Mediating Intimacy: Designing Technologies to Support Strong-Tie Relationships

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ABSTRACT

Intimacy is a crucial element of domestic life, and many interactive technologies designed for other purposes have been appropriated for use within intimate relationships. However, there is a deficit in current understandings of how technologies are used within intimate relationships, and how to design technologies to support intimate acts. In this paper we report on work that has addressed these deficits. We used cultural probes and contextual interviews and other ethnographically informed techniques to investigate how interactive technologies are used within intimate relationships. From this empirical work we generated a thematic understanding of intimacy and the use of interactional technologies to support intimate acts. We used this understanding to inform the design of intimate technologies. A selection of our design concepts is also presented.

Author Keywords

Intimacy, Cultural Probes, Intimate Technology, Ethnography, Participatory Design, Tactile Interfaces

ACM Classification Keywords

H.5.3 Group and Organization Interfaces

INTRODUCTION

Artifacts have commonly been used to mediate intimate relationships. Over the ages, intimacy has been mediated through symbols of affection such as flowers, missives and love letters. New and emerging technologies have also been appropriated to mediate close personal relationships. In particular, we observe this appropriation with the Internet and mobile phones. It is now commonplace for family members separated by distance to maintain contact via the Internet. Matchmaking and online dating are popular Internet services [7]. SMS (Short Message Service), i.e. sending a text message via mobile phone, is increasingly being used to forge new romantic relationships [3] and to coordinate activities with intimate friends [14].

Even though an intimate relationship often requires no mediation, new technologies are regularly manipulated to help us feel connected with those for whom we care. So strong is this desire, that we will spend significant amounts of money on communication technologies, and will be inconvenienced by poor usability so that our personal relationships are nurtured and maintained. For example, young people will endure SMS even though it lacks expressiveness, it has confusing syntax and it is prone to errors [14]. However, it satisfies an important social and personal need to feel connected. The strength of this desire together with the inadequacy of current technologies to support expressions of intimacy, offer a unique research opportunity.

In this paper we are interested in phenomena that are recognizably intimate – expressions of tenderness, acts of devotion and habits of demonstrable affection. We are interested in understanding how technologies are used to support these phenomena and in investigating methods for designing new ICT (Information and Communication Technologies) for mediating intimacy. This is not simply a question of creating representations for expressing emotions, as for example emoticons attempt to do. Rather it is a broader exploration of the role of ICT in people's intimate lives in order to create more fulfilling designs.

ATTEMPTS TO MEDIATE INTIMACY

There is a growing interest in technologies that support relationships with intimate others [1]. For instance Gaver proposes provocative ideas for connecting people in close relationships [8]. He describes technologies that provide a feeling of presence of remote lovers through *peripheral awareness*. Examples of awareness technologies are: a feather in a plastic cone that floats when the distant partner picks up a picture frame of the couple [27]; a light 'orb' that glows in New York when a family member walks into their London apartment [29]; and two sets of cylinders that roll and rotate in unison as they are manipulated by separated partners [2]. Through a critical analysis and review of

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awareness technologies, Gaver identifies three typical characteristics: (i) the designs often make use of evocative materials (such as feathers and scents); (ii) mappings are more likely to make use of literary rather than didactic metaphors (e.g. rolling cylinders that evolve into tactile languages); and (iii) objects have a unique physicality (e.g. a real feature is more poetic than one simulated on a screen).

These characteristics are common in technologies for mediating intimacy. For instance, Kaye [18] presents three *Intimate Objects* that address the problem of close couples trying to maintain feelings of intimacy when separated by large distances. These objects are intended to be used by a specific couple (i.e. custom built) for communicating intimacy specifically (e.g. not used for work-related activities). The first object is *How do I love thee*, a pair of abacus, whose beads are synchronized over the internet. Next is *Hand Holding*, devices that simulate the warm touch of holding hands. Finally is *Love Egg* that rolls on a concave dish when an intimate message is left on its messaging system. These objects display each of Gaver's three characteristics. They use evocative materials (soft silicone in Hand Holding), exploit non-didactic metaphors (positioning abacus beads) and have a unique physicality (the shape and texture of an egg).

Another intimate object with a dominant physicality is the *Sensing Bed* [13]. The Sensing Bed comes in pairs, and is intended for romantic couples who are not co-located. The bed senses the body position of one person and transmits warmth to congruent parts of the lovers' bed. The Sensing Bed is similar to the *Bench Object* [8], which has a seat that warms when somebody sits on a partner bench far away. Unlike the Sensing Bed, the Bench Object is public. The warmth on the Bench Object is generated by an unknown other (and so the effect is often disturbing). Even though the Sensing Bed and the Bench Object are technologically similar and both exploit peripheral awareness and physicality, their intent is different. The first is intended for couples in an established relationship, the latter is intended to provoke a visceral response between strangers in a public place. It is with the former that our work is more closely aligned.

A study concerning intimate relationships of a different kind comes from a group of students motivated by the routine of emptying their pockets of coins and keys when arriving home. They recall that the clanging of keys on the table is often followed by the cry "Mom, I'm home". The researchers exploit the association between the clang of keys and the arrival call to create the *Gustbowl* [30]. When items are thrown into the Gustbowl, the bowl wobbles and takes a picture of the items. The picture and the movement are transmitted over the Internet to an identical bowl that wobbles and receives the picture. The Gustbowl is intended to support the strong-tie relationship between mother and grown-up son. It is non-verbal, using pictures and sounds to trigger meaning from established routines and behaviors.

A comparable study, the ASTRA project [20], is also concerned with family members living apart, but focused on the interrelationships within the family rather than one-to-one relationships. Their motivation is to understand the role of peripheral awareness systems in social interactions within families.

CHALLENGES FOR STUDYING MEDIATED INTIMACY

Intimate relationships are different from the kinds of relationships that have been typically studied by HCI research. Intimate relationships are different to those found in the workplace or amongst social networks of friends. Intimate acts also differ from the domestic behaviours usually addressed in the literature [see 15 for a review]. Attempting to study acts of intimacy presents the researcher with a number of unique and interesting challenges [19]. Studying intimacy is challenging because intimate acts are ephemeral and transient yet ubiquitous and crucial to the ongoing life of an intimate relationship. They form the material and background of close personal relationships, yet occur in the doing and then often vanish unremarked. While the informational content of intimate acts may be low and seemingly trivial to outsiders, the act itself can be laden with emotional significance for those involved. Intimate acts often entail self-disclosure, and thus privacy is a concern. Much of what passes between intimates is unsaid and premised on deep knowledge and understanding of one another and occurs in the context of a rich, shared and sometimes idiosyncratic view of the world that may be difficult for others to fathom and comprehend. Intimacy also involves assumptions about commitment and mutuality. It carries nuanced expectations for reciprocity and exchange that are negotiated and arrived at over many years, yet remains fragile and is occasionally misjudged leading to misunderstandings and conflict. Finally, unlike instrumental tasks (e.g. coordination of family activities), or leisure activities (e.g. games) there is no generally accepted language for describing and discussing intimacy, especially in relation to designing technologies for its support.

In designing our research, we were mindful and sensitive to the challenges presented by studying intimate acts in the domestic setting. In responding to these challenges we wanted an approach that enabled us to maintain a longitudinal presence in the field so we could study the ongoing life of relationships. We were keen to capture the ephemeral and "unsaid" [11] aspects of intimate exchange and needed an approach that enabled intimate acts to be recorded as they occurred, or soon after. Given the private character of intimate relationships, we were keen to empower our subjects as participants in the research and to give them control over what was, and was not, revealed to us. Since intimate acts are highly nuanced and often subtly ambiguous to outsiders, we wanted to provide participants

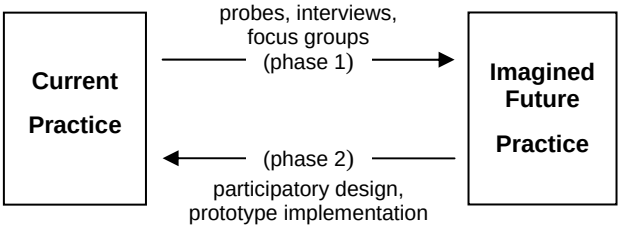

Figure 1. Cycle of use-centered innovation [16]

with materials enabling them to interpret and explain their practices to us. Finally, we wanted an approach that allowed us to carry out an ongoing conversation with participants and through this conversation arrive at a shared understanding of intimacy and the place of ICT in mediating intimate acts. We describe this approach in the next section.

RESEARCH DESIGN

Other researchers who have had to confront the difficulty of investigating personal relationships have adopted a range of research methods. These include: online questionnaires and surveys [3, 7]; data logs [14]; longitudinal focus group [28]; interviews [18]; and written reflections [24]. Since our goal is not only to understand intimacy, but to design for it, we adopted a suite of methods and techniques.

Our research plan is represented in Figure 1. In the first phase of our research we sought to understand current practice. We undertook ethnographically informed field studies using cultural probes [10] and contextual interviews to understand how people use ICT in their intimate relationships. In the second phase of our research we sought to use the insights into current practice gleaned from phase one to provoke and inform the design of future ICT to support intimate acts. In this phase, we engaged in a variety of design activities including expert design workshops, participative design workshops, scenario development and the development of low and high fidelity prototypes.

Method

Our approach extends the work of Gaver [10] and the Equator team [6] by combining cultural probes with contextual interviews and focus groups. We assembled a collection of cultural probes into a 'probe pack' (Figure 2). The probe pack contained: diaries and scrapbooks; digital camera with docking printer; postcards; pens, glue, scissors and catch-phrase stickers (e.g. "I feel alone when …", "I feel supported when …").

The diaries were used individually to record daily communication and interaction activities. This included the form of communication (e.g. SMS, telephone, email, letters, notes, tokens, gifts) and other details such as time, date, location, the content and the feelings associated with it (e.g. urgency or dissatisfaction).

The scrapbooks were used to tell rich and evocative stories about communicative events and to express the technology wants, desires, likes and dislikes surrounding these events. Couples were encouraged to work together with pens, crayons, glue, photos, magazine clippings, drawings to form a montage of their intimate lives.

The digital camera and printer were used to photograph and print significant events. The docking printer provided the immediacy of traditional Polaroid photographs with the convenience of lasting digital images. Participants were encouraged to take photographs of everyday artifacts and events that express some important dimension of their interactions: e.g. the answering machine at the time of receiving some unexpected news or of a child in a football final to share with an absent parent. Participants were asked to print, annotate and cut-and-paste the photographs into their scrapbooks or diaries or postcard, as they saw fit.

The participants were asked to read and reflect on the catchphrase labels, complete them, and stick them into the diary, scrapbook or on a post card. The stamped addressed postcards were used for sending short stories or images to the researchers or to the intimate other.

Finally, an additional probe element was introduced midway through the study. This new element consisted of small printed facsimiles of a variety of mobile device screens (e.g. mobile phones and PDAs). This new element served to both stimulate engagement in the study and encourage participants to envision possibilities for future technologies to support their relationship. Participants were invited to use these facsimiles to note design ideas and to insert them into the scrapbooks or diaries.

All the materials could be used in whatever way participants wished. The instructions were only suggestions. No time requirements were made, but it was suggested they should spend about 20-30 minutes each day using the probe pack materials.

Figure 2. Contents of Probe Pack

Participants

The study involved six Caucasian couples in stable heterosexual relationships spanning between 4 and 16 years in duration. All couples cohabitated, although work related travel occasionally required periods of separation. The age of participants ranged from late 20's to late 40's. Three couples had children, ranging in age from 18 months to 12 years of age. In one case the children were from a previous marriage. The couples could be broadly described as middle-class, leading professional lives in urban environments. The couples were neither very rich nor very poor, though some were reliant on government subsidies. The participants all had tertiary qualifications with occupations as Social Worker, Charity Worker, Business Analyst, Industrial Relations consultant, IT consultant, IT trainer and Journalist. Two participants were undertaking full time higher education, and one worked as a casual administration officer while caring for young children. All couples had access to the Internet and mobile telephony. They used a variety of electronic media such as landline and mobile phones, email, Internet chat, SMS and fax to communicate with each other, although the exact mix of technologies used by each couple varied markedly. The number of participants in our study is comparable to that in other probe research [10, 17].

The participants were recruited through calls via email, posters and personal contacts. The participants were allowed to keep the digital camera and docking printer as appreciation for their participation in the study.

Data Collection

Cultural probes were deployed for a period of seven weeks. This period was followed by focus groups and design workshops.

Week 0: Probe pack distribution and initial interview

An initial interview was carried out at the participants' homes. This included questions about the participants' backgrounds, their relationship, their communication habits and their use of technology. Following the interview, the researchers presented the cultural probe materials and informed participants of their use.

Week 1: Interview and process checking/steering

A week after the probes were distributed, researchers visited the participants' homes for a second time to answer questions about their use of the probes and to discuss activities of the first week.

Week 4: Interview and addition of new probe element

Researchers and participants discussed the materials accumulated through probe activities, and participants were encouraged to clarify, elaborate and reflect on the materials they composed. At the end of the third session, researchers introduced the printed mobile device screen facsimiles.

Week 7: Interview and probe collections

Diaries, scrapbook and other materials such as design ideas produced on the mobile device screen facsimiles were discussed. This session was used to bring closure to the seven-week process. All materials gathered through the cultural probes were retrieved at this time

Week 9: Focus groups

Several weeks after the probes were collected, participants in the study were invited to take part in one of two focus group discussions. In these sessions, we presented our preliminary themes to participants and invited them to comment and reflect on them. Their contribution was to refine and consolidate the intimacy themes.

Week 12-15: Design Activities

Intimacy themes identified during data analysis (see below) were used to motivate design ideas through three activities. We firstly conducted a series of brainstorming sessions, then a design workshop with HCI experts, and finally a participatory design with those involved in the study. The outputs of these activities were high-level descriptions of technologies to mediate intimacy, and development of a prototype to demonstrate a subset of design ideas. The design process is only partially reported in this paper.

Data Analysis

Six researchers were involved in data collection and analysis. Researchers worked in pairs with participants. Analysis and interpretation of data began immediately. Following each meeting with participants, the researchers who conducted the interview would meet to discuss the probe traces and interview contents using an open-ended process of rapid reflection [23] to identify important themes, ideas and concepts that emerged from their encounter with the participants. They would then compose a summary of the interview and this summary, along with the themes identified was reported back to the larger research team at weekly meetings.

At these weekly meetings themes emerging from the data were explored, debated and discussed. The probe data was naturally incomplete, unclear and biased [9]. This inevitably led to subjective interpretations where the data was often discussed in terms of the researchers' own experiences of intimacy. These ongoing discussions around the data and its analysis continued throughout the project and the themes identified in the data were refined iteratively. Data integration meetings were held at critical stages of the project. At these meetings, data and interim analyses were presented and debated. These meetings helped to develop and refine dominant themes. Finally, focus group discussions were held with participants in the study. These focus groups allowed the participants to make a final contribution and comment on our observations and findings.

FINDINGS

Despite numerous social science studies of intimacy and the exchanges that occur within intimate relationships, a universally acknowledged definition of intimacy has yet to surface. Of those definitions that have emerged [see for example 4, 22, 24, 25] few provide any significant design traction.

Figure 3 presents a schematic view of the primary themes induced from our qualitative data. The themes are placed according to affinity with their neighbors. Whilst each theme is evident in our data, they overlap to a significant degree, and the affinities we have tried to reveal in the structure of Figure 3 are complex and multidimensional; in truth the diagram could be rendered in many ways, with each alternative giving preference to different themes.

We've found it useful to think of intimacy in terms of those themes that precede its experience, *Antecedents*; those themes that characterize the act(s) itself, *Constituents*; and those themes that reflect the consequences of an intimate exchange, *Yield*. Figure 3 is structured according to these three clusters, before, during and after. So, for example, 'Commitment' is an antecedent or a pre-condition of intimacy. Being 'Emotional' is better considered an expression of intimacy, and so characterizes something about the intimate act itself. 'Presence-in-absence' is a feeling that results from an intimate exchange or an intimate thought, and so is a yield of intimacy. Of course, Antecedents and Constituents exist in a recursive relationship, and our so-called Antecedents can, over time, also be a consequence of intimate acts. The sub-themes are grouped and clustered around a central theme (shown as outlined boxes in Figure 3).We now illustrate the central themes, drawing on our data where useful.

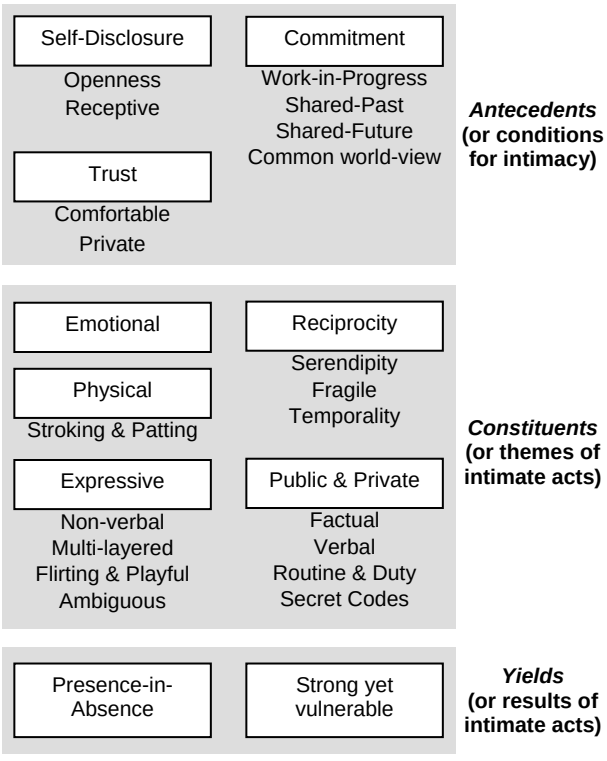

Figure 3. Antecedents, Constituents and Yields of Intimacy

Before Intimacy: Antecedents

Self disclosure

The price of intimacy is revelation and mutual openness [21, 22]. It is during self disclosure that we 'get to the heart of the matter'. An act of self disclosure carries with it an expectation that it be returned in-kind, and a failure to reciprocate is felt keenly as a breakdown in the maintenance of intimacy. One participant completed the catchphrases *"I misunderstand my partner when…"* with *"…he goes quiet."* The maintenance of 'partner awareness' rests on an almost constant background of chatter and stroking that both reveals and acknowledges each others' internal state; *"I really need to tell my partner…"* is completed with*"…what happens during my day and for him to tell me about his; it feels right."*

Trust

Intimacy requires trust and sincerity. The self disclosure that so keenly illustrates an intimate act risks both the self and the other, and that risk demands trust. Intimacy also requires a commitment to the relationship as something bigger than oneself [4]. The trust that characterizes strong-ties is deep and resilient, allowing each partner to be playful and flirtatious without any real risk to the relationship. This is exemplified by a participant who sent a sexually provocative text message to her partner, knowing that he was in a pressured business meeting. She was being playful and feeling sufficiently secure to risk provocative behavior. Their shared commitment extended beyond the act itself. The levels of trust and mutual commitment we observed provide a robustness against the negative effects of communication breakdowns; with trust comes tolerance for the inevitable little fractures in the intimate dialogue (e.g. failure to return a call within an expected time window) but a raised expectation for a deeper reciprocity.

Commitment

Commitment is the extent to which partners in a relationship perceive their relationship as ongoing for an indefinite period, and is a precondition for other aspects of intimacy to flourish [5]. Some of our participants framed this as being on a "shared" or "common journey" together. They shared both the costs and rewards of lives together. Features of participants' lives, such as raising children, caring for older relatives, maintaining the household, or traveling to work, were all enterprises that were shared and, in the sharing, became vehicles for enacting, affirming and maintaining their relationship. Joint responsibility was

taken for domestic life, including activities such as paying the bills, transporting children and preparing meals. These activities were often coordinated on the fly using interactive technology such as mobile phones. The division of labor within these relationships had regular patterns but was also fluid and renegotiated over the course of a day. Responsibilities also provided occasions for affirming the relationship. For example, the success of a child at school was affirming "our" achievement as "good parents". Even activities that were the sole responsibility of one member of the relationship became joint enterprises. Participants reported drawing on their partner's help and skills for work related tasks such as database development, setting up a web-based email account or writing a job application. Being able to help and share common tasks affirmed the relationship and sense of moving through the world together as a team, rather than as individuals.

During Intimacy: Constituent Themes

Emotional

In contrast to the routine and dutiful exchanges that characterize much work activity and family life, for example the coordinative activities that occupy much of parenting, intimate acts mediate emotion [22]. In intimate acts the medium can indeed be said to be the message; within most relationships, there is little new information exchanged in saying *"I love you"*, but few would argue against the value contained in its saying!

Reciprocity

Though many intimate exchanges are asynchronous, there remains a strong sense of reciprocal binding. At the atomic level, the utterance "*I love you"* demands to be answered in like terms; it is unimaginable that such an exchange be met with ignorance. In more general terms, intimacy depends on intimates who are co-engaged in a common cause [22].

An example of reciprocity is the 'goodnight message' [14]. One couple would insist on sending each other text messages late at night when one person was working a night shift. The recipient lies in bed, turns the phone volume down and awaits the incoming message. The preparation and expectation is part of the reciprocity of their imitate relationship.

Expressive

These are non-verbal but highly expressive interactions often involving playful, even ambiguous exchanges. Though intimate acts are not fact-free acts, the centrality of emotion to their meaning gives them a special quality. Intimate exchanges can themselves become the subject of 'personal innovation'; our intimates strive to keep the conversation of intimacy alive and fresh by changing its form or medium, often in playful ways. For example, Figure 4 shows a section of a scrapbook, where a participant used pictures to express his love. In another case, a participant would hide messages in places their partners are likely to visit (e.g. underwear drawer). These

Figure 4. Being creative and expressive.

gifts would be discovered later serendipitously; the element of chance involved in the discovery merely added to the experience of receiving the gift, rather than being something to be 'designed out' in an attempt to make the gift giving process more 'efficient' or 'effective'. "*Having fun, being creative and using humor is something we like to do"*.

A clear distinction existed between those participants who were parents, and those who were childless. The presence of children in a household colors all interaction, including intimacy. In comparison to child free couples, working parents are time poor to a highly significant degree. Where child free couples wish to experiment with the language of intimacy in playful and creative ways, working parents strive to reclaim space to 'be just us again'; their need is less for playful new ways of saying 'I love you' than it is for reclaiming opportunities to interact as a couple. Couples with children routinized time together, often late in the evening after children are bathed and put to bed.

Physical, involving stroking and patting

Intimates communicate in often non-verbal but nevertheless highly expressive and nuanced ways; ways not well supported by current technologies that are biased towards verbal language and encoding information. The physical expression of intimacy includes but is certainly not limited to sexual relations. Our intimates stroked and touched each other in gentle ways when co-present, and exchanged gifts that had physicality and could therefore act as a proxy when the partners were distant in space and/or time.

Public & Private

While much that is associated with intimate acts is quintessentially private in character, intimate relationships also have public expression. Couples present a 'face' to the world, that both affirms to themselves, and to others, their status as a couple [12]. This can occur through ephemeral public displays of affection, such as touching and kissing in public, or more concretely through the public and legal declaration of love and commitment entailed in marriage. While public, these expressions of self were also often highly nuanced and coded, allowing for the private communication of meaning in a public forum.

Intimate relations are rich sources of private covert language. Often obscure ("*NYUM"* meaning yummy or delicious and '*143'* meaning 'I love you') and sometimes containing hidden meanings ("*It is very simple really*" said during difficult times to refocus the couple onto what is

really important in life, i.e. 'us') they define their partners as distinct from the world and mediate their relations, allowing private interactions in public places whilst limiting the risk of being 'overheard'.

Consequences of Intimacy: Yield

Presence-in-absence

We frequently observed intimate exchanges when couples were face-to-face, and indeed it was surprisingly common for those exchanges to be mediated by technology. For example, participants sending an intimate text message from the living room to the bedroom, or from one floor of an office building to another floor, or sending an email to a partner who is working on another computer a few meters away. Email and SMS were used to facilitate stroking and patting behavior. However, perhaps the most vivid expression of the centrality of intimacy to our participants' lives came with the elevation of 'presence-in-absence' to a core need. When separated by distance or time, our intimates described a strong sense of presence-in-absence, a sense of the other despite their physical absence [24]. Our participants invested considerable time, effort and emotion in ensuring that their partners stay with them, at the forefront of their hearts and minds, throughout daily life. A good example of where presence-in-absence was missing is shown in Figure 5. The child is proud of having built a house of cards, and would very much like to show his father who was away on work duties. The ephemeral tower was captured by a photograph to be shown to him later.

Strong yet vulnerable

Our study has also taught us that it is important not to romanticize intimacy. Intimacy and the tight emotionally charged bonds it entails are strong, yet can be strangely and unexpectedly fragile.

While relationships may be robust, misunderstanding and misinterpretations do occur. When they occur, these breakdowns can have serious repercussions, creating ill will and emotional hurt that can obstruct and undermine intimacy within the relationship. When one participant was angry with his wife, he would put his mobile phone on the mantelpiece, declaring through his actions that he was unavailable. The phone represented a connection to his wife because it was used almost exclusively to talk to her. By placing it on the mantelpiece, he indicated that he did not wish to 'carry' her. Another couple had a routine of coordinating their departure from work each evening so that they could catch the train together. When as a result of an unexpected meeting one person caught the train without notifying the other, resentment and anger ensued. Such a fallout from a simple breakdown in understanding between partners can reverberate through the relationship for days, if not weeks. For these reasons, any interactive technology designed to support or mediate intimacy should mitigate against these forms of breakdown, allow repair of them when they do occur, and contribute to relationship stability.

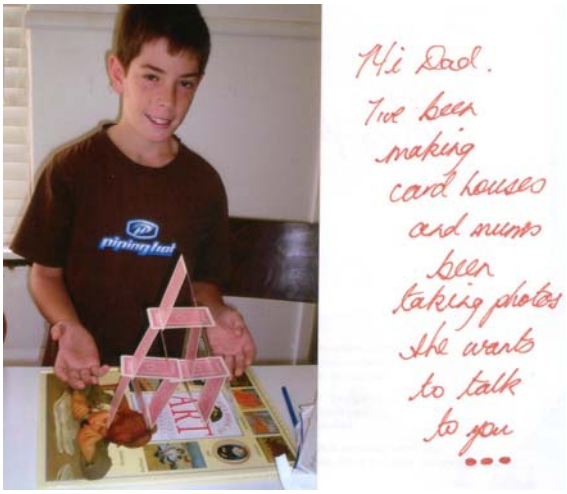

Figure 5. "Hi Dad. I've been making card houses and mums been taking photos. She wants to talk to you …"

IMPLICATIONS FOR AN 'INTIMATE TECHNOLOGY'

Based on the findings, we have developed a series of design ideas. This process had three phases. First, the research team conducted a brainstorm session to produce a series of design sketches. These designs were highly abstract, often consisting of a schematic drawing, a short description and keywords linking the ideas to the themes of intimacy emerging from our empirical data (Figure 3). Second, we conducted two one-day design workshops. One workshop was with experts in human-computer interaction design and the other workshop with couples participating in our earlier ethnographic study. Third, we developed and implemented a functional prototype to demonstrate some of our ideas and concepts. A selection of our design ideas are presented below.

Preliminary Design Sketches

The initial brainstorming of design ideas resulted in the development of 22 design sketches. The designs produced at this time were highly diverse, addressing a range of requirements, opportunities and challenges identified in our user study. Most of the ideas involved mobile as well as stationary devices, visual as well as auditory and tactile interfaces and explicit as well as ambient interaction. For example, we discussed several personal devices that would enable partners to interact unseen with each other throughout the day via low-fidelity communication channels. One of such devices was the "Secret Touch" (Figure 6), which enables partners to "virtually hold hands" while physically separated. The Secret Touch device allows partners to exchange tactile impulses over the Internet by padding or squeezing the device in their hand or pocket. At the receiving end, these pads and squeezes would be emulated as vibrations, heat or pressure.

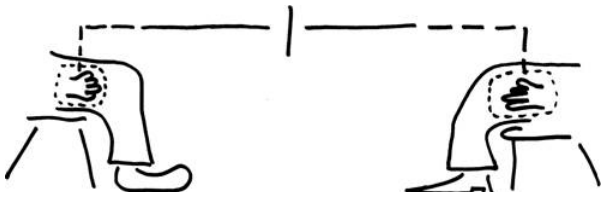

Figure 6. Secret Touch: handheld devices allowing partners to make secret tactile exchanges while physically separated.

Design Sketches from Workshops

The design workshops we conducted with interaction design experts and study participants produced significant results. Over two separate days, six groups of 4-5 people produced a refined design sketch that included: (i) a description of the functionality of their system, (ii) a central screen design, (iii) a basic interaction design, and (iv) a scenario of use illustrated with drawings, pictures and text.

One of the designs was a mobile device called *i.Fuzz* (Figure 7). The idea of the i.Fuzz concept is to provide a simple digital analogy of common analogue media, such as postcards and post-it notes. The i.Fuzz would be a cheap, light-weight, semi-disposable multimedia appliance that enabled pre-recorded messages to be left at different physical locations to be serendipitously discovered by one's intimate other. The i.Fuzz devices should thus include memory, processing power as well as facilities for recording and playing back audio and video. An example scenario, derived from our user study, illustrates i.Fuzz use. A missive for one's partner is left in their sock-drawer on an i.Fuzz pre-programmed to start playback when the drawer is opened in the morning and the i.Fuzz exposed to light. Other envisioned uses of the i.Fuzz included using it as a digital keep-sake or to carry video clips of one's children.

Importantly, this scenario is taken from the participants. A participant left a message of affection on a piece of paper hidden in a sock drawer before leaving for work. This story

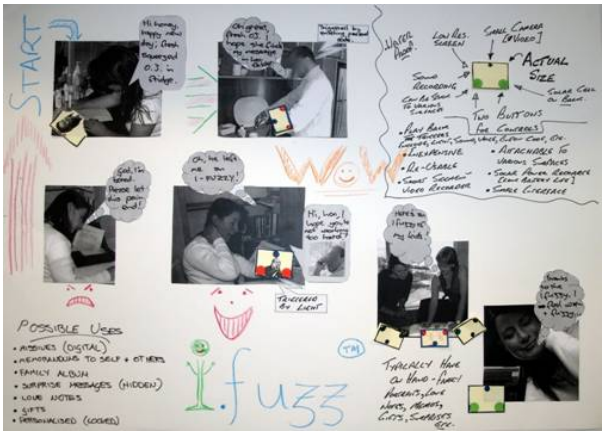

Figure 7. Design poster for the mobile device 'i.Fuzz' produced in the participatory design sign workshop

was an inspiration for the design workshops. It nicely encapsulated the playful, the emotional and the private themes of intimacy, and led to a feeling of presence-in-absence when the message was eventually found.

On the basis of the design sketches produced by the research team and in the two workshops, we produced a number of more refined designs and implemented a functional prototype. Some of these are described below.

SynchroMate

A more refined design responded to the user study observation that partners would sometimes send and receive messages simultaneously via SMS or email. The messages seem to "*cross each other in the air*". These coincidences, of receiving a message from someone while simultaneously sending that person a message, had a lasting impact on the couples. The coincidence was attributed with almost metaphysical significance, such as "*a stroke of faith*" or "*indicating a special personal connection*".

SynchroMate is a round device attached to the palm that aims to assist this "faith" a little and to make this metaphysical event more likely. It supports serendipitous synchronous communication by exchanging not only the message itself but also that a message is *being* composed. The SynchroMate allows intimate couples to 'stretch time' by allowing the serendipitous moment to last a little longer and to provoke anticipation. This device helps to express themes of reciprocity and serendipity.

Hug Over a Distance

Another of our early ideas took a step towards wearable computing and smart clothes; equipping partners with jackets providing couples with an open, physical and ambient channel of interaction, and enabling them to exchange a 'hug' while physically separated.

In the original idea for the *Hug Over a Distance* a person would be able to initiate a hug causing their remote partner's jacket to emulate, in some fashion, the feeling of a hug. This remote hug could then be rejected or reciprocated by the remote partner. When reciprocated, the jackets would remain synchronized in 'hug mode' until either of the parties chose to end the hug. This design idea was inspired by several of the themes of intimacy identified through our field study. It supports stroking and patting in a non-verbal but physical way. It is flirtatious, playful and it involves a high degree of reciprocity. Also, it permits couples to express private and discrete signs of affection in public places; a behavior identified by several of our participants.

We chose to implement a simplified, one-way version of Hug Over a Distance as a functional prototype (Figure 8) because it allows an immediate tactile interaction with an emotional content (similar to holding hands or giving a hug) and it can be used anywhere, anytime, yet discreetly and unobtrusively.

Figure 8. Hug Over a Distance prototype: showing pump, valve, battery, relay controller and wireless PDA. During use, these components are hidden inside the vest.

Hug Over a Distance uses two PDA devices connected wirelessly through TCP/IP via WiFi or through mobile phones via Bluetooth. One PDA is embedded in an inflatable, yet tastefully tailored sleeveless jacket. The other PDA is carried by the partner. If the PDA in the jacket receives a hug request, air channels embedded in the jacket are inflated to create a light, but palpable pressure on the body. After four seconds of pressure, an electronic valve opens and releases the air. The PDA sends an acknowledgement saying the hug was received, and thanks the sender with a kissing sound.

It is important to emphasize that we are not intending to recreate accurately the physical experience of a real hug using technology. Rather, we want to demonstrate, using a piece of wearable computing, that it is possible to send an emotional "ping" to a remote loved one with a tactile and unobtrusive interface. We are referring to a "hug", because the feeling of light pressure surrounding the body combined with the associated warmth is most closely related to a hug.

DISCUSSION

In this paper we have reported on ongoing work exploring designs ideas and concepts for technologies to support intimate acts. The significance of our contribution is threefold. First, we have presented an effective method for studying mediated intimacy in the 'wilds' of everyday life. Our approach used and interlaced cultural probes, contextual interviews, technology provocations, and participant observations to produce rich qualitative data of everyday situations of use. This approach is also applicable to the study of other forms of practice in the domestic environment.

Secondly, we have used these empirical materials to produce a nuanced and detailed understanding of mediated intimacy. This analysis and the thematic model produced have led to profound insights into the current role of technologies in intimate lives. It has also provided an empirically grounded springboard for inspiring and informing the design of future intimate technologies.

Finally, our various design activities, which included brainstorming sessions, and expert and participant design workshops generated a large number of design ideas and concepts. We have presented a small selection of these design ideas and concepts. In addition, one of these ideas – Hug Over a Distance – was developed as a demonstrator prototype.

While these designs for future technologies have not, as yet, been evaluated, they do emerge from empirically grounded understandings of current practice. Their validity is thus grounded in the real and observable practices of everyday life, as people use a variety of appropriated technologies to mediate their intimate lives. In the future, as indicated in our user-centered design approach (Figure 1), we intend to place prototypes of varying fidelity back in the field with participants in the study, as well as with other intimate couples, for evaluation and refinement of our ideas and methods.

Limitations

The schematic presented in Figure 3 is not a theory of intimacy. It does not explain why or how expressions of intimacy occur. Nor is it comprehensive. We do not consider likely influences on expressions of intimacy due to culture, sexual orientation, social class, age or geography. Nor is the thematic model a list of requirements. The themes are grounded concepts intended to trigger and inspire design ideas. For example, what would it mean to design for "stroking and patting", "routine and duty" and "work in progress"? These are not requirements in any traditional sense, but they may provoke further exploration of user needs.

We agree that probes are intended to "elicit inspirational responses from people–not comprehensive information about them, but fragmentary clues and their lives and thoughts" [9]. However, because we have chosen to visualize our probe data as themes, our results appear less fragmentary. We believe this helps to communicate our work without losing the power of provocation.

Conclusion

As Gaver points out communication of emotion is often not in the device output, but in the dynamics of use [8]. Similarly the innovations presented in this paper are not specifically conceptual innovations [e.g. 26 suggests the building of a Hug Over A Distance underwear device], but innovations of use. In other words, our design ideas and concepts are often a reconfiguration of existing technology, rather than speculation on future technology. Importantly, this reconfiguration is motivated by our understanding of current practices of intimate behavior. The innovation exists in the extensive analysis of the fieldwork and in the new uses that emerge from this reconfiguration.

Technology will never replace the physicality and immediacy of face-to-face contact. However, there is still much to understand about how interactive technologies can further augment, extend and support intimate experiences.

Our work takes an important step along this path to understanding, and we hope it will encourage further work in the development of technologies expressly designed for mediating intimacy.

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