# All You Need is Love: Current Strategies of Mediating Intimate Relationships through Technology

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A wealth of evidence suggests that love, closeness, and intimacy—in short relatedness—are important for people's psychological well-being. Nowadays, however, couples are often forced to live apart. Accordingly, there has been a growing and flourishing interest in designing technologies that mediate (and create) a feeling of relatedness when being separated, beyond the explicit verbal communication and simple emoticons available technologies offer. This article provides a review of 143 published artifacts (i.e., design concepts, technologies). Based on this, we present six strategies used by designers/researchers to create a relatedness experience: Awareness, expressivity, physicalness, gift giving, joint action, and memories. We understand those strategies as starting points for the experience-oriented design of technology.

Categories and Subject Descriptors: H.5.m [**Information Interfaces and Presentation**]: Miscellaneous

General Terms: Design, Human Factors, Theory

Additional Key Words and Phrases: Experience design, emotional communication, intimate relationships, relatedness, interaction design, review, long-distance relationships

**ACM Reference Format:**
Hassenzahl, M., Heidecker, S., Eckoldt, K., Diefenbach, S., and Hillmann, U. 2012. All you need is love: Current strategies of mediating intimate relationships through technology. ACM Trans. Comput.-Hum. Interact. 19, 4, Article 30 (December 2012), 19 pages.
DOI = 10.1145/2395131.2395137 http://doi.acm.org/10.1145/2395131.2395137

## 1. INTRODUCTION



The Beatles' "All You Need is Love" concisely summarizes at least 60 years of psychological research into human well-being. Love and the general feeling of being related to significant others are crucial to people's life satisfaction and happiness (e.g., Argyle [1987], Berscheid and Peplau [1983], Campbell et al. [1976], Freedman [1978], Miesen and Schaafsma [2008], Myers [1999]). Consequently, "relatedness" is a part of many psychological theories of human needs. For example, Maslow's *Theory of Personality* [Maslow 1954] quotes "love-belongingness" as one of five fundamental needs, Epstein's *Cognitive-Experiential Self Theory* [Epstein 1990] considers "relatedness" as one of four essential needs, and Ryan and Deci's contemporary *Self-Determination Theory* [Ryan and Deci 2000] even places "relatedness" among the top three of human needs. Sheldon et al. [2001, p. 339] conceptually defined fulfilled relatedness as the "feeling that you have regular intimate contact with people who care about you rather than

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DOI 10.1145/2395131.2395137 http://doi.acm.org/10.1145/2395131.2395137

feeling lonely and uncared for". Hassenzahl [2010] argued and demonstrated that the fulfillment of psychological needs, such as relatedness, is at the heart of positive experiences with technology and other artifacts [Gaver and Martin 2000; Hassenzahl et al. 2010; Jordan 2000; Partala and Kallinen 2012]. As long as we embed the present work into the larger endeavor of the experience-oriented design of technology or *Experience Design* (e.g., McCarthy and Wright [2004], Hassenzahl [2010, 2011]), we use relatedness as a theoretically rich and sufficiently broad label to subsume the diverse terms used throughout the literature, such as connectedness, intimacy, love, belonging, closeness, or togetherness.

While fulfilling the need for relatedness is of prime importance to humans, current developments in lifestyle often render this a challenge. The pressure of the job market and globalization forces employees to travel constantly and even to live apart from their loved ones. The consequence is an increasing number of long-distance relationships. According to the Center for the Study of Long Distance Relationships[1] approximately 3.6 million married U.S. Americans were involved in a long-distance relationship in 2006 and the rate of long-distance marriages between 2000 and 2005 increased about 23%. There were an estimated 4 to 4.5 million U.S. college couples in a long-distance relationship in 2005. Thus, premarital and dating couples, especially students, are even more prone to be in a long-distance relationship [Stafford and Reske 1990]. Even though long-distance relationships are as likely to endure as proximal relationships [Guldner 1996], they suffer from particular drawbacks. Partners, for example, regularly struggle with feelings of loneliness ([Magnuson and Norem 1999]; for a review see Rhodes [2002]). In order to cope with this situation, geographically separated couples make use of several possibilities to ensure the continuity of their relationship [Sigman 1991]. Couples use constructional artifacts (e.g., wedding rings, clothing, pictures, and ornaments) as reminders of the existence of the relationship and/or as signals to others. They express their commitment by talking with others about their relationship during separation. Finally, most couples stay connected through technology, such as the telephone (see Stafford [2005] for a helpful overview).

Most available technologies however focus on the transmission of explicit information, which neglects the emotional and subtle communication so typical for close relationships. This becomes apparent, for example, in interesting (mis-)uses of the telephone. In Italy people engage in a social practice called the *squillo* [Knobel et al. 2012].[2] A friend calls another and lets it ring only once to send a little "I think of you," a token of affection and act of emotional expressivity rather than an explicit act of verbal communication. However, the telephone itself is not built for this. The *squillo* is, thus, rather a product of people's inventiveness to fulfill their needs even in the face of "inappropriate" technological solutions.

This is not an exclusive problem of the telephone. Even more recent technologies, such as videoconferencing, do not explicitly consider emotional, expressive nonverbal information as a main purpose of a communication act. While video conferencing has the advantage of allowing for nonverbal cues, field studies (e.g., Ames et al. [2010]) show that video is merely treated as a "technical feature." It remains left to people to appropriate the feature, that is, to make it work as a social practice. A recent study by Neustaedter and Greenberg [2012] of video conferencing among long-distance couples demonstrated the richness of invented practices and the resulting experiences. In other words, the telephone and the widely available video conferencing systems such as *Skype* are built with functionality in mind (i.e., transmitting sound and video), not

[1]http://www.longdistancerelationships.net
[2]http://en.wikipedia.org/wiki/Missed_call

with the feeling and experience to provide. They may be used to achieve relatedness, but they are not built primarily with relatedness in mind.

Fortunately, research in Human-Computer Interaction (HCI), Experience Design, and Interaction Design acknowledges this problem. There has been—and still is—a growing and flourishing interest in designing technologies aimed at mediating (and creating) a feeling of relatedness (i.e., connectedness, intimacy, love, belonging, closeness, or togetherness) in romantic (and other) close relationships beyond explicit verbal communication and simple emoticons.

The main objective of this article is to provide an overview of this work. Based on 143 published artifacts from the HCI and Interaction Design domain, we identified six strategies of how designers attempt to explicitly create the experience of relatedness through technological artifacts. The article is meant as a starting point for readers, planning to design for relatedness. The Online Appendix lists the 143 artifacts, each with a short description, and a picture if available. While this repository of design ideas is of inspirational value in itself, it further supports putting new design ideas into a "historical" context. Just like a review of theories or empirical phenomena, this avoids reinventing the wheel and forces designers to more explicitly express how their new design advances what had been done before. In addition, we supply further exemplary references to psychological and HCI-related literature for each strategy as an inspiration to further ground new artifacts in relevant theory. All in all, the article is a tool for getting started with designing technological artifacts for creating and mediating relatedness based on what already exists in this domain.

The focus on reviewing artifacts rather than theories or studies has two additional implications. First, we get an overview of the strategies used and underused in designing relatedness experiences. Obviously, the artifacts embody and, thus, mirror available theoretical notions and empirical findings. There is nevertheless some additional value in creating a collection of strategies based on what is there (i.e., published artifacts) rather than what could be (i.e., published theories, visions, or context studies). At least, we can make sure that the vocabulary used to talk about the artifacts is one that is derived from and fits what is in the world. Second, focusing on artifacts allows for a brief review of the actual practice of designing for relatedness in terms of approaches, theories and processes.

We present six common strategies regularly found in existing technological artifacts for relatedness. Each strategy is described, examples are provided, and further exemplary psychological literature is added. In addition, we take a brief look at the theories and methods used by designers/researchers. Based on this, we recommend to turn more to already existing knowledge as inspiration and to consider analytical and critical approaches as an alternative or in addition to empirical evaluation.

## 2. STRATEGIES FOR RELATEDNESS

Our summarizing review of artifacts (i.e., concepts, objects, technologies) focused on relevant work published in the Association for Computing Machinery Digital Library[3] until end of 2009. We included all artifacts broadly addressing the mediation of intimate relationships by using the following search criteria: "intimacy," "romantic," "non-verbal communication," "emotional communication," "remote presence," "presence-in-absence," "romantic communication." We focused on artifacts that addressed the mediation of existing close relationships, primarily romantic couples and family members (e.g., cross-generational) (for informative overviews of research on close relationships see Regan [2011], Reis and Rusbult [2004], and Noller and

[3]http://portal.acm.org

Feeney [2006]). As long as the focus was on technology, this unavoidably touched on the problem of long-distance relationships as already discussed in the introduction [Stafford 2005]. We explicitly excluded artifacts designed for "communication" among strangers, colleagues, or rather remote acquaintances in the context of social networking. Consequently, the strategies we will describe are closely tied to the experience of relatedness among close couples and family members.

In total, we reviewed 92 publications containing 143 artifacts (see Electronic Appendix for a full list). We examined core elements and characteristics of the artifacts and clustered them according to similarities. Overall, we identified six broad strategies to create and mediate the feeling of relatedness: *awareness*, *expressivity*, *physicalness, gift giving*, *joint action*, and *memories*. Table I provides an overview.

Note that an artifact could potentially rely on any number and combination of those strategies. For example, artifacts based on physicalness often support expressivity as well. We nevertheless attempted to identify the single, most central strategy per artifact to get an idea of the distribution of the strategies. A large group of artifacts (39%, 56 of 143) addressed relatedness primarily by creating mutual awareness. The second group relied on expressivity (29%, 42 of 143). Thirteen percent (18 of 143) of the artifacts were based on physicalness, 8% (11 of 143) addressed gift giving, further 8% (12 of 143) addressed joint action, and only 3% (4 of 143) were based on (the re-experience of mutual) memories. Note that the six strategies are not exhaustive of relatedness. They simply capture the different approaches to designing for relatedness taken so far. Further note that our aim was not to fixedly categorize each artifact, but to map out and better understand the current state of strategies for designing relatedness experiences.

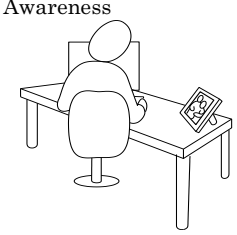
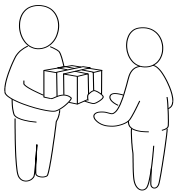
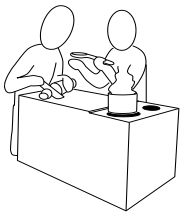
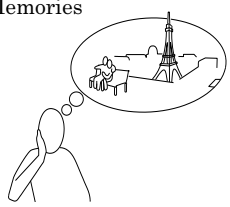
In the following, we discuss each strategy: We first describe the broad strategy addressed by the artifacts, and, when needed, further present clearly identifiably sub-strategies. Next, we exemplify each strategy by describing one or two exemplary artifacts. Finally, we provide references to relevant psychological principles as well as consequential key requirements and potential challenges for design, if possible.

### 2.1 Awareness

Awareness is the "state of knowing about the environment in which you exist; about your surroundings, and the presence and activities of others" [Wisneski et al. 1998, p. 24]. Strong and Gaver [1996] were among the first who placed emphasis on conveying awareness within the social and domestic context. Their work has inspired and motivated many designers to develop communication devices that support individuals in maintaining awareness of their loved ones. In general, "ambient" design [Dunne and Raby 1994; Ishii and Ullmer 1997; Wisneski et al. 1998], which aims at a rather peripheral, implicit experience, is closely related to awareness. As "peripheral" implies, those artifacts are designed in a way that they do not demand primary attention and are unobtrusive. Consequently, they fit into daily routines and activities without causing much disruption, neither for the receiver nor for the sender. This is in contrast to explicit, conversation-based technologies, such as the telephone.

Many concepts addressing awareness draw upon forms of implicit communication. To give an example, imagine that you are sitting at your desk in the living room, while your spouse is playing with the children in the back yard. You oversee the back yard. You hear your loved ones laughing and giggling. This can create a feeling of relatedness, without direct communication and without the need to interrupt your current activity. Awareness devices enable the exchange of continuous implicit information (such as children's laughter) to create a feeling of relatedness. We may further

Table I. Strategies

| Facet | Description |
|---|---|
| Awareness  | Artifacts that create a feeling of cognitive awareness and continuity by sharing different types of (ambient) information about current activities or moods among partners (without a conversation or doing anything together).<br>Substrategies: Display of presence, activity, or mood<br>Psychological principles and key requirements for design: reciprocal self-disclosure, ambiguity, counteraction against idealization |
| Expressivity  | Artifacts that emphasize the affective and emotional aspect of intimacy. They enable partners to express their feelings and emotions in a wide variety of ways, such as developing an own language or to use language in an ambiguous way.<br>Substrategies: on-off, symbol<br>Psychological principles and key requirements for design: enriched expression of emotions, reciprocity, integration in daily routines, open to interpretation, phatic communication |
| Physicalness  | Artifacts that mediate a feeling of physical intimacy. They simulate either secondary effects of physical proximity (e.g., body heat, heartbeat) or meaningful gestures (e.g., hugs, strokes).<br>Subcategories: Physiological parameters, gestures<br>Psychological principles and key requirements for design: Reciprocity, simultaneity, contextual constraints |
| Gift Giving  | Artifacts that demonstrate caring and valuing the other person by gift giving.<br>Psychological principles and key requirements for design: Reflection, effort and appreciation, thoughtfulness and similarity, symbolic communication |
| Joint Action  | Artifacts that allow for carrying out an action together, which usually requires being physically colocated.<br>Substrategies: Established routines, new routines<br>Psychological principles and key requirements for design: Activating communication, behavioral interdependence, selection of activities, serendipity |
| Memories  | Artifacts that keep records of past activities and special moments of a relationship.<br>Psychological principles and key requirements for design: Memorabilia, commitment, tangibility |

differentiate between three different types of "information" transmitted: *presence*, *activity*, and *mood*.

At first glance, the substrategy *presence* is similar to the availability status feature of common instant messenger services. However, according artifacts often go a step further, which make them especially meaningful and significant for close relationships. First, the artifacts do not enable users to directly communicate with each other, but convey only presence. Second, the functionality of transmitting presence is often built into everyday physical objects, such as picture frames, mirrors, or chairs. This aspect reflects upon habitual, social and domestic use, rather than the use at the workplace. Third, contrary to common instant messenger services, most artifacts are restricted to a single other person or only a small group of people (e.g., family). For example, Dey and De Guzman [2006] developed a series of presence display concepts (e.g., *PictureFrame*, *AugmentedMirror*), which incorporated all these aspects.

The substrategy *activity* attempts to create a sense of shared knowledge about mundane daily routines without explicitly asking for this type of information. The majority of artifacts using this strategy display current events. Some also focus on past or future activities. The major aim of exchanging information about future activities is to synchronize each other's schedule. Sharing information about past mundane activities will help to recognize any change from regular patterns that can be of importance, for instance, well-being of (grand)parents (e.g., *Digital Family Portrait*, [Mynatt et al. 2001]). The artifacts vary in the level of shared information and this information is often further transformed. For example, *Anemo* [Ogawa et al. 2005] consists of two devices, which detect sounds within a room and trigger a remote propeller to spin faster with increasing loudness. The activity is transmitted in a diffuse and fuzzy way. Another set of artifacts enables one-to-one transmission, either of a specific activity or activity in general. For example, *SyncDecor* [Tsujita et al. 2007] synchronizes pairs of daily appliances, such as desk lights, trash boxes, and TV sets, typically tied to specific activities (e.g., switching the desk light on implies work). Furthermore, there are artifacts, such as *MissU* [Lottridge et al. 2009], which enable two physically separated individuals not only to share music but also the ambient sound of the remote location.

Finally, the substrategy *mood* is to provide information about the emotional state (e.g., happy, sad, bored) of a partner by interpreting body language, physiological parameters, or external indicators (e.g., music). In contrast to a phone call, the sender does not consciously reflect his/her emotional state.

From a psychological point of view, the exchange of seemingly trivial "information" about mundane day-to-day events is crucial to the feeling of being involved in the loved one's life (see also the strategy of "joint action") [Guldner 2003]. That this can be technologically mediated was shown by Dey and De Guzman [2006]. They conducted a five-week field study with their presence displays. Participants were significantly more aware of their loved one's status and experienced increased feelings of awareness and connectedness.

Being aware of the significant other's mundane life counteracts the idealization of the partner, which is a common problem in long-distance relationships [Stafford and Merolla 2007]. The unrealistically positive, idealized view of the partner stems from the restricted interaction of couples in long-distance relationships. In addition, when being together, partners tend to avoid discomfort and conflict [Sahlstein 2004]. However, a more realistic perception is important for a successful relationship in the long run [Showers and Zeigler-Hill 2004]: an aspect supported by awareness devices.

An important precondition for creating relatedness through such devices is self-disclosure. While ***s***elf-disclosure is at the heart of relatedness, it is also associated with feelings of controllability and vulnerability from each individual's perspective. Consequently, couples do not disclose personal information right from the beginning

of a relationship, but rather reveal themselves over time [Reiss 1960]. Lottridge et al. [2009], for example, found that only couples actually living together acknowledged background noises of the loved one's environment. For couples, who did not live together, sharing sounds without verbalizations appeared intrusive and strange. Another example is a finding by Neustaedter et al. [2006]. Individuals had a strong need to maintain awareness for loved ones and at the same time experienced a duty to be available for intimate people (i.e., reciprocity). Depending on how close people already feel, they are willing to share more or less details, more or less often. On one hand, this demonstrates the necessity of an appropriate analysis of a couple's need for awareness. On the other hand, forcing a certain level of awareness upon couples through a device could possibly lead to a stronger experience of relatedness.

Awareness is the most comprehensive strategy. Several design principles (e.g., Dey and De Guzman [2006]) have been already suggested. The major principle is *ambiguity* [Gaver et al. 2003]. Providing information in an ambiguous way requires the 'user' to make meaning of this information, and, in the case of awareness devices, also takes into account privacy and autonomy concerns of each individual [Lottridge et al. 2009]. Thus, the great advantage of ambiguity is that it diminishes the feeling of being monitored, which is inherent to most approaches to creating awareness.

### 2.2 Expressivity

*Expressivity* supports the *explicit* expression and reflection of emotions, feelings, and affections, in an encoded or enriched way. It incorporates spontaneous, stimulating and playful communicative acts, which sometimes take place in either a synchronous or asynchronous way. Similar to awareness, this expressivity comprises a variety of different strategies, which can be subdivided into *on-off* and *symbols*.

The first substrategy, *on-off*, consists of artifacts that transmit simple on-off signals only. They assume that a minimal amount of information is sufficient to express affection. For example, *Virtual Intimate Object* [Kaye 2006] is a small disc in the computer's taskbar, which is connected to the partner's disc. When clicking on one disc, the partner's disc changes to bright red. The color then fades slowly over time. Kaye [2006] showed that such a simple mechanism can be sufficient to express mutual affection. Another example is *ComTouch* [Chang et al. 2002]. This mobile phone has extra buttons on the side and back. Pressure sensors enable users to squeeze the phone. The touch pressure under each finger is mapped to the intensity of vibration of the other phone. This allows for an immediate, simple, codified exchange of affection.

The substrategy *symbols* invites variety in messaging. In contrast to currently available technologies, which provide only limited customization for emotional messaging through, for example, emoticons, the majority of the *symbols* concepts encourage couples to develop their own emotional language. For example, the *Cube* [Garnæs et al. 2007] is a virtual three-dimensional cube for couples to compose and send symbolic messages. To compose a message, users can either select from an existing pool of symbols or create new symbols. This approach is based on the idea that couples tend to create an idiosyncratic universe with a "secret" language, with rules only known to the respective partners. This excludes the rest of the world and, thus, creates a strong feeling of relatedness [Cheal 1987].

Expressivity, that is, the communication of emotions and affection, is essential to close relationships [Clark et al. 2001]. In fact, suppressing emotional expressions has several negative effects. For example, Richards et al. [2003] instructed romantic couples to suppress their emotional expressions during a naturalistic interaction. They found that suppressing emotions took a lot of effort and negatively influenced attention, since participants who suppressed emotions had poorer memory for what was

said during the interaction. Guldner [2003] reported that couples in enduring long-distance relationships wrote emotionally expressive letters to each other twice as often compared to those that broke up, even when he controlled for differences, for instance, in trust, commitment. Hence, it seems important to physically separated couples to express their emotions more regularly.

An important aspect of expressivity is reciprocity. Reciprocity addresses peoples' expectation that others should and will respond to them in a way (e.g., in frequency) similar to their own input. Findings suggest that couples who experience reciprocity tend to have more satisfying relationships [Fletcher et al. 1987]. Emotional expressions are personal exchanges, which call for an almost instant reply from their partners [Kaye 2006]. This requirement in turn calls for the integration of expressive communication devices into daily routines, to facilitate the expression itself and a contingent reply.

A main advantage of *on-off* and *symbols* is the flexibility in terms of interpretation. Each couple can interpret the simple signal in their own way, that is, load it with meaning. In addition, depending on the context, the same signal may have different meanings for the same couple. For example, clicking the *Virtual Intimate Object* [Kaye 2006] in the morning might represent a "Good Morning," while a spontaneous click at any time might be interpreted as "I love you" or "I think of you". Moreover, the simple signal disguises the emotional content of the communication, which mitigates the privacy issue. For example, making an emotionally expressive phone call in public may appear as inappropriate. Some people avoid using nicknames in public (e.g., shnookums, sweet little teddy bear) or sometimes feel uncomfortable with unintentionally sharing their emotions with others. This discomfort in turn can lead to awkward phone conversations, potentially misinterpreted by the partner as distancing. In contrast, artifacts based on *on-off* or *symbols* can be easily used in public or other specific situations (e.g., a meeting), because only the partners involved know about the actual meaning. In general, this strategy is strongly related to the notion of "phatic communication" [Gibbs et al. 2005], which suggests the exchange itself to be the focus of the interaction and not necessarily the content.

There is empirical evidence suggesting the *on-off* strategy to be promising (see Baharin et al. [2008]). Kaye [2006] revealed that partners filled the "empty" token of pressing a button with rich and personal information. However, there are still a number of aspects to be considered in further research on devices for expressivity. In general, we must take into account that individuals vary in their ability to accurately express their emotions and to accurately identify the other's emotions [Fitness 2001]. There might be also systematic gender differences. For instance, for men, instrumental positive actions (e.g., cook a dinner) are more important than affective positive actions (e.g., say "I love you"). For women, it seems the opposite [Brehm 1992].

An aspect often neglected in expressivity is the exchange of negative emotions (e.g., arguing, conflict), although the expression of negative emotions might be important to the success of a relationship. For example, having an argument on the phone is more difficult to resolve than arguing face-to-face [Guldner 2003]. Thus, it might be interesting to look for new ways of supporting expressivity in such emotionally complex negative moments.

### 2.3 Physicalness

When asking couples what they miss the most during being separated, the spontaneous answer is "physical contact" [Werner et al. 2008]. Consequentially, simulating mutual touch and related aspects is a valid strategy for designing relatedness. One can further distinguish two substrategies: *physiological parameters* and *gestures*.

The first substrategy, *physiological parameters*, focuses on the incidental secondary effects of being physically close, typically associated with feelings of being in love, such as heartbeat, heart rate, and body heat. For example, Werner et al. [2008] developed *united-pulse*. It consists of two rings with a gap. These rings connect as soon as the user closes the gap with his/her finger. Then the user can feel the partner's heartbeat, signified by pulsing vibrations. The other substrategy, *gestures*, imitates intimate gestures, such as hand holding, stroking, and kissing. For example, *Hug over a Distance* [Mueller et al. 2005] is an inflatable vest designed to create an experience similar to being hugged.

From a psychological perspective, physical intimacy is a critical aspect of relationships, especially important for romantic couples [Moss and Schwebel 1993]. Blondis and Jackson [1982] even argue that touch may be the most important of all nonverbal behaviors. Touch positively impacts individuals' physical and mental well-being [Field 2001]. In fact, physical intimacy is one of the most direct ways to express feelings, such as empathy, sexual attraction, and care. Thus, it seems of great interest to enable physical intimacy through communication devices.

An important requirement for physicalness is simultaneity. Both users need to contribute to the experience in a synchronous way. For example, when being hugged, it is necessary to respond immediately and to reciprocate the hug. The need for simultaneity is one of the main challenges for concepts addressing physicalness, since technology always takes an intermediate function that slows down the process and might therefore even emphasize the separation. Many authors appear to be aware of this difficulty and therefore suggest a symbolic or poetic interpretation, rather than a one-to-one representation of physical intimacy, that is to replace physicalness with expressivity [Mueller et al. 2005; Werner et al. 2008].

Other difficulties of physicalness are all types of contextual constraints, similar to expressivity. For instance, kissing or holding hands are often spontaneous acts initiated by one partner and then reciprocated by the other. Under these circumstances, both individuals are in the same situation, and the initiator can take into account the adequacy of the action in this specific situation. When physically separated, he/she might not. Thus, one of the partners may want to feel physically close, while the other, for example, is giving a talk at a conference and understandably, he/she does not have the same desire, or at least cannot give in to it. In general, individuals in partnerships do not always feel comfortable being physically close and develop implicit rules and expectancies about when public intimacy is adequate and when it is not. This was also one of the insights reported by O'Brien and Mueller [2006], whose study showed that the moment participants felt the device caught too much public attention they hid it somewhere or left it at home.

All in all, we assume that the mediation of physicalness is one of the most challenging within the field of designing for relatedness. Even though Haans et al. [2007] showed that mediated social touch is perceived similar to unmediated touch, the results only demonstrated that several characteristics, such as location (stomach, arm, wrist, upper and lower back region) and type of touch (poke versus stroke) could be distinguished. However, physicalness is more. It is about sensual coexperience, highly emotional and with strong constraints concerning adequacy (e.g., public display). Rather than focusing too much on touch itself, designers may focus more on the experiences associated with touch, for instance, support, care, and empathy. This would be in line with the finding that the frequency of break ups in long-distance relationships is not greater than in geographically proximate relationships, suggesting that the needs from romantic relationships are more emotional and psychological and not mainly physically driven. Overall, from a design perspective, physicalness may be a difficult strategy to address relatedness, albeit its seeming obviousness.

### 2.4 Gift Giving

*Gift giving* refers to the voluntary transfer of a good without expecting compensation (see Otnes and Beltramini [1996] for an overview). Belk and Coon [1993] distinguished and found evidence for two different models underlying gift-giving in a dating context: an "exchange model" and "agapic love model". Exchange emphasizes the instrumental, pragmatic nature of gifts. The giver seeks control, expects a return, and monetary issues play a role (either symbolically or economically). In contrast, agapic love emphasizes the expressive, spontaneous, idealistic nature of gifts. The giver abandons control, the gift is nonbinding, and monetary issues do not play a role.

The person selecting a gift must carefully consider what the other might desire. This requires some intimate knowledge of the other person. A carefully selected and appropriate gift signals a certain intimacy and importance of the relationship. Furthermore, gift giving often involves effort, such as finding a suitable gift (e.g., only available from specific shops) or even making one. Effort also signals the importance of a relationship. Moreover, gift giving often features a moment of surprise, when the actual gift is revealed.

A concept exemplifying this strategy is *Hello There* by King and Forlizzi [2007]. It enables individuals to send audio messages associated with a particular location and time. A sender records a message on a computer and uses a map to select a geographical region to associate with the audio message. The receiver only gets the message when physically present in the particular geographic location. The message acts like a gift, hidden at a certain place as a surprise.

The most basic psychological function of gift giving is a symbolic communication with explicit and implicit meanings of love [Mick and Demoss 1990]. In a romantic relationship, partners regularly give gifts as a way to reveal their feelings [Shaver and Hazan 1988]. Not surprisingly, gifts are proclaimed to play an essential role in creating, maintaining, and enhancing relationships [Cheal 1987]. The exchange of gifts conveys a variety of messages. For instance, gifts operate as markers of similarity in tastes and interests between partners, signaling partner compatibility [Belk 1976]. Gifts are also beneficial for reducing the hazard of relationship dissolution as long as used at a moderate level of frequency; if used too often, gifts can increase relationship dissolution [Huang and Yu 2000].

Due to the pervasiveness of gifts and the pleasure they cause, it is tempting to incorporate aspects of gift giving into communication devices. In fact, a study of teenagers' use of mobile phones [Taylor and Harper 2002] already revealed a number of gift-giving-related practices, where, for example, messages are treated as gifts rather than explicit communication. A central challenge seems the repeated creation of a true gift giving experience with the same device, without losing significance and value.

### 2.5 Joint Action

Shared activities reinforce relationships [Wood and Inman 1993] by creating a shared experience through joint action. One substrategy is to create *new routines* for a couple. For example, *Mutsugoto/Pillow Talk* [Hayashi et al. 2008] is installed in the bedrooms of two partners, living apart. When both partners are in bed and wearing a special touch-activated ring, visible to a camera mounted above the bed, a system tracks the movement of the ring. It then transmits virtual pen strokes and projects them onto the body of the remote partner. If the partners' movements cross, the lines will react with each other and illuminate. This is an artificial, completely new activity for a couple to feel closer. New routines are also a strategy to create relatedness for parents and children [Yarosh et al. 2009]. For example, *Distributed Hide-and-Seek* [Vetere et al. 2006] allows grandchildren and grandparents to play a game when being apart.

Evjemo et al. [2004] suggested that the telephone is not a very suitable technology for supporting interaction between grandparents and grandchildren. Playing simplifies technology-mediated parent-child communication since any conversation is closely tied to the concurrent activity. In other words, joint action can serve as a trigger for concurrent and subsequent communication.

Another substrategy is to rely on *established routines*, and to enable the joint carrying out of mundane everyday activities, even when being separated. An example, the *Lover's Cup* [Chung et al. 2006], which consists of two wirelessly connected cups. If the user holds one cup, it triggers a soft glowing at the remote cup. When a person is drinking, the rim of the other cup begins to glow. If both owners take a sip at the same moment, both cups are glowing at its maximum. This artifact uses a simple activity, drinking, and creates a relatedness experience through encouraging simultaneous drinking. However, this example is also very close to an awareness device. Artifacts supporting more complex mundane routines, such as cooking, cleaning or having a breakfast over a distance, were not apparent in the analyzed sample of artifacts.

When designing for joint action, a central challenge is the careful selection of the activities. The goal is to create behavioral interdependence. This implies that each partner's behavior has implications for the other and at the same time signifies the mutual influence partners have on each other. In a geographically colocated relationship, behavioral interdependence is usually frequent, strong, diverse, and enduring. In times of separation, however, partners act autonomously and their behaviors have no impact on the other. To retain some of the behavioral interdependence while being separated is, thus, the goal of this strategy. So far, the use of joint action is rather restricted. There is an abundance of possibilities to, for example, play games against each other even when geographically separated. However, playing a game may not be the best example for behavioral interdependence, since games introduce additional and somewhat artificial activities for the purpose of feeling related (i.e., new routines). Sharing every day, mundane, real-world activities may be an alternative worthwhile further exploring [Neustaedter and Greenberg 2012].

### 2.6 Memories

The strategy *memories* is about enabling people to reexperience past joint moments without the necessary participation of the partner at the moment of reexperiencing. In contrast to the previous strategies, according artifacts expect much more effort from the user to create the potential reexperiencing, such as documenting special moments or curating them. An example is *SMOKS* [Berzowska and Coelho 2006], a suit capturing memories by representing traces of human touch, by recording and playing back sounds, and by providing hiding places for physical mementoes. The *SMOKS* neckline, for example, features a microphone to record intimate sounds (e.g., whispers) automatically.

The use of *memorabilia* to mediate relatedness in moments of separation is common. Constructional artifacts, such as wedding bands or other physical objects, such as clothing and ornaments, are typical for maintaining the continuity of a relationship in absence [Sigman 1991]. Couples tend to collect souvenirs, pictures, and other things that subsume and represent their past history (see Petrelli et al. [2008] about the meanings of mementos). Kjeldskov et al. [2004] reported that some of their participants made great efforts to maintain their memories (e.g., in photo albums). Photos and other tokens are a manifest declaration of the relationship. In addition, they act as signifiers and reminders of earlier investments made into the relationship [Rusbult 1980].

Other than the former strategies, artifacts relying on memory do not require a technical connection with the partner. Thus, they are very helpful when partners miss their loved ones, but know that they cannot contact them or do not want the other to know about his/her feeling. We further assume that one of the biggest challenges of this strategy might be the importance of tangibility. Bhandari and Bardzell [2008], for example, reported that the very fact that partners could touch artifacts that had a special meaning, made them feel closer to their remote partners. The tangibility of "sacred" objects is important, because people assume positive contamination: the notion that through physical contact the essence of an object (here: a memory) is transferred to the one touching it [Belk 1988].

### 2.7 Summary

Our review of published artifacts revealed six main strategies: Physicalness focuses on the physical aspect of relatedness, while awareness attempts to create a cognitive copresence of a couple. Expressivity particularly considers the emotional and affective aspects of intimate relationships and their deliberate exchange. Joint action addresses the importance of behavioral interdependence, while memories attempt to foster the commitment to an established close relationship. Eventually, gift giving is about expressing appreciation by carefully selecting something of meaning for the other, either material or immaterial. Our further analysis revealed differences in the relative frequency of using a particular strategy as the core of a concept, with awareness and expressivity being the most common. Obviously, the six strategies are not exhaustive. Designers/researchers will discover additional ways to create a relatedness experience over distance or time. But the six strategies are at the heart of current attempts to design for relatedness.

## 3. A COMMENT ON USE OF THEORIES AND METHODS

To design for relatedness, especially for close relationships, requires a profound understanding of people. To identify the extent to which designers of the artifacts exploited psychological theories, models, or empirical findings, we reviewed the reference lists of the 92 publications and located references to theoretical or empirical psychological work. Despite our large scope, considering not only close relationships but also the broader topics of communication and emotion, we identified only 44 publications with at least one external reference. In other words, slightly less than half of the artifacts (48%) made explicit use of external theoretical and empirical psychological knowledge. Among these, the most commonly mentioned topics were intimacy [Chung et al. 2006; Vetere et al. 2005], love [Pujol and Umemuro 2009; Saslis-Lagoudakis et al. 2006], communication [Lindley et al. 2009; Tsujita et al. 2009], emotion [Li and Jianting 2009; Tollmar and Persson 2002], touch [Chang et al. 2002; Motamedi 2007], and play [Feltham et al. 2007].

Additionally, we explored to what extent designers employed empirical methods in early phases of the design process (i.e., for analysis). Only slightly less than half of the publications (46%) explicitly mentioned a research method. Typical methods were interviews [King and Forlizzi 2007], observations [Tollmar et al. 2000], cultural probes [Vetere et al. 2005], contextual inquiries [Dey and De Guzman 2006], and focus groups [Lindley et al. 2009]. The application of the according methods itself varied immensely, from informal interviews with a small ad-hoc sample of people to comprehensive longitudinal studies. By linking the information given about the theoretical approach and research methods conducted, we found that 37% of the publications did neither refer to external psychological knowledge nor employed an explicit method for own empirical analysis.

We further investigated whether there was any kind of evaluation study or documentation of experiences created through the artifacts. Sixty-one percent received some sort of evaluation. We further categorized those according to the kind of evaluation study, and differentiated between (longitudinal) field studies (25%) and preliminary (laboratory) studies (36%). Field studies used functional prototypes. They varied in length from one week to several months. Slightly less than a half of the field studies did not last longer than two weeks. The average duration was about six weeks. The average sample size was about four couples (i.e., eight individuals). Self-report data and log data (e.g., frequency, content of messages) were collected. Depending on the length of the longitudinal study, participants were also asked to fill in diaries on a daily or a weekly basis. Additionally, most studies included interviews or open-ended questionnaires at the end of the study.

In general, the field studies can be characterized as exploratory. We found only a small number of studies with predefined hypotheses (an exception is Dey and De Guzman [2006]). Largely, researchers explored responses and reported on the specific issues, such as privacy or ambiguity, they found. Accordingly, only a small number of studies mentioned or employed standardized tests to capture the mediation of intimacy, such as the "Affective Benefits and Costs of Communication Questionnaire" [van Baren et al. 2004].

Laboratory tests used paper prototypes or working prototypes. In general, participants interacted with the prototype and were then asked about their experience. In some cases, they were further instructed to imagine interacting with the concept in predefined scenarios. Tests did not always take place in an actual laboratory. Researchers used conference workshops, demonstration sessions, museums or exhibitions, but in "laboratory mode," where the user got a demonstration and was asked for comments, rather than in a "field mode," where concepts are placed into a real setting. Due to missing documentation in some publications and differences in the evaluation methods, we can only estimate the average sample size as about 16 participants or eight couples, respectively. In general, most laboratory tests were framed as "pilot tests."

In sum, two—from our perspective slightly problematic—practices became apparent: (1) the underutilization of already existing knowledge and (2) the only preliminary empirical explorations of resulting experiences. The first is the consequence of a widely shared bottom-up approach to the analysis of people and contexts. Designers quite correctly insist on first-hand experience of their subject matter and use ethnography and phenomenological-inspired approaches to immerse themselves into the context to build up the empathy necessary for sensible design. While this is an important practice, which we should not abandon, there is another source of knowledge available through models and theories of the subject matter. However, despite of the availability of profound theoretical and empirical knowledge about relatedness (e.g., from Social Psychology), designers/researchers limit their scope to HCI-related or design-related publication outlets. In other words, even researchers working in a highly interdisciplinary field such as HCI tend to not make appropriate use of knowledge acquired by researchers from other disciplines. For instance, to our best knowledge, we did not find any artifact, reflecting explicitly upon potentially different requirements implied by different types of love [Sternberg 1986] or potential transitions in a relationship, such as psychological stage theories suggest [Reiss 1960]. Furthermore, insights from research investigating long-distance relationships and maintenance theories in close relationships were mainly disregarded. In general, we must tap into available, already cumulated knowledge by using external models and theories as an additional source of inspiration [Hassenzahl 2010, pp. 73]. Only half of the papers reviewed here made any external reference to this knowledge. It remains a common practice to exclusively

stick to one's own "research," which creates the danger to produce insights already available through previous, and often more elaborate research. It is difficult from a design perspective to research a given field such as close relationships professionally, so why not rely on the already available insights of experts, and use their theories in the sense of a "theoretically inspired design"?

The preliminary empirical explorations so typical for design work highlight a second problem, that of lacking resources. It can be overwhelmingly difficult to produce a functional prototype fit for a prolonged field test, carried out, analyzed and reported professionally. Yet the academic HCI community literally requires any designer/researcher to conduct an empirical evaluation of her or his artifact to be published [Greenberg and Buxton 2008]. The lack of resources leads to favoring easier, more informal ways of gathering empirical feedback, which can be riddled with methodological problems; problems not easily spotted by the same community, which presses for empirical evaluation. The question at hand is whether we actually need an empirical exploration (i.e., test, evaluation) at all that often or whether we should employ a more analytic alternative as an intermediate. As Greenberg and Buxton [2008] argued "[. . . ] authors should critique the design: why things were done, what else was considered, what they learned, expected problems, how it fits in the broader context of both prior art and situated context, what is to be done next, and so on" (p. 118). More formalized, Bardzell [2011], for example, offers "Interaction Criticism" as an analytic alternative, "a knowledge practice that enables design practitioners to engage with the aesthetics of interaction, helping practitioners cultivate more sensitive and insightful critical reactions to designs and exemplars." Such an analytic and critical approach may be a viable extension or even an alternative to empirical exploration. At least, critical reflection should serve as an ever-present first step in assessing new ideas and concepts, way before any empirical evaluation takes place.

## 4. CONCLUSION

Our summary revealed a substantial interest among HCI researchers and interaction designers in designing for relatedness experiences. Given the central role of the fulfillment of relatedness for humans' lives, this endeavor is highly relevant. The present article is intended as a tool to get into the field more easily. It aims at supporting the design of technology-mediated relatedness in at least five ways. First, the list of artifacts and the summarized strategies provide inspiration. Second, when interested in a certain strategy, further external material may guide the build-up of design-relevant insights. Third, the article describes current design practice, for example, through the estimates of which strategies are more common than others. This may help designers locating "white spots" to populate with novel design ideas. Fourth, we recommend making more use of already available knowledge (i.e., theories, models, findings) from external sources (e.g., Social Psychology) for inspiration. Fifth, we believe an analytical and critical practice of reflection to be a viable alternative to empirical evaluations too rushed and too informal.

Given the meaning of relatedness for human beings, the small number of commercial products explicitly supporting the mediation of relatedness beyond explicit communication is remarkable. Even though there seem to be market opportunities, with the high demands on personal mobility and the consequently increasing number of people living in a long-distance relationships, manufacturers seem hesitant. A rare exception is, for example, the *Hug Shirt* by Cutecircuit[4], a shirt to send and receive hugs over a distance by detecting and reproducing parameters, such as the strength of

[4]http://www.cutecircuit.com/hug-shirt

the touch, body temperature and the heartbeat rate of the sender. Altogether, we found only five products and two online services designed to connect distant individuals in a more subtle way than available technologies, such as email, mobile phones, webcams, already provide. The reasons for the skewed ratio of experimental to commercial concepts are manifold. First of all, the idea to enable relatedness by other ways than explicit, verbal communication or social media may be popular among researchers, but may have not reached industry, yet. Product managers might have difficulties to accept such concepts as a realistic product idea since they often do not fit into the efficiency and functionality-driven traditions of technology producing companies. The benefits of, for example, synchronized lamps or trash boxes, as suggested by *SyncDecor* [Tsujita et al. 2007] are difficult to capture in common marketing terms, or may even appear impractical. The appreciation of the experiential value that might result from integrating a device such as *SyncDecor* in daily routines requires a more thorough rethinking of models of customer value [Hassenzahl 2011]. Given that many products based on the classical conversational model of the telephone, enriched with video, such as *Skype* or Apple's video calling application *FaceTime*, are already a success, it needs a strategy to foster interest in new, more subtle forms of communication. Besides the challenge to point out the benefits of alternative, less explicit forms of communication, we require more profound insights into people's acceptance and willingness to use such devices. As already discussed, communication devices exclusively built to exchange emotions with the partner might evoke a (counterproductive) pressure to express one's feelings. Concepts addressing awareness require a high willingness for self-disclosure and, thus, affect privacy and surveillance issues. Although some authors acknowledged these issues, more research is needed to learn about the acceptance and problems of such devices to build a convincing case of designing the relatedness experience. We hope this article will encourage and help designers to work on ever more convincing examples of technologies designed to create and mediate relatedness.

## ACKNOWLEDGMENTS

Stephanie, all this could have been yours! We deeply miss you.

## REFERENCES

AMES, M. G., GO, J., KAYE, J., AND SPASOJEVIC, M. 2010. Making love in the network closet: The benefits and work of family videochat. In *Proceedings of the Conference on Computer Supported Cooperative Work*. ACM, New York, NY, 145–154.

ARGYLE, M. 1987. *The Psychology of Happiness*. Methuen, London.

BAHARIN, H., NOR, R., AND MÜHLBERGER, R. 2008. It's the thought that counts: Content vs. contact. In *Proceedings of the Australian Computer-Human Interaction Conference*. ACM, New York, NY, 235–238.

BARDZELL, J. 2011. Interaction criticism: An Introduction to the practice. *Interact. Comput. 23*, 604–621.

BELK, R. W. 1976. It's the thought that counts: A signed diagraph analysis of giftgiving. *J. Consumer Resear. 3*, 155–162.

BELK, R. W. 1988. Possessions and the extended self. *J. Consumer Resear. 152*, 139–168.

BELK, R. W. AND COON, G. S. 1993. Gift giving as Agapic Love: An alternative to the exchange paradigm based on dating experiences. *J. Consumer Resear. 203*, 393–417.

BERSCHEID, E. AND PEPLAU, L. A. 1983. The emerging science of relationships. In *Close Relationships*, H. H. Kelley, et al. Eds., W. H. Freeman, New York, NY, 1–19.

BERZOWSKA, J. AND COELHO, M. 2006. SMOKS: The memory suits. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 538–543.

BHANDARI, S. AND BARDZELL, S. 2008. Bridging gaps: Affective communication in long distance relationships. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 2763–2768.

BLONDIS, M. N. AND JACKSON, B. E. 1982. *Nonverbal Communication with Parents: Back to the Human Touch* 2nd Ed., John Wiley Sons, New York, NY.

BREHM, S. S. 1992. *Intimate Relationships* 2nd Ed. Random House, New York, NY.

CAMPBELL, A., CONVERSE, P. E., AND RODGERS, W. 1976. *The Quality of American Life. Perceptions, Evaluations, and Satisfactions*. Russell Sage Foundation, New York, NY.

CHANG, A., O'MODHRAIN, S., JACOB, R., GUNTHER, E., AND ISHII, H. 2002. ComTouch: Design of a vibrotactile communication device. In *Proceedings of the Conference on Designing Interactive Systems*. ACM, New York, NY, 312–320.

CHEAL, D. 1987. Showing them you love them: Gift giving and the dialectic of intimacy. *Sociological Rev. 35*, 151–169.

CHUNG, H., LEE, C. H. J., AND SELKER, T. 2006. Lover's cups: Drinking interfaces as new communication channels. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 375–380.

CLARK, M. S., FITNESS, J., AND BRISSETTE, I. 2001. Understanding people's perceptions of relationships is crucial to understanding their emotional lives. In *Handbook of Social Psychology*. Vol 2: Interpersonal Processes, G. Fletcher and M. S. Clark Eds., Blackwell, Oxford, UK, 253–278.

DEY, A. K. AND DE GUZMAN, E. S. 2006. From awareness to connectedness: The design and deployment of presence displays. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 899–908.

DUNNE, A. AND RABY, F. 1994. Fields and thresholds. In *Proceedings of the Doors of Perception Conference*. http://www.mediamatic.nl/Doors/Doors2/DunRab/DunRab-Doors2-E.html.

EPSTEIN, S. 1990. Cognitive-experiential self-theory. In *Handbook of Personality Theory and Research*, L. A. Pervin Ed., Guilford Press, New York, NY, 165–192.

EVJEMO, B., SVENDSEN, G. B., RINDE, E., AND JOHNSEN, J. 2004. Supporting the distributed family: The need for a conversational context. In *Proceedings of the Nordic Conference on Human-Computer Interaction*. ACM, New York, NY, 309–312.

FELTHAM, F. VETERE, F., AND WENSVEEN, S. 2007. Designing tangible artifacts for playful interactions and dialogues. In *Proceedings of the Conference on Designing Interactive Systems*. ACM, New York, NY, 61–75.

FIELD, T. 2001. *Touch*. MIT Press, Cambridge, MA.

FITNESS, J. 2001. Emotional intelligence and intimate relationships. In *Emotional Intelligence in Everyday Life: A Scientific Enquiry*, J. Ciarrochi, J. P. Forgas, and J. D. Mayer Eds., Edwards Brothers, Lillington, NC, 98–112.

FLETCHER, G. J. O., FINCHAM, F., CRAMER, L., AND HERON, N. 1987. The role of attributions in close relationships. *J. Personality Social Psych. 53*, 481–489.

FREEDMAN, J. 1978. *Happy People: What Happiness Is, Who Has It, and Why*. Harcourt Brace Jovanovich, New York, NY.

GARNÆS, K., GRÜNBERGER, O., KJELDSKOV, J., AND SKOV, M. B. 2007. Designing technologies for presence-in-absence: Illustrating the cube and the picture frame. *Pers. Ubiquitous Comput. 115*, 403–408.

GAVER, W. W. AND MARTIN, H. 2000. Alternatives. Exploring information appliances through conceptual design proposals. In *Proceedings of the Conference on Human Factors in Computing*. ACM, New York, 209–216.

GAVER, W. W., BEAVER, J., AND BENFORD, S. 2003. Ambiguity as a resource for design. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 233–240.

GIBBS, M. A., VETERE, F., BUNYAN, M., AND HOWARD, S. 2005. SynchroMate: A phatic technology for mediating intimacy. In *Proceedings of the Conference on Designing for User eXperience*. AIGA, New York, NY.

GREENBERG, S. AND BUXTON, B. 2008. Usability evaluation considered harmful (some of the time). In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 111–120.

GULDNER, G. T. 1996. Long-distance romantic relationships: Prevalence and separation-related symptoms in college students. *J. College Student 37*, 289–295.

GULDNER, G. T. 2003. *Long Distance Relationships: The Complete Guide*. JF Milne Publications, Corona, CA.

HAANS, A., DE NOOD, C., AND IJSSELSTEIJN, W. A. 2007. Investigating response similarities between real and mediated social touch: A first test. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 2405–1410.

HASSENZAHL, M. 2010. *Experience Design. Technology for All the Right Reasons*. Synthesis Lectures on Human Computer Interaction, Morgan and Claypool Publishers, San Francisco, CA.

HASSENZAHL, M. 2011. User experience and experience design. http://www.interaction-design.org/encyclopedia/user_experience_and_experience_design.html.

HASSENZAHL, M., DIEFENBACH, S., AND GÖRITZ, A. 2010. Needs, affect, and interactive products – Facets of user experience. *Interact. Comput. 225*, 353–362.

HAYASHI, T., AGAMANOLIS, S., AND KARAU, M. 2008. Mutsugoto: A body-drawing communicator for distant partners. In *ACM SIGGRAPH Posters*. ACM, New York, NY, Article 91.

HUANG, M.-H. AND YU, S. 2000. Duration models to analyze dating relationships: The controversial role of gift giving. *Family Consumer Sci. Resear. J. 28*, 411–427.

ISHII, H. AND ULLMER, B. 1997. Tangible bits: Towards seamless interfaces between people, bits and atoms. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 234–241.

JORDAN, P. 2000. *Designing Pleasurable Products. An Introduction to the New Human Factors*. Taylor and Francis, London.

KAYE, J. 2006. I just clicked to say I love you: Rich evaluations of minimal communication. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 363–368.

KING, S. J. AND FORLIZZI, J. 2007. Slow messaging: Intimate communication for couples living at a distance. In *Proceedings of the Conference on Designing Pleasurable Products and Interfaces*. ACM, New York, NY, 451–454.

KJELDSKOV, J., GIBBS, M., VETERE, F., HOWARD, S., PEDELL, S., MECOLES, K., AND BUNYAN, M. 2004. Using cultural probes to explore mediated intimacy. *Australas. J. Inf. Syst. 112*, 102–115.

KNOBEL, M., HASSENZAHL, M., LAMARA, M., SATTLER, T., SCHUMANN, J., ECKOLDT, K., AND BUTZ, A. 2012. Clique trip: Feeling related in different cars. In *Proceedings of the Conference on Designing Interactive Systems*. ACM, New York, NY, 29–37.

LI, M. AND JIANTING, H. 2009. Ambient environments for emotional physical communication. In *Proceedings of the International Conference NZ Chapter of ACM's Special Interest Group on Human-Computer Interaction*. ACM, New York, NY, 81–84.

LINDLEY, S. E., HARPER, R., AND SELLEN, A. 2009. Desiring to be in touch in a changing communications landscape: Attitudes of older adults. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 1693–1702.

LOTTRIDGE, D., MASSON, N., AND MACKAY, W. 2009. Sharing empty moments: Design for remote couples. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 2329–2338.

MAGNUSON, S. AND NOREM, K. 1999. Challenges of higher-education couples in commuter marriages: Insights for couples and counsellors who work with them. *Family J. 7*, 125–135.

MASLOW, A. H. 1954. *Motivation and Personality*. Harper, New York, NY.

MCCARTHY, J. AND WRIGHT, P. 2004. *Technology as Experience*. MIT Press, Cambridge, MA.

MICK, D. G. AND DEMOSS, M. 1990. Self-gifts: Phenomenological insights from four contexts. *J. Consumer Resear. 17*, 322–332.

MIESEN, H. W. J. M. AND SCHAAFSMA, J. 2008. Get a life: Relatedness needs, materialism, and subjective well-being. In *Proceedings of the IAREP/SABE World Meeting*. Luiss, Rome.

MOSS, B. F. AND SCHWEBEL, A. I. 1993. Marriage and romantic relationships: Defining intimacy in romantic relationships. *Family Relations 421*, 31–37.

MOTAMEDI, N. 2007. Keep in touch: A tactile-vision intimate interface. In *Proceedings of the Conference on Tangible and Embedded Interaction*. ACM, New York, NY, 21–22.

MUELLER, F., VETERE, F., GIBBS, M., KJELDSKOV, J., PEDELL, S., AND HOWARD, S. 2005. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 1673–1676.

MYERS, D. G. 1999. Close relationships and quality of life. In *Well-Being: The Foundation of Hedonic Psychology*, D. Kahneman, E. Diener, and N. Schwarz Eds., Russell Sage Foundation, New York, NY, 374–391.

MYNATT, E. D., ROWAN, J., CRAIGHILL, S., AND JACOBS, A. 2001. Digital family portraits. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 333–340.

NEUSTAEDTER, C. AND GREENBERG, S. 2012. Intimacy in long-distance relationships over video chat. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 753–762.

NEUSTAEDTER, C., ELLIOT, K., AND GREENBERG, S. 2006. Interpersonal awareness in the domestic realm. In *Proceedings of the Australian Computer-Human Interaction Conference*. ACM, New York, NY, 15–22.

NOLLER, P. AND FEENEY, J. A. 2006. *Close Relationships. Functions, Forms, and Processes*. Psychology Press, New York.

O'BRIEN, S. AND MUELLER, F. 2006. Holding hands over a distance: Technology probes in an intimate, mobile context. In *Proceedings of the Australian Computer-Human Interaction Conference*. ACM, New York, NY, 293–296.

OGAWA, H., ANDO, N., AND ONODERA, S. 2005. SmallConnection: Designing of tangible communication media over networks. In *Proceedings of the Conference on Multimedia*. ACM, New York, NY, 1073–1074.

OTNES, C. AND BELTRAMINI, R. F. 1996. *Gift Giving: A Research Anthology*. Popular Press.

PARTALA, T. AND KALLINEN, A. 2012. Understanding the most satisfying and unsatisfying user experiences: Emotions, psychological needs, and context. *Interact. Comput. 241*, 25–34.

PETRELLI, D., WHITTAKER, S., AND BROCKMEIER, J. 2008. Autotopography: What can physical mementos tell us about digital memories? In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 53–62.

PUJOL, R. S. AND UMEMURO, H. 2009. Productive love: A new approach for designing affective technology. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 2469–2478.

REGAN, P. 2011. *Close Relationships*. Routledge.

REIS, H. T. AND RUSBULT, C. E. 2004. *Close Relationships*. Psychology Press, New York, NY.

REISS, I. L. 1960. Toward a sociology of the heterosexual love relationship. *Marriage Family Living 22*, 139–145.

RHODES, A. R. 2002. Long-distance relationships in dual-career commuter couples: A review of counselling issues. *Family J. 10*, 398–404.

RICHARDS, J. M., BUTLER, E. A., AND GROSS, J. J. 2003. Emotion regulation in romantic relationships: The cognitive consequences of concealing feelings. *J. Social Personal Relationships 20*, 599–620.

RUSBULT, C. E. 1980. Commitment and satisfaction in romantic associations: A test of the investment model. *J. Exp. Social Psych. 16*, 172–186.

RYAN, R. M. AND DECI, E. L. 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Amer. Psychologist 551*, 68–78.

SAHLSTEIN, E. 2004. Relating at a distance: Negotiating being together and being apart in long-distance relationships. *J. Social Personal Relationships 21*, 689–702.

SASLIS-LAGOUDAKIS, G., CHEVERST, K., DIX, A., FITTON, D., AND ROUNCEFIELD, M. 2006. Hermes@Home: Supporting awareness and intimacy between distant family members. In *Proceedings of the Australian Computer-Human Interaction Conference*. ACM, New York, NY, 23–30.

SHAVER, P. R. AND HAZAN, C. 1988. A biased overview of the study of love. *J. Social Personal Relationship 5*, 473–501.

SHELDON, K. M., ELLIOT, A. J., KIM, Y., AND KASSER, T. 2001. What is satisfying about satisfying events? Testing 10 candidate psychological needs. *J. Personality Social Psych. 802*, 325–339.

SHOWERS, C. J. AND ZEIGLER-HILL, V. 2004. Organization of partner knowledge: Implications for relationship outcomes and longitudinal change. *Personality Social Psych. Bull. 30*, 1198–1210.

SIGMAN, S. J. 1991. Handling the discontinuous aspects of continuous social relationships: Towards research on the persistence of social forms. *Comm. Theory 1*, 106–27.

STAFFORD, L. 2005. *Maintaining Long-Distance and Cross-Residential Relationships*. Lawrence Erlbaum, Mahwah, NJ.

STAFFORD, L. AND MEROLLA, A. J. 2007. Idealization, reunions, and stability in long-distance dating relationships. *J. Social Personal Relationships 24*, 1, 37–54.

STAFFORD, L. AND RESKE, J. R. 1990. Idealization and communication in long-distance premarital relationships. *Family Relations 39*, 274–279.

STERNBERG, R. J. 1986. A triangular theory of love. *Psych. Rev. 93*, 119–135.

STRONG, R. AND GAVER, W. W. 1996. Feather, scent and shaker: Supporting simple intimacy. In *Proceedings of the Conference on Computer Supported Cooperative Work*. ACM, New York, NY, 443–444.

TAYLOR, A. S. AND HARPER, R. 2002. Age-old practices in the 'New World': A study of gift-giving between teenage mobile phone users. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 439–446.

TOLLMAR, K. AND PERSSON, J. 2002. Understanding remote presence. In *Proceedings of the Nordic Conference on Human-Computer Interaction*. ACM, New York, NY, 41–50.

TOLLMAR, K., JUNESTRAND, S., AND TORGNY, O. 2000. Virtually living together. Using multiple-method design in the search for telematic emotional communication. In *Proceedings of the Conference on Designing Interactive Systems*. ACM, New York, NY, 83–91.

TSUJITA, H., SIIO, I., AND TSUKADA, K. 2007. SyncDecor: Appliances for sharing mutual awareness between lovers separated by distance. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 2699–2704.

TSUJITA, H., TSUKADA, K., AND SIIO, I. 2009. InPhase: A communication system focused on "happy coincidences" of daily behaviors. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 3401–3406.

VAN BAREN, J., IJSSELSTEIJN, W. A., MARKOPOULOS, P., ROMERO, N., AND DE RUYTER, B. 2004. Measuring affective benefits and costs of awareness systems supporting intimate social networks. In *Proceedings of the 3rd Workshop on Social Intelligence Design*. CTIT Workshop Proceedings Series WP04-02, 13–19.

VETERE, F., GIBBS, M., KJELDSKOV, J., HOWARD, S., MUELLER, F., PEDELL, S., MECOLES, K., AND BUNYAN, M. 2005. Mediating intimacy: Designing technologies to support strong-tie relationships. In *Proceedings of the Conference on Human Factors in Computing Systems*. ACM, New York, NY, 471–480.

VETERE, F., NOLAN, M., AND RAMAN, R. A. 2006. Distributed hide-and-seek. In *Proceedings of the Australian Computer-Human Interaction Conference*. ACM, New York, NY, 325–328.

WERNER, J., WETTACH, R., AND HORNECKER, E. 2008. United-pulse: Feeling your partner's pulse. In *Proceedings of the Conference on Human Computer Interaction with Mobile Devices and Services*. ACM, New York, NY, 535–538.

WISNESKI, C., ISHII, H., DAHLEY, A., GORBET, M., BRAVE, S., ULLMER, B., AND YARIN, P. 1998. Ambient displays: Turning architectural space into an interface between people and digital information. In *Cooperative Buildings: Integrating Information, Organization, and Architecture*, N. Streitz, S. Konomi, and H. Burkhardt Eds., Springer, 22–32.

WOOD, J. T. AND INMAN, C. 1993. In a different mode: Masculine styles of communicating closeness. *J. Appl. Comm. Resear. 21*, 279–295.

YAROSH, S., CHEW, Y. C., AND ABOWD, G. D. 2009. Supporting parent-child communication in divorced families. *Int. J. Hum. Comput. Stud. 67*, 192–203.

Received November 2011; revised April 2012, July 2012; accepted July 2012