HCI and societal issues: a framework for engagement

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Acknowledgments

Many thanks to Catherine Plaisant and Chris North for inviting us to participate in this project; to the anonymous reviewers, Gary Marchionini, and Bongwon Suh for their constructive comments; and to Ben Shneiderman for many years of enthusiastic mentoring and support.

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Abstract

In its broadest sense, Human-Computer Interaction includes considerations of the social, political, ethical, and societal implications of computer systems. Concerns such as privacy, accessibility, universal design, and voting usability, have led to active HCI research. The interplay between HCI work and societal issues can be characterized by both the source of the concern and the roles that HCI researchers and practitioners can play in addressing these concerns. We present a categorization of previous work along these dimensions, as a tool for comparing and contrasting various approaches. This model provides suggestions for engagement of issues that are likely to either remain prominent or grow in importance over the next several years. A focus on these issues may lead to opportunities for HCI research to make a contribution towards addressing societal concerns.
1.0 Introduction

The assumption that the needs and concerns of human users are an intrinsically important part of computer system design is central to HCI work. As this assumption leads researchers and practitioners to move beyond specific interface design questions towards the consideration of larger contextual issues, societal and political questions necessarily intrude. The step between “which menu design is best for this task?” and “Is this task appropriately designed? Does this tool meet the user’s needs?” can be very small, but the implications can be significant. A slight broadening of the view taken of a problem can move the researcher or practitioner from a purely technical role to a one that might require balancing of technical, societal, political, and personal concerns.

As the population of computer users and the range of applications expanded through the 1980s and 1990s, HCI professionals engaged in a variety of societal challenges posed by these new uses. Accessibility research aimed at making computers usable by people with disabilities; interfaces for specific subpopulations such as children and the elderly; and explorations of the role of computers in various contexts were (and are) all active areas of HCI work. Innovations often led to analysis, as researchers investigated the social implications of tools for remote collaboration and communication. HCI expertise has also informed larger societal and political debates around the proper role of technologies for issues such as voting and privacy.

The expansion of the scope of problems in human-computer interaction was accompanied by a similar evolution in the participants and activities involved. From the early work of cognitive and computer scientists in academic, corporate and research labs, human-computer interaction has grown to include designers, sociologists, anthropologists, artists, and others
working in areas such as interaction design, experience design, and usability. In this discussion, we use the term human-computer interaction to include all of these efforts and related fields.

Engagement with broader concerns has proven to be enormously constructive, playing a hand in the opening of new fields of research (participatory design, universal usability) the development of technological solutions for addressing human challenges (accessibility, education), and countless innovations, both large and small, that make computer and communication systems easier for millions of people to use on a daily basis. The impact of these efforts is significant: bad interfaces can and have lead to discomfort, injury, death, or catastrophe, with user interface problems contributing to disasters such as the partial core meltdown at Three Mile Island (Burns, 1991; Schultz & Johnson, 1988) and the crash of American Airlines Flight 965 in December 1995 (Landsberg, 2001). Good interfaces can lead to improved communication among friends and family, improved access to health care information, and increased productivity, safety, creativity, and satisfaction (Shneiderman, 2002).

The HCI community can certainly play a constructive role in responding to concerns and questions raised by policy-makers, citizens, and other stakeholders. However, proactive efforts aimed at addressing concerns before technologies are widely developed and implemented will arguably have greater impact. A framework for understanding the interaction between HCI and societal/political issues can provide some context that can inform efforts to proactively contribute to our collective understanding of appropriate design and uses of computer technology.

The range of factors that might stimulate the involvement of HCI researchers provides a starting point for categorizing efforts. HCI efforts that arise out of opportunities created by other computing research can be quite different from those that are motivated by the need to
respond to societal problems that are largely non-technical. These motivating factors will be referred to as the influences that motivate HCI involvement in societal issues.

The nature of the community's involvement provides a second dimension for characterization. Traditions of building systems, evaluating designs, and proposing both theoretical models and approaches to research are found throughout HCI work that engages in societal and political issues. When tackling societal and political issues, HCI workers have often transcended these research-based approaches to engage in calls to action, both implicitly and explicitly arguing for the active participation of the HCI community in formulating appropriate solutions to various problems. Discussion of the types of responses of HCI involvement can be useful for characterizing these various responses. Examples of these influences and responses are given in Table 1.

The range of HCI efforts and problems that might be described will defy any neat and clean categorizations. Despite these inevitable shortcomings, an investigation of the influences that motivate HCI involvement with societal concern and the forms that responses might take can be a useful starting point for a model that can describe both research and development efforts. The goal of this analysis is to provide the basis for a generative theory (Shneiderman, 2006) that will help our community identify opportunities and constructively contribute to future societal and political challenges. Case studies of HCI involvement with accessibility, privacy, and voting will illustrate some of the challenges in these areas, and examples from current domains will suggest opportunities for action.

2.0 Influences motivating HCI Involvement in Societal Issues

The HCI literature includes numerous examples of HCI engagement with societal issues. A review of this literature led to the identification of two main classes of forces that have...
motivated these efforts. The needs of various constituencies – individuals, families, communities, governments, and businesses – often drive the development of new tools or the assessment of their impact. Technological innovation provides the other primary motivation: as new technologies present new possibilities, associated societal concerns have led to HCI involvement. Taken together, we will refer to these forces as the influences that drive societal engagement of HCI researchers.

2.1 Personal and Community Needs

The next few sections focus on some personal and community needs that have served as influences for the societal involvement of HCI researchers. Additional examples of efforts motivated by personal and community needs are given in Table 2.

2.1.1 Accessibility

The computing community’s involvement with the use of technology to meet the needs of people with disabilities predates the emergence of HCI as a field of study. Work at the TRACE center at the University of Wisconsin has progressed from early work on communication devices for people with physical disabilities (Vanderheiden et al., 1973), to the awarding of the SIGCHI Social Impact award to Greg Vanderheiden in 2005. A panel at CHI ’86 (Buxton et al., 1986) was soon followed by several early papers that both proposed systems designs (Edwards, 1988; Ladner et al., 1987) and explored issues such as needs assessment for users with disabilities (Kane & Yuschik, 1987). Early CHI discussions of disabilities also led to the direct engagements of HCI researchers with accessibility policy, in the form of a discussion of the usability requirements of the US Rehabilitation Act of 1986 (Ladner et al.,
The design and evaluation of accessible user interfaces has been a constant theme in HCI research ever since, including efforts for people with visual (Coroama, 2006; Lazar et al., 2007; Laz2004; Lumbreras & Rossi, 1995; Mereu & Kazman, 1996; Raman, 1996), cognitive (Carmien et al., 2005; Cole & Dehdashti, 1992; Tuedor, 2006; Wu et al., 2005) and muscular (Noirhomme-Fraiture et al., 1993; Roy et al., 1994; Steriadis & Constantinou, 2003) disabilities. This work has also led to theoretical models (Boy2006), and contributed to the success of the ACM ASSETS conference.

2.1.2 Children & Education

One of the few early efforts at computing for children was the Logo language in the early 1980s, created by Seymour Papert to help teach programming skills (Papert, 1993). Druin’s pioneering work has focused on getting children involved with the design process using techniques such as participatory design, contextual inquiry, and paper (and furry) prototypes (Druin, 1999, 2002). Others have focused on the design of screen interfaces (Sullivan et al., 2000) and input devices (Hourcade et al., 2004; Inkpen, 2001). Children helped create new applications for storytelling (Benford et al., 2000) and collaborative drawing (Stewart et al., 1999). As the varying needs of children in differing age groups can complicate interface evaluation, involving age-representative children in development and testing is especially important (Hanna et al., 1997). While many educational computing tools are aimed at enhancing learning, teachers, not children, are the end users of these tools, and their needs, limitations on time, and external influences (such as the “No Child Left Behind” Act) also need to be understood and addressed (Carroll et al., 2000).

2.1.3 Elderly
Communication is the main reason for many older users to get online (Fox, 2004). E-mail is the most popular application for older users, who may communicate to stay connected with others, especially if their mobility is limited (Hirsch et al., 2000). Researchers have therefore been very interested in how declining motor and cognitive skills will impact the ability of older users to interact with web sites and communication tools, (Ellis & Kurniawan, 2000; Hirsch et al., 2000). There is evidence that older users have more trouble finding information on web sites and dealing with multiple browser windows (Ellis & Kurniawan, 2000; Mead et al., 1997), and that they find pointing devices challenging to use (Worden et al., 1997). Errors can be especially problematic, given that these users may make errors more frequently and have stronger negative reactions to errors (Birdi & Zapf, 1997). Usability guidelines (National Institute on Aging, 2001) and automated site analysis tools (Becker & Nowak, 2003) provide assistance in designing web interfaces for older users.

2.1.4 Universal Usability

These interests in younger users, older users, and users with disabilities converged in the late 1990s to form the new field of Universal Usability, which marks a shift in thinking from interfaces aimed at specific populations to interfaces that are easy for all to use. The term, first introduced by Shneiderman in 2000, focuses on three areas—user diversity, technology diversity, and bridging the gap between what users know and what users need to know (Shneiderman, 2000). Universal usability includes populations that have been well-studied (users with perceptual or motor disabilities, older users, younger users), as well as populations that have not received much attention yet (users with cognitive or learning disabilities, low education or illiterate users, low motivation users, etc.). While these are all
being described as separate populations, they cover multiple dimensions—age, disability, education level, computer experience, income level, and language, with most users fitting into multiple categories. Universal usability includes technology diversity as well, ranging from modern laptops, cell phones, or PDAs with fast network connections to older machines with dial-up modems. The third leg of universal usability - bridging the gap between what users know and what users need to know - includes methods such as online help; user tutorials and demos; natural language systems; and documentation.

The concerns of international users raise issues closely related to universal usability. Appropriate design and testing of user interfaces that will work well for users in countries with differing cultures requires careful attention to language, colors, layouts, visual depictions, and cultural sensitivity (Fernandes, 1994; Jennings, 1994; Khaslavsky, 1998; Nielsen, 1990a; Nielsen, 1990b; Russo & Boor, 1993). These differences can increase the complexity of empirical evaluations (Law & Hvannberg, 2004), and may even necessitate the exploration of distinctions between cultures that may lead to the need for systems with fundamentally different designs for how computer work is done (Hugo et al., 2002). Challenges faced by people in the developing world have stimulated the design of innovative tools for addressing specific local needs in areas such as finance (Parikh et al., 2006) and health care (Grisedale et al., 1997).

2.1.5 Social Computing

The second half of the 1990s saw an explosion of social forms of computing. Online communities, involving tools for group communication (e.g. listservs, newsgroups, bulletin boards, chat rooms) and shared resources, seemed to sprout up everywhere, from communities for those going through health crises, to those who share a passion for sports,
and those who are interested in similar books on Amazon.com (Lazar et al., 1999; Preece, 2000). The worries about increased time online leading to isolation seem to have been tossed by the wayside, as multiple studies found online communities to actually be helpful in reducing isolation (Maloney-Krichmar & Preece, 2005; Preece, 1998). More recently, new sites and aspects of social computing have emerged, such as Flickr, Wikipedia, social networking sites (MySpace, Facebook, etc.) and online dating. Video games and virtual environments also became more social, as individuals could easily compete with players across the country and across the world.

Significant recent efforts have focused on the application of emotion in computer interfaces (Norman, 2004). Some researchers have attempted to let users send a hug over a network (Mueller et al., 2005). Devices mimic the sensation of being hugged, providing beneficial contact for older individuals living alone. Others have attempted to measure human emotion through techniques such as facial EMG (Hazlett, 2003), or heart rate changes (Anttonen & Surakka, 2005), to determine which interfaces impact on the mood of users and why.

Emotion, user diversity, and societal goals can converge. A recent project examined how cell phones could be used to improve communication among a group of teenage girls, to persuade them to exercise more often (Toscos et al., 2006). This project has societal goals (improving health), social computing, mobile devices, and user diversity (teenage girls). Both teenagers and registered dieticians took part in the development. In another example of convergence, the topics of interface design, conservation, and global warming have influenced HCI researchers to create new interface projects that make users more aware of their energy consumption, with the hope that this will help encourage conservation (see last row of table 2 for more details).
Business and management concerns about the ergonomics and human factors of computers predate the establishment of HCI as a research field (Ackoff, 1967; Grudin, 2005). When most computing was done in corporate or academic contexts, improved interfaces and functionality implicitly served the needs of business users. Explicit consideration of the organizational issues involved in promoting usability (Mosteller et al., 1987), cost-benefit analyses of usability (Bias & Mayhew, 1994), and the implications of system design for employee autonomy and control (Hochheiser, 1997) illustrate some of the tensions HCI efforts might create in organizations.

Increasing health care costs and the need for active consumer involvement in health information and decision-making has led to activity aimed at increasing the computerization of health records (Goldschmidt, 2005) and building tools for patient-based data monitoring (Mamykina et al., 2006; Pratt et al., 2006). Questions regarding ownership, presentation (Mamykina et al., 2006), access control (Adams & Blandford, 2005), and interpretation all involve interface content.

2.3 Government Needs

Online provision of government information and services – collectively known as e-government – requires careful design of interfaces for finding appropriate information (Brewer et al., 2005; Delcambre & Giuliano, 2005; Marchionini et al., 2005; Martin et al., 2002). Proposals for advanced identification cards raise questions relating to privacy, access to information, informed consent (Hagman et al., 2003; Karger, 2006; Shneiderman, 2001).

Recent concerns about terrorism and natural disasters have led to increased focus on the
analysis of large heterogeneous data sets and the dissemination of findings, in support of decision-makers and responders who work to prevent attacks and recover from disaster. A research agenda for visual analytics draws heavily on human-computer interaction, citing the need for advanced interfaces, support for collaboration, and provision for dissemination of results (Thomas & Cook, 2005). Examples of this work include interfaces for situational awareness, which combine domain configuration details such as network layouts or geographical maps with event timelines, allowing for visualizations that might indicate the progression of an epidemic throughout the country (Livnat et al., 2005). The recognition of the need for individual and community involvement in emergency response has also led to proposals for “Community Response Grids”, which would support requests for assistance, coordination, and information dissemination in the face of challenging emergencies (Shneiderman & Preece, 2007).

2.4 Technological Innovations

Research and commercial innovation, both from HCI professionals and from the larger computing community, repeatedly raises HCI questions of societal and political concern.

Wearable computing (McAtamney & Parker, 2006); mobile computing (Parikh et al., 2006; Toscos et al., 2006; Williams et al., 2005); and ubiquitous and context-aware computing (Consolvo et al., 2005) are just a few areas of active computing research where HCI professionals have addressed societal concerns.

Advances in interface capabilities and functionality also generated activity. The advent of more life-like interfaces spurred analysis into the impacts of interfaces that made computers seem more human (Nass et al., 1995). Examination of persuasive interfaces (Fogg, 1998), and trust (Friedman et al., 2000) raise similar questions about the ways in which people
interact with information and services presented through the mediation of a computer
interface.

The constructive use of technological approaches to addressing societal concerns can
often generate new problems requiring further consideration. Logging technologies such as
videotape are both useful and potentially troublesome, due to potential for abuse (Mackay,
1995). These concerns have led to innovative technological approaches (Hayes et al., 2004)
and analyses (Hayes & Abowd, 2006) aimed at preserving the value of data capture tools
while respecting privacy and related concerns. Additional examples are given in Table 3.

3.0 HCI Responses to Societal Concerns

Our review of the HCI literature showed that HCI engagement with societal and political
issues involves combinations of system design, evaluations, and models and theories.

3.1 Design and Development

Much of the HCI community’s involvement with societal issues has taken the form of
systems and designs aimed at solving specific problems. The engineering and computer-
science elements in the HCI community (Grudin, 2005) have designed countless systems to
address needs in many domains. Rural midwives (Grisedale et al., 1997), young children
(Johnson, et al., 1999b), emergency medical responders (Kristensen et al., 2006), and people
with cognitive and physical disabilities (Section 2.1.1) have been the focus of these efforts.
Additional examples are given in Table 4.
3.2 Evaluation and Analysis

Evaluations of voting systems (Bederson et al., 2003), assistive technologies (Dawe, 2006), health information practices (Mamykina et al., 2006), online communities (Maloney-Krichmar & Preece, 2005), and privacy and security (Cranor et al., 2006; Dhamija et al., 2006; Garfinkel & Miller, 2005; Gaw et al., 2006; Good et al., 2005; Karat, et al., 2006b; March & Fleuriot, 2006; Whitten & Tygar, 1999; Wu, et al., 2006) have provided valuable insight into how systems should be built to achieve specific goals and avoid problems. Other example evaluations involved digital libraries (Adams et al., 2005), elderly users (Ogozalek, 1994; Rowan & Mynatt, 2005; Worden et al., 1997), and children (Oosterholt et al., 1996; Rader et al., 1997; Rueb et al., 1997).

3.3 Models, theories, and methods

Interest in societal and political concerns has played a significant role in extending HCI theories and models. Participatory design techniques originally developed in Scandinavia as a response to concerns about the impact of computerization on workers have been adopted and adapted by HCI researchers (Muller, et al., 1991). Early examples in corporate environments provided examples and experiences from various approaches (Blomberg & Henderson, 1990; Muller, 1991, 1992; Schuler & Namioka, 1993). Extensions to the theory of participatory design include taxonomies (Muller, et al., 1992) and applications to heuristic evaluation (Muller & McClard, 1995). This approach has been further validated by application to a variety of domains, including middle and high school science teaching (Chin et al., 1997); emergency medicine (Kristensen et al., 2006), orientation for people with amnesia (Wu, et al., 2005).
The broadening of participatory design has arguably led to a less political focus on simply including users in design processes, as opposed to the earlier, explicit inclusion of goals such as workplace democracy. Value Sensitive Design (VSD) takes a slightly different view of accounting for societal concerns. An outgrowth of earlier examinations of bias in computer systems (Friedman & Nissenbaum, 1993, 1995, 1996), VSD focuses on inclusion of human values in design processes, conceptual, empirical, and technical inquiries (Davis et al., 2006). VSD efforts include investigations of the impact of browser interface design on the ability to make informed decisions (Millett et al., 2001), examination of user understanding of web security concerns (Friedman et al., 2002b), the design of urban simulation (Davis et al., 2006), open-source software licenses that respect privacy concerns (Friedman et al., 2006), and social games for teaching programming to girls in middle-schools (Flanagan et al., 2005).

Like participatory design, Value Sensitive Design uses explicit consideration of specific values as a means of achieving goals such as democracy, fairness, inclusion, and the appropriate use of technology. Although incorporating these values into design projects may prove challenging (Flanagan et al., 2005), these combinations of theoretical background and example applications in many domains provides developers and designers with some understanding of how to address concerns about societal values.

As design methods for building information systems, participatory design and value sensitive design differ fundamentally from reflective methods aimed at understanding systems and impacts. Participatory action research (PAR) is a research method, primarily qualitative,
aimed at building understanding of systems, processes, and social issues within organizations (Byrne, 2005). PAR focuses on not only performing a research project, but also working to improve the infrastructure or understanding so that a problem can be improved or resolved (Baskerville, 2001), making societal engagement in the interest of solving a practical, immediate problem a primary goal. As a result, the research is almost a byproduct (Baskerville, 1999). Although similar to PAR, “Service-Research” (Lazar & Norcio, 2002) focuses more on quantitative methods. In service-research, quantitative research projects are performed in a way that also provides benefits to a community-based organization. However, for both PAR and service-research, the focus is on engaging the greater community through the research itself. Although it maybe challenging to identify projects that provide benefits for a community or organization, these projects are often very rewarding.

Additional models and analyses provide domain-specific insights and guidance. CHI researchers have proposed models and theories for topics including privacy (Palen & Dourish, 2003), computers as social actors (Fogg & Nass, 1997; Nass et al., 1995; Nass et al., 1994), persuasive technologies (Fogg, 1997; Fogg et al., 2001), universal usability (Hochheiser & Shneiderman, 2001; Shneiderman & Hochheiser, 2001) accessibility (Lazar et al., 2004; Petrie et al., 2006) and voting system evaluation (Selker et al., 2006).

3.4 Testimony and reports

HCI engagement with societal issues has also taken the form of direct work with policy-makers. Congressional testimony regarding national ID cards (Shneiderman, 2001) and empirical and analytical reports regarding the interface implications of electronic voting (Center for American Politics and Citizenship & Human-Computer Interaction Lab, 2006) are recent examples. The role of HCI institutions such as ACM’s SIGCHI in addressing policy
issues has been discussed (Johnson et al., 1999a), with the ACM SIGCHI US Public Policy committee providing an institutional venue for HCI professionals in the US to become involved in policy efforts (Bederson et al., 2006; Lazar et al., 2005a; Lazar et al., 2005b).

Direct involvement in policy issues involves many challenges. Involvement in debates over controversial topics such as electronic voting can invite critical responses (Maryland State Board of Elections, 2003), seemingly iron-clad technical and scientific arguments may be over-ridden by political concerns, and diverging opinions within the HCI community may preclude the development of a consensus viewpoint. However, carefully-presented expert opinion from computing professionals has proven influential in policy discussions (Johnson, 1998), and the HCI community is uniquely situated to comment on concerns regarding computers and usability.

### 3.5 Calls to Action

Constructive visions, proposed research programs, and declarations of beliefs and values have defined opportunities and galvanized efforts. Shneiderman’s “Declaration of Responsibility” challenged the HCI community to directly tackle issues not normally associated with computing professionals, including world peace, freedom of expression, education, and health care (Shneiderman, 1990). A more concrete research agenda expanded upon some of these ideas, focusing on accessibility; information and communication poverty; and an explicit reconsideration of measures of success (Muller, et al., 1997). Recent books have called for greater attention to emotional aspects of interface design (Norman, 2004), and for increased efforts to build computers to augment human capabilities (Shneiderman, 2002). Other efforts have included proposals for increased disclosure of the human impact of computer systems through social impact statements (Shneiderman & Rose,
1996) and universal usability statements (Hochheiser & Shneiderman, 2001); and calls for explicit participation in public policy issues (Bederson et al., 2006; Lazar et al., 2005a, 2005b; Johnson, et al., 1999a).

4.0 Case studies: Accessibility, Privacy, and Voting

Accessibility, privacy, and voting have all generated significant interest and concern in the HCI community in recent years. A closer examination of these domains illustrates the opportunities and challenges facing HCI researchers who are interested in having a constructive impact.

4.1 Accessibility

The HCI community's long history of accessibility work has occurred in the context of early and continuing engagement with broader public policy questions. In the US, the Rehabilitation Act Amendments of 1986 and the Americans with Disabilities Act of 1990 directly addressed questions regarding the accessibility of computer technology (Gunderson, 1994; Ladner et al., 1988). As the growth of visually-oriented web browsers threatened to bypass users with visual disabilities, members of the HCI community worked together with standards efforts such as the W3C consortium’s Web Accessibility Initiative (http://www.w3.org/WAI) to develop guidelines and tools for promoting and ensuring web accessibility. Section 508 of the Rehabilitation Act required the US Federal government to only purchase or develop accessible software and web sites. This greatly increased the visibility of the accessibility work being done in the HCI community, moving accessibility a specialized HCI topic, to a broader concern within the government and government contractor community. As legal challenges have occurred, the topic of accessibility has even gained more attention in the corporate community.
Despite these successes, many HCI challenges remain. Many websites are still inaccessible (Lazar et al., 2004), widespread deployment of dynamic web technologies known as AJAX have introduced additional concerns (Gibson, 2006), and the difficulties of working with users with motor and cognitive impairments provide continuing challenges (Boyd-Graber et al., 2006). Government policies and the accessibility guidelines can sometimes be confusing and subject to revision. National computing and information systems curriculum models in the United States do not yet, cover accessibility.

4.2 Privacy

As the explosion of web commerce led to increased privacy concerns, policy-makers and activists in the US and Europe became involved, leading to discussions with groups like the Federal Trade Commission (Federal Trade Commission, 1998). As the model of “notice” and “choice” grew out of these discussions, the World-Wide-Web Consortium developed the platform for privacy preferences, known as P3P (Cranor et al., 2002), a language for describing the privacy practices of web sites.

P3P illustrates many of the HCI challenges presented by privacy concerns. As a flexible language for describing both the collection and use of data and user privacy preferences, P3P and companion tools had rich vocabularies, including terminology that may not have been clearly-defined to end users. The possible use of this framework to create a wide range of policies led to criticism that P3P was unclear and difficult to use (Hochheiser, 2002). The HCI challenges of reconciling the needs of information providers and users were described as significant (Ackerman & Cranor, 1999). A study of proposed interfaces for P3P identified several challenges for privacy interface designs, including the careful and consistent use of language, appropriate default settings, icon design, and the use of layered interfaces (Cranor
et al., 2006). Subsequent work in the design of interfaces for authoring privacy policies revealed the importance of meeting user needs, with user studies providing evidence of successful use of proposed interfaces (Brodie et al., 2005; Karat et al., 2006b; Karat et al., 2005b).

Recent privacy work has explored issues such as phishing (Dhamija et al., 2006; Wu et al., 2006), spyware (Good et al., 2005), and secure e-mail (Garfinkel et al., 2005b; Gaw et al., 2006). The challenge of building interfaces that present clear information in a manner that meets user needs, goals and cognitive models is a recurring theme in this work.

Many of the core divisions regarding privacy remain. Consensus regarding the appropriate balance between individual privacy and the goals of businesses or governments remains elusive. As new technologies such as RFID tags, RFID technology (Garfinkel et al., 2005a) and advanced identification cards (Karger, 2006) are more widely used and deployed, both controversy and the opportunity for constructive engagement will likely continue.

4.3 Voting

With the notable exception of Susan King Roth’s analysis of the ergonomics of voting equipment (Roth, 1998), the usability of voting machines did not generate much interest until problematic ballot designs played a prominent role in the 2000 US presidential elections. These difficulties, along with concerns about the usability of newer touch-screen voting machines, have led to a flurry of activity in recent years. These efforts include empirical evaluations of the usability of traditional voting machines (Greene et al., 2006) and newer touch-screen devices (Bederson et al., 2003; Hernson et al., 2006); methodologies for testing the usability of voting systems (Selker et al., 2006); attempts to track usability problems during elections (Johnson & Marshall, 2005); exploration of voting and accessibility concerns (Selker
et al., 2005a); analyses of the usability of vote verification technologies (Center for American Politics and Citizenship & Human-Computer Interaction Lab, 2006; Sherman et al., 2006); and voting interface design proposals (Robertson, 2005; Selker et al., 2005b; Yee et al., 2006).

The debate over electronic voting illustrates some of the nuances involved when computing researchers discuss public policy issues. While HCI studies provide some evidence that these machines are usable (Bederson et al., 2003), security researchers have identified significant concerns (Feldman et al., 2006) that have led to calls for voter-verified paper trails (Kohno et al., 2004). Other investigations have identified usability concerns with currently-available tools for vote verification (Center for American Politics and Citizenship & Human-Computer Interaction Lab, 2006; Sherman et al., 2006).

4.4 Discussion

A history of successful accessibility efforts stands in stark contrast to the more mixed records of privacy and voting efforts. Differences in the nature of these issues and in the details of the responses of the HCI community can explain some of this difference in outcomes.

A relative lack of controversy is perhaps the most notable factor that distinguishes accessibility from privacy and voting. While the legal issues relating to the accessibility of computer interfaces may not be clear cut, the rights of individuals with disabilities are well-established in US law. This consensus has been enacted through legislation (Gunderson, 1994; Ladner et al., 1988) and re-affirmed through recent legal decisions (Bangeman, 2006). Privacy debates have often been much more contentious, pitting those who would collect and use information about individuals against privacy advocates. Privacy protection advocates argue that privacy should be protected through minimization of data collection, as opposed to
Voting stands out as perhaps the one instance where accessibility issues are controversial. Although there are very few studies usability studies that address the usability of voting systems for users with disabilities, direct-recording electronic (DRE) touch-screen voting devices have been promoted as being most appropriate for these users (Dickson, 2006). One expert review found advantages for electronic voting machines (Norden et al., 2006), but these conclusions are hotly contested (Lipari & Berry, 2006). In a study of reading disabled users, usability results were mixed: when compared with people with similar, undiagnosed symptoms, participants with diagnosed reading disabilities performed better on some voting interfaces and worse on others (Selker et al., 2005a).

HCI involvement in privacy and voting issues is further complicated by regulatory and cultural differences in different countries. Conflicting privacy laws in different parts of the world – most notably, between the European Union and the U.S. – present legal challenges (Reidenberg, 2000) that have ramifications for the design of systems that use personal data to provide personalized services (Kobsa, 2002). Concerns over the implications of electronic voting systems have been raised in various countries, including experiences with electronic voting in Brazil (Rezende, 2004) and Estonia (Breuer & Trechsel, 2006), and international surveys of voter perceptions (Oostveen & van den Besselaar, 2004). Cultural and legal views of voting and the democratic process will likely influence perceptions of usability in these contexts for some time to come.

As before, accessibility is a different story. Many countries (Canada, Portugal, Australia, UK) agree on the need for requiring certain categories of web sites to be fully accessible to people with disabilities. While there might be differences in the types of web sites that are
covered by the laws in different countries, the guidelines used to enforce accessibility are based on the Web Content Accessibility Guidelines developed by the Web Accessibility Initiative. Thus, an accepted international definition of accessibility is due, at least in part, to the contributions of the HCI community.

Timing may have played an important role in the HCI community’s ability to constructively contribute to these issues. Early understandings of the needs and goals of accessibility efforts (Buxton et al., 1986) likely contributed to the adoption of accessibility techniques adopted in mainstream operating environments (Microsoft, 2006) and, later, to web accessibility efforts. For instance, the Web Accessibility Initiative, a project of the World Wide Web Consortium, came out with web accessibility guidelines in 1999. These guidelines served as the foundation for laws in many countries. The Section 508 guidelines (in force since June 2001) in the US cite the Web Accessibility Initiative guidelines and note the influence of guidelines on regulation. A full history of these efforts can be found in (Shneiderman, 2007).

HCI involvement in privacy and voting discussions has been much more reactive. Most of the studies of the privacy implications of various interfaces and how they influence internet behavior (Dhamija et al., 2006; Friedman et al., 2002a; Friedman et al., 2002b; Good et al., 2005; Good & Krekelberg, 2003; Millett et al., 2001; Wu et al., 2006) came long after web protocols and software tools were well-established and the policy concerns were aggressively debated by US policy-makers. Earlier involvement in these debates might have increased the influence of HCI researchers. Although HCI activity regarding voting has been similarly reactive, this is largely a reflection of the relative lack of interest in voting technologies prior to the US presidential election in 2000.

These contrasts and similarities may provide some guidance for HCI professionals hoping
to engage in societal and political issues. Early involvement in uncontroversial issues such as accessibility may be the most obvious route to a constructive contribution, both in terms of specific designs and more theoretical contributions. More contentious issues might involve wading into charged debates, but appropriate empirical studies and innovative designs can play a constructive role in providing guidance to policymakers.

5.0 Towards a Generative Theory for HCI involvement in Societal and Policy Issues

Previous sections discussed some of the involvement of the field of HCI in societal issues and warned of the pitfalls of delayed engagement. A two-part generative model of HCI and societal issues can help both in identifying areas that may need more attention either now or in the near future. The combination of proactive engagement and a willingness to tackle potentially controversial issues can aid in the identification and framing of opportunities for constructive participation. Once an issue has been identified, engagement matrices (based on the responses from Section 3) can be used to explore the possible contributions that HCI can make to these discussions. The application of these matrices to several domains illustrates possible uses of these matrices.

5.1 Proactive Engagement

Effective proactive engagement in societal issues will require a broader, critical view of emerging computer technologies and proposed applications. Visionary discussions of ambitious long-term goals for computing systems (Shneiderman, 2002) must be balanced by focused analysis and understanding of short and medium-term trends, moving beyond HCI research, into other areas of computing and general societal concern. Both privacy (Johnson & Nissenbaum, 1995) and voting systems (Friedman, 1990; Wilcox & Nilsson, 1998) attracted
the notice of others in the computing community long before HCI practitioners became involved: identification of similar issues can both help generate appropriate responses and stimulate innovative research and development.

HCI researchers and practitioners may never escape the tension between the desire to proactively anticipate concerns and the necessarily reactive nature of responding to issues as they arise. Although the ability to respond quickly may always be constrained by available human and financial resources, active and broad consideration of current and potential concerns may lay the groundwork for effective responses.

Timing may also constrain the types of responses available in specific situations. Proactive efforts may have time for implementations of designs and development of models, theories, and frameworks due to the time available. Reactive responses may be limited to evaluations, reports, and calls to action.

5.2 Controversy

Active participation in issues that involve consideration of values and goals may lead HCI researchers into areas that are controversial. Some issues may lead HCI researchers to take potentially controversial stands on public policy debates, such as the need for national ID cards (Shneiderman, 2001). Disagreements between HCI professionals and other computing professionals may lead to apparent inconsistencies that may confuse citizens and policymakers: do cautiously optimistic results regarding the usability of touch-screen voting systems (Bederson et al., 2003) outweigh analyses that identify significant security concerns (Feldman et al., 2006; Kohno et al., 2004)?
Trade-offs between usability and security present similar concerns. A fully usable but not secure system is obviously not a good goal, but complex security measures may confuse users, decreasing both usability and eventually security. Tensions between graphic design and accessibility may require similar trade-offs. Even within the HCI community, there are internal debates such as the legendary CHI and IUI debates on agents (Shneiderman & Maes, 1997).

Recent work on “CAPTCHA” tests (von Ahn et al., 2004) – mechanisms for distinguishing human web site visitors from computational agents - provides an example of the convergence of all of these concerns. Those working on security feel a victory each time they develop a newer and stronger CAPTCHA. Those working on artificial intelligence feel a victory each time they break a CAPTCHA. The HCI community may feel that CAPTCHAs are inappropriate, as they add a layer of complexity that may decrease usability, and accessibility advocates argue that these tests limit the participation of individuals with visual impairment or learning disabilities (May, 2005).

The likely persistence of both individual controversies and the general question of how they should be handled should not prevent the HCI community from contributing. Attempts at understanding differences and working towards consensus will help identify areas where coordinated effort may be constructive.

5.3 Influences and Responses as Generators of Engagement

An examination of issues from each of the four influences (Table 1) provides some examples of current and potential proactive efforts that might be undertaken to address issues of societal and political concerns. The possibilities in each area are summarized in engagement matrices, which suggest current and future work in each of the response areas
5.3.1 Personal and Community Needs: Energy Efficiency and Sustainability

The need for sustainable energy sources has led to a renewed interest in energy efficiency. The HCI community can contribute to these efforts by developing tools and models that help individuals and communities understand how they use energy, and how they might use it more efficiently.

Recent design proposals have suggested ambient indications of household energy use: the power-aware cord glows to indicate energy used through its outlets (Gustafsson & Gyllenswärd, 2005), while the flower lamp “blooms” when household energy use is low (Backlund et al., 2006). Process visualizations (Matkovic et al., 2002) could support detailed analysis of energy usage profiles, with detailed monitoring of energy use changes over time providing insight into the effects of specific conservation measures. Discussion and support groups (Maloney-Krichmar & Preece, 2005), tools for community process deliberation (Davis et al., 2006), and social networks (Mankoff et al., 2007b) could help participants share ideas for conservation and to discuss and debate larger changes in community-wide energy practices.

Evaluations and analyses of these tools might start with traditional investigations into the efficacy of various interface designs, moving into more general questions regarding the larger goal. Researchers might ask whether these tools actually led to discernible changes in energy usage, and whether such changes were significant enough to offset the energy requirements of the devices needed for implementation. Study of the risks and unintended consequences will be particularly important for these tools that could involve monitoring of potentially sensitive data.
Theoretically, these efforts would both draw upon and influence emerging work in sustainable interaction design (SID): the view that design involves choices among possible futures, and that sustainability should be an important consideration in making those choices (Blevis, 2007; Mankoff et al., 2007a). Other models and theories that might emerge from these efforts would address the challenge of motivational user interfaces. Building on existing efforts that explore the use of interfaces for encouraging exercise (Consolvo et al., 2006; Goudarzi & Tomic, 2006; Lin et al., 2006; Toscos et al., 2006), and earlier work on persuasive interfaces (Fogg, 1997), generalized models of this class of interfaces would identify common features that work across problem domains. Attention to manipulative aspects of these tools would identify concerns regarding potential abuses.

Dissemination of these efforts might involve working with regulators and representatives of multiple industries to turn research prototypes into widely-used tools. Reports might detail best practices in designs of interfaces, tools, and overall systems, and broad visions would describe a constructive role of computer technology in the service of sustainable energy use.

5.3.2 Business and Organizational Needs: Electronic Health Records

Electronic health records may bring about health benefits, but the costs of the underlying infrastructure are not well understood (Charette, 2006). Given the variety of populations (health practitioners, patients, research) that must be served by such records, the designs of data representation standards (Bossen, 2006a, 2006b) and interfaces for accessing that data (Stroetmann et al., 2003) play an important role in determining how such systems will affect people’s lives. Personal health records – intended primarily for use by individuals to manage their own health information – present additional challenges distinct from those associated with records intended for use by health professionals. Ideally, these tools will support
customized arrangement of data and sharing of information for vastly different users facing different challenges (Marchionini et al., 2007; Pratt et al., 2006).

HCI professionals can explore interface designs that might meet these potentially-conflicting needs, working towards general models for appropriate interfaces for information sharing. Criteria for evaluating the success of such interfaces – and their roles in larger systems – might help industrial and organizational partners improve their products. The presentation of a vision for providing electronic health records while still respecting the concerns of individuals might provide a model that would help achieve efficiency while minimizing negative outcomes. Table 6 provides an engagement matrix.

5.3.3 Government needs: National ID Cards

In the US, the Real ID Act of 2005 allows the federal government to set standards for state-issued ID cards or driver’s licenses, leading to what some argue is the de-facto establishment of a national ID card (Rotenberg, 2006). These proposals have also been criticized as creating the potential for privacy violations, without commensurate increases in security (Neumann & Weinstein, 2001).

Principles of informed consent can be used to suggest appropriate designs (Hagman et al., 2003). In addition to proposing best practices for the use and design of such IDs, contributions from the HCI community might include system designs of both cards and readers of information stored on those cards that would demonstrate the possibility of combining the use of information for legitimate purposes with safeguards that would protect privacy and personal autonomy. An engagement matrix is given in table 7.
Radio-frequency ID tags provide an example of a technology that was extensively analyzed before having a critical impact. Widely criticized as having security and privacy concerns – particularly when used in products - (Garfinkel et al., 2005a), RFIDs have also been used to aid blind people with navigation (Willis & Helal, 2005), and to augment museum exhibits (Hsi & Fallt, 2005). RFIDs have been proposed for use in identification and authentication contexts (Perakslis & Wolk, 2006).

Opportunities for constructive engagement efforts with RFID include the development of personal, portable RFID readers, which would help individuals determine which items were tagged and how. Similar approaches have been used to build portable bar code readers as shopping aids for blind people (Narasimhan, 2006). Tools that would allow for selective disabling of RFID chips upon user request might also be useful. These approaches might inform construction of a set of best practices which would describe approaches for appropriately using RFIDs while respecting privacy rights.

National IDS, health records, and RFIDs are not disjoint topics. Discussions of National ID cards and electronic health records might converge into proposals for a single “smart” card containing identification and health information. Proponents might even suggest that embedded sensors could unobtrusively scan such a card upon entrance to a physician’s office or hospital, retrieving necessary information. Proactive examination of these issues should also include explicit consideration of the expansion of scope (“feature creep”) and unanticipated uses that often occur in large-scale societal information systems. Table 8 gives the engagement matrix.
5.4 Limits

HCI concerns rarely exist in a vacuum. Practitioners frequently address tradeoffs between usability and other factors, including security, reliability, and cost (Bias & Mayhew, 1994). If cost is the primary criterion used, many systems that address societal needs would never be justifiable. Voting systems are both expensive and infrequently used, leading lawmakers to resist arguments for revisions that might increase security and usability. The likelihood that voting machines may never be as useful as is theoretically possible should not deter HCI experts from arguing for whatever improvements are politically feasible.

Insight from HCI research and practice can also inform discussions of the appropriate balance between technology and laws, regulations, or other forms of achieving societal or political goals. Technological solutions have been proposed as preferred mechanisms for addressing such questions such as freedom of speech (Hoanca, 2005) and privacy (Lessig, 1999), but usability questions may have limited the impact of these technologies (Hochheiser, 2002). The HCI community’s detailed understanding of how technologies work in context can be a vital resource for these discussions.

In some cases, the best computer interface may be to decide not to use the computer: the HCI community should also be willing to take a broad view that includes questions of whether or not certain computing systems should be built at all. Although a 1970s era call for a moratorium on community information networks (Press, 1974) may seem somewhat quaint in 2007, potential negative impacts can argue against the impact of certain technologies. Growing concerns over the environmental issues has led to an interest on the potential impact of pervasive technologies (Koehler & Som, 2005; Krauchi et al., 2005) and visions for sustainable computing (Fuchs, 2006; Mocigemba, 2006). In the spirit of working HCI
professionals should be prepared to consider whether environmental concerns outweigh the possible benefits of widespread deployment of these technologies.

Tackling such questions may not be easy. Stepping outside of well-defined bounds of professional expertise, exploring controversial topics, and perhaps building consensus may prove challenging and frustrating. Arguments that carefully draw on the HCI community’s unique expertise and accumulated scientific insight will likely be the most compelling.

6.0 Summary: A Call to Action

More so than many other fields of computing research and innovation, Human-Computer Interaction includes all aspects of how people engage with computer systems, and how those systems change our world. Health care, education, electronic government, privacy, and voting are just some of the concerns with strong computing involvement that would benefit from the expertise of the HCI community, but contributions need not end there. Creative approaches to broader problems including global warming, poverty, and world peace can arise from our community as well. By tackling the challenges of these broader issues, the HCI community can find new problems to solve and expand our understanding of the field as a whole, while helping technicians and policy-makers build and use computer systems that appropriately meet human needs, goals, and aspirations. Motivated professionals in all lines of work can contribute to these efforts. Researchers can build research programs aimed at understanding the details of specific questions and the implications of design alternatives. Well-designed studies can be particularly helpful in informing disputes between competing claims about system performance and impact. Engineers, product designers, and others in industry can argue for the consideration of impact concerns in product design, ideally leading to improved products that will be better for business. Appropriately constructed arguments can
lead corporations and industry leaders to consider HCI concerns. Policy makers with HCI expertise can raise concerns regarding the implications of government computer systems and regulations, helping legislators and regulators understand complex technical issues. Educators can include these topics in HCI courses and one potential approach is through service learning courses (Mankoff, 2006; Rosmaita, 2007; Shneiderman et al., 2006). Professional societies such as SIGCHI and UPA can present a public face for the profession, actively engaging in discussions and attempting to inform policy-makers and the general public. Examples include the SIGCHI US Public Policy Committee (Bederson et al., 2006; Lazar et al., 2005a; Lazar et al., 2005b) and the UPA’s work on electronic voting usability (Usability Professionals Association, 2007). These societies may also be particularly well-suited for engagement with others in related professions, journalists, and consumer groups.

The societal issues discussed in this paper were primarily limited to topics that have been of great interest in the United States. These issues are generally influenced by cultural and societal norms in a country. However, some of these issues, especially accessibility and privacy, have become issues that cross borders. The responses will still need to be tailored to the specific needs, norms, and processes of a specific country. While there is currently a CHI Public Policy group dedicated to US issues (of which both authors are members), we encourage the formation of similar policy groups in other countries.

Active, principled engagement in these topics may not be without risk. Professionals may not share the same views or goals regarding issues at the intersection of HCI and policy. Unpopular stands on controversial topics may involve risks to research funding and career advancement. Professional standards and conduct can help in these circumstances, as analyses grounded in successful research frameworks, experience in design and implementation, and empirical analyses can provide a solid scientific basis for participating in
policy discussions. Community support can play a strong role as well: by encouraging our peers to contribute to these complex and challenging issues, we hope to foster new and creative efforts that will make positive contributions both within our field and beyond.

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Nielsen, J. (Ed.). (1990b). Designing user interfaces for international use. Essex,


Sillence, E., Briggs, P., Fishwick, L., & Harris, P. (2004). Trust and mistrust of online...


Table 1: Factors influencing HCI involvement with societal concerns, and possible responses.

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<tr>
<th>Influences</th>
<th>Responses</th>
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<td>Personal and Community Needs</td>
<td>Design &amp; Development</td>
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<td>Business and Organizational Needs</td>
<td>Evaluation</td>
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<tr>
<td>Government needs</td>
<td>Models and Theories</td>
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<tr>
<td>Technological Innovation</td>
<td>Reports, Testimony, and Related Public Policy Activities</td>
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<td>Calls to Action</td>
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<tr>
<td>Category</td>
<td>Relevant Efforts</td>
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<tr>
<td><strong>Communication</strong></td>
<td>Girls, technology and privacy (March &amp; Fleuriot, 2006), children and wireless technology (Williams et al., 2005), context-enhanced mobile messaging (Jung et al., 2005), deception (Hancock et al., 2004)</td>
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<tr>
<td><strong>Civil society</strong></td>
<td>Informatics Design (Walker &amp; Dearden, 2005), Participation (Kavanaugh et al., 2005)</td>
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<tr>
<td><strong>Underserved populations</strong></td>
<td>IT &amp; Community (Harrison et al., 2005; Pinkett, 2002), Social Networks (Foth, 2006)</td>
</tr>
<tr>
<td><strong>Home &amp; Family</strong></td>
<td>Social communication (Hindus et al., 2001), Shared calendars (Neustaedter &amp; Brush, 2006; Plaisant et al., 2006) Device design (Taylor &amp; Swan, 2005), Mobility and technology use (Shklovski &amp; Mainwaring, 2005)</td>
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<td><strong>Health Care/Medical</strong></td>
<td>Personal health information management (Pratt et al., 2006), Emergency medicine (Kristensen et al., 2006), Encouraging exercise (Consolvo et al., 2006), Diabetes (Mamykina et al., 2006), Evidence-based care (Hayes &amp; Abowd, 2006), Software engineering for clinical systems (Schrenker, 2006), Advanced surgical interfaces (Gary et al., 2006)</td>
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<td><strong>Gender Issues</strong></td>
<td>Gender &amp; end-user debugging (Beckwith et al., 2005), Values and game design (Flanagan et al., 2005)</td>
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<td><strong>Energy Conservation</strong></td>
<td>Devices and interfaces for energy use awareness (Backlund et al., 2006; Gustafsson &amp; Gyllenswärd, 2005; Harter et al., 2004)</td>
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Table 2: Factors motivating HCI involvement in addressing family and community needs

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<tr>
<th>Factor</th>
<th>Keyson et al., 2000</th>
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<tr>
<th>Category</th>
<th>Relevant Efforts</th>
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<tr>
<td><strong>Privacy implications of new technologies</strong></td>
<td>Displays in public spaces (Little et al., 2005), Information disclosure (Price et al., 2005), Awareness applications (Patil &amp; Lai, 2005), Design methods for ubiquitous computing (Iachello &amp; Abowd, 2005), Privacy policies (Brodie et al., 2005; Jensen &amp; Potts, 2004; Karat et al., 2005a; Karat et al., 2006b; Karat et al., 2005b), Medical applications (Adams &amp; Blandford, 2005), Impact on e-business (Horn et al., 2005; Jensen et al., 2005)</td>
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<td><strong>Trust and credibility</strong></td>
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<tr>
<td><strong>Computer Security</strong></td>
<td>Phishing (Dhamija et al., 2006; Wu, et al., 2006), Secure email (Garfinkel et al., 2005b; Gaw et al., 2006), Human interaction proofs (Chellapilla et al., 2005), Mental models of security (Friedman et al., 2002b)</td>
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<tr>
<td><strong>Informed Consent</strong></td>
<td>Cookie-management interfaces (Friedman et al., 2002a; Friedman et al., 2001; Millett et al., 2001), ID-Card bar codes (Hagman et al., 2003)</td>
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*Table 3: Examples of HCI work motivated by technological innovation*
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<th>Category</th>
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<td>Voting and ballots</td>
<td>“Pre-rendered” ballot interfaces (Yee et al., 2006), Voting and decision-support systems (Robertson, 2005)</td>
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<td>Accessibility</td>
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<tr>
<td>Privacy</td>
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<td>Universal usability</td>
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<td>Underserved Populations</td>
<td>Mobile phones for rural microfinance data capture (Parikh et al., 2006)</td>
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<td>Elderly</td>
<td>Tabletop photo sharing (Apted et al., 2006),</td>
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<td>Family</td>
<td>Shared calendars (Neustaedter &amp; Brush, 2006; Plaisant et al., 2006) Support for aging in place (Mynatt et al., 2001)</td>
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*Table 4: Design responses to societal issues.*
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<tr>
<th>Response</th>
<th>Example</th>
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<tbody>
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<td><strong>Design &amp; Development</strong></td>
<td>Flower Lamp (Backlund et al., 2006),</td>
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<td>Power-Aware cord (Gustafsson &amp; Gyllenswärd, 2005)</td>
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<td><strong>Evaluation &amp; Analysis</strong></td>
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<td><strong>Models &amp; Theories</strong></td>
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<td><strong>Reports, Testimony and related activities</strong></td>
<td>Best practice design reports for industry, regulators, citizens, and communities</td>
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<tr>
<td><strong>Calls to Action</strong></td>
<td>Computer Information Technologies as Drivers of Sustainable Energy Use</td>
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Table 5: An engagement matrix for energy efficiency. Proposed and future work is italicized
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<th>Response</th>
<th>Example</th>
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<tr>
<td><strong>Design &amp; Development</strong></td>
<td>Usable standards and interfaces for health records (Bossen, 2006a, 2006b)</td>
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<td><strong>Reports, Testimony and related activities</strong></td>
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<td><strong>Calls to Action</strong></td>
<td>Visions of Electronic Health Records as Providing improved Health Care and Protecting Privacy</td>
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*Table 6: An engagement matrix for electronic health records.*
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<th>Response</th>
<th>Example</th>
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<tr>
<td>Design &amp; Development</td>
<td>Informed Consent (Hagman et al., 2003)</td>
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<td>Selective Access Controls?</td>
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<td>Evaluation &amp; Analysis</td>
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<td>Reports, Testimony and related</td>
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<td>activities</td>
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<td>Calls to Action</td>
<td>Public discussion of ID cards and their implications</td>
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*Table 7: An engagement matrix for electronic National ID cards.*
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<th><strong>Response</strong></th>
<th><strong>Example</strong></th>
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<tr>
<td><em>Design &amp; Development</em></td>
<td>Wayfinding for blind</td>
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<td>Navigation (Willis &amp; Helal, 2005),</td>
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<td></td>
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<td><em>Personal RFID Readers, User-controlled access</em></td>
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<td><strong>Evaluation &amp; Analysis</strong></td>
<td>Overview of Problems and Solutions</td>
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<td></td>
<td>(Garfinkel et al., 2005a)</td>
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<td><em>Evaluation of use in context</em></td>
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<td><strong>Models &amp; Theories</strong></td>
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<td><em>Best Practices</em></td>
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<td><strong>Reports, Testimony and related activities</strong></td>
<td>National Academy Report on RFID Workshop (Computer Sciences and Telecommunications Board, 2004)</td>
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<td><strong>Calls to Action</strong></td>
<td>Recommendation of privacy practices</td>
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<td>(Privacy Rights Clearinghouse, 2003)</td>
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*Table 8: An engagement matrix for RFID.*