Introduction to this Special Issue* on Awareness Systems Design

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As people engage in ordinary activities, they typically maintain awareness of other people around them. *Awareness systems*, broadly defined, are intended to help people construct and maintain similar levels of awareness of each others' activities, context, or status, even when the participants are not co-located. Researchers argue that supporting awareness has important, if subtle, benefits, such as increasing the effectiveness of collaborative work, fostering social relationships, and improving the general well being of individuals.

Awareness systems vary greatly, with different strategies for collecting, communicating, and displaying information that serve diverse purposes. Awareness research is often characterized along specific axes, such as *location* (e.g. work or home), *mobility* (e.g. in-place or on-the-move), or *time* (e.g. 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 always on, 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 on-going activities to demanding conscious action from the participants.

Current awareness systems have been deeply influenced by the *media spaces* of the late 1980s, which supported sustained audio/video links among remote co-workers and emphasized the importance of awareness for maintaining social coherence (see Bly, Harrison, and Irwin, 1993, for an excellent review of this literature). At the time, Computer-Supported Cooperative Work systems were usually measured in terms of productivity. These benefits of social awareness proved difficult to quantify (Gross and Stary, 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 have lead to a resurgence of interest in awareness systems, both as research prototypes and in commercial systems. No longer expensive and difficult to install or maintain, awareness systems have moved from the office into domestic and healthcare 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 on-line and internet-connected photo frames and robots permit users to display awareness information, either from broadcasts such as the weather, or from members of the participants 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 - valuing systems that move beyond simple

collaboration - making it easier to justify systems in terms of their support for maintaining informal social relationships, both in the home and in the office. 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.

This Special Issue contributes to the state-of-the art of awareness systems research, with empirically and theoretically grounded accounts of awareness systems in use. The papers all explore two key themes:

1. What are the meanings and uses that people find in awareness information?

2. What are the best ways to present awareness information to users, so as to fit their contexts, activities, and intentions?

The first two papers focus on design innovations regarding the automatic capture and presentation of awareness information, exploring the availability of remote workers and collocated collaboration respectively. These papers focus on short term evaluations, whereas the next three involve long-term evaluations, with real-world deployment and use of the systems. All three describe cases in which awareness is achieved through explicit input and intent by the use. All provide insights derived from observations of sustained use of an awareness system, describing how users adapted various design features to express their intentions and how the communities developed conventions of use. These papers also use a similar methodology, with qualitative analyses of message content and usage patterns to discover how users developed and evolved their shared understandings over time. The final paper rounds out the special issue with a theoretical contribution, using Activity Theory to examine presence displays.

Begole and Tang discuss the concept of *Rhythm Awareness*, having a sense of regularly recurring temporal patterns among groups of collaborators. They describe different rhythmic patterns on awareness that can be found in a data-set collected through Awarenex, which shares rhythmic information in real time to help co-ordinate moment-to-moment activities. The paper explores a variety of pattern visualizations and discusses how they can be interpreted by co-workers. The paper also discusses the trade-offs between machine interpretation of rhythm patterns versus the human interpretation of awareness cues.

DiMicco, Hollenback, Pandolfo, and Bender focus on collocated groups. Their Second Messenger system displays feedback regarding speaker participation patterns in face-to-face group discussions. They report the results of two experiments and conclude that individual behavior changes in response to real-time awareness displays and that a group's process of information sharing can be positively affected by reviewing group participation information. Their findings point towards new challenges for designing effective awareness displays that may help improve group collaborative processes.

Oulasvirta, Petit, Raento, and Tiita present the design and the use of ContextContacts, a contact list for mobile phones enriched with graphical cues presenting awareness information about one's contacts. They present the results of three field trials, with a primary emphasis on how cues are interpreted and acted upon in mobile settings. They identified three distinct roles

that mobile awareness cues can play, i.e. tools for co-ordination, tools for expression, and as a proxy for companionship.

Rittenbruch, Viller, and Mansfield discuss how expressing intentions can support awareness, based on their observations of AnyBiff, used by a large community of distributed co-workers. Users may publish and subscribe to simple and laconic announcements of the activities of its members, which they call 'biffs'. The simplicity and flexibility of their system enabled users to briefly and flexibly express intentions to their group. The authors analyze the uses this community found for the tool, giving insights into the challenges and potential of intentional disclosure, the trade-offs between communication and notification and the evolution of biffs as the community developed new meanings for them and developed their own usage patterns.

Cheverst, Dix, Fitton, Rouncefeld, and Graham discuss lessons learned through the design and extended use of two situated display based systems, Hermes and SPAM. Hermes allows messages to be posted to devices acting as office door displays and SPAM is a messaging system that connects two work places rather than specific individuals. The study contrasts the situatedness of these two displays pertaining to their location, social, and organizational contexts and how these factors shaped the usage patterns that evolved within their user communities. For both, the flexibility of the medium allowed for the users to capitalize on assumed shared context information, to adapt content, tone of message but also its intended audience.

Matthews, Rattenbury and Carter apply Activity Theory to reconceptualize the understanding of peripheral displays. They propose a framework for the design and evaluation of peripheral displays, with evaluation criteria (appeal, learnability, awareness, breakdowns, and distraction) prioritized according to the three dimensions from activity theory: scope of user, classes of supported activities, and criticality. This theoretical underpinning allows the clarification of concepts such as ambient and notification displays, addresses the context-dependent nature of awareness as discussed by Schmidt (2002) and clarifies some apparent confusion in earlier literature regarding the notion of awareness being achieved effortlessly or in the background.

In addition to the specific design innovations described in the papers in this Special Issue, it is also clear that they illustrate the growing maturity of the field. Empirical studies have become more in-depth and longer term, moving beyond informal evaluations of prototypes to more critical evaluations in the context of actual use. The theoretical foundations are deeper and more innovative, with contributions of concepts such as rhythm awareness and intentional enrichment, as well as an empirically grounded use of Activity theory. The systems are also more sophisticated, but with a greater pragmatism and improved understanding regarding the difficulties involved in sensing and interpreting human behavior in the context of social interaction. Awareness Systems have evolved rapidly in the past few years, and we hope this Special Issue will provide an important milestone in their continuing evolution.

NOTES

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