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Community computing as human–computer interaction

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Abstract. There is too little engagement between community computing and human–computer interaction. In the future there should be more. Better integrating community computing and human–computer interaction can help to make HCI richer and more comprehensive, conceptually and methodologically. It can help HCI to have more of an impact on society and on everyday collective life. Six examples are briefly discussed.

1. Introduction

Community computing supports human–computer interaction among neighbours. It facilitates information dissemination, discussion and joint activity pertaining to municipal government, public schools, civic groups, local events, community issues and concerns, and regional economic development and social services.

It is not a new idea. In the USA, its roots are in 1970s community activism—jobs, housing and veterans' issues in the Berkeley Community Memory (Farrington and Pine 1997), community health in the Cleveland Free Net (Beamish 1995), and problems of the homeless in the Santa Monica Public Electronic Network (Rogers *et al.* 1994). Public education has also been a major focus. For example, Big Sky Telegraph supported teachers in rural Montana, linking one and two-room schools with regional libraries, and providing computer support for the literary and artistic projects of Native Americans (Uncapher 1999). Social activism remains a strong theme in community computing (Schuler 1996).

It is a rapidly growing segment of computing world wide. A few minutes search of the World Wide web can easily identify hundreds of community networks. Today, activities like sending e-mail to a plumber, posting choral music selections for a church service to a web page, or joining a chat on proposed changes to school-bus routes are everyday computing experiences for many people.

Community computing brings computer-supported co-operative work (CSCW) to personal computing, integrating two prominent themes of the past two decades in human–computer interaction. The basic rationale for community computing, as for any computer-supported co-operative work, is that people who want to communicate and collaborate are not always in the same place at the same time. The distinguishing feature is that the collaborators are neighbours, and that computer support supplements diverse opportunities to interact face to face.

Although community computing is as old as human–computer interaction (HCI) itself, and encompasses some of the most intimate HCI, there has been little mutual engagement between the two. This may be due to accidents of history. Human–computer interaction developed out of problems in the commercial software industry. Civic sector computing developed as a topic in computers and society. In the landscape of the Association for Computing Machinery (ACM), for example, these are largely disjoint special interest group areas (SIGCHI and SIGSOC, respectively).

There are, however, many reasons to expect synergies from better incorporating community computing into HCI. In part, these would be realized merely from broadening the scope of HCI, but I think there is potentially more to it than that. Assimilating civic sector computing into HCI would fundamentally enrich the concepts and approaches of HCI:

- clarifying the notion of community, used so widely, and yet so lightly, in contemporary HCI discourse;

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- broadening the range of organizational models countenanced in CSCW;
- emphasizing social engagement and human development in personal computing software;
- providing a highly accessible and rigorous incubator for new HCI technologies and applications;
- expanding the concept of usability to include larger-scope and longer-term social impacts; and finally
- complementing formal approaches to the training challenge of an information technology workforce and to the global challenge of the digital divide.

In this brief discussion, I develop the suggestion that community computing should be incorporated into HCI under these six headings, though these are clearly not six independent points, and, naturally, reflect the provisional status of my thinking and on-going research.

2. A better understanding of 'community'

Though investigations of community computing are not common in HCI, the term 'community' has become a pervasive mantra. Contemporary writing is peppered with hopeful terminology like online community, user community, design community, virtual community and, of course, HCI community (permuted in the US as CHI community). I believe the popularity of the term reflects a desire on the part of many HCI professionals to participate in and contribute to more meaningful social interchange. But the term is also clearly now just a buzzword; the collection of people who have recently ordered a pair of socks from the same website is a rather impoverished example of community.

Traditional proximate communities are of course not utopias. People who live in small, relatively isolated groups really cannot afford to initiate avoidable conflicts. They must deal regularly with one another. They are mutual competitors for local resources, and yet need to rely on one another in times of crisis. Their children will associate with, and perhaps marry into, other families in the community.

The underlying tensions of a proximate community are managed through morals and behavioural norms. In a moral community, members share a common ethical system entailing mutual obligation; such a community is bound by commitment to a common purpose. In a normative community, members share rules for behaviour and interpretation of behaviour; such a community is bound by shared meanings. Thus, the social construction of a traditional community involves conflating the practical dependencies of living in proximity with commitments to shared purposes and meanings, often referred to as *social capital* (see Komito 1998 and Putnam 2000 for further discussion).

Such a first-order analysis of community dynamics makes it possible to articulate distinctions among types of communities that are otherwise merely figures of speech. For example, Komito (1998) discusses the Mafia as an example of a moral community, and the medical profession as an example of a normative community. These examples suggest how specific qualities of communities can be isolated and contrasted. In Komito's examples, practical dependencies *not* deriving from living in proximity are supplemented and regulated with social mechanisms. These examples also help to emphasize the significant level of commitment involved in community memberships.

The term community appears to capture part of the consensus vision of HCI. An appropriate propaedeutic is a more serious articulation the concept so it can be used with technical content. Instead of merely labelling every newsgroup and chat room a community, we should seek to understand how such interacting groups can be analysed as communities, and what follows from such an analysis. An obvious component of such a project would be the study of how computing and networking facilitates and transforms the clearest cases of human communities, namely, proximate communities.

3. A richer concept of groups and collaboration

One of the most important developments in HCI during the past two decades is the area of computer-supported co-operative work (CSCW). It may seem unbelievable that before the mid-1980s, HCI was concerned only with isolated individuals, who were interacting only with data. Many types of groups and group work situations have been studied under the aegis of CSCW, but almost all are instances of workplace computing. This focus on workplace interactions derives partly from what is of commercial value to the computing industry, and partly from the contemporary focus of ethnographic research. It can also be seen as a simplifying heuristic: workplace activity is well-structured relative to other areas of human endeavour such as recreation.

However, too singular a focus on workplace computing has limited the understanding of groups and group work that can emerge from CSCW. There are many opportunities and challenges for computer-supported collaboration beyond the workplace—in recreation, education, informal learning, family and community

interactions, and so forth. Investigating these other contexts could provide a broader perspective on what groups and group activity can be like, and on issues and possibilities for computer-supported collaboration.

Some of the most tantalizing fieldwork in CSCW describes the tension between formal lines of authority and official views of job roles and workflow, on the one hand, and the actual flow of work activity and information, on the other (Button in press). In the civic sector, these issues manifest differently. Unlike a business, no one is even officially in charge of a community; there is no single line of authority. Laws and officials, like a mayor or town council, have limited scope and impact. Official actions either have little consequence or tend to be planned and implemented very publicly through extensive negotiation processes.

Most community activity occurs through minimally co-ordinated and highly localized initiatives. When the senior citizens community create a mentoring programme, they only need the concurrence of the subgroups they wish to mentor. Communities function as confederations of largely autonomous subgroups. Groups publicize their activities to inspire themselves, to attract participation and support, and to leverage activities of peer groups. But they co-ordinate only to the extent of avoiding duplication of effort and minimizing conflicts over shared resources, such as the use of meeting rooms in a community centre or public library. The motivation and reward structure for community network use is fundamentally different than for workplace computing, relying almost exclusively on intrinsic motivation and individual initiative-taking.

The diversity among the people constituting a community is greater than the range of job roles and relationships constituting most workplace organizations. To be sure, there are interesting distinctions and relationships among lawyers, legal assistants and legal secretaries, but most of these can be understood in terms of a small number of role stereotypes and task dependencies. Proximate communities, in contrast, span all phases of life (children, teenagers, adults, the elderly), all personal roles (parents, siblings, friends), and all occupations (teachers, shop owners, police). Any given community member plays multiple roles; one is simultaneously an adult, a parent, a friend, a teacher, a Rotarian, a first-baseman, and so forth.

Understanding groups and collaboration is obviously a key to the future of HCI. Studying the development, adoption, use and impact of collaboration technology for existing workplace organizations is an excellent approach to this. But too narrow a focus will limit both the practical and scientific utility of such studies. Work organizations of the future may differ significantly from those of the present. They may be less hierarchical, and more distributed; they may rely on intrinsic motivation and loosely co-ordinated initiative-taking. CSCW should continually expand its focus to include the greatest variety of organizational models, and specifically, it should investigate proximate communities.

4. A more engaging vision of personal computing

Computing in the home was an early inspiration in the development of HCI. It has now clearly emerged as an important social phenomenon and market. However, like the first visions of office automation in the 1970s, many concepts of home computing are focused on individual use, and conceive of the potential users as relatively passive consumers of technology and information. Typical scenarios emphasize asymmetric interactions in which people request items and services, as in home shopping, computer games and video-on-demand. These may be valuable applications, but they address only a part of personal life.

Much of what people do in the private portion of their lives is active, productive and collaborative. Traditionally, the home and the community are places of intergenerational collaborative learning and working. Families cook, clean, do laundry, give and receive care from one another and maintain communication with distant family members. They recall and preserve family history, discuss current events and read together. They visit and entertain neighbours. Neighbours work together to plan and build schools, parks and other community infrastructure. Computing has been recruited to support many of these more active aspects of personal life: children and parents work together on Internet research projects; grandparents distribute family letters via e-mail and participate in genealogy websites.

Community computing highlights and facilitates an active concept of personal computing. For example, in our study of the Blacksburg Electronic Village, a community network in southwestern Virginia (Carroll and Rosson 1996), we observed that senior citizens had organized a mailing list to exchange and develop stories about life in Blacksburg during the 1960s, a period when members of the group were young adults. The group was interested in preserving these stories and making them available to other community members. We worked with them to create a web-based forum, Blacksburg Nostalgia, for posting and annotating stories (Carroll *et al.* 1999). We found that the forum was used not only by other seniors, but also by younger people in the community, as well as by former members of the community—people who had moved away from Blacks-

burg, but who still felt connected to it. This is an example of a very traditional activity, namely community oral history, transformed by community networking.

Many visions of ubiquitous computing emphasize the consequences of being unbound to place, for example, the potential flexibilities of sending an e-mail from the patio or making stock purchases while in an airport departure lounge. A variety of more personally-significant interactions are also enabled by ubiquitous computing. Family members and friends reassure us and depend upon us through direct contact, but in modern life one cannot always be co-present with loved ones. Kentaro Go developed the concept of familyware in which simple emotional messages—basically tantamount to 'I am thinking of you now'—are subtly conveyed to distant loved ones (Go *et al.* 2000). Similar concepts are being developed, such as remote monitoring of the well-being of distant elderly relatives (Mynatt and Rowan 2000).

A complementary view of ubiquitous computing takes specific advantage of being in a particular place. For example, a kitchen could sense and advise on actions taken there—managing inventory, food expiration dates, dietary constraints, nutrition, and food preparation (Kellogg *et al.* 1991). Outside the home, a personal digital assistant alarm might be triggered by proximity to a specific resource, for example, passing by the pharmacy when a prescription is ready, the dry cleaner when the clothing is ready, or the post office when a package has just arrived. Such notifications could also be triggered 'manually' by to-do items; for example, passing by the deli with a mozzarella to-do or by the hardware store with a weed-and-feed to-do. Place-based applications may be most effective in circumstances where a person's sense of place is most developed, as in his or her own community.

In their personal lives, people utilize and relate to information technology in many ways. Consuming retail products and services and enjoying leisure time are, and will continue to be, important areas for personal computing. But they are not a comprehensive view of personal life. Personal life is also about learning and using tools, and creating and sharing resources. In order to adequately investigate and characterize current and future developments in personal computing, HCI must encompass the active and creative aspects of personal life. To do this, it must encompass community computing.

5. A robust and accessible technology incubator

Communities are often used for home-oriented technology field trials. In the mid-1990s there were several high-profile field studies of home video services, including interactive shopping, games and programme guides, with movies, news and sports on demand. The Time Warner 'Full Service Network' trial in Orlando, Florida, may have been the largest of these studies, involving over 4000 families. The goal of such trials is to refine underlying technologies, to characterize consumer preferences and to provide a testbed for developing products. Such trials function, to some extent, as formative evaluations in that their outcomes often redirect products and corporate strategies. After the three year Orlando trial, Time Warner shifted its focus to television – Internet integration. But fundamentally, such trials are summative; they determine what will come to market.

Community settings are also appropriate, though less typically used, for incubating new HCI technologies through rapid prototyping and formative evaluation. Communities are highly robust technology incubators; the diversity among users, applications and hardware and software infrastructures that one finds in a community contrasts with the relative homogeneity of work organizations. Communities are also highly accessible technology incubators; they are easy to get to and inexpensive to use; we all live in one. Because the culture of community computing depends on intrinsic motivation, it is easy to get rich feedback, one only has to listen. Indeed, had Time Warner taken a more formative perspective, they would surely have noticed before mid-1997 that interactive video concepts required integration with the Internet.

Aspects of our work in the Blacksburg Electronic Village illustrate how community computing can serve as an HCI technology incubator. One of our interests was supporting long-term but intermittent collaborations. We worked with middle and high school science teachers who were interested in having their students work together and with community mentors on long-term projects. The school setting models many key requirements for collaboration environments: The interaction is document based (that is, not merely chat) and requires some level of shared editing support. Synchronous and asynchronous interactions must be integrated to accommodate differences in schedules, and to maintain task awareness over significant spans of time. The environment must incorporate desktop video to enable sharing of physical artefacts. Our solution was an integration of existing collaboration mechanisms that was more comprehensively task-oriented (Isenhour *et al.* 2000).

Working with community groups has emphasized to us the potential importance of exploiting 'sense of place' in organizing collaborative virtual environments (Harrison and Dourish 1996). For example, we worked with

the local government in Blacksburg to support collaborative annotation of zoning plans and other digital artefacts in virtual town meetings. This guided us to eventually develop a new kind of MOO, as an interactive website navigated by a sophisticated point-and-click map (Carroll *et al.* 2001). Community applications can also drive underlying technologies. We identified a variety of needs for document-level sharing in community applications that motivated the development of an architecture for lightweight client-server updating of shared objects (Isenhour *et al.* 2001).

In these projects, we found that rapid cycles of user feedback and prototyping were enabled by the accessibility of our community partners and the informality of our relationships with them. One of our current collaborators in a stream monitoring project rather happily observed that he expected our involvement to enrich the project, though not necessarily to make anything faster or better in the short term. We found the same sort of attitude among the teachers we worked with. Our partners understand that our participation involves investigating computer support by supporting them. This kind of orientation makes it easier to engage users at a higher level, as opposed to getting caught up in details of keystrokes and pixels. It is tremendously useful to have on-going, high-bandwidth feedback; it contrasts sharply with the Time Warner sense of a community testbed in which only a small number of indicators are tracked.

Communities are also good incubators for methods and techniques. Unlike commercial clients, community groups can afford greater tolerance for the vagaries of exploring new practices. For example, during the early 1990s various participatory design methods came into wide use in software development. However, in most cases these were incremental refinements of previous market research practices like focus groups and requirements interviews. We wanted to explore the consequences of involving users directly and pervasively in a 5–6-year lifecycle project. We were able to create a relationship with a group of public school teachers that allowed us to investigate techniques and consequences for what we now call long-term participatory design (Carroll *et al.* 2000). It is difficult to imagine how a commercial organization could have sustained a methodology project like this.

Standard engineering practice in HCI is to develop methods and tools through an iterative process of prototyping, evaluation and refinement. This process requires early and continuing access to rich and robust usage contexts. Particularly given the growing focus on personal computing, communities are essential technology incubators for assuring the relevance and effectiveness of new HCI technologies and applications.

6. A broader notion of usability

One of the most interesting threads of development in HCI through the past two decades is the conception of 'usability'. Initially, the term was taken as synonymous with easy or simple. As understanding of the usage experience and its consequences developed, usability was enriched with ideas from human development to include notions like cognitively stimulating, consistent with prior knowledge and transparently useful in the work at hand. During the 1990s, as CSCW became the dominant problem area for HCI and organizational issues became better understood, usability was further elaborated to incorporate notions like awareness of and access to other people in the performance of a work task, and support for existing workplace roles and practices.

As the utilization of computing expands into private and civic life, our understanding of usability should broaden further to encompass qualities like eudaimonic well-being (Ryan and Deci 2001), collective efficacy (Bandura 1997), cultural identity (Clifford 1986) and social capital (Putnam 2000). In community computing, people accomplish tasks together, but the most significant consequence of these collaborations is often larger-scale and/or longer-term.

In HCI, health and well-being are usually thought of in terms of workplace ergonomics—problems of physical posture and manipulation that can be long-term, and psychological stressors that are generally short-term. Technology can clearly have broader effects. People who report being happy when engaged in social interaction, report being bored and unhappy when watching television (Kubey and Csikszentmihalyi 1990); television viewing is linked to reduced physical activity, and poorer physical and mental health (Anderson *et al.* 1998, Sidney *et al.* 1998). These are issues of usability-in-the-large. Indeed concerns about impacts of Internet computing on health and well-being have already been raised quite visibly (Kraut *et al.* 1998).

People's beliefs about their own specific capabilities exert influence on learning and performance outcomes (Bandura 1997). High perceived self-efficacy for a domain causes individuals to set more challenging goals, to work harder on difficult aspects of tasks, to master new competencies and to achieve more. Group members' beliefs about *collective* efficacy predict group performance. Collective efficacy is a function of interrelated personal efficacy beliefs, including both members' appraisals of personal capability for functions performed within the group (for example, the belief that there is someone you can turn to for advice about handling problems with your family) and members' appraisals of the group's capability (for example, the

belief that one's community can improve the quality of public schools without help from the state government). The tools people use, such as computers and software, can affect their perceptions of both self-efficacy and collective efficacy, and thereby enhance or impair future learning and performance.

Although it can seem like the world has been thoroughly homogenized, we are not all members of the same culture. Moreover, the nature of cultural groupings is itself dynamic, as evidenced by the on-going re-examination of multiculturalism in the USA triggered by the 2000 census. Cultural identity, including regional folkways, mores, and concerns, contributes to the creativity of the self and to the diversity of society, but it is a complex social construction that must be accommodated, encouraged and celebrated. It is under assault throughout the world by mass production of all sorts, including, of course, one-size-fits-all software and user interfaces. Although the risks of poor usability with respect to cultural identity are becoming better understood, it is not now well-understood how to manage HCI design to ensure preferred outcomes (Prabhu and delGaldo 1999, Stephanidis 2000).

Social capital is a key concept in contemporary studies of the decline of civil society and the rise of utilitarian individualism (Bellah *et al.* 1986, Putnam 2000). The creation of social capital involves the establishment and maintenance of social networks, shared goals and values, and social norms of reciprocity. Social capital is not a transient state, like satisfaction or frustration, or a discrete achievement, either present or absent; it is a social resource that it developed. It is not an individual state or achievement; it is a collective good benefiting everyone who lives in the community. Systems and applications that enhance social capital will have greater long-term usability for the members of the community; those that diminish the social capital of organizations are less usable.

Usability is the touchstone concept of HCI. As our understanding of the usage experience and its consequences has grown, the concept of usability has grown. Community computing emphasizes further personal consequences of interacting with technology and, thereby, can help to develop the concept of usability and techniques for evaluating usability (Carroll and Rosson 2001).

7. Addressing the challenge of developing an IT workforce

Much of the earliest HCI research concerned itself with the problems of 'new users'. In the 1980s, spreadsheet and word processing applications were widely adopted for routine office tasks. Office workers were, rather abruptly, asked to learn computing skills just to perform their jobs. This was the first information technology workforce crisis; notions like 'computer phobia' became common. During this period, HCI research helped to produce effective training designs, more transparent user interface metaphors, and measurement-oriented approaches to developing usable systems.

Today, society faces a broader version of the 'new user' challenge. Some computing skill is required in almost every job, and a rapidly-increasing proportion of jobs require a variety of highly sophisticated computer skills. Many secondary schools now treat computing as an element of basic literacy, and computer science is now often the largest undergraduate major in universities. However, a large number of adults already in the workforce lack computing skills entirely, or have only basic office application skills (the ones that were the objective of the first 'new user' challenge). Other adults are not currently in the workforce, and thus face the double challenge of attaining the skills that would allow them to enter the workforce (for example, homemakers, disabled persons, the elderly, and members of marginalized minority groups).

In the USA, and I presume in other 'advanced' nations, many education initiatives are underway to address the challenge of developing an information technology workforce. Most approaches involve formal education, for example, expanding and better utilizing university programmes in computer science. And it is clearly important to increase the capacity and accessibility of such programmes. However, formal education is frequently inaccessible to adult learners in a sense more profound than the mere availability of classroom seats. Adult learners are not engaged effectively by the 'learning for learning's sake' orientation of formal education. For adults it is critically important to learn new skills in a meaningful context, in which real goals are pursued and achieved in the course of the learning (Knowles 1973). This is not news to HCI; it proved to be a key to meeting the first 'new user' challenge 20 years ago (Carroll 1990).

Informal, community-based activities can complement formal approaches to the training challenge of an information technology workforce. Persons not in workforce may still be active and engaged members of their community. Indeed, homemakers and retired people are typically more engaged in community development activities than the fully employed, who often work outside the community. People with existing and active commitments to their communities may find it more meaningful to learn about web programming,

for example, by helping to create a web application for a community service organization, than by attending an intensive programming class (Carroll *et al*. 2001). What we know about adult learners suggests that this would indeed be the case.

The training challenge of an information technology workforce in advanced nations is a special case of what is now widely called the 'digital divide': the global chasm between those who have access to technology and the skills to use it, and those who do not. The digital divide clearly originates in inequitable distributions of wealth and resources around the world. But the problem will not be remedied just by sending out hardware and software. The bigger issue will be effectively engaging the knowledge, interests and experiences of new users—a challenge HCI has successfully confronted before. I believe that the argument for community-based training interventions given above extends, *mutatis mutandis*, to addressing the broader problem of universal access to information technology. HCI has not played much of a role in addressing either the information technology workforce challenge or the greater challenge of the digital divide, but it definitely could.

To close this discussion, I suggest that greater engagement with community computing can make HCI richer and more comprehensive in its concepts and methods, as well as helping it to be more effective and to have more impact with respect to the significant technical issues facing computing and all of society. The case for this must be made in research and development results, but the possibility should be nurtured by a more ambitiously social conception of what HCI is.

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