PART I

Introduction

CHAPTER 1

Cyberpsychology: Changing Roles and Tools

1.1 Cyberpsychology: Defining the Discipline

What is cyberpsychology? The answer is often more in line with a definition of human computer interaction than the emerging psychology of social media and simulation technologies. That said, there are some definitions that tap into cyberpsychology as a subdiscipline of psychology. For example, Norman's (2008) definition breaks the term "cyberpsychology" down into the prefix "cyber" and "psychology." The prefix "cyber" comes from the term "cybernetics," which represents a study of the operation of control and communication systems. The "psychology" part of cyberpsychology refers to the study of behavior and cognitive processing. For Norman, cyberpsychology is best understood as research into the impact of computers, technology, and virtual environments on the psychology of individuals and groups. Alison Attrill (2015) expands the discussion of cyberpsychology to include research into the psychological processes (e.g., motivations, intentions, impacts) and behavioral outcomes that occur relative to an individual's online and offline association with any form of technology. Perhaps one of the most progressive definitions of cyberpsychology (as it relates to contemporary developments in affective computing) is Giuseppe Riva's (2014) definition of cyberpsychology.

> Cyberpsychology is a recent branch of psychology whose main research objects are the processes of change induced by new technologies. Some of these processes are related to and involve a variety of affective processes. The discipline's overlaps with affective computing and human-computer interaction in general are significant, yet its psychological origins suggest that the research communities have somewhat different focuses. (p. 547)

While cyberpsychology is a relatively new discipline, it is one that is growing at an alarming rate. Perhaps this is because humans are witnessing a time of rapid progress in an increasingly connected world. Needless to say, technology is seemingly ubiquitous in the everyday lives of most readers of this text. Users may connect or disconnect from others via multiple telecommunication options: Internet, smartphones, tablets, gaming consoles, and wearables.

The growth of cyberpsychology as a discipline is apparent in the development of dedicated societies, journals, and book series. For example, 2016 marked the 21st Annual Conference on CyberPsychology, CyberTherapy and Social Networking. For over two decades this conference has been a premier cyberpsychology conference and has regularly showcased presentations on studies using virtual-reality, social networking, online behavior, serious games, augmented/mixed reality, virtual humans, virtual worlds, mobile health, and other emerging applications. This conference is the destination of many members of the International Association of CyberPsychology, Training, & Rehabilitation (iACToR). Furthermore, there are currently a number of peer-reviewed academic journals dedicated to cyberpsychology (see Table 1.1).

Table 1.1 *Peer-reviewed academic journals dedicated to cyberpsychology*

Title	Editor-in-Chief	Issues Per Year	Current Volume	Impact Factor
Computers in Human Behavior	Robert Tennyson	1	56	2.694
Cyberpsychology, Behavior, and Social Networking	Brenda Wiederhold	12	18	2.182
Cyberpsychology: Journal of Psychosocial Research on Cyberspace	David Smahel	4	9	N/A
Journal of Computer-Mediated Communication	S. Shyam Sundar	4	20	3.117
Journal of Media Psychology	Nicole Krämer	4	27	0.882
Media Psychology	Silvia Knobloch-Westerwick	4	19	2.457
New Media & Society	Steve Jones	8	17	2.007
Presence: Teleoperators and Virtual Environments	Janet Weisenberger Roy Ruddle	4	24	0.731

Note: The listed journals are examples of established journals that cover cyberpsychology topics. This is not an exhaustive list.

In addition to societies, conferences, and journals dedicated to cyberpsychology, a number of academic-level texts have emerged. Early texts by Riva and Galimberti (2001) "Towards cyberpsychology: Mind, cognition, and society in the internet age" and Norman (2008) "Cyberpsychology: An introduction to human-computer interaction" paved the way for recent publications. New cyberpsychology book series are emerging from publishers such as Cambridge University Press and Palgrave (Palgrave Studies in Cyberpsychology). Examples of recent texts in cyberpsychology include:

- Attrill, A. (Ed.). (2015). *Cyberpsychology*.
- Attrill, A. and Fullwood, C. (Eds.). (2016). *Applied cyberpsychology: Practical applications of cyberpsychological theory and research*.
- Connolly, I., Palmer, M., Barton, H., and Kirwan, G. (Eds.). (2016). *An introduction to cyberpsychology*.
- Power, A., and Kirwan, G. (2013). *Cyberpsychology and new media: A thematic reader*.

The material discussed in these cyberpsychology texts ranges from studies with offline platforms (using desktop computers, word processors, virtual/augmented reality, gaming consoles, and statistics packages) to online Internet use (how we engage in online banking, shopping, dating, and gaming), to mobile phones. Cyberpsychologists view these devices as tools that either facilitate or impede human interaction and communication.

Interestingly, these academic journals and books have offered very limited direct coverage of the rapid progress in brain sciences. This is surprising given the advances in the human neurosciences over the past couple of decades. Specifically, clinical, social, and affective neurosciences have seen extraordinary increases in their theory and praxis (Parsons, 2015). There are now dozens of laboratories around the world that have converged to investigate neurocognitive, affective, and social questions. While there is a great deal of work in cyberpsychology that deals with neural correlates of persons interacting with technology and neuroscientific investigations of cyberpsychology issues, there is no text that pulls together this material for cyberpsychologists. This book is a first attempt at bringing together this information for researchers and students in cyberpsychology.

Why has it taken so long for cyberpsychology to embrace neuroscientific approaches to studying human neurocognitive and affective processes? Potential reasons include the apparent resistance to the notion of neurological reductionism and a belief that an understanding of brain mechanisms is not needed for developing theories and praxes in cyberpsychology. While there are good reasons to question an eliminative materialism that wants to replace words like "mental states" with a vocabulary of "brain states," there are also good reasons to embrace advances in the human neurosciences to inform the theory and praxes of cyberpsychology.

1.1.1 *Cartesian Dualism and Folk Psychology*

Reticence to embrace neuroscientific advances may reflect a received folk psychology that has not kept pace with neuroscientific progress. Folk psychology represents the way most people understand how thinking occurs. A common folk psychological assumption follows a dualism, formulated by Rene Descartes, in which persons are understood as consisting of an immaterial mind that is both ontologically distinct and interactive with a material body. Within Cartesian dualism, the immaterial mind somehow causes actions of the physical body. Furthermore, perceptions are delivered to the immaterial mind from the material body. According to Descartes, this interaction takes place in the brain's pineal gland. Unfortunately, he never clarified how a completely immaterial mind could have a causal effect on the material brain, or vice versa.

If the cyberpsychologists want to maintain a Cartesian dualist perspective (though I would wager that many do not), then the differences in the vocabularies of cyberpsychology and neuroscience might limit interdisciplinary theorizing. From a Cartesian dualist perspective, the vocabulary of cyberpsychology belongs to the social sciences and includes mental terms such as understanding and identity. It is tailored for the description of behavioral phenomena – both psychological and social. Contrariwise, for the Cartesian dualist the vocabulary of neuroscience belongs to the biological sciences. This vocabulary includes material terms such as hemodynamic response and white matter tracts. This vocabulary is tailored to describe physical occurrences. Hence, a Cartesian dualism seems to preclude any reconciliation between the mental terms of cyberpsychology and the material terms of neuroscience.

1.1.2 *Behaviorism and the Cognitive Revolution*

In the early twentieth century, behaviorism arose out of developments in psychology and philosophy, which came together and challenged Cartesian Dualism. For the behaviorists, mental events can be reduced to stimulus-response pairs. Moreover, descriptions of observable behavior are the only scientific way to describe mental behavior. Hence, for the behaviorists, utterances about mental events (e.g., images, feelings, desires) are better understood using a vocabulary of behavioral dispositions. This behavioral revolution transformed experimental psychology and established a new vocabulary. Words like "perception" became "discrimination," "language" became "verbal behavior," and "memory" became "learning." In response to the behaviorist revolution, a cognitive counter-revolution occurred. George Miller (2003) of Princeton University was part of the cognitive revolution, in which psychology freed itself from behaviorism and restored cognition to scientific respectability. Following the cognitive revolution, words like "cognition" were defined as processing of information incoming to the brain from the external environment through sensory entrances. Within the pervasive Computational Theory of Mind found in cognitive science "cognition" is often used as a mark of brain functions used to facilitate behavioral adaptations and survival.

1.1.3 Rethinking the Cognitive Revolution from an Affective Neuroscience Perspective

Since the ushering in of the cognitive revolution in psychological science, the term "cognitive" has been one of the most widely used conceptual terms in behavioral neuroscience. That said, there are some that argue that the resulting choice of conceptual terms used to describe mental functions may actually limit research by constraining study results to ostensibly expedient "conceptual" categories that actually are not reflective of neurobiological processes. Howard Cromwell and Jaak Panksepp (2011) argue that the term "cognition" has been both overused and misused. Moreover, they contend that top-down perspectives found in cognitive approaches miss the affective and motivational "state-control" perspectives. Specifically, they call for a greater inclusion of a bottom-up affective neuroscience approach, in which lower-level (i.e., subcortical) brain networks are foundational for the construction of higher-level (cortical) "information-processing" aspects of mind.

1.1.4 Social Cognitive Affective Neuroscience

A recent development in the understanding of mental events is the acceptance of the fact that not all cognitive and/or affective processes occur in isolation of other people. This is important because a good deal of cognitive neuroscience research has focused on the cognitions and/or affects of persons in isolation from others. Today, we find social neuroscientists endeavoring to answer central questions about the nature of human social cognition by adding neuroscience techniques to methods used by social scientists (Adolphs, 2009; Cacioppo, 1994; Ochsner & Lieberman, 2001). Social neuroscience is a discipline that endeavors to identify the genetic, cellular, neural, and hormonal mechanisms that underlie social behavior (Cacioppo et al., 2010). Through these investigations, social neuroscientists seek a greater understanding of the reciprocal associations and influences among social and neurobiological levels of organization. Much of this work has resulted from our growing interest in the human brain's ability to facilitate, make use of, and be molded by social interactions (Cozolino, 2014; Gazzaniga, 2008; Lieberman, 2013). While research into the neural correlates of social processes has been discussed in the literature for decades (Cacioppo & Bernston, 1992), the advent of functional neuroimaging has resulted in a period of rapid expansion (Adolphs, 2003; Ochsner & Lieberman, 2001).

1.1.5 Extended Cognition via Technology

An additional component for our understanding of cognitive, affective, and social processes for cyberpsychology is the notion that technology is an extension of our cognitive processes. It is becoming increasingly apparent that the social media technologies (e.g., Internet, Twitter, texting, smartphones) have the potential to extend our cognitive processes beyond the embodied cognition of our forebears. Theorizing in this area by Andy Clark and David Chalmers (1998) has resulted in an "extended mind" theory, in which cognitive processes are understood as going beyond wetware (i.e., brain) to software and hardware used by the brain. This perspective allows for an understanding of human cognition as processed in a system coupled with the environment (Clark, 2008; Clark & Chalmers, 1998). In their work, they describe the "extended mind" in terms of an extended cognitive system that includes both brain-based cognitive processes and external objects (e.g., technologies like the Internet) that serve to accomplish functions that would otherwise be attained via the action of brain-based cognitive processes acting internally to the human. The potential for the extended cognitive processing perspective seems even more apparent with the advent of mobile technologies. Whilst early iterations of the Internet were bounded by wires, later iterations only had to be in close proximity to a router. Today, with the arrival and augmentation of tablets and smartphones, the enormous knowledgebase of the Internet is available in one's pocket. The number of tablets and smartphones in use is rapidly approaching the point where billions will have access. Furthermore, the technological properties of smartphones proffer a number of enhancements to discussions of externalization. While early metaphors focused on external memory storage, smartphones connected to the Internet extend beyond memory assistants to powerful mobile computation devices. In fact, mobile technologies connected to the Internet allow for novel investigations into the interactions of persons as they engage with a global workspace and connected knowledgebases. Moreover, mobile access to the Internet may allow for interactive possibilities: a paradigm shift in how we see ourselves and the ways in which we understand the nature of our cognitive and epistemic capabilities.

1.2 Neuroscience and Cyberpsychology

To encourage the inclusion of brain science research in the cyberpsychology domain, this book emphasizes the potential of neuroscience for the study of cognitive, affective, and social processes found in cyberpsychological research and the neural systems that support them. Given these emphases, cyberpsychology will be understood as a branch of psychology that studies (1) the neurocognitive, affective, and social aspects of humans interacting with technology; and (2) affective computing aspects of humans interacting with devices/systems that incorporate computation. As such, the cyberpsychologist studies both the ways in which persons make use of devices and the neurocognitive processes, motivations, intentions, behavioral outcomes, and effects of online and offline use of technology. This expanded definition and framework emphasizes a network approach to brain function that provides a principled approach to predicting cyberpsychological processes associated with specific brain systems. In this framework, a systems neuroscience view is adopted that considers cyberpsychological processes (cognitive and affective functions during media use) to arise from the interactions of brain areas in large-scale distributed networks (Bressler & Menon, 2010; Mesulam, 2000). Findings from systems neuroscience have characterized specific large-scale brain networks that are identifiable in the brain both while it is active and when it is at rest (Seeley et al., 2007). The three most prominent networks are the executive control network, the default mode network, and the saliency network. The first two networks can be recognized straightforwardly by observing the profile of activation and deactivation typically found during cognitive tasks. The executive control network typically shows increases in activation during cognitively demanding tasks, whereas the default mode network has decreased activation. The third network is a salience network that processes affective stimuli and allows for switching between the competitive interactions of two other major networks.

While some of these processes are controlled processes in which nodes are activated through the controlled attention of the person, other processes are activated automatically without the necessity for conscious control or attention by the person (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977). This dual-process perspective that human cognition may be made up of automatic and controlled processes was introduced by William James (1890) over a century ago. Dual-process models of automatic and controlled processes have been proposed in nearly every domain of executive functioning. Specifically, controlled processes (e.g., inhibiting a prepotent response during the Stroop task) are associated with conscious awareness, effort, intention, and the capacity for inhibition. Contrariwise, automatic processes (e.g., overlearned responses like reading) are not necessarily in conscious awareness and occur spontaneously (see Table 1.2).

Examples of automatic and controlled processing in cyberpsychology literature are plentiful: automatic and controlled assessments of social status on social media sites (Slagter van Tryon & Bishop, 2012); automatic and controlled social browsing and social searching on Facebook (Wise, Alhabash, & Park, 2010); relationships between individual differences in

Table 1.2 *Dual processes theories: Automatic and controlled processes*

Automatic	Controlled
Fast processing Spontaneous (heuristics and biases) Parallel processing Non-reflective consciousness	Slow processing Effortful and deliberate Serial processing Reflective consciousness
Phylogenetically older	Phylogenetically older
Similar across species	Unique in humans
Independent of general intelligence	Correlated with general intelligence
Brain Regions: Ventromedial prefrontal cortex, dorsal anterior cingulate cortex, lateral temporal cortex, ventral striatum, amygdala	Brain Regions: lateral prefrontal cortex, medial prefrontal cortex, lateral and medial posterior parietal cortex, rostral anterior cingulate cortex, hippocampus and surrounding medial temporal lobe

Note: Descriptions of the brain areas can be found in Chapter 2 of this book.

automatic and controlled aspects of self-regulation and problematic Internet use (Billieux & Van der Linden, 2012); effects of distracting ads on automatic responses and controlled processing of online news stories (Kononova, 2013); automaticity and executive control in videogames (Boyle et al., 2013); and the use of virtual-reality environments for assessment of the supervisory attention system in lieu of automatic and controlled processes (Armstrong et al., 2013; Parsons et al., 2011; Parsons, Courtney, & Dawson, 2013).

This chapter provides an introduction to large-scale brain networks, the automatic and controlled processes involved in each, and their applications to a framework for cyberpsychology and the brain. This framework aims to emphasize the study of neurocognitive processing and behavior in relation to the ways in which persons use and communicate via technological devices.

1.3 Large-Scale Brain Networks

From the neurosciences, we have learned of the collaborative function of brain areas working together as large-scale networks (Bressler, 1995; Mesulam, 1990; Sporns et al., 2004). The neuroanatomical structures of large-scale brain networks offer a network of linked brain areas that expedites signaling along particular pathways to support specific neurocognitive functions (see Chapter 2; Figure 2.9). Over the course of evolutionary development, the primate brain has evolved to increase survival via behaviors that are adaptive to multifarious environmental contingencies. The result is a brain with large-scale brain networks that can be used to analyze environmental conditions, compare perceptual information with learned concepts, and ultimately generate solutions to the immediate environmental contingencies. There is a growing acceptance of the idea that the brain is a collection of interconnected large-scale brain networks acting together to generate solutions and corresponding behaviors (Bressler & Menon, 2010). Hence, large-scale functional networks can be understood as networks of interconnected brain areas that interact to cause circumscribed functions (Mannino & Bressler, 2015).

1.3.1 Executive-Control Network

The brain's large-scale functional networks apply organized effects on cortical areas, subcortical brain structures, and effector organs during a variety of neurocognitive functions. Large-scale functional networks