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Article *in* Studies in health technology and informatics · February 2005

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Future of Intelligent and Extelligent Health Environment

Edited by

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Cyber-Anthropology: A New Study on Human and Technological Co-Evolution

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Abstract. For the first time cyber-anthropology is defined as a concept and a new field of study aimed at the analysis of person's reciprocal relations with the computer-generated (CG) world evolved as a result of technological progress. In the cyber-era, simulated reality has come to the point of becoming a force that has the potential to transform the human race. Digital beings such as virtual and embodied agents, although not a part of the natural human habitat, have become necessary elements of people's surroundings and life conditions. As a theoretical construct, Cyber-anthropology is concerned with the merger of natural and artificial worlds mediated by the human imagination, as well as compatibility between people and digital life they have created. As an empirical study, Cyber-anthropology deals with the psychophysiology and psychophysics, semantic and semiotics of human engagement with computer-generated reality that is viewed as a Complex Interactive System. Personal competence as a crucial element of any cyber-system underlines the importance of psychological culture in artificial world exploration. A newly developed concept of Psychological Culture is viewed as an essential part of Cyber-anthropology while concentrating on the following core issues: (1) ethical questions, such as whether or not technological tools can be employed to solve human problems; (2) moral consequences of bringing cutting edge technology into our every day life; (3) studies of individual differences regarding psychological competence of technology users through effective vs. ineffective, independent vs. addictive, and active vs. passive dichotomies. Psychological Culture is defined as the study of a person's competence associated with the use of modern technology and individual acceptability of technological innovations. Several crucial dilemmas arise when a human being is engaged in a simulated environment, and artificial agents inhabit a human world. The ultimate goal of Psychological Culture is to provide people with the knowledge necessary for adequate recognition of scientific innovations to overcome obstacles in the process of implementing technology to enhance human well being.

1. Computer-Generated Reality: A Personal Touch

Since ancient times people employed their imaginations to model fictitious realities filled with bizarre creatures and strange life forms capable of acting beyond human possibilities. When all the other necessary survival tools were exhausted, people used the power of their minds to gain the strength of the spirit when fighting unknown diseases or trying to understand unpredictable chains of events. Sometimes, the thin line between the real and imaginary worlds would became blurry or even disappear. The degree of self-immersion into one's own fantasy combined with people's ability to keep up with their actual life requirements would result either in total mal-adaptation or in the re-construction of the existing realities. Modern technological tools have enriched human abilities not only in exploration, but in altering our inner and outer worlds. With the development of digital vehicles for in-

formation technologies, we entered a realm never experienced before by the human mind or senses. How do these new experiences fit into the existing methodology of human studies? What are the conceptual frames for analyzing and interpreting a person – cyber-world interaction? Is it possible to predict the outcome of those interactions? Below are defined some primary coordinates of the emerging field of Cyber-anthropology – a theoretical and practical study of human-centered, digitally-based technological systems, their structure, development, and functioning.

1.1. On the Crossroad of Anthropology and Cybernetics

A clashing charisma of anthropological studies attracted materialists and idealists, empiricists and methodologists, naturalists and humanitarians. The term 'anthropology' (from Greeks 'anthro-' – a man, and 'logos' – a study) was coined by Aristotle more than 2000 years ago [1], and the new discipline of anthropology was formulated by Kant in 18th century [2] acknowledged the beginning of a science that focused on studying physical, psychological, and cultural trends in human development. The aims of anthropology include the whole range of analyses from cultural artifacts (i.e., archeological method) and diversity of customs and beliefs (i.e., ethnographical method) to the study of human kind's similarity to and divergence from the animal kingdom (i.e., methods of physical anthropology and sociobiology). The body of knowledge about human life phenomenology was greatly expanded by the explorations of philosophical, structural, psychological and semiotic anthropology (see Table 1). However, regardless of the scientific paradigm underlying the investigation of a particular aspect of human – world interactions, anthropological analysis strived to search for the answers to the two inter-related questions posed by our very existence: *How do human beings transcend themselves in their own experience?*, and: *How do people actually behave?* [3].

Over the last twenty centuries, the systematic study of *Homo sapiens*, specifically their physical, psychological, and socio-cultural functioning, went through numerous transformations. The recent one is associated with the rise of highly technological systems based upon electronic "brains" and digitally originated behaviors. In such hybrids, a person appears as a human agent who performs a peripheral or – sometimes – a central role in the complex system functioning. A concentrated view on the essence of relationships between artificial and living systems was formulated by Norbert Wiener in 1948 in a concept named cybernetics (from Greek *kybernet*(es) or steer(-s) man) [4]. Cybernetics is viewed as a science of control processes in organic, and technological, mechanical and electronic systems. Cybernetic principles are employed by psychology for exploring the phenomena of artificial intelligence and emotion-like behaviors, by social sciences for studying effective management, and by engineering for analyzing the optimizing possibilities of technology-based processes.

Both worlds – human and artificial – came to existence as a result of evolution: socio–biological or technological respectively. The development of two independent subjects of study – anthropological and technological – brought to life a new field of Cyber-anthropology. Its dual nature is an adequate systematic method for studying this hybrid phenomenon – the cyber world.

1.2. Cyber-Anthropology: Human World Through the Prism of Technology

The definition of the new phenomenon is unavoidably multi-semantic, for it has to account for the methodology and the epistemology of the variety of analyzed experiences, as well as their theoretical and practical implications. Bearing this in mind, we would like to present a unified framework that combines various meanings – or, rather, dimensions for the analysis – of the emerging field named Cyber-anthropology (see Table 1):

Table 1. Definitive classification of Cyber-anthropology.

Anthropological models of man	Cyber-anthropology elements		
	Focus of the computer-mediated analysis	**Subject of Cyber-anthropology study**	**Related cyber-phenomena**
Physical anthropology/ Cognitive anthropology	Reconstruction of human beings via virtual representations	Archeological and evolutionary aspects of human physical representations through the historical and geographic prospective	Digital reconstruction of human's predecessors, their behavior, and associated artifacts
Ethnographical anthropology/ Social anthropology	Analysis of computer-mediated social interactions	Social manifestation of interactions between humans and virtual agents	Virtual heritage and Internet culture
Philosophical anthropology	Methodological analysis of computer-generated phenomena such as presence and immersion	Reflection on human existence into digital world	Sense of immersion and presence produced by person's engagement in virtual reality or virtual communications
Structural anthropology/ Semiotic anthropology	Structural analysis of semantic and semiotic of digital artifacts	Functioning of digital symbols	Imaginary, virtual, and embodied personages; digital folklore; myths of computer era
Psychological anthropology	Study of compatibility between human and technology	Psycho-physiological, psychological, and social effects produced by human – computer interactions	Digital self and virtual identity; cyborg-dilemma; psychological aspects of people-robot co-existence

Cyber-anthropology for the first time is defined as a concept and a new field of study aimed at the analysis of human reciprocal relations with the computer-generated (CG) world which have evolved as a result of technological progress. In the cyber-era, simulated reality has come to the point of becoming a force that has the potential to transform the human race. Digital beings such as virtual and embodied agents, although not a part of the natural human habitat, have become necessary elements of people's surroundings and life conditions. As a theoretical construct, Cyber-anthropology is concerned with the merger of natural and artificial worlds mediated by human imagination, as well as the compatibility between people and the virtual and embodied forms of digital life they have created. As an empirical study, Cyber-anthropology deals with the psychophysiology and psychophysics, semantic and semiotics of human engagement with computer-generated reality viewed as a Complex Interactive System [5].

2. Cyber-Anthropology as a Science of Differentiation Between Living and Artificial Complex Interactive Systems

The importance of the notion that speaks to distinctions in origin, structure and ultimate goals of living and non-living, inanimate, artificial systems has been emphasized by many authors. The founder of differential psychology and inventor of the IQ (Intelligence Quotient) hypothesis, William Stern, pointed out that the biggest methodological mistake is to apply mechanistic interpretation to the analysis of '*a person*', which transforms it into '*a*

thing' by eliminating a certain psychological component from the epistemological and phenomenological analysis [6,7]. A differing criteria, based upon the '*closed vs. open*' dichotomy, was offered by von Bertalanffy, a creator of the modern systematic approach, to distinguish between *non-living, closed* and *living, open complex systems* [8].

A study of the principles of mental representation revealed the fundamental role of tactile-kinesthetic gestalts in forming a hierarchical structure not only of sensory-motor, but emotional and cognitive mental phenomena [9]. Only the neuronal core of an open living system is able to produce tactile-kinesthetic sensation unavailable in the artificial systems. The latter is based exclusively upon information exchange in the form of electric impulses, which lie at the foundation of electronic-originated phenomenology. No matter how complex the system is and how high the level of the system's internal or external interactivity is, the ability of living beings to transform non-transitive physical properties of an object into the internal sensation through the tactile-kinesthetic mechanism [9], remains a major criteria that differentiates between natural and artificial phenomena, mental and virtual representations, real and unreal experiences.

It is notable that a concept of complexity brings two vitally significant components into the cyber-anthropological approach – the non-linear nature of examining phenomena and its interactive nature. Perhaps because interactivity is a main characteristic of the brain [10], mental functioning [9] and human development in general [11], an interactive nature of cyber-applications makes them natural – like part of our physical and social environment. On the other hand, having human personality as a main element in person–cyber-world interactions emphasizes the key role of psychological knowledge in understanding the character of cyber-anthropological models. In 1930, Vygotsky rightfully suggested that a study of psychological systems focuses rather on the analyses of relations between different functions and modifications of these relations over time, than on changes within each function and their structure [12].

Differentiation between living and artificial systems, based upon open–closed dichotomy and tactile-kinesthetic criteria, interactive complexity, and structural analysis of functional frames, outlines the theoretical part of Cyber-anthropological approach.

3. Practical Applications of Cyber-Anthropology

The artifacts produced by digital technologies form the subject for experimental and applied Cyber-anthropology research. Primary classification of computer-generated phenomena sheds some light on the practical agenda of Cyber-anthropology, which includes an examination of:

A. *Cyber-space*, including: 1) computer-mediated communication such as Internet, Email, Chat groups, Virtual communities, 2) World Wide Web as a mediated form of immediate social contacts, 3) cyber-culture
B. *Virtual environments* as part of 1) VR-based application (i.e., database representations, cyber-therapy products), 2) video games, and 3) virtual projection of digital structures
C. *Digital representation* or reconstruction of real experiences associated with 1) living beings such as humans – ancient in case of traditional physical anthropology and archeology, or modern in case of virtual medicine, and 2) material objects (i.e., virtual heritage or modern architecture)
D. *Human-computer interactions* as constellation of psychological and ergonomic factors including multi-modal interfaces
E. *Embodied agents* in the form of interactive robotic creatures with artificial intelligence and sensory feedback, e.g., lifelike robots imitating living beings, humanoids, etc.

The first three sub-groups (A-C) are organized in a class of virtual phenomena, the fourth group is structured as a transitional class combining both virtual and embodied elements, and, finally, the last group (E) presents a newly emerged class of embodied agents – a materialized form of digital activity. Cyber-anthropological studies of person – robot interactions are carryied out in two modes recognized as *Robotic Psychology* and *Robotherapy*. Robotic psychology focuses on the compatibility between humans and robots [13], while Robotherapy concentrates on using interactive robots as therapeutic agents for people with psychological problems or limited physical, cognitive, or emotional resources [14,15].

4. First Research Priorities from the Cyber-Anthropologist's Point of View

Although traditional approach has proved the effectiveness of the formula 'All's well that ends well', a more important rule at the beginning of new ventures (ought to sound like) sound like: "It's better to start well". Presented below is a brief schema for the Cyber-anthropology research necessary to establish a systematic techno-knowledge [16] about the field:

- Emotional experiences triggered by both virtual and embodied digital interactions;
- Criteria of differentiation between real and imaginary worlds;
- Symbolic meaning of computer-mediated interactions and digitally-generated experiences;
- Stereotypes and myths about the origins and functioning of cyber-reality;
- Psychological and psycho-physiological effects produced by person interactions with virtual and embodied agents;
- The nature of presence and immersion;
- Classification of cyber-phenomena based on tactile-kinesthetic and visio-geometrical gestalts and related studies on multi-modal interfaces.

Finally, the concept of Psychological Culture deserves a special attention in Cyber-anthropology study program.

5. Psychological Culture as a Subject for Cyber-Anthropology Studies

In the technological age, Psychological Culture plays an essential role in balancing real and artificial worlds' co-existence through mediated interactions. Personal competence underlines the importance of psychological culture in artificial world exploration as a crucial element of any cyber-system. From this point of view, Psychological Culture is defined as the study of a person's competence associated with the use of modern technology and individual acceptability of technological innovations. Special consideration is given to the study of individual differences in people's interactions with the artificial world. The personality-oriented focus of Psychological Culture makes it an integral part of Cyber-anthropology. One of the fundamental standpoints of Cyber-anthropology is that our co-existence with the artificial world, though highly complex, complies with physiological, psychological and cultural regularities of the individual and social life. Psychological Culture is based upon a humanistic approach and concentrates on investigating the following Cyber-anthropology related issues:

- Exploring advantages and disadvantages of human-cyberworld co-existence;
- Understanding the psychological specifics of interactions between persons and their artificial partner (i.e., virtual or embodied agent) on all levels: sensory-motor, emotional, cognitive, behavioral and social;

- Studying how the rich diversity of our personalities justifies a broad variety of environments and agents;
- Searching for possible solutions of moral dilemmas stemming from human- technology interactions;
- Providing people with knowledge required for the further virtual space expansion and effective person–artificial agent collaboration.

First of all, Psychological Culture concentrates on ethical questions such as whether or not technological tools can be employed to solve human problems. The next important issue relates to the study of the moral consequences of bringing cutting edge technology into our every day life. The third core question involves a study of individual differences with relation to psychological competence of technology users through effective vs. ineffective, independent vs. addictive, active vs. passive dichotomies.

Among the main topics that catch the attention of psychological culture researchers are such questions as '*Why does one person maintain a lifestyle independent from modern technologies while others develop technology (TV, computer, internet etc.) addictions?*', '*What are the psychological parameters that can predict effective or ineffective technology usage?*', *and* '*How technology can help people cope with their problems without putting an extra burden on them?*'

In sum, Psychological Culture studies the extensive range of psychological aspects of technology–mediated communication that arise on the merge of artificial and human worlds.

6. Technology–Mediated Solutions for Human Problems

In recent decades, the merger of artificial and human worlds has shown its promising results. Many researchers, engineers, and practitioners have already proven the productivity of technological applications in such areas as health, education, therapy and entertainment. In particular, exploration of virtual reality advantages known as 'immersion' and 'sense of presence' promoted a creation of original VR-based methods of psychological therapy. A new approach named Cybertherapy [17] showed effectiveness of VR-applications employed for treating psychological disorders including phobias (i.e., fear of flying, agoraphobia, etc.), social anxiety, different kinds of addiction (i.e., gambling, tobacco addiction), and cognitive and emotional deficits (i.e., autism, attention deficit hyperactivity disorder, sensory disintegration, etc.). Computer-generated reality has proven to be a useful therapeutic tool for a wide variety of populations such as children and the elderly, persons with physical and mental disabilities, and people who live both in home environment and clinical settings.

Success of early VR-based therapeutic interventions has inspired designers to further investigate the potential of artificial tools to provide real-life benefits. This is a vivid example of mutually advantageous collaboration between technology and psychology.

Another promising technological application concerns the development of embodied digital agents or interactive robots. The contemporary world of robotics is inhabited by a broad variety of artificial creatures designed for the purpose of helping people with special needs to overcome their limitations and enrich their quality of life. Nowadays, robotic creatures are used as mediators in the treatment of mood disorders, loneliness and depression, and as rehabilitation aids. The concept of an artificial partner [5] places person-robot interactions into a psychological, rather than a technological, context. Beneficial features of robots as human companions lie at the foundation of a new field of study named Robotic psychology and Robotherapy [13,14]. Even so, interactive robots serve as therapeutic agents or

stimulating companions, the effectiveness of people's communication with their artificial partners depends on their compatibility. Therefore, the robot's design should take into an account a whole range of both psychological and ergonomic parameters. This means performing a comprehensive analysis of human differences that underlie preferences in communication mode or intensity of interactions, degree of emotional or tactile stimulation, and the specifics of personal needs that are essential for maintaining effective person–robot compatibility.

Obviously, the broad diversity of people's personalities justifies the creation of a wide variety of virtual and embodied agents. Since a person is the central part of technology-mediated communication, human factors define the adequacy and effectiveness of the process' organization *per se*. An outcome of computer-mediated interactions depends on two inter-related issues:

- whether or not the person's individuality matches the specifics of artificial environment or agent;
- the level of the person's psychological culture based upon an understanding of the role and place technology takes in human life.

7. Moral Dilemmas of Human Engagement with the Artificial World

Without doubt, exciting virtual reality (VR) and robotics' applications have enriched science and engineering, industry and public service, medicine and entertainment, psychology and psychiatry, education and therapy. Technological agents positively influence the quality of human life by bringing accessibility and comfort, inspiration and enjoyment. Computerized tools have greatly expanded the human capability to visualize desires, materialize images, and observe the hidden processes. However, several crucial dilemmas arise when a human being is engaged in the simulated environment, and artificial agents inhabit the human world.

7.1. Virtual Presence vs. Reality Absence

Cyber-phenomenon known as 'presence' is a subjective sense of being in a virtual environment. Sheridan defines presence as 'sensory information generated only by and within a computer... a feeling of being present in an environment other than the one that person is actually in' [18]. Visual, auditory and haptic sensations produced by virtual reality applications are a part of an artificially simulated environment, otherwise known as artificially simulated illusions, which allow persons to experience 'presence'. Artificially triggered senses of presence may create positive, though illusory, experiences (i.e., VR-based treatment of phobias), or create false experiences resulting in a new chain of real problems (i.e., MUD-addiction based on false identity). One of the main psychological problems and moral dilemmas associated with the phenomena of presence stems from the person's inability to distinguish between real and artificial words. Individual inability to understand that those two worlds are not identical, but different, creates a barrier for implementing the achievements of engineering science. Psychological culture aims at studying the nature of simulated illusions and elaborating criteria for experiencing the sense of presence without side effects.

7.2. Coping with Difficulties vs. Escaping from Life

Technological applications provide people with new tools for coping with life's difficulties.

The level of individual psychological culture or psychological competence depends on understanding the meaning of technological progress for one's own life. If used appropriately, artificial reality expands human possibilities and enhances quality of life. However, there is much evidence of using technological innovations as an excuse to escape from real life problems into an illusory world. Psychological Culture is aimed at studying the criteria of differentiation between technology–mediated coping and defensive strategies. Coping strategies are defined as cognitive, emotional, and behavioral efforts *directed toward resolving an experiencing difficulty*. Defensive strategies are cognitive, emotional and behavioral efforts *directed away from actual problem solving* [19].

7.3. Assistance vs. Substitute

The next main task of Psychological Culture is to bring awareness to an individual as well as social consciousness about the value of both technology–mediated assistance and human support. Neither artificial reality nor any of its superlative products may serve as a replacement for genuine human relationships. Lack of psychological competence necessary for the adequate use of technical innovations in our daily life leads to various side effects, such as computer dependence, mixed identities resulting from rejection of real self in favor to the virtual persona, replacing human communications with electronic message exchanges and interpersonal relationships with person–machine interactions.

In particular, the moral dilemma of 'assistance vs. substitute' stressed in the use of robotic creatures for therapeutic purposes. The most important concern many researchers and practitioners pose is that robots would become a substitute for human caregivers [20,21]. This is true for any kind of robotic assistance. For instance, the use of robotic pets poses a question: '*Are robotic pets designed with the intention of replacing our favorite cats and dogs?*' This dilemma requires special attention from psychological culture research. When a robotic creature is employed in therapeutic practice, it is necessary for a therapist to keep in mind that any state-of-the-art robot is only a technological tool. The use of technological innovations establishes special requirements for psychological culture of the therapist or professional caregiver. It is especially important to not delegate a therapist's function to a robot. Humanistic robotherapy considers innovative technological tools as an additional resource essential to human care, but not the other way around. Robotherapy cannot be interpreted as an excuse for a therapist to avoid responsibility or deprive caretakers from human assistance. Effective technology–mediated health intervention of any kind is based upon conscious preference of technological means viewed as a way to improve human assistance while providing compassionate professional treatment [22].

Thus, a concept of Psychological Culture based upon an idea that human engagement with an artificial world is not an escape from reality and an excuse to avoid life's challenges, but an opportunity to expand coping resources.

8. Conclusion

Cyber-anthropology can be defined as a study of how humans are influenced by the artificial world produced by the technological evolution. In a broad sense, Cyber-anthropology is the science of investigating physiological, psychological, and socio-cultural phenomena that occur as a result of interactions between human mind–body systems and artificial computer–generated reality.

To gain benefits from cyberspace exploration, as well as from interactions with virtual and embodied agents, one needs to employ a systematic analysis of psychophysiology and psychophysics, semantic and semiotics of human–artificial world co–existence. Cyber-

anthropology, while studying a complexity of person–machine interactions, employs principles of Psychological Culture. The ultimate goal of the new approach is to provide people with the knowledge necessary for adequate recognition of scientific innovations to overcome obstacles in the process of implementing technology to enhance human well–being.

Acknowledgments

Authors would like to thank the Faculty at the Department of Psychology at the Georgetown University, and especially our dearest friend and colleague Professor James T. Lamiell, and Professor Lee Ross at the Department of Psychology at Stanford University for their continuing support of our projects and for their enthusiasm so necessary at the beginning of any new venture.

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