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Emotion-Oriented Systems

The Humaine Handbook

With 104 Figures and 35 Tables
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Contributors

Vered Aharonson  Tel Aviv Academic College of Engineering, Tel Aviv, Israel, vered@afeka.ac.il

Noam Amir  Department of Communication Disorders, Tel Aviv University, Tel Aviv, Israel, noama@post.tau.ac.il

Elisabeth André  University of Augsburg, Augsburg, Germany, Andre@informatik.uni-augsburg.de

Orlando Avila-García  Open Canarias S.L., Santa Cruz de Tenerife, Spain, newoavila@hotmail.com

Ruth Aylett  Heriot-Watt University, Edinburgh, UK, ruth@macs.hw.ac.uk

Anton Batliner  Lehrstuhl für Mustererkennung, Friedrich-Alexander-Universität Erlangen, Erlangen, Germany, batliner@informatik.uni-erlangen.de

Holger Baumann  Universitärer Forschungsschwerpunkt Ethik, Universität Zürich, Zürich, Switzerland, baumann@ethik.uzh.ch

Aaron Ben-Ze’ev  Department of Philosophy, University of Haifa, Haifa, Israel, benzeev@research.haifa.ac.il

Elisabetta Bevacqua  University of Paris 8, now at CNRS, Telecom-ParisTech, Paris, France, elisabetta.bevacqua@telecom-paristech.fr, e.bevacqua@iut.univ-paris8.fr

Felix Burkhardt  Deutsche Telekom Laboratories, Berlin, Germany, felix.burkhardt@t-systems.com

Antonio Camurri  University of Genova, Genoa, Italy, antonio.camurri@unige.it

Lola Cañamero  School of Computer Science, University of Hertfordshire, College Lane, Hatfield, Herts, UK, L.Canamero@herts.ac.uk

George Caridakis  Image, Video and Multimedia Systems Lab, National Technical University of Athens, Athens, Greece, GCari@image.ece.ntua.gr
Valeria Carofiglio  Department of Informatics, University of Bari, Bari, Italy, Carofiglio@di.uniba.it

Cristiano Castelfranchi  Institute of Cognitive Sciences and Technologies, National Research Council, Rome, Italy; Department of Communication Sciences, University of Siena, Siena, Italy, christiano.castelfranchi@istc.cnr.it

Ginevra Castellano  Queen Mary University of London, London, UK, ginevra@qmul.ac.uk

Federica Cavicchio  CIMEC Università di Trento, Trento, Italy, federica.cavicchio@unitn.it

Roddy Cowie  Department of Psychology, Queen’s University Belfast, Belfast, Northern Ireland, UK, roddy.cowie@qub.ac.uk

Cate Cox  Department of Psychology, Queen’s University Belfast, Belfast, Northern Ireland, UK, C.Cox@qub.ac.uk

Laurence Devillers  LIMSI-CNRS, Orsay, France, Devil@limsi.fr

Ellen Douglas-Cowie  Department of Psychology, Queen’s University Belfast, Belfast, Northern Ireland, UK, E.Douglas-Cowie@qub.ac.uk

Arjan Egges  Universiteit Utrecht, Utrecht, The Netherlands, egges@cs.uu.nl

Ylva Fernaeus  SICS, Stockholm, Sweden, Ylva@dsv.su.se

Nickolaos F. Fragopanagos  Department of Mathematics, Kings College, London, UK, nikofrago@gmail.com

Alejandra García Rojas  Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, alejandra.garciarojas@epfl.ch

Peter Gardner  Institute of Psychological Sciences, University of Leeds, Leeds, UK, P.H.Gardner@leeds.ac.uk

Peter Goldie  Department of Philosophy, University of Manchester, Manchester, UK, peter.goldie@manchester.ac.uk

Didier Grandjean  Neuroscience of Emotion and Affective Dynamics Laboratory, Department of Psychology, University of Geneva, Geneva, Switzerland; Swiss Centre for Affective Sciences, Geneva, Switzerland, Didier.Grandjean@unige.ch

Jonathan Gratch  University of Southern California, Marina del Rey, CA, USA, gratch@ict.usc.edu

Marco Guerini  Fondazione Bruno Kessler-Irste, Povo, Trento, Italy, guerini@fbk.eu
Contributors

**Dirk Heylen** Faculty of Electrical Engineering, Mathematics and Computer Science, University of Twente, Enschede, The Netherlands, d.k.j.Heylen@ewi.utwente.nl

**Florian Hönic** Lehrstuhl für Mustererkennung, Friedrich-Alexander-Universität Erlangen, Erlangen, Germany, Hoenic@informatik.uni-erlangen.de

**Kia Höök** Department of Computer and Systems Sciences, Stockholm University/KTH, Kista, Sweden, Kia@dsv.su.se

**Katherine Isbister** Center for Computer Games Research, IT University of Copenhagen, Copenhagen, Denmark, KIsbister@itu.dk

**Kostas Karpouzis** Image, Video and Multimedia Systems Lab, Institute of Communications and Computer Systems, National Technical University of Athens, Athens, Greece, kkarpou@image.ece.ntua.gr

**Joseph Jofish Kaye** Nokia Research Center, Palo Alto, CA, USA, jofish.kaye@nokia.com

**Jonghwa Kim** University of Augsburg, Augsburg, Germany, Kim@informatik.uni-augsburg.de

**R. Benjamin Knapp** School of Music and Sonic Arts, Queen’s University Belfast, Belfast, Northern Ireland, UK, B.Knapp@qub.ac.uk

**Stefanos Kollias** Image, Video and Multimedia Systems Lab, Institute of Communications and Computer Systems, National Technical University of Athens, Athens, Greece, Stefanos@cs.ntua.gr

**Nienke Korsten** Department of Mathematics, Kings College, London, UK, nienke.korsten@kcl.ac.uk

**Brigitte Krenn** Austrian Research Institute for Artificial Intelligence, Vienna, Austria, brigitte.krenn@ofai.at

**Jarmo Laaksolahti** Department of Computer and Systems Sciences, Stockholm University/KTH, Kista, Sweden, jarmo@sics.se

**Myriam Lamolle** Université Paris VIII, Paris, France, m.lamolle@iut.univ-paris8.fr

**Meiyii Y. Lim** Heriot-Watt University, Edinburgh, UK, myl@macs.hw.ac.uk

**Orla Lowry** Department of Psychology, Queen’s University Belfast, Belfast, Northern Ireland, UK, E.Douglas-Cowie@qub.ac.uk

**Pablo Lucas** University of Bath, England, P.Lucas@bath.ac.uk

**Nadia Magrenat-Thalmann** University of Geneva, Geneva, Switzerland, thalmann@miralab.unige.ch
Emanuela Magno Caldognetto Institute of Cognitive Sciences and Technologies, Rome, Italy, emanuela.magno@pd.istc.cnr.it

Maurizio Mancini InfoMus Lab, Università di Genova, Genoa, Italy, maurizio@infomus.org

Claudia Marinetti Department of Psychology, Katholieke Universiteit Leuven, Leuven, Belgium, claudia.marinetti@chch.oxon.org

Jean-Claude Martin Computer Sciences Laboratory for Mechanics and Engineering Sciences (LIMSI), Paris, France, Martin@limsi.fr

Irene Mazzotta University of Bari, Bari, Italy, mazzotta@di.uniba.it

Sheelagh McGuinness Centre for Professional Ethics, Keele University, Staffordshire, UK, S.McGuinness@peak.keele.ac.uk

Margaret McRorie Department of Psychology, Queen’s University Belfast, Belfast, Northern Ireland, UK, M.McRorie@qub.ac.uk

Giorgio Merola Università Roma Tre, Rome, Italy, merogio@hotmail.com

Maria Miceli Institute of Cognitive Sciences and Technologies, CNR, Rome, Italy, maria.miceli@istc.cnr.it

Rada Mihalcea Department of Computer Science, University of North Texas, Denton, TX, USA, rada@cs.unt.edu

Penny Moore Department of Psychology, Oxford University, Oxford, UK, penny.moore@psy.ox.ac.uk

Radek Niewiadomski Telecom ParisTech, Paris, France, niewiado@telecom-paristech.fr

Radoslaw Niewiadomski CNRS, Telecom-ParisTech, Paris, France, radoslaw.niewiadomski@telecom-paristech.fr

Daniel J. O’Keefe Northwestern University, Evanston, IL, USA, d-okeefe@northwestern.edu

Maja Pantic Department of Computing, Imperial College, London, UK; Faculty of Electrical Engineering, Mathematics and Computer Science, University of Twente, Enschede, The Netherlands, M.Pantic@imperial.ac.uk

Brian Parkinson Department of Psychology, Oxford University, Oxford, UK, brian.parkinson@psy.ox.ac.uk

Sabine Payr Austrian Research Institute for Artificial Intelligence, Vienna, Austria, Sabine.Payr@ofai.at

Catherine Pelachaud CNRS-LTCI, TELECOM ParisTech, Paris, France, Catherine.Pelachaud@telecom-paristech.fr
Contributors

**Christian Peter**  Fraunhofer IGD, Rostock, Germany, christian.peter@igd-r.fraunhofer.de

**Christopher Peters**  Coventry University, Coventry, UK, Christopher.Peters@coventry.ac.uk

**Paolo Petta**  Österreichische Studiengesellschaft für Kybernetik, Austrian Research Institute for Artificial Intelligence, Vienna, Austria, paolo.petta@ofai.at

**Hannes Pirker**  Austrian Research Institute for Artificial Intelligence, Vienna, Austria, hannes.pirker@ofai.at

**Isabella Poggi**  University of Rome 3, Rome, Italy, Poggi@uniroma3.it

**Amaryllis Raouzaïou**  National Technical University of Athens, Athens, Greece, araouz@image.ntua.gr

**Kostas Rapantzikos**  National Technical University of Athens, Athens, Greece, rap@image.ntua.gr

**Matthias Rehm**  University of Augsburg, Augsburg, Germany, matthias.rehm@informatik.uni-augsburg.de

**Etienne B. Roesch**  Centre for Integrative Neuroscience and Neurodynamics, University of Reading, Reading, UK, contact@etienneroes.ch

**Zsófia Ruttkay**  University of Twente, Enschede, The Netherlands, zsofi@cs.utwente.nl

**David Sander**  Department of Psychology, University of Geneva, Geneva, Switzerland; Swiss Centre for Affective Sciences, Geneva, Switzerland, david.sander@unige.ch

**Marc Schröder**  Deutsches Forschungsinstitut für Künstliche Intelligenz, Saarbrücken, Germany, Schroed@dfki.de

**Björn Schuller**  Institute for Human-Machine Communication, Technische Universität München, Munich, Germany, schuller@tum.de

**Dino Seppi**  Fondazione Bruno Kessler-Irst, Trento, Italy, seppi@fbk.eu

**Ian Sneddon**  Department of Psychology, Queen’s University Belfast, Belfast, Northern Ireland, UK, I.Sneddon@qub.ac.uk

**Stefan Steidl**  Lehrstuhl für Mustererkennung, Friedrich-Alexander-Universität Erlangen, Erlangen, Germany, steidl@informatik.uni-erlangen.de

**Oliviero Stock**  Fondazione Bruno Kessler-Irst, Povo, Trento, Italy, stock@fbk.eu

**Carlo Strapparava**  Fondazione Bruno Kessler-Irst, Povo, Trento, Italy, strappa@fbk.eu
Petra Sundström Department of Computer and Systems Sciences, Stockholm University/KTH, Kista, Sweden, Petra@dsv.su.se

Naomi Sussman Department of Philosophy, University of Haifa, Haifa, Israel, snaomi@research.haifa.ac.il

Ed Sutherland Institute of Psychological Sciences, University of Leeds, Leeds, UK, E.J.Sutherland@leeds.ac.uk

John G. Taylor Department of Mathematics, Kings College, London, UK, john.g.taylor@kcl.ac.uk

Daniel Thalmann Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, daniel.thalmann@epfl.ch

Asimina Vasalou University of Bath, Bath, UK, MinaV@luminainteractive.com

Frédéric Vexo Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, frederic.vexo@epfl.ch

Laurence Vidrascu Iminent SA, Paris, France, laurence.vidrascu@free.fr

Thurid Vogt Multimedia Concepts and their Applications, University of Augsburg, Augsburg, Germany, thurid.vogt@informatik.uni-augsburg.de

Gaultiero Volpe University of Genova, Genoa, Italy, gualtiero.volpe@unige.it

Peter Wallis University of Sheffield, Sheffield, UK, P.Wallis@dcs.shef.ac.uk

Steve Westerman Institute of Psychological Sciences, University of Leeds, Leeds, UK, S.J.Westerman@leeds.ac.uk

Massimo Zancanaro Fondazione Bruno Kessler-Irst, Povo, Trento, Italy, Zancana@fbk.eu

Enrico Zovato Loquendo S.p.A., Torino, Italy, enrico.zovato@loquendo.com
Emotion pervades human life in general and human communication in particular. The point has been made often and elegantly, for instance, in the opening of de Sousa’s piece on emotion in the Stanford Encyclopaedia of Philosophy:

No aspect of our mental life is more important to the quality and meaning of our existence than emotions. They are what make life worth living, or sometimes ending. (de Sousa, 2010).

The pervasiveness of emotion sets information technology a challenge. Traditionally, it has focused on allowing people to accomplish a practical task in the most efficient way and has set emotion to one side – or expected users to. That is acceptable when the technology is a small part of life; but the more technology becomes interwoven through the fabric of life, the more unsatisfactory it becomes to expect that people will suspend their emotional nature and habits when they are interacting with the technology. The problem is particularly acute for groups who find it difficult to adopt the required unemotional stance (for instance, because of age or cognitive limitations); or in situations that push people away from that stance (for instance, because they are challenging or relaxed); or in activities where emotional factors play a central role (for instance, learning or modifying entrenched habits).

The problem began to attract attention during the 1990s, for instance, with work on the synthesis of voices that convey at least some emotional colouring rather than a remorseless monotone (Murray and Arnott, 1993). The research came to general notice with Picard’s groundbreaking book ‘Affective Computing’ (1997). Around the same time, the European Commission funded a series of projects on emotion and computing led by John Taylor and Stefanos Kollias (Cowie et al., 2001). The European work led to a major project called HUMAINE. The name reflected the spirit of the enterprise, which was to ‘humanise’ computing. It was from that project that this handbook grew.

HUMAINE included distinguished figures from a wide range of academic backgrounds, some of whom have gone on to publish collections that deal in-depth with the issues that arise from the standpoint of their own discipline. For example, Peter Goldie (2010) edited the Oxford Handbook of Philosophy of Emotion, and Klaus Scherer’s team brought together research on the psychological underpinnings of the...
area in their ‘Blueprint’ for an affectively competent agent (Scherer et al., 2010). HUMAINE members were also deeply involved in conferences whose proceedings are an essential resource – Affective Computing and Intelligent Interaction in 2007 and 2009 (Paiva et al., 2007; Cohn et al., 2009) and the Royal Society’s workshop on the Computation of Emotion in Man and Machines (Robinson and al Kaliouby, 2009). However, it was always part of the intention that the members of HUMAINE, along with key members of the wider community, would produce a book that offered newcomers to the area an academically sound introduction to the whole range of disciplines that are involved – technical, empirical, and conceptual. This is that book.

The fundamental aim of the book is to provide readers with a broad overview of the areas that should be familiar to any team that wants to do credible work on affective/emotion-oriented computing. That is easy to say, but it is actually not straightforward to form a cohesive map of the areas that are relevant. One of the tasks that HUMAINE faced was to form a working understanding of the material that needed to be addressed and the way it could be parcelled out. Eventually eight working parts were identified. The chapters are grouped into those eight parts. The next part of this introduction summarises them in turn.

It is worth neutralising a point of terminology at this stage. Some descriptions of the part use the term ‘emotion’; others use ‘affect’. ‘Emotion’ is used in this editorial because it is generally understood. Debates about the advantages of different terminologies are left to the substantial chapters.

It is also worth commenting on critiques of what those who write them call ‘affective computing’. Some of these have received a considerable amount of publicity (e.g. Gaver, 2009; Turkle, 2010). Certainly some visions of affective computing do fully deserve criticism. They may fail to register the first point that was made in this Introduction, that emotion is something that pervades life rather than a discrete phenomenon. They may fail to acknowledge the complexity of even the most basic kinds of emotional competence. They may fail to acknowledge that engaging seriously with emotion requires engagement with several established disciplines. They may imply that they are creating machines with the ability to feel as humans do, rather than simply to take account of the way humans signal various kinds of feelings.

The spirit of this collection is that if research does any of these things, then it deserves criticism. On the other hand, the criticism ought to rebound on writers who criticise the research area as a whole without having taken the trouble to understand how issues like these are actually understood and handled within it. Readers are invited to think through the relationship between criticisms and the research effort that they see reflected in these chapters.

Part I: Theories and Models

Designing systems that can engage with emotion depends on having an appropriate understanding of emotion. The outstanding problem in this area is the temptation to
overestimate the approaches to emotion that come easily to hand. On the one side, ‘folk psychology’ gives people a comfortable feeling that they understand emotion simply because it is part and parcel of their everyday life. Sadly, what folk psychology provides is a massively simplified image of an immensely diverse and complex set of phenomena. Research that accepts it uncritically can all too easily be diverted into dead ends, such as studying stereotyped renditions of smiles and angry voices, on the false assumption that they are an adequate representation of the way emotion is expressed in reality. Many more misdirections wait – such as false assumptions about the effect of cheerful voices or alignment between parties in a conversation. On the other side, the shelves of academic libraries are well stocked with theories that offer admirably clear prescriptions. It is natural to assume that picking them up and implementing them is the scientifically correct thing to do. Alas, clear theories in this area are generally opening bids in what the parties know will be a long negotiation. They are extremely useful points of reference, sometimes even when they are thoroughly discredited; but they are not like the theory of evolution, or the theory of relativity, or the theory of plate tectonics.

In that spirit, the chapters in Part I set out to give a broad, tolerant overview of ideas that are known to be useful. The chapters approach from three perspectives – broadly cognitive, broadly social, and broadly computational neuroscience. It is well known that differences arise when people take these different perspectives. The chapters do not attempt to hide that, but neither do they seek out confrontational positions. The aim is that a reader who has absorbed the material in all three will have a mature idea of the resources and the difficulties that typify the area.

**Part II: Signals to Signs**

The second part is one that engineers are drawn to, because it seems to be a straightforward application of standard techniques – particularly techniques from signal processing. There are well-developed technologies for face recognition, voice recognition, automatic speech recognition, and so on. Emotion recognition seems to offer an opportunity to apply those in a different domain. Up to a point that is true, but there is now a solid body of research on the specific problem of emotion recognition, and it has identified a great many wheels that need not be reinvented (and shown that some of them come off).

The single most important point to make about the material in this section is that it treats emotion detection as a multimodal task. There are separate chapters on recognition from speech and visual cues, because there are quite highly developed technologies there. There is also a chapter on inputs that are often seen as a royal road to emotion recognition, that is, sensors that detect the bodily changes associated with strong emotional reaction – heart rate, skin conductance, and so on. All of those sources do yield information, but critically, all of them are limited. Speech carries limited amounts of information about how positive or negative the speaker is, and it tends to be intermittent. When it is taking place, it seriously complicates extraction of information from the face. That information in turn is
limited outside social situations; and in social situations, it is not necessarily sincere. Bodily changes do not have those limitations, but they are very hard to distinguish from effects of non-emotional physical or mental activity. In recognition of those lessons, the section explicitly includes a chapter on multimodal recognition.

**Part III: Data and Databases**

Many of the technologies in the area depend on substantial collections of recordings, associated with ‘labels’ that describe their emotional content or emotion-related features. That is linked to the caution about theory that was expressed above. Systems that engage competently with emotion need a depth of information about detail that traditional theory does not provide; and direct recordings of the phenomena are the only obvious source.

From that point of view, a suitable collection of recordings, furnished with suitable labels, serves much the same kind of function as a theory of human behaviour, except that it covers details that theories omit. If that is so, then building suitable databases is a way of doing basic science in this area. The chapters in this section are written in that spirit. They look at the development of that viewpoint; then at the issues of making suitable collections and developing suitable descriptive schemes; and then they describe a prototype for the kind of database that seems to be needed.

**Part IV: Emotion in Interaction**

The original intention was that this part would be a mirror image of Part II. One dealt with the transition from pixels (or other signal elements) to high-level descriptions; the other would deal with the transition from high-level descriptions to pixels (or other signal elements). Experience showed that it was wrong to expect that kind of symmetry. The areas that were difficult on the upward path (from pixels to high level descriptors) were not particularly interesting on the downward path; but it was a major challenge for research concerned with the downward path to recreate patterns that were there at ground level in the upward path.

As a result, the chapters in this part highlight problems at a very different level. The chapters in Part I: Theories and Models indicate that emotion has intimate links to attention (a person who is frightened of the knife does not gaze casually at the couples on the beach). How can we generate an agent that shows emotionally appropriate attention patterns? Two people who are in emotional rapport will co-ordinate their behaviour in particular ways. How can we generate an agent that displays the relevant kinds of co-ordination? Behind those, how can the relevant flows of events be represented?
**Part V: Emotion in Cognition and Action**

The emphasis in the previous sections has been on behavioural patterns – facial and vocal – that are relatively specific to emotion. However, everybody knows that emotion can be signalled by the way a person goes about making a meal or shopping. That is because emotion has pervasive effects on different aspects of cognition and action, such as the way people perceive, move, evaluate, think, and make choices. The chapters in Part V are concerned with modeling those effects. Progress at that level would pay multiple dividends: ability to simulate convincingly emotional behaviour; ability to recognise signs of emotion that are not contained in specific signals; and ability to anticipate how a person in a particular emotional state might react to a particular ‘move’ that the agent considered making.

Simulating the processes involved in the emotional modulation of our cognition and action is a huge task, and at present no single approach comes close to solving it. Hence the chapters reflect three main, and in our view complementary, approaches. On the one side, ‘embodied’ approaches use models based on biological processes to capture a style of fast, automatic processing that is characteristic of the emotions more closely related to survival. On the other side, ‘rational’ approaches use symbolic representations to model key mental processes. Some of these are grounded in cognitive science and deal with processes such as appraisal and anticipation. Perhaps less obviously, others draw on ideas from sociology and address the way emotion functions in interactions and relationships.

**Part VI: Persuasion and Communication**

It is a feature of emotion that a great deal of the communication associated with it is nonverbal. That does not mean that a balanced view of emotion can ignore verbal communication. On the contrary, there are specific and important types of communication that depend on words and emotion working in tandem. The chapters in this section concentrate on two of those.

The first, which is more extensively covered, is persuasion. Recognising that emotion is fundamental to persuasion is hardly a new insight. One of the most influential early discussions of emotion is Aristotle’s. The book where it occurs is the *Rhetoric*, which is about swaying people’s minds to a particular viewpoint – in other words, persuasion. It takes on a very different colour in this context, though. It is a deep challenge to integrate the logical formalisms that are usually used to construct arguments with representations that express emotional values. The chapters cover the ground systematically, looking first at the part emotion plays in persuasion; then at verbal aspects of persuasion; then at the nonverbal elements that need to accompany them to convey that the agent is trustworthy, credible, and so on.

Last but not least, the section considers humour. It is very understandable that people tend not to take humour seriously. However, humour plays an enormous part in creating an appropriate emotional climate. Anyone who doubts it only needs to think how difficult it is for politicians to win elections if they totally lack a sense
of humour. It is unlikely that a humourless artificial agent would be much more popular – particularly if our efforts to lighten the tone were met invariably with a brick wall.

**Part VII: Usability**

There is no point in building systems that simulate human emotional behaviour exquisitely if people hate them (at least, no practical point). The chapters in this section focus attention on the problem of gauging what kind of system people will actually welcome into their lives. That calls for a shift of perspective which is more challenging than one might imagine.

The section highlights an analysis of human beings that is quite different from the kind of analysis that was introduced at the beginning of the book. It considers people as actors in particular social settings, who are drawn to artefacts that enhance the life experiences that are open to them in those settings. In that context, it is natural to view emotion as a feature of the way that people relate to things and other people in their environment, rather than as a (largely) inherited set of behaviours and dispositions. The editors regard the difference between the two not as a conflict, but as a shift of focus (wide angle to zoom, so to speak): not everyone agrees.

A second key point is that questions about people’s response should not be held back until the product is complete. Instead, they need to be integrated into the design process. That calls for methods of accessing people’s emotional responses that can realistically be integrated into the design cycle and that connect with designers’ thought processes. Some of them will raise eyebrows among people with a formal scientific training. However, design is not a formal science. It is a practical culture and one that it is extremely important for the scientific discipline to engage with.

On the other hand, the section also covers more recognisably scientific evaluation methods. Few, if any other sources, present as comprehensive a review of them.

**Part VIII: Ethics and Good Practice**

Research on human beings takes it for granted that there are ethical questions it has to address. It should be no surprise that when technology moves into similar areas, it has to face similar questions. After all, the aim is to lower barriers that currently divide humans from machines. The aim of lowering the barriers is to benefit human beings. However, it is in the nature of lowering barriers that what flows across them will not necessarily be beneficial.

Subtle minds have been thinking for at least 3,000 years about the ethics of interactions between human and human. By comparison, there has been hardly any time to think about interactions between humans and machines with human-like capacities. Arguably there has been no time at all. In the domain of emotion, the machines that we actually have may well be less competent than lizards, and it is hard to doubt that they are less competent than crows. That should be borne in mind when voices
elsewhere make pronouncements based on machines in science fiction movies. The voices in this collection try to deal with the ethical issues raised by technologies that an informed person might realistically imagine.

At a conceptual level, the chapters consider three types of issue that the area needs to be aware of. The first is identifying a suitable basis for ethical judgements. The second is understanding the basis for moral concerns, whether or not they are justified. The third is recognising the human characteristics that are most deeply involved in the ethical concerns.

Finally, the section looks at the mainstay of practical responses, that is, the ethics committee. They are the instrument that related areas have developed to manage their ethical challenges. Experience in those areas offers a resource that is well worth assimilating.

The outline of the chapters underlines the range of disciplines that the area involves. The fact that it is so interdisciplinary has always meant that incomers brought different perspectives, paradigm assumptions, and values to it. As a result, HUMAINE meetings rarely passed without one party transgressing across lines that another regarded as fundamental. It would be wrong to pretend that the tensions were all resolved or are resolved now. There are areas where the contributors do not agree and will not pretend to. The collection tries to represent them fairly, not to present an illusion of unanimity. The fact that there are disagreements is a true reflection of the fact that the challenge being addressed is large and very difficult. It is right and proper that different groups should have different ideas about the best way to address it.

Nevertheless, it is a hallmark of the teams who took part in HUMAINE that they were thoroughly exposed to others who had different backgrounds and priorities and acquired the ability to disagree constructively and with mutual respect. It is still a shock to encounter teams who did not have that experience and find it difficult to register that their own perspective may not hold all the answers.

Perhaps the single most positive outcome of the book would be to widen access to that feature of HUMAINE. Reading articles written by people with diverse backgrounds is not the same as meeting them, and talking to them, and coming to appreciate where they are coming from. However, it can go part way. The enterprise of humanising computing is too large and too diverse to work without establishing that kind of human underpinning: and that, of course, depends on engaging not only intellectually but emotionally.

Paolo Petta

_Austrian Research Institute for Artificial Intelligence, Vienna, Austria,
paolo.petta@ofai.at_

Catherine Pelachaud

_CNRS – LTCI, TELECOM ParisTech, Paris, France,
catherine.pelachaud@telecom-paristech.fr_

Roddy Cowie

_Department of Psychology, Queen’s University Belfast, Belfast, Northern Ireland, UK, roddy.cowie@qub.ac.uk_
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