

HUMAN-COMPUTER INTERACTION SERIES

7

FROM BROWS TO TRUST

EVALUATING EMBODIED CONVERSATIONAL AGENTS

Edited by

Zsófia Ruttkay and Catherine Pelachaud

Kluwer Academic Publishers

FROM BROWS TO TRUST

HUMAN-COMPUTER INTERACTION SERIES

VOLUME 7

Editors-in-Chief

John Karat, *IBM Thomas Watson Research Center (USA)*
Jean Vanderdonckt, *Université Catholique de Louvain (Belgium)*

Editorial-Board

Gregory Abowd, *Georgia Institute of Technology (USA)*
Gaëlle Calvary, *IHM-CLIPS-IMAG (France)*
John Carroll, *School of Information Sciences & Technology, Penn State University (USA)*
Gilbert Cockton, *University of Sunderland (United Kingdom)*
Mary Czerwinski, *Microsoft Research (USA)*
Steve Feiner, *Columbia University (USA)*
Elizabeth Furtado, *University of Fortaleza (Brazil)*
Kristiana Höök, *SICS (Sweden)*
Robert Jacob, *Tufts University (USA)*
Robin Jeffries, *Sun Microsystems (USA)*
Peter Johnson, *University of Bath (United Kingdom)*
Kumiyo Nakakoji, *University of Tokyo (Japan)*
Philippe Palanque, *Université Paul Sabatier (France)*
Oscar Pastor, *University of Valencia (Spain)*
Fabio Paternò, *CNUCE-CNR (Italy)*
Costin Pribeanu, *National Institute for Research & Development
in Informatics (Romania)*
Marilyn Salzman, *Salzman Consulting (USA)*
Chris Schmandt, *Massachusetts Institute of Technology (USA)*
Markus Stolze, *IBM Zürich (Switzerland)*
Gerd Szwillus, *Universität Paderborn (Germany)*
Manfred Tscheligi, *Center for Usability Research and Engineering (Austria)*
Gerrit van der Veer, *Vrije Universiteit Amsterdam (The Netherlands)*
Shumin Zhai, *IBM Almaden Research Center (USA)*

From Brows to Trust

Evaluating Embodied Conversational Agents

Edited by

Zsófia Ruttkay

and

Catherine Pelachaud

KLUWER ACADEMIC PUBLISHERS

NEW YORK, BOSTON, DORDRECHT, LONDON, MOSCOW

eBook ISBN: 1-4020-2730-3
Print ISBN: 1-4020-2729-X

©2005 Springer Science + Business Media, Inc.

Print ©2004 Kluwer Academic Publishers
Dordrecht

All rights reserved

No part of this eBook may be reproduced or transmitted in any form or by any means, electronic, mechanical, recording, or otherwise, without written consent from the Publisher

Created in the United States of America

Visit Springer's eBookstore at:
and the Springer Global Website Online at:

<http://ebooks.springerlink.com>
<http://www.springeronline.com>

Contents

Contributing Authors	vii
Preface	xv

Part I Evaluation Methodology

1. The Blind Men and the Elephant Revisited <i>Katherine Isbister and Patrick Doyle</i>	3
2. Embodied Conversational Agents on a Common Ground <i>Zsófia Ruttkay, Claire Dormann, and Han Noot</i>	27
3. Empirical Evaluation Methodology for Embodied Conversational Agents <i>Noor Christoph</i>	67
4. Evaluating Users' Reactions to Human-Like Interfaces <i>Loredana Cerrato and Susanne Ekeklint</i>	101

Part II The User in Focus

5. User-Centred Design and Evaluation of Affective Interfaces <i>Kristina Höök</i>	127
6. 'User as Assessor' Approach to Embodied Conversational Agents <i>Clifford Nass, Erica Robles, and Qianying Wang</i>	161

Part III Evaluation of ECAs

7. More about Brows <i>Emiel Kraemer and Marc Swerts</i>	191
8. Evaluation of Multimodal Behaviour of Embodied Agents <i>Stéphanie Buisine, Sarkis Abrilian, and Jean-Claude Martin</i>	217
9. ECA as User Interface Paradigm <i>Richard Catrambone, John Stasko, and Jun Xiao</i>	239

Part IV Evaluation of Applications

- | | |
|--|-----|
| 10. Talking to Digital Fish | 271 |
| <i>Courtney Darves and Sharon Oviatt</i> | |
| 11. Experimental Evaluation of the Use of ECAs in
eCommerce Applications | 293 |
| <i>Hazel Morton, Helen McBreen, and Mervyn Jack</i> | |
| 12. What we can Learn from Avatar-driven Internet Communities | 323 |
| <i>Brigitte Krenn, Barbara Neumayr, Christoph Schmotzer,
and Martine Grice</i> | |

Contributing Authors

Sarkis Abrilian is a researcher at the Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur - Centre National de la Recherche Scientifique (LIMSI-CNRS) in France, working in the field of multimodal human-computer interfaces. He graduated in Computer Sciences and Cognitive Sciences. He has mainly worked on the design of multimodal input interfaces for interacting with 2D agents and on the definition of the Tycoon Markup Language in XML, for representing the multimodal behaviour of these agents. He can be contacted at: sarkis@limsi.fr.

Stéphanie Buisine is currently a PhD student in Cognitive Psychology at the Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur - Centre National de la Recherche Scientifique (LIMSI-CNRS) in France. She holds an academic master's degree in Experimental Psychology and a professional master's degree in Ergonomics. Her research interests focus on bi-directional multimodal interfaces, especially experimental evaluation of multimodal interfaces with and without ECAs, and model of user's multimodal behaviour when interacting with such systems. She can be contacted at: stephanie.buisine@limsi.fr.

Richard Catrambone is an Associate Professor in the School of Psychology at the Georgia Institute of Technology. He received his B.A. from Grinnell College (Iowa, USA) in 1982 and his PhD in Experimental Psychology from the University of Michigan (USA) in 1988. His research interests include problem solving, analogical reasoning, educational technology, and human-computer interaction with a focus on using cognitive principles for the design of teaching and training material that helps students learn basic tasks quickly and promotes transfer to novel problems. He has served on the editorial boards of the *Journal of Experimental Psychology: General* and the *Journal of Experimental Psychology: Applied* and has published in those journals and a variety of others. He can be contacted at: rc7@prism.gatech.edu.

Loredana Cerrato is a PhD student at the department of Speech Musing and Hearing (TMH/CTT) at the Royal Institute of Technology (KTH) in Stockholm, and is a participant in the Swedish Graduate School of Language Technology. She received her Master's degree you

may want to use MA, like all others do in Foreign Languages and Linguistics from the University of Naples ‘Federico II’ (Italy) in 1992. Her current research is concerned with the analysis of feedback phenomena in human-human and human-machine communication. Particular attention is paid to the analysis of prosodic and gestural cues of feedback expressions across different modalities and across different languages. The main aim of the investigation is to formalize some aspects of human communication that can be implemented in the design of human-computer interfaces. She can be contacted at: loredana@speech.kth.se.

Noor Christoph is a PhD student at the Department of Social Science Informatics at University of Amsterdam. She has been involved in various European Union funded projects. The Lilienthal aimed at developing and evaluating an interactive learning environment for theoretical instruction of airline pilots. The KITS project focused on developing and evaluating a gaming simulation environment for the domain of knowledge management. In her PhD she addresses the role of metacognitive skills on learning to solve ill-defined problems. She can be contacted at: noor@swi.psy.uva.nl.

Courtney Darves is currently a PhD student in the Department of Psychology at the University of Oregon. Her research focuses broadly on adaptive human behaviour, both in the context of human-computer interaction and more generally in terms of neural plasticity. She can be contacted at: courtney@alumni.reed.edu.

Claire Dormann is currently a researcher at the Human Oriented Technology Lab, Carleton University, Canada. Her background is Psychology and Computer Graphics. Her PhD addressed human-computer interaction and rhetoric. She participated in the project GAIA (Generic Architecture for Information Availability) to support electronic brokerage and multimedia in the home. Lately, she became interested in ECAs and virtual environment. Her research interests include usability evaluation, affective applications, computer mediated persuasion, and emotions and humour in user interfaces. Some of her recent works relates to evaluation, emotional appeal, and cultural differences. She can be contacted at: cdormann@ccs.carleton.ca.

Patrick Doyle is a doctoral candidate in the Knowledge Systems Laboratory at Stanford University. His research focuses on embedding knowl-

edge in virtual environments that ECAs can use to improve both their effectiveness and the quality of their believability. His interests also include the design of ECA architectures and the social and psychological issues in building ECA interfaces. He has designed and taught several courses on the creation of intelligent characters, with an emphasis on their use in computer games. He can be contacted at: pdoyle@cs.stanford.edu.

Susanne Ekeklint is a PhD student at the School of Mathematics and Systems Engineering at Växjö University in Sweden. She is also one of the participants in Graduate School of Language Technology (GSLT), which is collaboration between leading centres of research and teaching in language technology in Sweden. Her PhD thesis concerns information requests especially natural language questions, mainly with respect to open-domain question answering systems. She graduated from Göteborgs University with a Master in Computational linguistics 2000. She can be contacted at: sek@msi.vxu.se.

Martine Grice is Professor of Phonetics at Cologne University, Germany. She holds an MA and PhD in Linguistics, and a Habilitation in Phonetics and Phonology. Her main area of research is intonation theory, in particular the structure of tonal representations, and the relation between prosody and articulatory gestures. She has developed schemes for the database annotation of tonal and junctural phenomena, both for Standard German (GToBI) and for a number of varieties of Italian (IToBI). She is also currently investigating the interaction between linguistic and paralinguistic factors determining voice quality and intonation. She can be contacted at: mgrice@coli.uni-sb.de.

Kristina Höök is currently working as a Professor at the Department of Computer and Systems Sciences at Stockholm University. She also holds a part-time position at Swedish Institute of Computer Science (SICS). Her research has focused first on user-centred design of human-computer interaction from a situated action approach as reflected in her thesis, and then on social navigation, following the traces of others, as an alternative way to achieve adaptivity in the interface. Her work on affective interaction follows the same line of reasoning: a user-centred approach and a better basis in how human cognition really works will achieve better design of interaction than theory- or technology-driven approaches. She can be contacted at: kia@dsv.su.se.

Katherine Isbister is a visiting scholar in the Communication Department at Stanford University. She teaches a course in the Computer Science Department's Human Computer Interaction series on the design of characters for computer games. Isbister received her PhD and MA from Stanford, with a focus on using principles from psychology to design embodied agents. Her research interests include developing ECAs and socially augmented avatars to support inter-cultural contexts, and investigating the psychological foundations of successful game characters, towards broader applications of these principles in ECA and social interface design. She can be contacted at: ki@katherineinterface.com.

Mervyn Jack is Professor of Electronic Systems at the University of Edinburgh. A Fellow of the Royal Society of Edinburgh, he leads a multidisciplinary team of twenty researchers investigating Usability engineering of eCommerce services. His main research interests are dialogue engineering and virtual reality systems design for advanced eCommerce and consumer applications. He is author of some 230 scientific papers and 5 textbooks. He can be contacted at: Mervyn.Jack@ed.ac.uk.

Emiel Krahmer is an Assistant Professor in the Communication and Cognition group at Tilburg University. He has an MA (1991) and a PhD (1995) in computational linguistics, both from Tilburg University. After completing his PhD he worked for six years at Center for User System Interaction (IPO) at the Eindhoven University of Technology. His research concentrates on multimodal information presentation, with an emphasis on spoken language generation and audio-visual prosody. He can be contacted at: e.j.krahmer@uvt.nl.

Brigitte Krenn is Senior Scientist at the Austrian Research Institute for Artificial Intelligence. She holds a Master's Degree in German Language and Literature, Psychology, Philosophy and Pedagogy, and a PhD in Computational Linguistics. Since 1990 she has worked in a variety of research projects in the field of computational linguistics. Her current research focuses on animated conversational character technology, including multimodal interaction and affective communication. She can be contacted at: brigitte@ai.univie.ac.at.

Jean-Claude Martin is Assistant Professor and head of the Conversational Agents Team created in 2003 within the Architecture and Models for Interaction Group (AMI) at LIMSI-CNRS, France. His research

concerns multimodal communication including typologies of cooperation between modalities; creation, annotation, and analysis of corpora of multimodal human-human and human-computer interactions, design of bi-directional multimodal interfaces and their application to user interface of games. He has been involved in European research project about International Standards for Language Engineering (IST-ISLE), Natural Interactive Communication for Edutainment (NICE), Computer Mediated Communication (MagicLounge). He can be contacted at: martin@limsi.fr.

Helen McBreen currently works as a Research Engineer with Digital Fashion Limited, Osaka, Japan. She completed her postdoctoral research at The University of Edinburgh in 2002 under the supervision of Professor Mervyn Jack. Her thesis, entitled “Embodied Conversational Agents: Extending the Persona Metaphor to Virtual Research Environments” explored, through extended empirical evaluation, the usability of 3D conversational characters in a variety of eRetail applications. Her research on the subject has been published in notable proceedings, journals and books. She can be contacted at: helen_mcbreen@yahoo.co.uk

Hazel Morton is a Research Associate at the Centre for Communication Interface Research at the University of Edinburgh. She holds a Masters degree in English, a Masters degree in Applied Linguistics and is currently pursuing a PhD. Her work involves experimental design, testing and evaluation of applications with conversational agents, with particular interest in the perceived personality of agents and the evaluation of the effectiveness and user acceptability of animated conversational agents in eCommerce and eLearning applications. She can be contacted at: Hazel.Morton@ccir.ed.ac.uk.

Barbara Neumayr is responsible for product development within the sysis NetLife platform and for project management of research projects. As a co-founder of the Austrian company sysis, she has been working for sysis on a part time basis since 1994. Following her studies of business administration and economics, she had worked as an assistant professor in both teaching and research at the Vienna University of Economics and Business Administration for four years before joining sysis on a full time basis in 2000. She can be contacted at: barbara.neumayr@sysis.at.

Han Noot is a software engineer at the Center for Mathematics and Computer Science (CWI) in the Netherlands. He has an MA in theoretical physics (1973). His professional interests include computer graphics, lip-sync visual speech and computer animation systems. He can be contacted at: han@cwi.nl.

Sharon Oviatt is a Professor and Co-Director of the Center for Human-Computer Communication (CHCC) in the Dept. of Computer Science at Oregon Health and Science University (OHSU). Her research focuses on human-computer interaction, spoken language and multimodal interfaces, and mobile and highly interactive systems. Examples of recent work involve the development of novel design concepts for multimodal and mobile interfaces, robust interfaces for real-world field environments and diverse users, and adaptive conversational interfaces with animated software partners. She is an active member of the international HCI, speech and multimodal communities. She can be contacted at: oviatt@cse.ogi.edu.

Catherine Pelachaud is currently a professor at the IUT of Montreuil, University of Paris 8, directing the research team ‘Technology and Communication’. She has been involved in research on Embodied Conversational Agent for a long time, looking at several aspects such as the link between facial expression and intonation, lip movements and coarticulation, facial and gesture communicative behaviours. She has been participant in several EU-projects as well as she was co-organisers of workshops on ECAs. Her current research interest includes conversational agent and human behaviour simulation, individual agents and representation language for agent. She can be contacted at: c.pelachaud@iut.univ-paris8.fr.

Zsófia Ruttkay is senior research at the Center for Mathematics and Computer Science (CWI) in Amsterdam, where she is head of the group ‘Social User Interfaces’. She has been doing research on facial animation, hand gesturing and style for ECAs. She was involved in empirical evaluation of talking heads. With a background in AI, she applied constraint satisfaction to define facial expressions in a declarative way, and used logic programming for hand gesturing. She is also interested in beyond realism possibilities for virtual characters; she was co-author of the CharToon system to model and animate cartoon talking heads. She can be contacted at: zsofia.ruttkay@cwi.nl.

Christoph Schmotzer has been working for sysis in Austria as a content developer, project manager and usability researcher. He holds an MA degree in Psychology from the University of Vienna. His focus of research lies on empirical study design, test construction, psychological diagnosis and media psychology. Major areas of his current work at sysis are psychological user modeling, game design and interface ergonomics. He can be contacted at: christoph.schmotzer@sysis.at.

John Stasko is an Associate Professor in the College of Computing and the GVU Center at the Georgia Institute of Technology, where he is Director of the Information Interfaces research group. He received the BS degree in mathematics from Bucknell University in 1983 and the ScM and PhD degrees in computer science from Brown University in 1985 and 1989. His research interests are broadly in HCI, with a particular focus on information visualization, user interfaces, and software agents. He has been author or co-author of over 80 journal and conference papers. He can be contacted at: stasko@cc.gatech.edu.

Marc Swerts is now a senior researcher in the Communication and Cognition group at Tilburg University. He works on the project ‘Functions of audiovisual prosody’, sponsored by the Netherlands Organisation for Scientific Research (NWO). After having studied Germanic linguistics at Antwerp University, Marc Swerts got a Ph.D. (1994) in experimental phonetics from the Eindhoven University of Technology. Then he worked as a visiting researcher at various institutes in the USA, Japan, Sweden and Italy. He can be reached at: m.g.j.swerts@uvt.nl.

Qianying Wang is a PhD candidate of Stanford University, Communication Department. Her advisor is Professor Clifford Nass. She is interested in Human-Computer Interaction, human factors, cognitive and social psychology. From 1997 till 2001, Qianying worked as a staff research member for IBM Research and earned multiple IBM Research division awards. She is the author of nine filed patents worldwide. Qianying earned her B.S. and a M.S. cum laude in Electric Engineering from Shanghai JiaoTong University. She can be reached at: wangqy@stanford.edu.

Jun Xiao is a PhD student in the College of Computing at Georgia Institute of Technology. His research focuses on the evaluation of interface agents. In particular, he is gathering a set of experimental data through

empirical studies to provide insights for understanding the conditions under which users could best benefit from interactions with interface agents. He received his B.S in Computer Science from Fudan University in Shanghai. She can be reached at: junxiao@cc.gatech.edu.