One

Introduction

Importance, Implications, and Historical Perspectives

Scenario 1

Mary heard the familiar sound of a new message on her iPhone. She unlocked the device with her thumbprint. She clicked on Molly; her thread of messages appeared; and she typed, "Hey, what's up?" A few seconds later she read, "Have an intro psyc test tomorrow … studying the notes online. You?" Mary typed, "Not much, trying to write a paper and looking for refs. Doing a little shopping on the side." She glanced at her shopping cart in the Amazon app, which held a bag of Free Trade coffee and a Pogo coffee mug she was getting for her father's birthday. Just then, both of them noticed that their friend Martha was messaging them, so they opened a multi-chat app. Each girl had her own icon. Mary had a picture of a female vocalist, Molly was a kitten, and Martha had a miniature picture of herself with a big grin. As it turned out, Martha was checking the movie listings and hoping to get the other two girls to go with her to a 3-D movie. Martha enticed them with a movie they had all been talking about seeing together. Mary typed, "OK, I'm done with shopping and my paper isn't due until next Monday. I'm ready." Molly keyed in, "Hey, it's a psyc test, I can wing it. I'm in. Let's go." Mary, Martha, and Molly got up and left the dorm room where they had been sitting together for the past hour, each at her own device.

Scenario 2

Dr. Mike J.:   *Mark can you move that scope just a little to the left? OK, I see it. Yes, there it is. Apply the clamp just to the left on the artery. Perfect. OK, let's get a biopsy on that tissue.*

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Dr. Mark M.:   OK, Mike, I've got the biopsy. Let me just scan it in. Melvin, what's your read on it?

Dr. Melvin N.:   Just a second, I am running a full DNA sequence on it. So, how was the fishing trip, Mark? Catch any trout?

Dr. Mark M.:   Great. Would have got my limit if it hadn't been for this emergency. How was your golf game, Mike?

Dr. Mike J.:   Terrible, I was glad to get out of the game.

Dr. Melvin N.:   The analysis just finished. Take a look. Everything is OK.

Dr. Mike J.:   Wonderful! Mark, you want to close him up and give his wife the good news? Wish I could join you fishing out there in Wyoming. Got to go to a faculty meeting here at Johns Hopkins. Melvin, thanks for quick analysis from DNAtronics, UK!

Contents

1.1   Overview

Since the beginning of the computer revolution, a number of us have been trying to convince our colleagues in psychology about the importance of human–computer interaction (HCI). Some got it, but many didn't. They viewed computer technology as a powerful research tool, but stuck to "basic psychology" for their research. The study of HCI was "too applied" to be of central importance in psychology. Now that the computer revolution is not only over but we have entered into the post-PC era of mobile computing, we psychologists have to acknowledge that a major proportion of human activity is either with a computer interface or mediated through that interface as in Scenario 1.

Amazingly, we have transitioned from a population of computer illiterates to a generation of digital natives. Forty years ago, most computers were locked away behind heavy security doors, and only computer technicians had access to them. Today, personal computers, laptops, tablets, and smartphones are common retail items. Access to the Internet is not an option, it is an essential service. We spend so much time interacting with computers, emailing, and messaging that we may forget that we are communicating with people in the same room, as in Scenario 1, or half way around the world, as in Scenario 2. Nearly every job entails the use of computers on a constant basis. Every cash register, filling station pump, and auto parts lookup station is a computer connected to a network. Every bank, hospital, airline, and social agency runs off networked computers and databases. Scenario 2 illustrates their use in telemedicine. Computers are ubiquitous and pervasive. They are hidden behind the dashboards of our cars; they are at the other end of telephone calls to credit card companies; and they are the brains of our smartphones, digital cameras, game consoles, and devices seen and unseen all around us. There is no escaping daily time with computers. Even if you don't use any electronic device, they are all being used around us, controlling the environment and monitoring our behavior. There are no computer-free days. Consequently, we have to come to grips with their presence in our psychological reality.

Living in a computerized, automated, digital world is different than living in the manual, analog world of the past. What we see and hear today is mediated through computer displays. How we take actions to do things is channeled through computer input devices. Where and how we store and organize things is determined by computer storage media, data structures, and the cloud. How we think and solve problems is either limited or augmented by computer functionality. Who we are, our goals and our aspirations, and even our sense of self are altered by the electronic environment with digital communications, digital images, artificial intelligence (AI), icons, screen names, and passwords.

Psychology as a science and a discipline must do more than merely acknowledge that we live in a digital environment with computers and automation. It must do more than add a footnote, chapter, or illustration to current texts while perpetuating theories developed in the predigital world. Instead, it must rethink its basic theories in every area – from sensory and perception to social and clinical.[1] Fortunately, this is already occurring in many areas. Cognitive science and neuroscience were founded in the digital age, and human factors psychology has embraced the interaction with computers, but some areas have fallen behind. Rather than make too much of this now, instead we will develop and push these areas forward as we go through the successive chapters of this book. In doing so, we will try to cover the full range of psychology. To do this, we will use as our guide the list of topics and chapters in a typical Introduction to Psychology course.

1.2 Psychology or Computer Science? Two Paths, One Journey: A Personal Reflection

In high school, I was interested in science and electronics. So, naturally, I should have majored in science or engineering in college; yet, when I entered Southern Methodist University as a freshman, I decided to major in psychology. My reasoning, suggested by my brother, was that what the world needed was not a better transistor radio or a new formula for plastics, but solutions to the deeper problems of the human mind. I did, however, take one introductory course in computer science, Computers and Society, in which the instructor taught us how to program in a language called PL/1 and covered a wide range of social issues. Many of these issues are still central today, such as computer fraud, AI, privacy, and secrecy. Although tempted to change majors, I stayed in experimental psychology with a parallel interest in computers and mathematics. Through my graduate studies at the University of Iowa and postgraduate work at the University of California at San Diego, I looked for avenues that connected psychology and computer science. I focused on mathematical psychology and computer simulations of human

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[1] I am not as extreme as to say that basic theories need to be discarded or reinvented. I am only saying that we need to rethink them in light of the computer revolution.

judgment and decision making. We were looking for ways of modeling human behavior using equations and computer programs. Along with many others in experimental psychology, I used computers to plan, control, and analyze experiments on learning, memory, judgment, and decision making, using minicomputers such as the PDP-12 and mainframe computers such as the IBM-360.

As it turned out, over the years I found many avenues between psychology and computer science. Psychology used computers as research tools and to model human behavior. The Society for Computers in Psychology (SCiP) was and remains a lively forum for psychologists to share ideas and software.

Computer scientists also had several reasons for being interested in psychology. First, those who were developing ideas in AI were interested in studying human problem solving as a starting point for heuristics and strategies, for common sense and expert knowledge about the world, and as a mind to reverse engineer. Second, as computers started to be used by the masses, those who were programming the computer interface needed to know how people interacted with the computer and why so many "human" errors and frustrations were occurring. This group continues to study the human–computer interface in order to make it more intuitive, easy to use, error free, and require little or no training.

Moreover, there has been a realization in psychology that the world has changed and that there are significant forces on psychological and sociological processes from the digital environment. This has given birth to what is now called "cyberpsychology."

Consequently, we find two groups of people on the path between psychology and computer science: those interested in psychology but looking in the direction of computers for answers, and those interested in computers but looking in the direction of psychology for answers. The merging of these two paths is the goal of this text and my story.

1.3   What Is Human–Computer Interaction?

As psychologists, we are interested in studying human behavior and brain function. Why do people act the way they do? How can we explain and predict behavior? How do people learn, modify, and correct behavior? We are also interested in subjective feelings, perceptions, moods, and emotions. We want to understand how people think, solve problems, and make decisions. All of this has to do with people in the environment interacting with physical stimuli and with one another. As computer technology becomes a greater part of that environment, psychologists will have to come to grips with its impact.

Computer scientists are interested in the theory of computing, the design and construction of computers, the development of computer programs and OSs, and their application to real-world systems such as personal computers, the Internet, and an endless variety of software applications in business,

government, education, and personal use. Ultimately, computer scientists have to deal with the "user" (i.e., the person interacting with the system). To know what to display on the screen and how to interpret user input, they have to ask, "What is this person thinking?" Computer scientists working with the human–computer interface, like psychologists, want to explain and predict user behavior. They want to know how people learn to use applications, how they modify their input, and how they identify and correct their mistakes. They are also interested in subjective impressions and the user experience. What is the attitude of the user? Is the user frustrated, anxious, or satisfied with the interaction? Finally, how do users solve problems, search for information, and make decisions (e.g., click "add to cart")? Today, it seems that most computer scientists working with the human–computer interface and most designers of interactive technologies are doing the work of psychologists. Corporations such as Google, Amazon, and Facebook employ psychologists doing front line psychological research on users, although the results are proprietary.

Thus, the psychology of the human–computer interface is the study of thinking, behavior, and attitudes of the person or groups of people interacting with computers or computer systems. In Chapter 3, we develop this in greater detail by discussing a number of theories and models of the human–computer interface.

1.4 What Is Cyberpsychology?

The prefix "cyber" comes from the word "cybernetics," the study of the operation of control and communication systems and comes from the Greek word for steersman. Cybernetics was popularized by Norbert Wiener (1948/1961) in his book by the same name, *Cybernetics*. In it, Wiener discusses the primary ideas of feedback loops, homeostasis, and the hierarchical structure of machines.

The second part of cyberpsychology, "psychology," refers to the study of human behavior and cognitive processes. When we put the two parts together to create the term "cyberpsychology," we engender a unique synergistic combination. Why? Because we, as humans, are inherently involved in control and communication. When these are mediated by machines, new factors and forces emerge that enhance and extend the purposes and intentions of the individual human mind and the collective purposes of communities of minds.

The study of cyberpsychology involves all aspects of human behavior and thought. One could easily pick up an introduction to psychology textbook and use the table of contents as the collection and the organization of topics. In fact, that has been my plan for this book. We will talk about everything from the biological bases of behavior, sensation and perception, learning and motivation, thinking and problem solving, social processes, and developmental stages, to clinical and counseling psychology and psychotherapy! The difference is that in approaching each topic, we explore the avenues of contact between psychology and the emerging world of computers and digital technology.
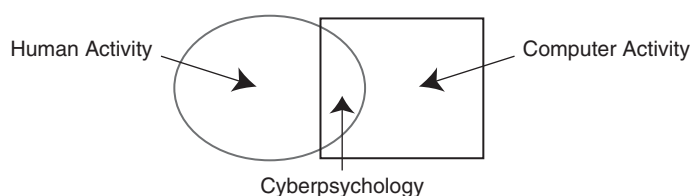
Figure 1.1 Cyberpsychology as the intersection of human and computer activity.

On the computer side, we talk about hardware and software and personal computers, mobile devices and central servers, operating systems (OSs) and human–computer interfaces, local area networks (LANs) and the World Wide Web (WWW), programming and debugging, multimedia and hyper-media, AI and software agents, and so on.

Cyberpsychology as a study is daunting. On one side, we have psychology with a myriad of theories and an exponentially increasing number of research results. On the other side, we have computers with complex technology and rapidly changing applications and devices. How can we cope with two such vast domains without having only one foot in psychology and the other in computer science? Fortunately, instead of there being a void of confusion between the two, there are a number of commonalities, links, and analogs between the two that both simplify the situation and turn it into an intellectual playground for ideas and theories and a powerful laboratory for exploration.

In sum, cyberpsychology is the study of the impact of computers, technology, and virtual environments on the psychology of individuals and groups.

Although HCI refers more to an interface, cyberpsychology includes more of an overlap of space. It is the study of things that pertain to both the lives of humans and the activities of computers. As we go through the topics of this book, we explore what is in the overlap.

Figure 1.1 shows a diagram of areas covered by human activity and computer activity.

1.5 The Impact and Importance of Cyberpsychology and the Human–Computer Interface

The turning point in penetration of computers, the Internet, and related technologies was the beginning of the twenty-first century. It was roughly around the turn of the millennium that we in the United States broke the 50 percent mark in Internet use, personal computer use, and cell phone use. Some countries were ahead, and many have followed, but overall more than 50 percent of the populations of most industrialized countries now spend significant amounts of time interacting with computers and the Internet. Today, many countries have over 90 percent penetration of the Internet.
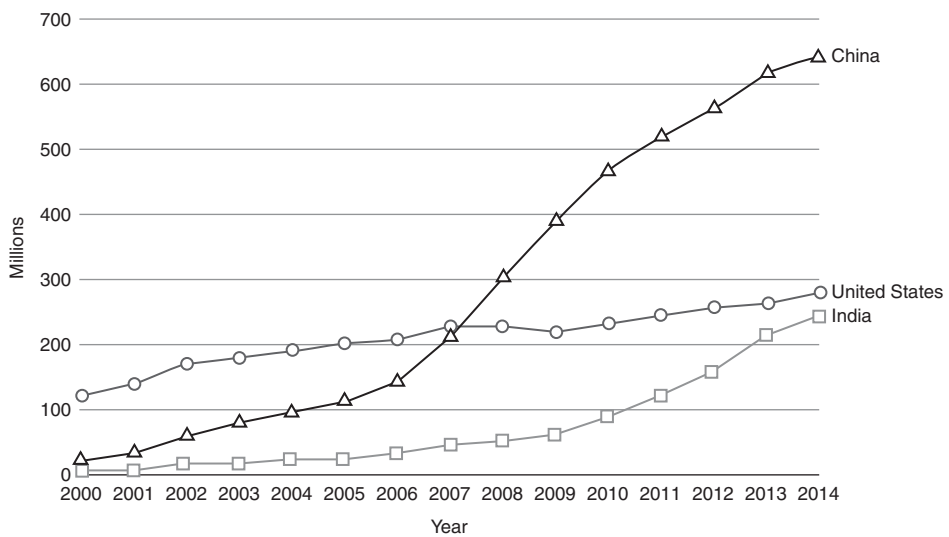
Figure 1.2 World access to the Internet (Produced using data from internetlivestats.com).

Figure 1.2 shows the number of people who had access to the Internet from 1993 to 2014. In 2014, nearly 3 billion people had access to the Internet, just over 40 percent of the world population. China has more than twice as many users as the United States and India will soon surpass the United States.

The sphere of activities of computers has grown drastically over the past decades and engulfed larger amounts of human activity. Over time, the area covered by computer activity has dramatically increased, whereas the size of the area covered by human behavior has remained relatively the same. But as the area covered by computer activity has increased, the overlap with human behavior has increased with it, as illustrated in Figure 1.3.

What is it that fills these areas of overlap between humans and computers? In the early years, it was primarily computer programming, database management, and mathematical and statistical computing. The overlap was limited to a select few computer programmers and analysts, and it was not much of an interface with teletypewriters and line printers. When the personal computer was introduced in the early 1980s, many more people and activities were drawn into the overlap. With the introduction of word processors, more people composed and edited online rather than using paper and pencil or typewriters. Increasingly more of our conscious moments are spent in front of the computer, interacting with the mouse and keyboard. With personal management applications, people started to use electronic calendars, address books, notebooks, and planners. Our smartphones and tablets are ever with us. Our entertainment centers, kitchens, and cars are filled with computer interfaces of one type or another. At the workplace, we have seen a mass conversion to digital devices and databases for secretaries, accountants,
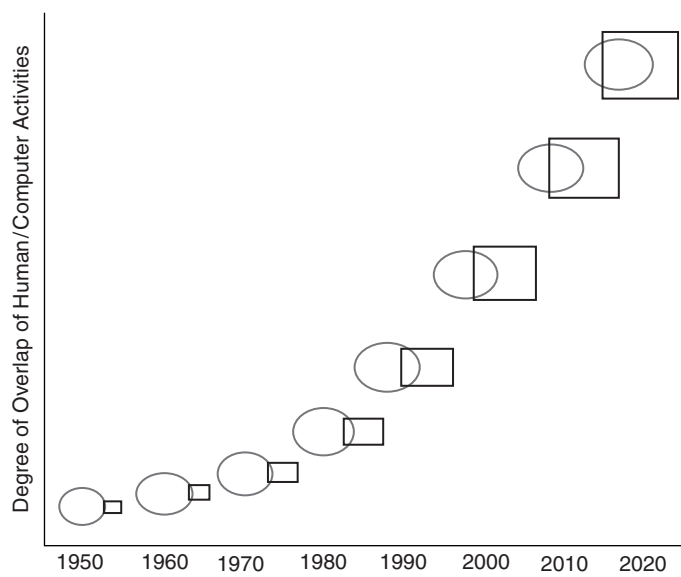
Figure 1.3 The increasing overlap of human activities (ovals) and computer activities (rectangles).

lawyers, librarians, and so on. Nearly every profession has been computerized.

In fact, the overlap has been so encompassing, pervasive, and ubiquitous that in just a few years we have taken it for granted. Now that we live in the age of digital technology, we must consider ourselves in light of the new environment with all of its enabling powers, all of its stresses, and all of its constraints. We must explore the overlap between human activity and computer activity. To do this, we need to understand things from both the perspective of psychology and the development of computers.

1.6   A Brief History of Psychology

Modern beginnings of psychology are credited to a number of influential scientists who pioneered theory and experimental research on behavior and the mind. Among them are Wilhelm Wundt, John Watson, Max Wertheimer, William James, and Sigmund Freud. Extensive histories can be found in other texts (Schultz & Schultz, 2004), but a brief history and a listing of a few names is given here as a review to set the perspective of what modern psychology is founded on and to relate historical forces to current and future directions.

The origins of psychology come from different countries, laboratories, and perspectives. These origins are so diverse that it is amazing that they coalesced into one discipline.
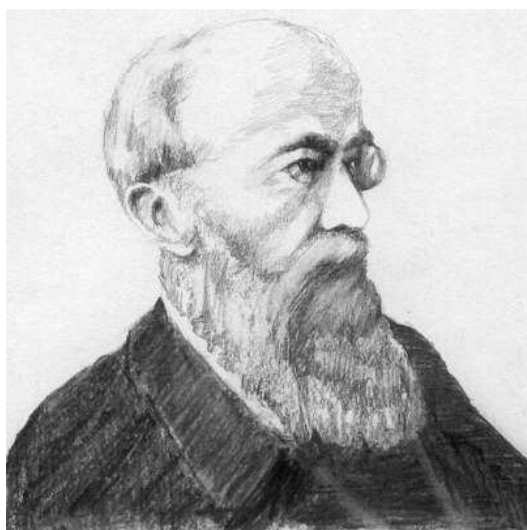
Figure 1.4 Wilhelm Wundt (1832–1920).

1.6.1   Wilhelm Wundt

Wilhelm Wundt (1832–1920) (Figure 1.4) is credited as being the "world's first psychologist." In 1874, he wrote the first textbook on psychology and conscious experience. In 1879, he established the first institute for experimental psychology at the University of Leipzig in Leipzig, Germany. Wundt used the method of introspection to study conscious processes. Observers were trained on how to report the contents of their own immediate states of consciousness (Humphrey, 1963). The purpose of the research was to determine the components of the conscious mind. He emphasized the elements of sensory, perceptual, and response processes.

Wundt used the person as the observer of his or her own impressions, thoughts, and behavior, which has become an important perspective in current psychology and especially in research on HCI. He conceived of the idea that elemental components of consciousness combine to form experiences that are more complex. Consequently, the first thing that researchers needed to do was to identify these components. This idea was later termed "structuralism" by Edward Titchner (1867–1927), one of Wundt's students who popularized the idea in America. Structuralism is the essential concept for understanding how models of HCI are constructed today.

Wundt could also be called the "father of psychology" because between 1876 and 1919 he had more than 100 students who obtained doctoral degrees under his supervision (Fernberger, 1933; Tinker, 1932). A number of these students went on to become famous in their own right. For example, G. Stanley Hall (1844–1924) founded the American Psychological Association in 1892 and James McKeen Cattell (1860–1944) developed the