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Dylan D. Schmorrow Leah M. Reeves (Eds.)

Foundations of Augmented Cognition

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Foreword

The 12th International Conference on Human-Computer Interaction, HCI International 2007, was held in Beijing, P.R. China, 22-27 July 2007, jointly with the Symposium on Human Interface (Japan) 2007, the 7th International Conference on Engineering Psychology and Cognitive Ergonomics, the 4th International Conference on Universal Access in Human-Computer Interaction, the 2nd International Conference on Virtual Reality, the 2nd International Conference on Usability and Internationalization, the 2nd International Conference on Online Communities and Social Computing, the 3rd International Conference on Augmented Cognition, and the 1st International Conference on Digital Human Modeling.

A total of 3403 individuals from academia, research institutes, industry and governmental agencies from 76 countries submitted contributions, and 1681 papers, judged to be of high scientific quality, were included in the program. These papers address the latest research and development efforts and highlight the human aspects of design and use of computing systems. The papers accepted for presentation thoroughly cover the entire field of Human-Computer Interaction, addressing major advances in knowledge and effective use of computers in a variety of application areas.

This volume, edited by Dylan D. Schmorrow and Leah M. Reeves, contains papers in the thematic area of Augmented Cognition, addressing the following major topics:

- Augmented Cognition Methods and Techniques
- Applications of Augmented Cognition

The remaining volumes of the HCI International 2007 proceedings are:

- Volume 1, LNCS 4550, Interaction Design and Usability, edited by Julie A. Jacko
- Volume 2, LNCS 4551, Interaction Platforms and Techniques, edited by Julie A. Jacko
- Volume 3, LNCS 4552, HCI Intelligent Multimodal Interaction Environments, edited by Julie A. Jacko
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- Volume 9, LNCS 4558, Interacting in Information Environments, edited by Michael J. Smith and Gavriel Salvendy
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- Volume 11, LNCS 4560, Global and Local User Interfaces, edited by Nuray Aykin

- Volume 12, LNCS 4561, Digital Human Modeling, edited by Vincent G. Duffy
- Volume 13, LNAI 4562, Engineering Psychology and Cognitive Ergonomics, edited by Don Harris
- Volume 14, LNCS 4563, Virtual Reality, edited by Randall Shumaker
- Volume 15, LNCS 4564, Online Communities and Social Computing, edited by Douglas Schuler
- Volume 17, LNCS 4566, Ergonomics and Health Aspects of Work with Computers, edited by Marvin J. Dainoff

I would like to thank the Program Chairs and the members of the Program Boards of all Thematic Areas, listed below, for their contribution to the highest scientific quality and the overall success of the HCI International 2007 Conference.

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Constantine Stephanidis
General Chair, HCI International 2007

Preface

This 3rd edition of the Foundations of Augmented Cognition (FAC) represents the latest collection of diverse and cross-disciplinary research and development (R&D) efforts being performed by international scientists, engineers, and practitioners working in the field of Augmented Cognition. Since the first edition published in 2005, the FAC texts have become the leading science and technology (S&T) references for those working in this burgeoning new field and for those simply aiming to gain a better understanding of what Augmented Cognition R&D truly represents.

The goal of Augmented Cognition research is to create revolutionary human-computer interactions that capitalize on recent advances in the fields of neuroscience, cognitive science, and computer science. Augmented Cognition can be distinguished from its predecessors by the focus on the real-time cognitive state of the user, as assessed through modern neuroscientific tools. At its core, an Augmented Cognition system is a 'closed-loop' in which the cognitive state of the operator is detected in real time with a resulting compensatory adaptation in the computational system, as appropriate (Kruse & Schmorow, FAC, 1st edition).

Being able to non-invasively measure and assess an operator's cognitive state in real time and use adaptive automation (mitigation) techniques to modify and enhance that user's information processing capabilities in any application context is a goal that could substantially improve human performance and the way people interact with 21st Century technology. Such a goal is now possible thanks in large part to the Augmented Cognition pursuits of numerous government, academic and industrial laboratories and businesses, and the continued investments from agencies such as: the National Science Foundation (NSF), National Research Council (NRC), the National Institutes of Health (NIH), and the Department of Defense (e.g., Defense Advanced Research Projects Agency [DARPA], Office of Naval Research [ONR], Air Force Research Laboratory [AFRL], Disruptive Technologies Office [DTO] and the Army Soldier Center). The aggressive goals and objectives in these funded programs have fostered the development of many neurophysiological-based tools and techniques that are maturing enough to become feasible toolsets for HCI researchers, designers and practitioners in their pursuit of improving human-computer system efficiency, effectiveness and general user accessibility.

The numerous and varied Augmented Cognition methods, techniques, and applications that are flourishing today range from basic academic research to industrial and military fielded operational and training systems to every day computing and entertainment devices. This edition provides a snapshot of such R&D and represents cross-disciplinary collaborations and contributions from more than 200 international Augmented Cognition researchers and developers of varied backgrounds, including psychology, neurobiology, neuroscience, cognitive neuroscience, mathematics, computer science and engineering, human-systems integration and training, and general

human factors and ergonomics. To capture the essence of the S&T that is emerging from such cross-disciplinary collaborations, this edition is divided into two main sections. The first section is focused on general Augmented Cognition methods and techniques, including physiological and neurophysiological measures (e.g., EEG, fNIR), adaptive techniques, and sensors and algorithms for cognitive state estimation. The second section is devoted to discussions of various Augmented Cognition applications (e.g., simulation and training, intent-driven user interfaces, closed-loop command and control systems), lessons learned to date, and future directions in Augmented Cognition-enabled HCI.

The articles in this edition could not have been successfully compiled and edited without the due diligence in support received from the 2007 HCII Augmented Cognition Thematic Area paper session co-chairs and from the Associate Editors, COL Mike Russo of USAARL and Dr. Martha Crosby of the University of Hawaii at Manoa.

With each new FAC edition, I continue to be amazed at the quality and progress of the discoveries, innovations, and applications that Augmented Cognition scientists and technologists are cultivating because such discoveries, innovations, and breakthrough S&T solutions are no longer the exception—they have become the norm.

Dylan D. Schmorrow

HCI International 2009

The 13th International Conference on Human-Computer Interaction, HCI International 2009, will be held jointly with the affiliated Conferences in San Diego, California, USA, in the Town and Country Resort & Convention Center, 19-24 July 2009. It will cover a broad spectrum of themes related to Human Computer Interaction, including theoretical issues, methods, tools, processes and case studies in HCI design, as well as novel interaction techniques, interfaces and applications. The proceedings will be published by Springer. For more information, please visit the Conference website: <http://www.hcii2009.org/>

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