to shape it—must be actively maintained.

The land is experienced, too, in terms of clans and lineage groups; the very features of the land link it to the Dreamtime actions of totemic creatures whose continuance is marked by patterns of land occupancy and responsibility.

Finally, the land is experienced in terms of historical events: The actions of humans leave their marks, both physically and spiritually, on the land. Any movement through the landscape, and any experience of it, is cast in these terms. There is much more to be "read" in the land than purely physical form, but this is an aspect of daily experience, not an information experience to be looked up in a dictionary. Indeed, the land may be experienced first in terms of its symbolic meaning and only second in terms of its physical form. The landscape is experienced as meaningful, not read or processed as information [4].

If we think of information as a cultural category, then, and of "informating"—that is, the process of reading aspects of everyday life in information terms—then it is sensible to ask what is being done by that process. Arguably, the process of describing aspects of the world in information terms makes them amenable to information-based processes, to the forms of representation, transformation, and processing associated with a variety of technical disciplines. In recent discourse, though, the informating of everyday life brings it particularly into the domain of computer scientists and of commercial information systems providers. If your problem can be conceived of as an information problem, then it is a problem that

Microsoft and IBM can help to solve. If your problem can be conceived of as an information problem, then it is a problem that a computer scientist can address. If your problem can be conceived of as an information problem, then it is one on which Moore's Law will naturally have its effect. What is at stake, then, is the right to create, define, and lay claim to both problems and solutions.

More broadly, this alternative view suggests some important research challenges for ambient intelligence. Recent shifts in how we think about technology and experience as embodied phenomena [4] mark not only an increasing concern with the physical aspect of interaction design, although that has clearly been an important issue and a significant element of the ambient intelligence program, but a quite different reading of interaction beyond the "information processing" approach. Research in ubiquitous computing and ambient intelligence has often made use of methods from social science as ways of understanding settings into which technology might be introduced. Our considerations here suggest that research in ambient intelligence might fruitfully also use these approaches to investigate how these settings are understood by the people who populate and enact them. If "information," "ambience," and "intelligence" are cultural categories, then how can the relationship between technology and social and cultural practice be re-imagined?

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NEW TECHNOLOGIES FOR HUMAN CONNECTEDNESS

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HUMANS HAVE A BASIC NEED for contact with other humans. Authors like Lewis, Amini & Landon discuss the important regulating effects that social contact and healthy relationships have on human mental and

physical well-being, and the consequences that arise from a lack of these requirements [2]. House, Landis, and Umberson have pointed out that a lack of social relationships constitutes a risk factor for health that exceeds that of more commonly known risk factors like cigarette smoking, obesity, and lack of physical activity [3].

Many factors jeopardize our ability to form and achieve balance in relationships with other people. Work requirements might necessitate travel or even living in a different place apart from one's immediate family and friends. Societal trends, such as those pointed out by Putnam, indicate that people increasingly lack social interactions with each other in everyday life [1]. But new technologies also undoubtedly affect our behavior in relationships as well, and in ways that are likely specific to each individual. Everyone can probably recall situations in which a technology enabled or assisted engaging in a relationship, as well as situations in which technologies "got in the way."

The mission of the Human Connectedness research group was established to explore the topic of human relationships and how they are mediated by technology. The ultimate mission of the group was to conceive a new genre of technologies and experiences that allow us to form and engage in relationships in new ways. The group operated at Media Lab Europe, the European research arm of the MIT Media Lab, for about three-and-a-half years in Dublin, Ireland. This article briefly recounts some of the major themes and results that emerged from the group during this period. More information and refer-

ences can be found on the group's Web site [5].

Media Space Revisited. The notion of a "media space" was pioneered in the late 1980s in research projects like that at Xerox PARC which connected several offices and common areas in multiple geographic settings via continuous audio and video links. Many such spaces were developed in various research institutes over the following years, and our lab was no exception. One of the first projects that emerged from our group was a media space called iCom that connected several laboratory areas in the MIT Media Lab with Media Lab Europe on a 24-hour basis.

The iCom operated more or less continuously for about four years and served as a lightweight communication tool for holding project meetings for cross-lab collaborations, as well as for informal socializing between remote friends (including occasional flirting). Otherwise, the activities supported and behaviors observed in the space were not altogether different from those recorded in earlier efforts, and we began to think of ways to rethink the idea of a media space. We felt that in many earlier experiments, which often took the form of always-on video conferences between

remote locations, passerby still perceived a sense of separation because they see each other through wide-angle views captured by cameras mounted at a distance from them.

In order to create a greater sense of intimacy, we developed a new computer vision system to enable interaction at a very short distance to a screen

The Passages installation creates the feeling of touching the shadow of someone standing directly behind a translucent screen.

The miniature audio modules integrated directly into whiSpiral's fabric whisper audio messages recorded by loved ones.

surface, to the point that passersby can actually touch it. The installation, named Passages, creates a bidirectional link between distant locations in which passersby can interact with and

touch the projected silhouettes of their remote counterparts as captured by this vision system. The aim was to create the feeling of touching the shadow of someone standing directly behind a translucent screen.

Catalyzing Interaction through Shared Experience. Urban environments can often be unfriendly and iso-

Iso-phone, as exhibited at Ars Electronica Festival 2004, Linz, Austria

Breakout for Two participants throw or kick a soccer ball at a wall to break through a projection of virtual "blocks" partially obscuring a live video image of other players.

lating places in which to live and work. Sometimes you might find yourself curious about someone nearby yet unable to initiate contact for fear of appearing awkward or intrusive in an environment already full of distractions. Inspired by these observations, we wanted to explore ways that new technologies could facilitate lightweight contact between people who happen to be nearby. We felt that one way to support such contact would be through the creation of a shared experience that could serve as a starting point or catalyst for a conversation.

In the tunA project, the main focus of this shared experience is music. tunA is a mobile wireless application that allows users to share their music locally through handheld devices. Users can either listen to their own music or "tune in" to other nearby tunA music players and listen to what someone else is listening to. The application displays a list of tunA users that are in range, gives access to song information, and enables synchronized peer-to-peer audio streaming over ad-hoc WiFi links. An instant-messaging feature allows users to exchange short text messages without necessarily knowing anything about each other except what they are listening to. In initial user studies, this messaging feature was felt to be an essential component to support the desired ice-breaking effect of the application.

Keepsakes of the Future. Keepsakes are an important feature of human relationships. We often present people who are important to us with objects and things to remember us by and to remind us of each other. How can various technologies enhance the bonds that these keepsakes represent? From a wearable-computing point of view, this domain is an interesting one because keepsakes are often things that sit close to our bodies and that we carry with us all the time (like pocket watches, wedding rings, etc.). Thus, in addition to any technical challenge, there exists a design challenge in making non-intrusive objects that don't feel like "devices" and that are comfortable having nearby for long periods.

We developed the whiSpiral, a keepsake that explores how technology can enhance the way garments and accessories evoke memories of relationships. Miniature audio modules integrated directly in the textile allow friends or loved ones to record short audio messages at different points in a spiral-shaped shawl. These messages are whispered back each time you wrap the shawl around yourself, or by caressing different parts of the fabric. The project was inspired by the power of a simple human voice to evoke rich memories of a person, and by the power of a whisper as a medium of intimacy.

Slow Communication. Trends in the design of interpersonal communication technologies in the past several years have been toward efficiency, flexibility, and mobility. The mobile telephone, for example, allows you to talk on the telephone anytime, anywhere, no matter what else you might be doing. Audio quality may not be the best, but it's enough to get a message across. In these ways, the mobile tele-

phone is a little bit like "fast food."

The work of our group proposes a converse approach to the design of communication technologies, one that results in the equivalent of a gourmet restaurant experience. Just as the "slow food" movement celebrates fine food and the enjoyment of an entire meal experience, "slow communication" devices celebrate our ability to telecommunicate and emphasize the *purity* and *singularity* of the communication experience.

One example of such technology is the Iso-phone, which could be described as a cross between a telephone and a flotation tank. Iso-phone users are submersed completely underwater and wear a special mask that blocks out external aural and visual distraction while providing compressed air for normal breathing. The water is heated to body temperature, dulling the sense of touch, and blurring the physical boundaries of the user's body. The only sensory stimulus presented is a two-way voice connection to another person possibly using the same apparatus in another location.

Trials of the Iso-phone at exhibitions suggest that the system enables a more relaxed stream-of-consciousness style of conversation that might be well-suited to activities requiring creativity such as brainstorming meetings. Participants also lose their sense of the passage of time and display unexpected behaviors, such as gesturing not only with the arms but also with the legs and the entire body, which are unencumbered while floating in the water tank.

Sports over a Distance. Sports and other physical activities are a good way of introducing people to each other and maintaining relationships. In addition to physical benefits, numerous studies have shown that working up a sweat and getting your adrenaline moving while playing sports increases your propensity to bond socially with teammates and competitors. Inspired by this, the group created Breakout for Two, an interactive installation for playing sports over a distance. The game is a cross between soccer, tennis, and the vintage video game. In Breakout, participants in remote locations throw or kick a physical soccer ball at a wall to break through a projection of virtual "blocks" that partially obscure a live video image of the other player.

The project employs what we call an "exertion interface," an interface that deliberately requires intense physical effort. Our hypothesis was that augmenting an online sport or gaming environment with exertion would enhance the potential for social bonding, and we conducted a study to investigate this claim. The results were encouraging: Players of Breakout for Two said they got to know each other better, felt the other player was more talkative, and were happier with the audio and video quality, in comparison with a control group playing an analogous game using a traditional non-exertion keyboard interface.

Minimizing Mediation. Our impressions of people in distant places and cultures are often mediated by the biases of numerous "third parties" writing reports, telling stories, making documentaries—researchers, directors, producers, camerapeople, distributors, censorship organizations, and so on. Thus, we don't always have a good sense of what people and their everyday lives are like in other places in the world, and having this sense might be helpful in improving understanding and relations between people in different cultures.

The goal of the RAW project was to develop a new kind of recording tool, together with a method for processing and presenting the material captured with the tool, that enables a more direct, minimally-mediated relationship between its user and the later audience, possibly in a far away place or time. The RAW tool consists of a digital still camera and a high-quality digital stereo audio recorder that captures one minute of sound before and after a picture is taken. Audio is recorded binaurally using high-quality miniature microphones that are placed in the user's ears. This design was chosen in an attempt to enable the later audience to immerse themselves "into the shoes" of the person who originated the content they are experiencing, and to place greater emphasis on the subjective point of view of this original source.

In order to evaluate if such a recording tool could be considered relevant and valuable in a plurality of cultures, we conducted workshops in Dublin and Paris, as well as a large-scale study in the country of Mali during which about 30 people used the RAW tool to capture aspects of their daily life. Through these experiences, we were able to uncover several distinct categories describing the ways participants would make use of the tool for different storytelling and documentation purposes, ranging social modes of engagement to more journalistic styles, and inwardly reflective commentaries. Overall, the results

reaffirm the belief that introducing a new technology does not always have to increase a sense of something "standing in between" two parties in a relationship.

Next Steps. Media Lab Europe, which was established in 2000 and housed ten research groups at its height, closed its doors in January 2005 due to unfortunate political circumstances stemming from a lack of an agreement between its stakeholders on how its activities would be funded and managed going forward. Nevertheless, the vision of the Human Connectedness group is still alive and some of the projects discussed above are moving forward on independent tracks of commercialization or further research.

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CASE STUDY: BRINGING SOCIAL INTELLIGENCE INTO HOME DIALOGUE SYSTEMS

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AMBIENT INTELLIGENCE. Since the early visionary articles and white papers that introduced Ambient Intelligence, [1] for example, this vision has been associated with a widely prophesized proliferation of devices and applications populating our physical environment. Increasingly we are lead to anticipate that ambient intelligent technology will mediate, permeate, and become an inseparable component of our everyday social interactions at work or at leisure.

The social dimension of ambient intelligence is clearly an important topic for human-computer interaction (HCI) research. The field of HCI has justifiably turned its attention to issues pertaining to how users will be able to manage such complex, adaptive environments and the critical concerns that arise regarding privacy. A less-explored

design problem is how such technologies can be designed to fit the social processes in which they are embedded and to blend socially in the activities of their users.

Another critical defining characteristic for ambient intelligence vision is the use of system intelligence that will allow ambient intelligence applications to sense, adapt to, and serve human needs. Considering our interest in the social side of ambient intelligence, we argue in favor of considering intelligence beyond its narrow sense of problem solving, learning, and system adap-

tation to cover the ability of a system to interact socially with people and become a socially competent agent in the group interactions it supports.

Psychologists have debated for several decades regarding the multiple kinds of intelligence that humans possess. Over the years, different theories have identified various numbers and types of dimensions to describe intelligence. Despite their disagreement