Book Review

Affective Computing and Interaction:
Psychological, Cognitive and Neuroscientific Perspectives

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Affective Computing and Interaction: Psychological, Cognitive and Neuroscientific Perspectives
Didem Gökçay and Gülsen Yildirim (Eds.).
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INTRODUCTION

"Without having a scientifically deep understanding of cognition, we can't create the software that could spark the singularity." Paul Allen (Allen & Greaves, 2011)

In the recently published *Affective Computing and Interaction: Psychological, Cognitive and Neuroscientific Perspectives,* edited by Gockay and Yildrim, we find such spark in the world's (first?) collection of international research linking contemporary issues in neuroscience, psychology and cognitive science to the social discourse between humans and machines. The contributors to this volume are moving away from conventional wisdom on cognition by focusing on the interaction between humans and machines. The book represents the present and future of the 21st century conversation that is human-machine symbiosis. The sections or topics of the book - affective neuroscience, affect in non-verbal communication, affect in language-based communication and human-computer interaction – when placed together in a single volume, point to a pre-paradigm shift. All of these topics are formed in the context of ideas that overturned or shook-up bedrock concepts in cognition. As such, the sections are springboards for further shift.

The significance of the material presented by Gockay and Yildrim is that the next level of conversation between human and machine is being created using scientific evidence of

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the importance and contribution of affect, not just in cognition, but in our lives, health and interactions. The research presented in *Affective Computing and Interaction* taps into affective research discoveries in neurophysiology, psychology and cognitive science. What's unusual in Gockay and Yildrim's volume, and in the context of affective user interaction in general, is that although each of these disciplines has many components and are often treated separately, for the purpose of considering affectively intelligent dialogue, they are integrated, because each affects the other.

The book is organized as a teaching tool and most chapters are written as tutorials or surveys. Each one follows a similar story-telling format that makes the interdisciplinary material easy to read. *Affective Computing and Interaction: Psychological, Cognitive and Neuroscientific Perspectives* may also serve as a reference in reviewing basic foundations of emotions in the neuro- and cognitive sciences and psychology, because many of the chapters reference decades of research in their respective fields.

The intended audience is computer science, but studies by Clifford Nass's team and others tell us we (humans) not only anthropomorphize our machines, but have begun to treat one another as machines, so the book also has significance and relevance to fields outside of computer science, including social anthropology and rehabilitation medicine. The Gockay and Yildirim book is also of interest to futurists and educators, because it is an example of the likely shape of knowledge to come. It contains a collection of interdisciplinary concepts inspired by a singularity of purpose, and built from the vantage point of a world-wide scientific superbridge that is composed of bridges on top of bridges connecting fields of study that each gives us new discoveries.

Paul Allen reflected that scientific progress is affected in part "by the creativity of researchers in dreaming up new theories. It is also governed by the ways that we socially organize research work in these fields, and disseminate the knowledge that results" (Allen & Greaves, 2011). In Gokcay and Yildirim's book there is an emphasis of psychology, cognitive science and neuroscience, with a heavy slant towards neuroscience. However, within the context of understanding and building enhanced human machine interactions, it also relates to the fields of sociology, anthropology, education, telecommunications, psychoneuroimmunology, psychoneuroendocrinology, behavioral medicine, preventive medicine and more. The integration of discoveries and innovations across these disciplines is giving rise to new fields of study such as *social signal processing* (Chapter 7, "Towards a Technology of Nonverbal Communication: Vocal Behavior in Social and Affective Phenomena" by Alessandro Vinciarelli at the University of Glasgow) and *psychophysiology* (Chapter 3, "Emotional Axes: Psychology, Psychophysiology and Neuroanatomical Correlates" by Didem Gockay, Middle East Technology University).

Gockay and Yildirim's book comes to press at the same time as a similar book by Sherer, Banziger and Roesch entitled *A Blueprint for Affective Computing: A Sourcebook and Manual* (Sherer et al., 2010). Both books are comprehensive interdisciplinary collections, but, blueprint or not, Gockay and Yildrim's book is richer and more tightly connected to neuroscience, where many of the most remarkable discoveries on affect are being made. To Molyneux's 300-year-old question "Is there a connection between touch and sight?" or more broadly, is there a common association of space among our senses, neuroscientists have provided us with "fossil records" – evidence-based accounts that neurons in cortical regions devoted to one sensory modality in fact respond to two or more modalities (Falchier et al., 2002). Psychologists and philosophers no longer need to debate such questions in abstract terms but can include real evidence from high-density electrophysiology, functional magnetic resonance imaging (fMRI), structural MRI including diffusion tensor imaging (DTI), positron emission tomography (PET) and immune and endocrine measures.

For reasons that may never be clear, emotions and affect were minimized or ignored in a variety of fields, most notably AI. It turns

out affect is deeply intertwined with cognition and the brain and consequently, many aspects of our health:

- Rate of wound healing is affected by emotional happiness (DeVries et al., 2007).
- Lower cardiovascular reactivity is related to warm partner contact (Kiecolt-Glaser, 2005).
- Brain glucose metabolism is affected by psychosocial stressors (Kern et al., 2008).
- The creation of neural stem cells governing short term memory and the expression of genes regulating the stress response are positively affected by motherly affect (Meaney et al., 2001).
- Positive cognitive state influences positive immune response and vice versa (Azar, 2001; Davidson et al., 2003; Wager et al., 2004).

In many parts of the world, healthcare is either non-existent or impossibly expensive but phones and other gadgets with interfaces are everywhere and relatively affordable. These discoveries mean that positive affect in human machine interfaces promises to globally widen both cognitive and physical health at all social levels. In the US over 50% of the bankruptcies are attributed to health-care expenses (Bortz, 2009). Thus there are also civic and economic implications of creating positive affect in human-machine interaction. Like the first picture of whole earth sphere, human-machine symbiosis may also change our self-conception. So, I ask you, should we be applying what we know about the brain, cognition and affective computing in interfaces? The answer is yes.

Controversy

In the Epilog, "A Philosophical Perspective on Emotions in Human-Machine Interaction," Zeynep Basgoze and Ahmet Inam, from Middle East Technical University, provide an opening conversation on the philosophical implications, possibility and plausibility of creating affective machines. Affective computing interaction is a Hubble telescope for the human soul but what will we see when we look through the lens? The technical conquest of affect in human machine interaction promises to rattle us, because it poses us with the most fundamental of questions "What are we?" "Are we part software now?" "Where are we going?" If motherly love can change gene expression, as demonstrated by scientists at McGill University (Meaney, 2001), what happens to us when we succeed in building kindness into affective interfaces?

The field of AI is definitely due for a radical revision, but could this whole idea of creating machines with affect be a wrong turn? In John McCarthy's story, "The Robot and the Baby" a nanny robot saves a baby by staying calm when the mother panics (McCarthy, 2003). The story successfully makes the point that sometimes it is not useful for robots to have emotions. Disruptive emotions also cause wars and break up families. Yet the potential of positive human emotion is enormous. Survivors of Nazi concentrations camps have described how love and kindness helped them overcome the most incredibly horrible situations and beat the smallest odds (Frankel, 1959). In the growing field of psychoneuroimmunology, scientists are beginning to understand the biological mechanisms of positive and negative emotions on our nervous and immune systems (Urry, 2004). The complete syntax for the relation between emotion and health is still unfolding, but studies indicate mood influences pain perception (Weisenberg, Raz, & Hener, 1998; Cogan et al., 1987), and positive emotions such as mirthful laughter enhance immune response (Lambert & Lambert, 1995; Dillon, Minchoff, & Baker, 1985). There are people (and animals) whose affections and ways of interacting are worth imitating. Emotion Oriented Programming was designed with this in mind (Mason, 2010).

As we find ourselves surrounded by gadgets and constantly plugged in, how brilliant to create human computer interactions that can quell road rage or quiet a murderous thought. Steve Jobs was on the right track when his company brought touch in the human machine interaction. We are born of touch and wither away without

out it (Montague, 1986). But are we ready to *be touched*? Is this a Kurzweilian future?

Description and Structure of the Book

Topics Covered in the book include

- Neurophysiology of Emotion
- Neuroanatomy and Psychophysiology of Affect and Cognition
- Biology and Psychology of Affect and Behavior in Humans
- Processing of Affect in Communication, Body Language, Facial Expressions and Speech
- Processing of Context in Affective Human Machine Interactions
- Representation of Affect and Computational Models
- Affective Software Agent Applications
- Applications of Affective Hardware
- Social and Philosophical Issues in Affective Computer Interactions

In the words of Gokay's preface "we tried to bring together several aspects of affective interactions within the field of affective computing in a pleasant scholarly reading format."

The layout of the chapters flows from learning basic foundations of emotions to understanding the contribution of affect in our lives, and finally ends by revealing the current trends and the promising technologies for defeating the emotional gap between humans and machines, all within the context of interactions.

The book is divided into five sections. In the first section, three chapters are devoted to reviewing the foundations of affect in cognition according to the cognitive science, psychology and neuroscience perspectives. Although there are individual books on each of the topics in this section, the coverage of material here focuses on concepts relevant for building human-like systems. The neurophysiology chapter includes current anatomical drawings and pictures that could be used to teach engineers, scientists, medical students and possibly educators about affect in the brain. The second section presents selected examples of emotional models and affective cognitive frameworks, mostly related to the knowledge provided in Section 1. The next two sections are organized according to interaction context. Section 3, "Affect in Non-Verbal Communication," covers psychology and technology of non-verbal, face-to-face interactions. Section 4, "Affect in Language-Based Communication," focuses on affect in verbal communication and text-based machine-mediated human communication. Finally, Section 5, "Emotions in Human-Computer Interaction," covers current trends and promising technologies for designing affective interactive participation for human-computer environments in the entertainment, gaming and assistive technology industries. Below we include chapter summaries from this section.

Summaries of Selected Chapters

In Chapter 13, "A Scientific Look at the Design of Aesthetically and Emotionally Interactive Entertainment Experiences", authors Magy El Nasr of Simon Fraser University, Jacji Morie from University of Southern California and Anders Drachen, from Dragon Consulting in Copenhagen, give the reader a look at the science of designing aesthetically and emotionally interactive experiences for the entertainment industry, now a multi-billion dollar industry, with revenues overcoming those of the movie industry (ESA, 2009). The subject is of interest because participants (they no longer consider themselves an 'audience') in these environments have come to expect certain aesthetic and artistic qualities that engage them at a very deep emotional level.

Chapter 14, "Bringing Affect to Human Computer Interaction," by Akgun, Akilli and Cagiltay, focuses on affective issues that impact the success of human computer interaction. The stance of the authors emphasizes a need to redesign computers to adapt to people. Affective issues related to the design processes in the chapter include Social Norms, Apologetic Feedback, and Emotionally Supportive inter-

actions. The chapter provides an extensive literature review and synthesizes a number of important studies related with affective aspects of human computer interaction.

Chapter 15 discusses the application of physiology-based affect-sensitive assistive-technology during human-computer interaction (HCI) and human-robot interaction (HRI) for children with Autism Spectrum Disorder (ASD). ASD is a group of neurodevelopmental disabilities that can cause significant social, communication and behavioral problems and statistically is now more prevalent than childhood cancer. The authors discuss their experiments working with technology to automatically detect and flexibly respond to affective cues such as eye gaze and social distance of children with ASD within a clinical intervention paradigm. The authors measure physiological indices, including electrodermal signals, skin temperature signals, electromyographic signals and other indices extracted from cardiovascular signals. This chapter is authored by a team of 5 researchers from Vanderbilt University – Welch, Lahiri, Sarkar, Warren, Stone, and Liu, and Karla Conn Welch from the University of Louisville.

In Chapter 16, "Affective Games: How iOpiates Elicit an Emotional Fix," author Jonathan Sykes from Glasgow Caledonian University makes a case for a future in which video games have become the opiate of the masses using techniques based on play to move us emotionally, much like movies and television do now. Sykes gives an accounting of the relationship between play and affect and the neurological significance of play and presents an engaging review of the present in affective game psychology and technology that explains why games are very likely to continue to increase in popularity.

Recommendation

Presently, commercial off the shelf devices do not reflect conventional wisdom in human computer interaction nor much of the research in affective HCI that has addressed social and emotional aspects of cognition, brain function, or genetics. It can be difficult from today's vantage point (Facebook, Twitter, Skype, cell phones, texting) to see why this is so. Perhaps in our initial machine design, it was not mathematically necessary because at the time people were not so connected to machines. This is no longer the case. Gokay and Yildrim's book is an essential volume to create our future and can spark the move to put happier cognition into our devices and our lives!

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