, sense, and understand the world around them, using sensor-based technologies, speech recognition, and various mechanical servos embedded in their bodies. For example, the interactive doll Luvabella exhibits facial expressions, such as blinking, smiling, and making baby cooing noises in response to how her owner plays and looks after her. The more a child plays with her, the doll will learn to speak, transforming her babble into words and phrases.

A YouTube video (<https://youtu.be/au2VG9xRZZ0>) shows Luvabella in action and asks viewers to decide whether the interactive doll is creepy or cool. What do you think?

Furnishing technologies with personalities and other human-like attributes can make them more enjoyable and fun to interact with. They can also motivate people to carry out various activities, such as learning. Being addressed in the first person (for instance, “Hello, Noah! Nice to see you again. Welcome back. Now what were we doing last time? Oh yes, Exercise 5. Let’s start again.”) is more appealing than being addressed in the impersonal third person (“User 24, commence Exercise 5.”), especially for children. It can make them feel more at ease and reduce their anxiety. Similarly, interacting with screen characters like tutors and wizards can be more engaging than interacting with a dialog box.

ACTIVITY 6.4

A Robot or a Cuddly Pet?

Early robot pets, such as Sony's AIBO, were made of hard materials that made them look shiny and clunky. In contrast, a more recent trend has been to make them look and feel more like real pets by covering them up in fur and making them behave in more cute, pet-like ways. Two contrasting examples are presented in Figure 6.15a and 6.15b. Which do you prefer and why?



Figure 6.15 Robot pets: (a) Aibo and (b) The Haptic Creature

Source: (a) Jennifer Preece, (b) Used courtesy of Steve Yohanan. Photo by Martin Dee

Comment

Most people like stroking pets, so they may prefer a soft pet robot that they can also stroke, such as the one shown in Figure 6.15b. A motivation for making robot pets cuddly is to enhance the emotional experience people receive through using their sense of touch. For example, the Haptic Creature on the right is a robot that mimics a pet that might sit in your lap, such as a cat or a rabbit (Yohanan and MacLean, 2008). It is made up of a body, head, and two ears, as well as mechanisms that simulate breathing, a vibrating purr, and the warmth of a living creature. The robot “detects” the way it is touched by means of an array of (roughly 60) touch sensors laid out across its entire body and an accelerometer. When the Haptic Creature is stroked, it responds accordingly, using the ears, breathing, and purring to communicate its emotional state through touch. On the other hand, the sensors are also used by the robot to detect the human’s emotional state through touch. Note how the robot has no eyes, nose, or mouth. Facial expressions are the most common way humans communicate emotional states. Since the Haptic Creature communicates and senses emotional states solely through touch, the face was deliberately left off to prevent people from trying to “read” emotion from it. ■

A number of commercial physical robots have been developed specifically to support care giving for the elderly. Early ones were designed to be about 2 feet tall and were made from white plastic with colored parts that represented clothing or hair. An example was Zora (see Figure 6.16), developed in Belgium, that was marketed as a social robot for healthcare. One was bought by a nursing home in France. Many of the patients developed an emotional attachment to their Zora robot, holding it, cooing, and even giving it kisses on the head. However, some people found this kind of robot care a little demeaning. Certainly, it can never match the human touch and warmth that patients need, but there is no harm in it playing an entertaining and motivating role alongside human caregivers.

This video demonstrates how the Zora robot was used to entertain seniors and to help them get some exercise: <https://youtu.be/jcMNY5EnQNQ>.



Figure 6.16 The Zora robot

Source: <http://zorarobotics.be/>

In-Depth Activity

This in-depth activity requires you to try one of the emotion recognition apps available and to see how well it fares in recognizing different people's facial expressions. Download the AffdexMe app or Age Emotion Detector for Apple or Android. Take a photo of yourself looking natural and see what emotion it suggests.

(Continued)

1. How many emotions does it recognize?
2. Try to make a face for each of the following: sadness, anger, joy, fear, disgust, and surprise. After making a face for each, see how well the app detects the emotion you were expressing.
3. Ask a couple of other people to try it. See whether you can find someone with a beard and ask them to try, too. Does facial hair make it more difficult for the app to recognize an emotion?
4. What other application areas do you think these kinds of apps could be used for besides advertising?
5. What ethical issues does facial recognition raise? Has the app provided sufficient information as to what it does with the photos taken of people's faces?
6. How well would the recognition software work when used in a more natural setting where the user is not making a face for the camera?

Summary

This chapter described the different ways that interactive products can be designed (both deliberately and inadvertently) to make people respond in certain ways. The extent to which users will learn, buy a product online, quit a bad habit, or chat with others depends on the believability of the interface, how comfortable they feel when using a product, and/or how much they can trust it. If the interactive product is frustrating to use, annoying, or patronizing, users will easily become angry and despondent and often they stop using it. If, on the other hand, the product is pleasurable, is enjoyable to use, and makes people feel comfortable and at ease, then they will continue to use it, make a purchase, return to the website, or continue to learn.

This chapter also described various interaction mechanisms that can be used to elicit positive emotional responses in users and ways of avoiding negative ones. Further, it described how new technology has been developed to detect emotional states.

Key Points

- Emotional aspects of interaction design are concerned with how to facilitate certain states (for example, pleasure) or avoid certain reactions (such as frustration) in user experiences.
- Well-designed interfaces can elicit good feelings in people.
- Aesthetically pleasing interfaces can be a pleasure to use.
- Expressive interfaces can provide reassuring feedback to users as well as be informative and fun.
- Badly designed interfaces often make people frustrated, annoyed, or angry.
- Emotional AI and affective computing use AI and sensor technology for detecting people's emotions by analyzing their facial expressions and conversations.
- Emotional technologies can be designed to persuade people to change their behaviors or attitudes.
- Anthropomorphism is the attribution of human qualities to objects.
- Robots are being used in a variety of settings, including households and assisted-living homes.

Further Reading

CALVO, R.A and PETERS, D. (2014) *Positive Computing*. MIT. This book discusses how to design technology for well-being to make a happier and healthier world. As the title suggests, it is positive in its outlook. It covers the psychology of well-being, including empathy, mindfulness, joy, compassion, and altruism. It also describes the opportunities and challenges facing interaction designers who want to develop technology that can improve people's well-being.

HÖÖK, K. (2018) *Designing with the Body*. MIT. This book proposes that interaction design should consider the experiential, felt, and aesthetic stance that encompasses the design and use cycle. The approach suggested by the author is called *soma design*, where body and movements are viewed as very much part of the design process, and where a slow, thoughtful process is promoted that considers fundamental human values. It is argued that adopting this stance can yield better products and create healthier, more sustainable companies.

LEDOUX, J. E. (1998) *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*. Simon & Schuster. This book explains what causes us to feel fear, love, hate, anger, and joy, and it explores whether we control our emotions versus them controlling us. The book also covers the origins of human emotions and explains that many evolved to enable us to survive.

McDUFF, D. & CZERWINSKI, M. (2018) Designing Emotionally Sentient Agents. *Communications of the ACM*, Vol. 61 No. 12, pages 74–83. This article provides an accessible overview of the burgeoning area of emotional agents. It presents the challenges, opportunities, dilemmas, concerns, and current applications that are now being developed, including bots, robots, and agents.

NORMAN, D. (2005) *Emotional Design: Why We Love (or Hate) Everyday Things*. Basic Books. This book is an easy read while at the same time being thought-provoking. We get to see inside Dan Norman's kitchen and learn about the design aesthetics of his collection of teapots. The book also includes essays on the emotional aspects of robots, computer games, and a host of other pleasurable interfaces.

WALTER, A. (2011) *A Book Apart: Designing for Emotion*. Zeldman, Jeffrey. This short book is targeted at web designers who want to understand how to design websites that users will enjoy and want to return to. It covers the classic literature on emotions, and it proposes practical approaches to emotional web design.