Human-Computer Interaction Series

Human-Computer Interaction is a multidisciplinary field focused on human aspects of the development of computer technology. As computer-based technology becomes increasingly pervasive – not just in developed countries, but worldwide – the need to take a human-centered approach in the design and development of this technology becomes ever more important. For roughly 30 years now, researchers and practitioners in computational and behavioral sciences have worked to identify theory and practice that influences the direction of these technologies, and this diverse work makes up the field of human-computer inter-action. Broadly speaking, it includes the study of what technology might be able to do for people and how people might interact with the technology.

In this series, we present work which advances the science and technology of developing systems which are both effective and satisfying for people in a wide variety of contexts. The human-computer interaction series will focus on theoretical perspectives (such as formal approaches drawn from a variety of behavioral sciences), practical approaches (such as the techniques for effectively integrating user needs in system development), and social issues (such as the determinants of utility, usability and acceptability).

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Editors

Awareness Systems

Advances in Theory, Methodology, and Design

Springer

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Preface

1 About Awareness and Awareness Systems

As people engage in ordinary activities, they maintain *awareness* of others around them, which amounts to *an understanding regarding what others do, where they are, or what they say*. This understanding can help people in making inferences regarding intentions, actions or even emotions of others and provides a context for their shared activities and social interactions. Awareness of others extends to people not in the immediate vicinity but of whom one can have an understanding of whereabouts and current activities, within some time frame, e.g., knowing the whereabouts of a friend or their state of mind after a recent meeting or thanks to a recent communication.

Awareness systems can be broadly defined as *systems intended to help people construct and maintain awareness of each others' activities, context or status, even when the participants are not co-located*. Supporting awareness can bring about important, if subtle, benefits, such as increasing the effectiveness of collaborative work, fostering social relationships and improving the general well-being of individuals. The work described in this volume addresses these themes, making explicit the nature of these benefits and how they are attained through the design and use of awareness systems.

Importantly the definitions above focus on awareness of people rather than on systems and their environment. This can be contrasted to the concept of *situation awareness* as this has been studied extensively in the field of human factors. Situation awareness can be understood as "knowing what is going on" or more precisely "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future." (Endsley and Garland, 2000, p. 5) A more generic definition of situation awareness is provided by Sarter and Woods (1991) as "the accessibility of a comprehensive and coherent situation representation which is continuously being updated in accordance with the results of recurrent situation assessments."

Both these definitions of situation awareness assume an objective reality, an actual situation that the individual concerned has to understand in order to operate successfully. The accuracy of this understanding is paramount for ensuring successful performance. Some notion of completeness with respect to a bounded task

domain is implicitly assumed to be meaningful and desirable. The design of systems to support situation awareness can then be reframed as choosing the appropriate representations, appropriate abstractions and aggregations of information to overcome limitations of human perception and cognition.

In the context of cooperative work, the classic notion of situation awareness can be applied to describe awareness of actions and context of others, through which individuals align and integrate interdependent activities: "the up-to-the minute knowledge of other people's activities that is required for an individual to coordinate and complete their part of a group task" (see Gutwin and Greenberg, 2002). Taking this perspective, awareness pertains to knowledge of others and phenomena that are not tangential or external to the task (Schmidt, 2002).

This book takes a broader perspective on awareness that examines the social interactions between individuals and groups. In this context, awareness takes a different meaning and can serve a different purpose. Individuals may seek awareness for their own sake, as a means for understanding their own self, reflecting on relations with others or simply as a means for engaging with their social network. At work they may seek awareness of the social context, giving rise to informal and serendipitous interactions (Dourish and Bly, 1992) and knowledge sharing. At leisure they may seek the formation and strengthening of social ties (Markopoulos et al., 2005) or provide affective support to each other (Romero et al., 2007).

Contrary to the assumptions underlying the notion of situation awareness, accuracy and completeness of awareness is not the golden standard to strive for. Full knowledge of activities of others is usually not at all desirable, with people preferring to control the flow of information from others (Palen and Dourish, 2003) or preferring to cooperatively agree on setting limits to this awareness in order to facilitate social processes and allow equivocation and politeness (Aoki and Woodruff, 2005).

The discussion on awareness in this volume highlights a number of issues that become important when awareness is considered in the context of social interactions: how individuals assign meaning to information provided by others, how they selectively attend to this information, how intentions are assigned to information provided to others and how the awareness that results is associated with benefits and costs for individuals.

Apart from a narrower focus on the object of awareness, a major departure from the theme of situation awareness concerns the granularity and purpose of awareness. Whereas situation awareness typically concerns the time frame of a particular task or a mission, this volume considers a much more variable time frame that may even extend to weeks or months.

Another departure from the concept of situation awareness concerns its purpose. While situation awareness considers that the purpose of awareness is to support a task typically involving some decision, in the present context, awareness is often an end in itself that provides affective benefits, e.g., staying in touch, feeling connected or lowering the barriers for serendipitous social interactions between individuals. The same awareness information may be used and appropriated by individuals to

address different purposes: to coordinate a shared activity, to appraise a social relation or even to reflect on one's self and one's relations with others.

Current awareness systems have been deeply influenced by the *media spaces* of the late 1980s, which supported sustained audio/video links among remote coworkers and emphasized the importance of awareness for maintaining social coherence; see Bly et al. (1993) for an excellent review of this literature. At the time computer-supported cooperative work systems were usually measured in terms of productivity, the benefits of awareness proved difficult to operationalize (Gross et al., 2005). As a result, awareness systems were sometimes criticized as having marginal benefit (Schmidt, 2002) and were largely ignored for a decade.

However, the prevalence of the World Wide Web and significantly cheaper consumer electronics has led to a resurgence of interest in awareness systems, both as research prototypes and as commercial applications. No longer expensive and difficult to install or maintain awareness systems have moved from the office into domestic and health-care environments and are starting to appear on mobile devices as well.

Today, many of the functions that appeared in early research prototypes have reached the general public: instant messaging and mobile phones provide awareness cues about others who are currently online and Internet-connected photo frames and robots permit users to display awareness information, either from broadcasts such as the weather or from members of one's social network. As this technology becomes more affordable, with greater quality and diversity, awareness systems offer tremendous potential for innovation, with a wide range of forms and contexts for transforming the space around us.

The research culture has changed as well, making it easier to justify systems in terms of their support for maintaining informal social relationships, both in the home and the office, and valuing systems that move beyond simple collaboration. For example, Putman (2000) defines the creation of social capital as an important feature of social organization and argues that systems should support social relations, including the norms, networks and trust that facilitate cooperation and co-ordination for mutual benefit. We adopt a correspondingly broad interpretation of awareness and a more inclusive consideration of potential benefits.

2 About This Volume

The pragmatic and broad definition presented in the previous paragraph was adopted recognizing that a bewildering variety of practices, application domains, and systems are associated with the terms awareness and awareness systems.

Awareness systems vary greatly, applying different strategies for collecting, communicating and displaying information and serving diverse purposes. Awareness research is often characterized along specific axes such as the location or the context of use of awareness systems, e.g., at work, at home, and on the move, or

time/duration over which awareness is built up ranging from momentary pauses to months-long connections. Some awareness systems are utilitarian, designed to support awareness during specified collaborative work tasks. Others act as a decorative, informal background for daily activities. Some awareness systems incorporate rich media, using video and audio to provide interaction that approaches face-to-face communication. Others value simplicity and privacy, providing aesthetic communication appliances that exchange minimal or abstracted information or convey simple meanings such as "I'm thinking of you". Some systems are assumed to be "always on" rather than to be activated in the context of a specific task, allowing participants to pay attention or not as they engage in other activities. Others provide short-term awareness in the context of separate, primary activities. The level of synchrony may also vary; some systems require simultaneous awareness, whereas others reflect activity patterns over time that may be consulted at leisure. Levels of interaction among participants range from providing implicit awareness through simple capture of ongoing activities to demanding conscious and focused action from the participants, even to the extent of making this very fact communicable as a token of appreciation to the other party.

The diversity described above was noted already by Schmidt (2002), who commented that awareness has become an elastic concept used to describe anything from the moment-to-moment aligning and integration of activities of cooperating actors to messaging applications. In his introduction to the special issue on Awareness Systems of the *CSCW Journal*, he went on to criticize some of the assumptions and paradoxical arguments that have been either explicitly or implicitly adopted by researchers in the field, e.g., that awareness can be achieved without attention, that there are somehow fundamental divides between intentional and explicit coordination and implicit practices.

Many of the concerns raised by Schmidt persevere today, as the field has grown even further in size and diversity, and some of the themes originally discovered in the context of cooperative work are magnified when transposed in the domain of leisure or everyday social interactions. Overloading terminology seems to remain prevalent and may even be unavoidable, as awareness is recognized as an important concept in different domains. On the other hand, several researchers have responded to Schmidt's call for conceptual clarity, developing a range of specialized and focused theoretical works that can guide the design of awareness systems, help explain the phenomenon of awareness in its various manifestations and guide the design and evaluation of awareness systems.

This volume captures the state of the art regarding such developments; it was designed to put together works that help look beyond point solutions, that can provide a theoretical underpinning for design and development work and systematize evaluation practices. Starting from a related workshop on Awareness Systems, which was held as part of the ACM CHI conference in 2005, and following the publication of a dedicated special issue by the HCI journal by early 2007, a call for chapters was issued to put together a more comprehensive collection of works that could be used as a source material for master students and researchers working in this field.

3 Organization of Material in This Volume

The chapters in this volume are organized in four parts as follows:

3.1 Part I: Introduction to the Topic of Awareness

Part I starts with an historical overview of awareness research in computer-supported cooperative work (CSCW) over the past 20 years, by **Markus Rittenbruch** and **Gregor Mcewan**. Covering topics such as the conceptualization of the notion of awareness, prototypes illustrating approaches to providing awareness, models and extensions of awareness. This chapter provides a thorough introduction to the field of awareness research that is highly commendable for research students in this field.

Whereas the first chapter takes a more historical perspective and focuses upon cooperative work, Chapter 2 by **Markopoulos** focuses on awareness systems used for informal social communication. It provides a brief overview of related works, describing the related design space and identifying eight interaction design challenges that designers of social awareness systems are called to resolve.

Chapter 3 by **Greenberg, Neustaedter** and **Elliot** describes the notion of interpersonal awareness and discusses how home inhabitants achieve awareness of each other by exchanging information. They then consider how different locations lend meaning to the information displays within them as people make use of different timings, ownership and awareness relating to these locations.

3.2 Part II: Theoretical Perspectives

This part presents several studies that propose some theoretical underpinning to the design of awareness systems. First **Eggen** and **Mensvoort** discuss a range of concepts that play an important role in designing awareness displays: different levels of awareness, transitions between these levels, use of multiple modalities, and aesthetic quality of information displays. The chapter discusses three design concepts: "Home Radio", "Data Fountain" and "Birds Whispering", concluding with a philosophical look at our future where information decoration becomes our next nature and the responsibilities this brings upon interaction designers.

Oulasvirta discusses the interpretation of awareness cues by individuals through social cognitive processes. The chapter reviews relevant factors, such as pre-knowledge of the person and of the situation, the task at hand, available cues, the abstractness of cues, and the order of processing the cues. Evidence is gathered from two sources: field trials with awareness systems and experimental research on social cognition. The chapter concludes with a discussion on design implications.

Metaxas and **Markopoulos** present a development of the spatial model of focus and nimbus model by Benford. Their model makes salient the social interaction issues relating to awareness systems, and that allows to reason about social

interaction issues surrounding the use of awareness systems, such as reciprocity, accountability, equivocation, deception, which are relevant for enabling users to protect their privacy and to manage how they present themselves to others.

Vetere, Smith and **Gibbs** discuss the notion of phatic interaction, i.e. communication between individuals pertains to how a communicative connection is maintained rather than how to convey information as such. By asking "What phatic exchanges should the awareness system support?" instead of "What information should the awareness system convey?" the authors advocate reorienting our design focus to seriously consider the extent to which awareness systems contribute to feelings of awareness and ongoing connectedness between people.

Privacy challenges in Awareness Systems are discussed thoroughly by **Patil** and **Kobsa**. They discuss the nature of privacy concerns surrounding awareness systems and their use, along with various principles and techniques for addressing them. They argue that meeting the challenges posed by privacy concerns holistically requires that designers consider them in every phase, from conception to deployment.

Romero and **Markopoulos** introduce the Privacy Grounding Model, an application of Common Ground Theory, to describe how interpersonal privacy is cooperatively managed by individuals over communication media.

Kainulainen, Turunen and **Hakulinen** describe the use of auditory displays for supporting group and peripheral awareness. In particular, it focuses on the use of speech and non-speech audio for presenting awareness information, the range of interaction techniques they can offer, and how they can be used to support awareness in different settings.

3.3 Part III: Applications

The collection of papers in this part aims to portray the diversity of applications that are described as awareness systems and the scope of the relevant design space. Also, shared concerns and practices amongst the different application domains emerge illustrating some of the trade-offs discussed in the earlier chapters.

Cohen and **Fernando** discuss narrowcasting: the deliberate filtering of multiple duplex information streams. Narrowcasting addresses the need to control the transmission from multiple sources to sinks which arises in current multimodal and multi-user systems. A set of narrowcasting operations based on a first-order logic formalization of the focus–nimbus model have been implemented in a range of applications that are described.

Ibanez, Serrano and **Garcia** describe Emotinet, a flexible and extensible framework for the development of social awareness systems. Emotinet was initially designed and developed to facilitate our explorations on how to augment a person's work environment with information which enables to feel the presence of intimate companions.

The chapter by **Tran, Yang** and **Raikundalia** presents an investigation into mechanisms to enhance awareness support in text-based, computer-mediated

communication (TCMC). It describes the design and evaluation of two prototypes: Relaxed Instant Messenger (RIM), a sequential interface with an adaptive threaded interface to enhance users' awareness of turn-taking and conversational coherence, and Conversational Dock (ConDock), which uses a focus and context visualization technique to support awareness of multiple conversations.

Morris explores the potential of social network feedback displays. Visualizing data on remote and face-to-face interaction were gathered by wireless sensor networks, these displays were designed to raise awareness of social connectedness as a dynamic and controllable aspect of well-being. This chapter reviews the psychological rationale for these applications and highlights some reactions of participants to the displays.

A popular scenario of using context-sensing technology for monitoring the well-being of a lone elderly is explored by **Metaxas**, **Metin**, **Schneider**, **Markopoulos** and **de Ruyter**. The *Daily Activities Diarist* illustrates the potential and the pitfalls associated with systems of this ilk, especially when inferences regarding user activity need to be made. The authors make the case for narrative presentation of awareness information and for "seamful" design of awareness systems.

Rittenbruch, **Mansfield** and **Viller** discuss the notion of intentional enrichment: the process of actively engaging actors in the awareness process by enabling them to add meaning to seemingly disjoint activities. They discuss the challenges of designing such systems and some experiences from the design of anybiff application. The chapter concludes with implications for extending current awareness and instant messaging tools.

The last two chapters of this part focus on how awareness displays can be embedded in their physical and social context. **Cheverst, Dix, Fitton, Graham** and **Rouncefield** describe not only a 27-month-long deployment of the Hermes messaging system at the University of Lancaster but also two other messaging systems they developed: SPAM and Hermes@Home. The chapter can help designers understand the various dimensions of situatedness for situated messaging systems and how these dimensions can be exploited to arrive upon appropriate designs.

3.4 Part IV: Evaluation

This final part presents three chapters illustrating different approaches towards the evaluation of awareness systems.

Sellen, Taylor, Kaye, Brown and **Izadi** describe an exemplary field trial of the Whereabouts Clock they developed. This is a "domestic" awareness system that displays the location of family members deliberately coarse-grained categories (HOME, WORK, SCHOOL or ELSEWHERE). The results show that awareness of others through the Clock supports not only family communication and coordination but also more emotive aspects of family life, such as reassurance, connectedness, identity, and social touch.

Matthews, Hsieh and **Mankoff** present a collection of design of evaluation knowledge relevant to peripheral displays. In particular, we discuss peripheral

display design implications, evaluation criteria, formative evaluation methods, summative lab methods, and summative field methods. As an example a case study is presented where lab and field evaluations of the same two email peripheral displays were carried out using a variety of methods. The case study highlights the different data yielded by and the pros and cons of each method.

Finally, turning to quantitative methods, **IJsselsteijn**, **van Baren**, **Markopoulos**, **Romero**, and **de Ruyter** present ABC questionnaire, an instrument developed for the quantitative measurement of the affective costs and benefits relating to the use of awareness systems to connect individuals or groups. The chapter focuses on the discussion of the concepts underlying the instrument and on instructing interested readers how to use it.

4 Conclusion

As editors we hope that this volume is useful to its readers. In collecting the chapters for this book we have aimed to

- provide a theoretical and methodological underpinning for the design of awareness systems;
- provide a reflective account of the field, tracking progress from past visions to current trends and future challenges;
- put together a representative collection of design concepts in the area.

Some of the chapters are of a distinctly theoretical nature; we hope that designers can find them a useful resource when considering awareness systems. The chapters collected illustrate also some of the contemporary concerns for this vibrant research field: privacy, understanding and using situatedness of the display, communicating intentionality, peripherality of displays, etc.

Given the size of this field and the rapid rate of progress, the collection of works presented here cannot be considered comprehensive. However, to our view, the volume packages a coherent collection of related works in a volume, can be a valuable guide and introduction to interested students and designers and a thorough introduction to researchers starting in this field.

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References

Aoki P.M., Woodruff A., Making Space for Stories: Ambiguity in the Design of Personal Communication Systems. In Proceedings CHI 2005, ACM Press, New York, 181–190.
Bly S.A., Harrison S.R., Irwin S. (January 1993) Media spaces: Bringing people together in a video, audio, and computing environment. Communications of the ACM 36(1), 28–46.

Dourish P., Bly S. (1992) Portholes: Supporting awareness in a distributed work group. Proceedings CHI'92, ACM Press, New York, 541–547.

Endsley M.R., Garland D.J. (2000) Situation Awareness Analysis and Measurement. Lawrence Erlbaum Associates, London.

Gross T., Stary C., Totter A. (2005) User-centered awareness in computer-supported cooperative work systems: Structured embedding of findings from social sciences. International Journal of Human–Computer Interaction, 18(3), 323–360.

Gutwin C., Greenberg S. (2002) The effects of workspace awareness support on the usability of real-time distributed groupware. ACM Transactions on Computer–Human Interaction, 6(2), 243–281.

Markopoulos P., IJsselsteijn, W., Huijnen C., de Ruyter B. (2005) Sharing experiences through awareness systems in the home. Interacting with Computers, 17(5), Elsevier, 506–521.

Palen L., Dourish P. (2003) Unpacking "privacy" for a networked world. In Proceedings CHI'03. ACM, New York, 129–136.

Putman R.D. (2000) Bowling Alone: The Collapse and Revival of American Community. Simon and Schuster, New York.

Romero N., Markopoulos P., van Baren J, de Ruyter B., IJsselsteijn W., Farshchian B. (2007) Connecting the family with awareness systems. Personal and Ubiquitous Computing, 11(4), Springer, 299–312.

Sarter N.B., Woods D.D. (1991) Situation awareness: A critical but ill defined phenomenon. International Journal of Aviation Psychology, 1, 45–57.

Schmidt K. (2002) The problem with awareness. Computer Supported Cooperative Work, 11: 285–298.

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