Finding Meaningful Uses for Context-Aware Technologies: The Humanistic Research Strategy

Antti Oulasvirta
Helsinki Institute for Information Technology
Helsinki, Finland
oulasvir@hiit.fi

ABSTRACT

Human–computer interaction (HCI) is undergoing a paradigm change towards interaction that is contextually adapted to rich use situations taking place "beyond the desktop". Currently, however, there are only few successful applications of context-adapted HCI, arguably because use scenarios have not been based on holistic understanding of the society, users, and use situations. A humanistic research strategy, utilized at the Helsinki Institute for Information Technology, aims to structure the innovation and evaluation of scenarios for future technologies. Population trends and motivational needs are analyzed to recognize psychosocially relevant design opportunities. Ethnography, ethnomethodology, bodystorming, and computer simulations of use situations are conducted to understand use situations. The goal of design is to empower users by supporting their autonomy and control. Three design cases illustrate the approach. The paper showcases an emerging framework for informed innovation of use potentials.

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INTRODUCTION

At the present, human–computer interaction (HCI) is undergoing a paradigm change from desktop-bound interaction towards contextually adapted interaction taking place in rich use situations "beyond the desktop" [26]. The new kind of interaction has been proposed to be more physical, engaging, and tangible [5], but at the same time more natural and implicit [20]. It has also been thought to provide resources for spontaneous user-initiated action [11], whereas others think it should be proactive [24]. The tenet of "access to information anywhere, any time" [19], has been criticized, and asynchronous interaction that leaves more room for reflective cognition has been called for [6]. This balkanization indicates that there is still no consensus on what the new technologies are going to be used *for*. Partly because some of the useful ideas are not technologically feasible, but partly because scenario innovation has been unsystematic and based on intuition, there are few if any mass consumer products of context-awareness. Consequently, in a recent panel at the Mobile HCI 2003, representatives of major technology companies named finding novel uses for future technologies as a key challenge for research.

This paper reviews methods that have emerged from attempts by the User Experience Research Group (UERG) at the Helsinki Institute for Information Technology to identify potentials for future technologies. The hypothesis is that by using ethically grounded (i.e., humanistic) criteria for uncovering societal demands for technology, by conducting carefully focused empirical studies to understand use situations, and by aiming for empowerment in design, we can better comprehend what "good technology" entails.

Background

Formed in 2000, UERG investigates potentials in everyday lives of normal people (not just researchers or businessmen) for future technologies, especially in areas where Finnish IT industry has or may reach a significant global role. It complements research in industry by studying the psychological, social, and ethical aspects of technology.

HUMANISTIC RESEARCH STRATEGY

The prevailing strategy to find use potentials could be called *technology-driven*. In short, it takes technology as granted and attempts to find some minimum use case that justifies its existence. This can be contrasted by the *humanistic strategy*. Humanism believes in human rationality, creativity, and morality, and recognizes that human values have their source in experience and culture. It emphasizes that all people have ability to lead meaningful lives. People acquire purpose in life through developing talents and using them for the service of humanity. This ideal is here translated into three guiding *research goals:*

Relevance. Design must aim to address problems or needs that are relevant to people. Explicating the relevance is important early on in design, as it legitimates it and guides it.

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Understanding. All design must be based on a holistic (meaning: including their psychological, social, and ethical aspects) understanding of people and their activities.

Empowerment. The objective in design is to provide tools and services that empower and enable people themselves to address their social, rational, and emotional needs. Equality, autonomy, and control are the goals of empowering design.

The rest of the paper is organized according to these goals.

Related Approaches

The three research goals in the humanistic strategy are inspired by many influential approaches in HCI.

From *user-centered product concept design* [8], the idea of human needs inspiring innovation is borrowed. From the *contextual design* approach [2], the humanistic research strategy takes the objective of understanding users in their natural use contexts. A premise is adopted from *user-centered design* [14] according to which enhancing people's activities and tasks is the goal of design. However, this approach assumes a design brief as given. Discovering use potentials, in contrast, is a wider endeavor where people cannot be viewed as users yet but rather as humans.

The *value-sensitive design* approach [4] adds to the previous ones by emphasizing the role of human values and morals in decicing on what features of technology are relevant and worth pursuing in design (e.g., user autonomy). *Social computing* (e.g., [21]) focuses on technology that facilitates social interaction. It emphasizes the embeddedness of technology to social context and studies the social change it causes. As it stands, it is a way to look at technology rather than a strategy with a set of methods. However, the idea of looking at social practices evolving with and through new technologies is borrowed.

RELEVANCE: DESIGN IDEAS THAT MATTER

The ethical ideal of "creating design for the good of humanity" provides a starting point for looking for novel use potentials. Two approaches to this ideal have been investigated by UERG: societal demands and human needs.

Population Trends Reveal Societal Demands

Finding market segments or first adaptors are not the only possible goals in analyzing population statistics. Population statistics can reveal the social, economic, demographic, and consumption-related patterns that are becoming future shaping trends. Oulasvirta et al. [16] analyzed statistics to identify population segments and activities related to societal demands for technologies.

Identifying emerging themes in the society. Trends are good starting points for identifying themes that may pose challenges in the societal scale. For example, in Finland, some of the most significant population trends are gradual aging of the population caused by decreasing fertility and mortality rates, migration to population centers, increasing number of immigrants, decrease in the number of marriages and increase in the number of common-law marriages, displacement of nuclear family, increase in the proportion of women in labor and students, unemployment, and increase in socio-economical differences. Of these, UERG has selected the aging population as one of the research themes.

Examining key population segments. As the theme has been selected, statistics can be used for selecting population segments and examining their qualities. For example, the proportion of people over 60 years old in Finland is increasing from 15 % in 1997 to 23% in 2020, and they have poorer educational background than younger cohorts. To understand psychosocial qualities, segments can be related to psychosocial theories. For example, for people over 60 years old, significant challenges include finding new activities and roles in the society, advancing and maintaining cognitive capabilities, developing a viewpoint for dying and a psychohistorical perspective, and coping with aging. Introspection and social support become necessary to integrate the self and to cope with feelings of despair.

Analyzing promising activities. Statistics can provide data to understand the activities the new technology is going to replace or change. For example, for mobility, which is one of the target activities at UERG, important activity statistics are: Finns use 62 minutes per day for moving between places, 26 of which are used for visiting acquaintances, 17 for shopping and 14 for work trips, and 4 for household related trips. Use of public transportation, bicycles, and walking in urban mobility has been predicted to increase. Moreover, the amount of money spent for mobility and telecommunications are predicted to increase to year 2004.

To summarize, analyzing population trends serves the purpose of discovering and elaborating social demands for future technologies in the early phase of concept development. It is the first step towards "Design Ideas that Matter".

Human Needs: Opportunities at the Individual Level

A. Kankainen [7-9] has distinguished between two types of human needs: *motivation* level and *action* level. Motivation needs rationalize and motivate action in a context. They therefore provide a fruitful starting point for discovering design opportunities at the level of the individual.

The aim of A. Kankainen and Oulasvirta was to discover motivational needs in mobility in public and semipublic urban areas [7]. In order to gather rich data, focus groups, photodiary studies, interviews, and observation studies of 25 urbanites were conducted. The idea in *triangulation* is to gather both third-person and first-person data to describe what, how, and why a person did something. Situations that participants consider problematic, or where they fail, or where they are forced to deviate from routine action, provide the bases for discovering motivational needs. Over 1300 travel episodes (descriptions of a person moving in a city in a pursuit of a goal) were analyzed this way.

Three classes of needs related to mobility were found. The first class is *personal* needs. For example, when paying or sharing costs with other people in public places, participants expressed concerns of losing control over their money. While moving, certain places often trigger memories and opinions that are considered worth preserving. Other needs in this category are finding silence or privacy in the middle of crowd, finding bargains, and killing time by seeking fun and exceptions.

The second class of needs relates to *navigation* or wayfinding, and these are mainly *cognitive* in nature. Many participants expressed a need to know and optimize routes. For example, a participant got lost after returning home from picking flowers in an unfamiliar place. Similarly, a group of journalists often got email invitations to events that took place in unknown locations around the city. Reaching the navigation goal in time is considered important, but equally important is to have enough time for sidestepping (i.e., unplanned deviations from the planned route). Packing and carrying items got plenty of attention, as they are related to the need to anticipate and prepare for predicted events (e.g., taking an umbrella for a forecasted rain). Other needs are related the ability to combine several sites to one route, finding the shortest route, locating missing objects, and safety (here: avoiding potentially dangerous areas).

Third, a class of *socially determined needs* was identified. For example, an amateur theatre group had to decide on their new training schedule, but not all group members were present when the decision took place, and the absent members had to be informed in a call ring. Later on, however, somebody had forgotten to call another, and some of the actors did not show up in the first training. This reflects a need for awareness of changes in shared schedules. Many situations were observed in which participants had a need to be continuously aware of social surroundings. They often expressed a need to be aware of acquaintances when moving in the city. Some participants also had a need to meet new likeminded people while killing time. When such situation was realized, however, finding something to talk about was difficult. A similar need for discussion topics was also gathered in a situation where three friends were waiting in a café and skimmed through a newspaper and discussed the headlines. Other participants were curious about events taking place in their environment and eager to share opinions about them. They expressed needs to shop together with a friend or get opinion from a friend for a product, and wanted to delight others by dropping to a promising store and buying gifts.

Tiitta conducted a similar study to discover needs of elderly people related to mobility and communication [25]. The study revealed needs for maintaining contacts with family (some participants even had learned to use email and Internet for this purpose) and with friends met before retirement. They also had more time and curiosity to get to know their surroundings and find new places, but on the other hand, they were often afraid of safety or getting lost. They expressed skepticism over changes in their environment and wanted to share these opinions, and used considerable time in monitoring their neighborhoods. Aesthetics and nature in the environment were also important. Shopping was often combined with having experiences, for example, by going to shop abroad. While traveling, they reserved extra time to be well in time at the bus stop or station. They appreciated fast, reliable, and quiet transportation, where platforms are not slippery in winter. Traveling alone during nighttime was considered unpleasant, and they were eager to share their experiences of unsafe areas, practices, or services.

Corporations have traditionally used market research methods such as surveys to investigate needs. Surveys have worked well in quantifying customers' preferences among *existing* solution options but they cannot really help in discovering *new* needs that might not come from existing applications [17]. Discovering motivational needs is useful for three main reasons: 1) Human need lasts longer than any specific solution; 2) Needs are opportunities for design, not just guesses at the future. Innovation of use potentials does not have not to depend only on predicting future because a crucial part of that future already exists in the form of human needs; 3) Human needs provide a "roadmap": empirical data wherefrom needs are interpreted are valuable in all later stages of design, as will be discussed later.

UNDERSTANDING: USE CONTEXTS OF THE FUTURE

The next step, after discovering social and individual demands, is to take a closer look at the use context to understand how, exactly, technology will intervene. A demand for methodology that concentrates on the context-awareness has been recognized [10]. The four methods proposed below suggest some starting points for tackling this challenge.

Ethnography to Characterize Use Contexts

Obviously, mobile use contexts present a challenge for context-awareness as they differ from the traditional desktop contexts in HCI. Internal factors such as task goals are different and external factors such as social resources and physical surroundings are more dynamic and less predictable. Indeed, when our mobility data were classified, shopping, evaluating people, selecting routes, ad hoc meetings, SMS messaging, relaxing, waiting, surprising and delighting others, rendezvousing, being late, safety, acquiring information, collecting memories, and gags were among the most frequent, in a contrast to "desktop contexts".

Tamminen, Oulasvirta et al. [20] conducted observation studies to find *distinctive* (in comparison to static contexts), *general* (from the point of view of frequency), and *useful* (from the point of view of design) socio-psychological aspects of mobile contexts. It was argued that the characteristics would be useful to understand what restrictions and resources prevail in mobile use contexts.

The results show that "mobility" is *socially structured* around navigation. Situational acts are embedded to planned ones in navigation—dropping by, ad hoc meetings, and other forms of sidestepping are socially motivated and require flexibility from the plans related to navigation. It was recognized that since mobile places are rarely private, personal spheres must be actively constructed and claimed by socially recognizable acts. Distinct temporal tensions (fluctuations of importance of time in relation to space) were identified—waiting for example—that pose radically different cognitive and social demands for behavior. It was observed that most problems in navigation were solved utilizing social contacts and only rarely by using schedules, maps or the like. Aspects of multitasking were also identified, most importantly how different stages in navigation (e.g., reaching the goal vs. calibrating speed) pose different cognitive and social restrictions for multitasking resources.

The study demonstrates that ethnography provides a powerful method for explicating and analyzing future use contexts. Particularly, some central social needs and resources that determine behavior in mobile contexts were identified and explicated. Similar work has been done for desktop contexts (e.g., [12]), but more work is needed for mobility and other components of future use contexts.

Ethnomethodology to Operationalize Social Interaction

As argued above, social needs and resources play a central role in future use contexts. At some point, however, *describing* social phenomena is not enough, but we need to *model* and *operationalize* it. A basic problem for computer models of the social is caused by the fact that computers cannot learn social interaction as humans do. Therefore, social knowledge has to be "hard-wired", at least to some extent. This calls for more rigorous concepts of context.

Context, though a relatively new concept for technology developers, has long been studied in social sciences, which have highlighted its dynamic and constructive aspects. Particularly, the *turntaking* approach [18] emphasizes that events have sequential structure that unfolds in time in the actions of individuals. Context is actively interpreted and constructed, to be interpreted and renewed again in the subsequent actions of the participants. These actions are called *turns*, which often consist of speech, but may also include nonverbal acts: bodily orientations, gaze, and speech. The power of this approach is that social interaction becomes *operationalized* through concepts that are better recognizable, in principle, by context-adapting devices.

Oulasvirta and Kurvinen [12] analyzed group invitations, a complex social practice, and evaluated how well turntaking could be operationalized into computational models in context-aware devices. The interest was not so much in dialogues or direct and explicit invitations such as invitations to events (e.g., parties or meetings). Instead, invitations were analyzed that are embedded in action and remain partly or completely implicit and yet recipients are able to recognize them as invitations and act accordingly.

Three cases illustrated how the participants actively transform their social contexts in turns. In all of the invitations, a the *inviters* propose the *invitees* to meet at some time and place in the future. In the first case, the inviter attempts to invite friends to their favorite café by sending a simple SMS: "Kafka" (the name of the café). For the invitee, this marks a change in the inviter's context that could be, but does not has to be, reacted upon. This invitation, consisting one nodal turn, while often failing to realize as a meeting, produces group awareness and coherence.

In the second case, a woman working at a children's park invites parents to a sing-and-play. Here, the invitations are embedded in the small details of her interactions with the potential participants for the play. She greets some, nods or waves to others, but not all people in the park. While doing so, she makes sure that those who have participated in the game before will notice that she has arrived and the play is about to begin. Her selection of the walking route, greetings, and casual remarks are not just compliments but they also function as invitations to participate. Again, the invitations need not to be presented as direct verbal questions or requests. Even though sing-and-play is a scheduled event, it requires further specification of time and place, notifications to the potential participants, and gathering of those who eventually attend. That there is a sing-and-play every Thursday morning and that there is a poster on the wall constitute preconceptions that help to reason inviter's intentions from her behavior. Furthermore, invitations are left implicit not only because the shared preconceptions make it possible, but also because it gives the invitees the option not to participate without having to give an excuse.

In the third case, journalists working in an open space office invite to lunch by loitering, with their coats on, in front of an elevator. The inviters know that at a given time, other journalists may have work in a phase not allowing for interruptions. They therefore have to balance between the convenience of having lunch together and the possible disturbance caused by the invitation. That is why the invitation has evolved into an embedded, yet easily recognizable, routine of hanging about at the exit with overcoats on before stepping out of the office. In contrast to the second case, there is no explicit prior agreement behind the invitation to lunch. Still, going for lunch, as a result of it being a daily routine, is easily recognized by the participants and offers similar resources for interpreting behavior. Whereas in thefirst and second example SMS messages and greetings were directed at specific individuals, the implicit invitation here does not have any recipients at all. Moreover, in contrast to the first two examples, the invitation was achieved in cooperation with others. A single person standing next to the exit does not make an invitation. The other journalists, still sitting at their desks, while recognizing that an invitation has been presented, may select themselves as being invited, even when the invitation did not specify any recipients.

The cases exemplify the richness and complexity of seemingly simple social interaction. Obviously, without sensitivity to its nuances, services provided by a context-aware device may be needless, proactive actions wrongly timed, and interaction styles inappropriate, eventually causing disturbance to social lives. Modeling social interaction therefore calls for powerful conceptual tools. Turntaking seems promising for this end as it views contexts from the point of view of how people actively construct them in turns. In particular, recognizing turns seems feasible to current day sensor technologies, because turns consist mostly of pausing, overlappings, distribution of speech, movement, bodily orientations, eye-gaze, and telemessaging. Recognizing whole turntaking activities, however, may require special mechanisms for coping with uncertainty and missing information. Finally, it will be challenging to build the system general enough, while still leaving room for idiosyncratic expressions of turns. More theory construction and empirical work is needed to provide a sound conceptual basis for building working prototypes of socially-aware computers.

Bodystorming to Bring Use Context to Design Session

One problem in innovating good technology is that ideas of design features and functionality are based on documents (e.g., field notes) that often include omissions, biases and even distortions. These may, of course, easily lead to misunderstanding the social and psychological aspects of the use context. The notion of *bodystorming* refers to the simple idea that the design team does not speculate about use situations at their office, but goes out and innovates design on site. By "being there" (instead of remaining at the office), researchers can more easily focus their attention to relevant aspects of context that might not be available in documents. Oulasvirta et al. [15] adopted this idea from industrial design and developed it in four case studies.

The method is as follows: before a bodystorming session, a preliminary observation and documentation is conducted. From the documents, interesting phenomena are selected and edited into *design questions* (e.g., "Go to a mall and innovate a system that helps elderly people to better remember product information.") that present problems in the events, experiences, or practices of users. Participants then go to a representative environment and attempt to solve one design question at a time. Crucially, this attempt takes place in a context where the phenomenon (or parts of it) are *directly observable*. This is in contrast to traditional brainstorming conducted in office environment unrepresentative of the studied environment. In some cases, to encourage further re-enactment, participants in bodystorming are not just passive observers but are asked to act out the activities. Generated ideas are recorded on-site and later elaborated.

In four case studies, some parameters of bodystorming were explored to understand how they contribute to the quality of the design innovations. First, *similarity* of the bodystorming environment to the studied environment was considered an important factor, and identical or very similar locations preferred over staged ones. Bodystorming participants' ability to observe the environment directly was considered necessary. Second, *acting out* was observed to be frustrating and causing costly preparations. It was speculated, however, that it could be useful in the long run when participants get used to the method. Third, *inclusion of stories* from the preliminary observation data to accompany design questions was considered useful, although not necessary. Concrete stories can help to focus attention to aspects of context that could otherwise go unnoticed.

The method was subjected to evaluation, including an expert evaluation of how "socially plausible" the scenarios created in bodystorming were in comparison to those created in brainstorming. The conclusion was that the main benefit of bodystorming is that it creates highly memorable sessions and inspires researchers to criticize and develop their design ideas already on the site. Furthermore, bodystorming was argued to advance the analysis of kind of use situations that the members of the design team are most unfamiliar with (e.g., a senior center). Bodystorming should be seen as a way of playing with data in embodied ways, "being there", to enhance understanding of the problem domain. Ethnography is largely based on long-term stay within a culture, conversation analysis on tape recorded data distributed and analyzed in data sessions, and contextual design on the simultaneous use of several representation formats. In respect to these methods, the contribution of bodystorming lies in the utilization of collected observation data in a contextually situated design session. This provides a possibility for a larger group of people not familiar with the data to better understand the use situation.

A. Kankainen [9] has studied other methods for bringing aspects of the use context to the design session. First, role-playing with toy characters that represent mobile users on a map of environment has been found to suit the purposes of concretizing use situations and finding social constraints of use. Second, drawing a social map including users and their places has been found useful for innovating concepts that involve location as the main context feature. Third, participatory evaluation of design ideas with low-fidelity prototypes has been found fruitful for examining user attitudes in the early phase of design, and a "market method", where users rank or "pay" for designs, has been found useful for understanding what ideas users find useful and why.

Simulation to Find Preconditions for Design

The last method reviewed here is simulation, which means manipulating parameters of simulated use scenarios. Simulation is done in order to find *preconditions* for design.

Inspired by Rantanen [22], Rantanen and Oulasvirta wanted to test a possibility for a context-aware device to recognize meeting situations in an editorial office; especially meetings that take place with out a journalist who has been in the meetings in the past. This kind of group awareness, or "social translucence" [3], could also support, albeit indirectly, the management and organization of group activities.

In gathering information about tasks, several hours of video material acquired from intensive participant observations of five journalists were analyzed. In constructing *task profiles*, tasks were named, their durations timed, starting places and times noted, movement of the person and involved technological devices registered, marked calendar events noticed, and interruptions and pauses marked. For each task, frequency characteristics (how often is the task performed during a day) were assessed as were the relative priority of different tasks (if two tasks are to be performed, which one is selected with what probability) and calendar entries (what is shown, if anything, on the calendar), soundscapes (including simple distributions of speech), and keypress and mouse activity distributions. Probabilities for making a transition between tasks of different priorities were estimated. Where observation data were inadequate, missing information was interpreted from other data (diary study, focus group, or interview) or judged by the authors.

On average, a journalist had 20 tasks that lasted from 1 minute up to 25 minutes, a median being about 3 minutes. While most of the tasks were performed in front the desktop, some tasks were carried out away from the desktop (e.g., fetching prints, going to toilet, meetings, article editing discussions, chat with colleagues, lunch, etc.).

Profiles were used for building a simulation. After initiation, the *Simulator* starts to simulate, moment-by-moment, all task profiles assigned for an office plan and outputs a data row upon any *change* in the state of the office. The report file is given as input to *Observer*, a program that simulates what the context-aware system can actually "see" or pick up from the world. It simulates the locations, number and types of sensors, and the model of information distribution. Moreover, it introduces "noise" to data.

Output from Observer is given as input to *Interpreter* that simulates the actual context-aware application. In this case, a Bayesian network was built to calculate how likely it is that a given person *should* be in another context, particularly in a meeting that he/she has used to be in. The strength in using a simulation is that we know exactly what took place and can compare that to what was interpreted. In the case of the group-awareness application, we can evaluate the Bayesian apparatus by calculating the proportion of times it had correctly inferred that there is an important meeting going on in the office that the user is not part of.

The benefits of simulation stem from the fact that it provides a way to run scenarios with control over parameters:

Privacy. Different Observer models can be run that correspond to different models of information distribution. For example, a situation where a device knows only its own context can be compared to one where it can exchange information with other devices. Or, we can evaluate the potential benefits of a "Big Brother system" that can freely aggregate information from all the sensors in the office.

Sensor selection. Often only a very limited number of sensors can be used, for economic and energy-consumption reasons. By replicating the simulation with different sensor configurations in the Observer, we may evaluate the contributions of each to the overall performance of the Interpreter and select the most suitable combination.

Usefulness. Qualitative data involves no indication of quantitative aspects of use situations, such as how frequently some behaviors occur. For example, from observations in the editorial office one could not know how often a journalist takes his/her mobile phone when leaving desktop. This information, however, was needed to decide if it would be enough to augment mobile phones with a positioning system (cheap) or should the users wear a badge that would guarantee accurate positioning in the office (expensive). In order to answer this question, the simulation can be run with different probabilities of how often the user picks up the phone (1.0 corresponding to the badge). Several other user and group behaviors can be simulated similarly. Results of such runs may help to find necessary preconditions for the usefulness of an application.

Scalability. What happens when more users enter the system? Will the system scale to address the increasing complexity? The simulation can be run with different number of tasks or people who contribute to data.

Simulation serves the goal of understanding by providing a powerful tool for playing around with scenarios. The present version of the simulation offers a relatively inexpensive way for examining preconditions for a scenario. However, the value of simulation depends on how well it corresponds to the real world it simulates. To address this problem, valid observations are needed and resources for eliciting enough detail from the data. Still, many parameter values have to be merely educated guesses. A related problem is that the present simulation focuses entirely on behavioral and physical aspects of the office—perceptual or cognitive of the individual, or social interaction (how actions change actions of others) were not simulated for reasons of complexity. Future work is needed to evaluate how crucial role these shortcomings play. In order to assess the simulation approach, one would need to compare estimations of simulation to results acquired from prototype field trials.

EMPOWERMENT: THREE DESIGN CASES

Finally, not just any design will do, even though it addressed a clearly relevant problem and was based on empirically acquired understanding; the design must aim to empower people, support their autonomy and control.

Supporting Autonomy

Supporting autonomy of people presupposes addressing problems in people's lives that hinder their capabilities. For example, *EventTagger* was inspired by observations and interviews of elderly people who had difficulties in remembering past events and objects (e.g., products), which indirectly hampered their ability and freedom for mobility.

EventTagger consists of a small button, wirelessly connected to a handheld computer. Upon pressing the button, which can be kept in a pocket, EventTagger "tags the moment" by gathering all information available from the digital and physical environment, including a 15 second audio clip, current calendar events, time, location (from GPS), and a list of other near-by system users. This information is saved to a log file that can be accessed and edited by the user. The tagged information serves as a retrieval cue that helps the user to later on do mental "time travel" to bring in mind the to-be-remembered information.

By supporting remembering and organizing everyday events, EvenTagger facilitates elderly people's impaired ability for reminiscence and supports sharing of life events in social situations. In essence, empowering autonomy of aging people in their everyday social-cognitive practices is needed to prevent early solitude and displacement.

Designing for Human Control

The second challenge for empowerment is to design a kind of interaction style that provides the best resources for the human to understand and control the device. This presupposes empirical work, because aspects of users and use contexts determine the needed features and functionality.

For example, *CoffeeMug* is a tangible container interface that provides a link between a physical object (here, a RF-ID tagged coffee mug) and recently edited documents on a desktop computer. The purpose of CoffeeMug is to support the short-term spontaneous face-to-face social practice related to journal editing. When the user takes the CoffeeMug upon leaving his or her workstation, recent documents are automatically uploaded to server, and the documents can be selected for downloading to another computer if the owner authorizes this by scanning the mug in a reader.

CoffeeMug was inspired by participant observations in an editorial office. The study uncovered a social practice of a chief editor walking to kitchen to fill his coffee mug and on the way back casually dropping by to co-workers with the tacit purpose of delegating jobs and monitoring on-going work. It often occurred that during the discussion a need to view documents that were not readily available emerged, and fetching them caused disruption to the activity. The instantaneous, portable, and tangible access to most recent documents provided by CoffeeMug is less disruptive and poses fewer cognitive demands than alternative work-station-based access methods (e.g., email, intranet), because with CoffeeMug users need not to manage access rights, memorize what files to send to a colleague after a discussion, or anticipate what documents will be important in a future discussion. The features that make the design better understood and controlled, in this situation, are tangibility (for privacy and spontaneity of action), simplicity (does not tax cognitive resources), and transparence (the algorithm that decides which documents are selected is simple).

Evaluating Empowerment by "Subtraction"

It has been accepted that traditional usability testing is not suitable as such for context-aware services as it neglects social issues, is too concerned of task-based issues such as performance rather than activities, and is based on the (here invalid) assumption that interaction is attention-intensive. For evaluating empowerment, our group has utilized the *subtraction method*, inspired by cognitive neuroscience. Essentially, from observations or other data we gather a *baseline* of behavior that is being "subtracted" from behavior indicated by a field study with a real prototype. This "left-over" or "added value" that indicates change in practices is then assessed. The method has some resemblance with usability benchmarking. However, whereas the latter uses standard usability measures and has no hypotheses or anticipation, Understanding and Relevance inform the former in hypotheses, measurements, and analyses.

For example, *InfoRadar* is a location-aware messaging system implemented on a handheld computer (here, IPAQ) and based on a positioning system, an electronic compass, and GPRS. Participant observations and diary studies suggested that location-aware communication system that aims to cater mobile communication cannot be based on just one channel (e.g., location-based messages). Instead, they must include auxiliary channels that help users to both *initiate* and *sustain* communication. For these ends, InfoRadar includes functionality to track and find near-by associates, voting system to raise awareness of communal issues, capability for attaching digital pictures to messages to attract other users to read messages, and message *threads* to sustain communication independently of location and time.

InfoRadar was tested in two field trials (see [1]) where, in the first study that used a group of participants that did not know each other (baseline), InfoRadar, by stimulating discussion about location-related issues, managed, for example, to create new friendships (a change in social practices). In the second study that used a group of friends (normally telecommunicating only through SMS and phones; baseline), it managed to trigger and sustain relatively long chains of discussion (change in social practices).

Looking for how technology changes human practices is the key for evaluating designs within the humanistic framework. The idea in subtraction is simple, but requires explicating a baseline and a hypothesis of how the design might introduce a change in behavior. Essentially, it is a step towards transforming the evaluation of context-aware technology from exploratory studies to hypothesis testing.

CONCLUDING REMARKS

Even a brief inspection of scenarios proposed in key articles in interaction "beyond desktop" reveals a need for discovering truly useful design ideas. Consider, say, scenarios underlying a whole research project lacking empirical justification: a video projector that warms up proactively before the presenter comes to the room (saving approx. 30 s) or an agent that prevents an audience to see a confidential Powerpoint slide that was accidentally left in a presentation (saving one click needed to skip to the next slide) [19].

The research framework presented proposes some solutions to this problem. First, it takes as the starting point societal demands and individual human needs, and proposes methods for discovering them. The second step is to dig deeper by conducting ethnographic studies and possibly using turn-taking to operationalize social interaction and bodystorming to bring aspects of context to the design session. From these data, a simulation can be built to examine preconditions for usefulness, privacy and other practical questions. Third, in design, the goal is to create empowering applications that support human autonomy and control. Finally, the "method of subtraction" can be used to guide evaluations of a design.

As such, the humanistic framework can be seen as an extension of the user- or human-centered approach to earlier, strategic phases of design. The strength of the humanistic strategy is that it functions as "glue" that binds together different stages of design. Grounding innovation to simple ethical principles provides starting points for looking at societal and individual demands for novel technologies, helps to focus empirical studies to relevant human and contextual aspects, guides design in the form of simple goals, and structures evaluation of ideas. Moreover, it helps to recognize scenarios where a proposed technology or interaction style does not address any relevant need or where the need could be satisfied more easily by other means. However, it comes with a price as it requires time-consuming empirical studies and an ability to explicate, track, and rationalize design goals in all stages of design.

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