Hold Me Tight: A Tangible Interface for Mediating Closeness to Overcome Physical Separation

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Abstract. This paper presents a sense appealing tangible user interface as an innovative technological solution to increase a feeling of closeness for two physically separated persons: an interactive pillow pair allowing intimate voice message exchange over a distance. The pillow shape incorporates the comfortable characteristics of the intimate going-to-bed ritual and is meant to provoke a relaxed and reflective ambience in which dedication for one another can be revealed. A working proof of concept prototype is evaluated in a qualitative study based on a combination of cultural probes and interviews to investigate its applicability for couples living in long-distance relationships. Initial findings indicate that the pillow concept is successful in the matter of providing an appealing solution to make lovers feel closer over a geographical distance. Users slow down, feel warm and safe and compose messages meant to express support, consolation, love and appreciation.

Keywords: Tangible interface · User experience · Closeness · Physical separation · Long distance relationship · Cultural probes

1 Introduction

Flexibility and mobility are major aspects of today's society. Education and career paths are no longer limited to local areas. Additionally, online dating platforms facilitate finding the right partner outside the local scope. As a result, many couples live in Long Distance Relationships (LDR) today. Digital technology keeps them connected over vast geographical distances and theoretically enables them to interact with each other at anytime and anywhere. However, it is questionable whether these common tools are sufficient enough to create meaningful and pleasant interactions that ease coping with separation. The aim of this paper is to explore the target group of physically separated loved ones and to present a reasonable and effective technical solution to overcome the distance between them.

Social interactions, love and the feeling of belonging are major human needs [1]. Interactions taking place in enduring and stable frameworks with the same person are particularly important to satisfy this human need to belong, while a lack of belongingness is considered as harmful, causing ill effects such as loneliness and isolation [2].

A reasonable model to define close relationships is provided by Sternberg's Triangular Theory of Love, which includes three basic components of love: intimacy (closeness felt to another person and emotional investment), passion (state of physical or psychological arousal) and commitment (decision to build a significant bond with someone) [3]. In order to strengthen love, it is important to translate these components into perceivable actions, which is challenging over a distance.

2   Overcoming Separation in Long Distance Relationships

Couples living in LDRs have to overcome several difficulties. Firstly, they need to establish and hold up a certain level of intimacy. This can only be accomplished in a private setting, since reciprocal self-disclosing acts like revealing secrets and desires are essential to build intimacy [4]. Secondly, physical contact is severely missed while being separated [5]. Hence, using physical objects acting as a proxy for the distant partner is a common strategy of LDR couples to feel the partner's presence [6, 7]. These are often received as gifts, which signal great intimate knowledge about the receiver and can thus be seen as responses to self-disclosing acts by displaying understanding, care and appreciation. Thirdly, joint actions and rituals are important for taking part in each other's life, but are hard to schedule and are often mediated by technology. Due to that, LDR couples tend to establish digitally mediated rituals to counteract weakening emotional ties [8]. Recent research investigated how well commonly available tools and novel design approaches are able to counteract these issues and will be discussed in the following.

Video mediated communication (VMC) is a wide-spread technique to communicate over long distances and is used in diverse fields of application [5, 9, 10]. Video connection enables to perceive rich subliminal information by body language, facial expression or the partner's surrounding, which can be used to gain a deeper understanding about the partner's mood and constitution. Hence, VMC is often described as particular natural and offers the opportunity to join in specific actions and rituals [10]. The time synchronously spent with each other demonstrates presence in absence and illustrates effort and engagement since the couple grants a dedicated moment in time in which both are totally focused on the conversation [10]. However, VMC requires great timing, which is hard to schedule for LDR couples. Besides, being captured by a camera diminishes the privacy aspect, which is important to reveal self-disclosing acts [5, 10]. Furthermore, it was observed that the unfulfilled desire to touch the partner causes a sense of an even greater distance between both of them [5].

Smartphones provide a more flexible usage of VMC or at least voice transmission, because they can be used on the go. However, being theoretically available 24/7 does not mean that people are permanently approachable and in the mood for intimate conversations. This might lead to false expectations: Although it is technically possible to respond asynchronously at a later time, people expect each other to respond fast and equally extensive [11]. Delayed responses might result in frustration and negatively influence the enjoyment of intimate messages on both sides, either by waiting for a message or by feeling forced to rush. In contrast, handwritten letters follow a slowed down process that provides time for reflection and demonstrates how much time and

effort were spent to create a message, which was found to increase the perceived meaningfulness [7, 11]. As a consequence, future designs should focus on efficient timing that allows taking a dedicated moment in time for reflection as well as a personal and contextual fitting to create meaningful intimate messages.

Most of the commonly available technology sets its focus on explicit information exchange and neglects typical emotional and subtle communication patterns in close relationships [12]. Following a more recent user experience design approach that focuses on the user's emotions, affects and desires, there are various ways of mediating closeness and intimacy over a distance by addressing awareness or expressivity [12]. Those range from simple yet valuable "one-bit communication" like an on/off signal effectively used based on great intimate knowledge [13] to complex synchronous joint actions like having dinner over a distance [14].

Since taking time for synchronous communication can be hard to schedule, innovative asynchronous approaches were more recently developed and tested [15–17]. Here again, results indicate that abstract cues such as texts or visible cues are able to reflect emotions and are sufficient for creating a sense of awareness when being deployed in an interpretable context [16]. Furthermore, recent designs and studies focus on physicalness by providing various approaches: A feeling of relatedness can be enhanced by reconstructing specific movements [17], displaying physical parameters such as heart beat rates [18] or using inflatable vests meant to mimic hugs over a distance [19]. However, finding appropriate ways to physically interact with each other over a distance is a great challenge, since tools might be perceived as too artificial leading to uncomfortableness [15]. Hassenzahl et al. [12] suggest that instead of focusing on directly simulating touch, the experience connected with touch should be addressed by future designs. Following a metaphorical approach, tangible user interfaces can provide pleasant interaction possibilities. Tangible objects inherently have a certain affordance character, which invites users to perform a certain action [20]. Furthermore, a tangible device could serve as a proxy for the distant partner, which helps people to feel closer to each other by interacting with it [7, 9]. Chien et al. [21] introduce a well translated interaction concept in which a pillow is used to leave messages for the partner, but since one pillow has to be shared by the couple, it cannot be used over a great distance. Using a pillow as an interaction device is also followed by two recent commercial projects: Pillow Talk[1], which allows listening to the partner's heartbeat, and Pillo[2], which uses a pillow as an interface for playing games.

3 Development of an Interactive Good Night Pillow Pair

In summary, transmitting intimacy over a distance is important to achieve a feeling of closeness. In this context, privacy and trustworthiness are basic conditions for reciprocal self-disclosure and hence intimacy. The ambiance created should allow users to relax and take time in order to demonstrate appreciation and care by composing

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[1] http://www.littleriot.com/.

[2] http://pillogames.com/.

reflective messages and to enjoy receiving them. This should be further supported by the device's physicality and interaction pattern. All of these criteria are bundled up to a novel design approach that uses an asynchronous communication pattern, in which interaction depends more on the experience of being connected in a similar mood and environment, rather than on being time-dependent.

3.1 Good Night Pillow Concept

Two interactive pillows connected to each other were designed allowing intimate voice message exchange. Both partners have their own pillow each in order to record a message by talking to it. This message can then be send to the partner's pillow where it waits for the partner to come home and to listen to it in an equally relaxed manner by placing the head on it. The pillow pair is implemented in the context of a couple's goodnight ritual, which is located in the private bedroom offering a trustworthy surrounding for intimate communication. The timing is advantageous for reflective messages, because daily duties are already fulfilled. The pillow shape is associated with coziness and comfort and has the affordance character to calm down and relax. It can be cuddled and hold tight when used as a proxy for the distant partner (see Fig. 1).

Consistent with this conceptual idea the interaction concept is based on quite sound to support the relaxed setting and to shield the conversation in an intimate way. Voice messages can be equally created, send and listened to on both pillows. To preserve the soft and comfortable nature of a pillow, common user input solutions such as buttons cannot be implemented. Instead, the three core functionalities are triggered by gestures performed on the pillow. In order to start the recording, the user needs to hold the pillow tight as long as he/she wants the recording to take place. Through this hugging gesture, the user is forced to concentrate on the message by spending a dedicated moment in time without any distractions. Likewise, the listening function is activated by gently pressing ones head in the cushion. In regard of usability and safety, feedback
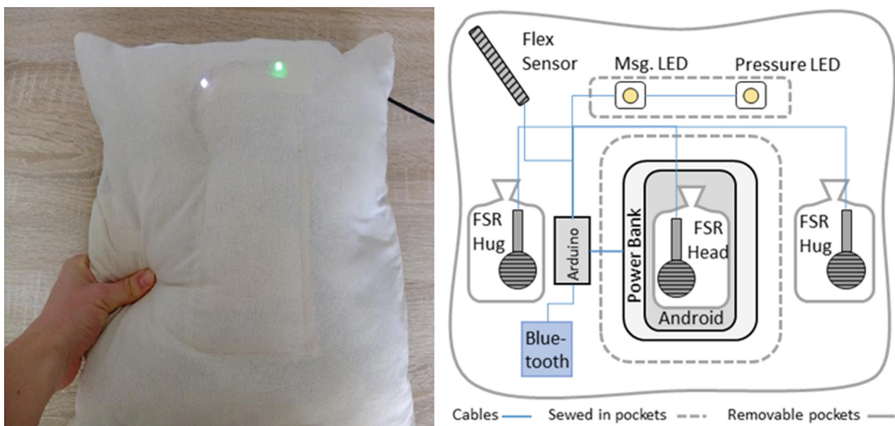

Fig. 1. Final pillow interface on the left and schematic overview on the right.

mechanisms are implemented. A message is not automatically uploaded. Instead, the user is able to listen to the recorded message and potentially revise it before consciously sending it by bending one designated corner of the pillow. In addition, visual feedback is provided by two color changing lights to inform the user about applied pressure, as well as the message's state (see Fig. 1).

3.2   Technical Implementation

Technically, three main components are used: An Arduino board with attached sensors and modules, an Android smartphone for recording as well as playing back sounds and the Dropbox Sync API working as a server to store messages. The Arduino Nano board is equipped with three force sensitive resistors (FSR) (see Fig. 1). Two are placed in small pockets and stowed at both sides of the pillow to detect a hug, the remaining one is placed in the middle of the pillow to detect if the user's head is placed on the pillow. A flex sensor is embedded in the upper left corner of the pillow to control message upload. Two LEDs provide visual feedback: The hug LED changes its color according to applied pressure, whereas the message LED changes its color to indicate an ongoing recording, a waiting message to be send as well as a successful or unsuccessful upload. A Bluetooth module is attached to the board in order to establish a connection to the Android smartphone, which is stuffed inside the pillow's cushion and reacts to incoming Bluetooth commands. The smartphone starts and handles the recording of messages as well as their playback and provides additional user feedback through vibration. Furthermore, its Wi-Fi access is used to connect remote pillow pairs with each other by using the Dropbox Sync API, which allows storing and exchanging messages between remote pillows.

4   Prototype Evaluation

The evaluation followed a user-centered approach focused on user experience to point out initial findings about the prototype's applicability to mediate closeness. To gain in-depth insights about the users and their interaction context, the evaluation was based on qualitative research extended by descriptive quantitative data.

4.1   Evaluation Method and General Procedure

The exploratory survey strategy consisted of two phases. In the first phase the current use of technology was requested to compare the prototype with already existing strategies and to identify most promising fields of application. Participants were encouraged to report personal rituals, such as saying goodnight. The pillow was then presented and tested in the second phase. Here, emotional aspects and the overall interaction context were focused including ambiance, timing, content of messages, physicality, personal meaning of the prototype and attitude towards it.

Two closely interwoven methods were used: cultural probes and interviews. Cultural probes are packages including assortments of artifacts, such as diaries or craft

materials. Along with evocative tasks they are meant to record inspirational responses to specific events, feelings or interactions [22]. They subjectively focus on the everyday life and can be used flexibly within private settings without disturbing or unsettling participants [23]. Since results gained by this method are often ambiguous and less appropriate to be formally analyzed [24], additional follow-up interviews in which participants explained the completed materials were conducted. This strategy allowed participants to concisely reflect on their behavior before being interviewed.

The center piece of the first cultural probe package was a handbook in which participants were proposed to answer questions with several techniques: text based methods (e.g. writing story fragments or expressing thoughts by brainstorming) and graphical presentations (e.g. sketching or completing comic scenarios) (see Fig. 2). The cultural probe package of the second phase included the pillow prototype and a diary for recording experiences with it. The two semi-structured interviews followed a pre-defined guideline and took approximately 30 min with each participant being interviewed separately. The interviews were audio recorded, transcribed word-by-word and pseudonymized. In a second step they were analyzed by using the bottom-up technique affinity diagramming in order to identify thematic clusters [24].

Fig. 2. Cultural probes material including diaries and craft materials.

Only couples living in a LDR were included and were chosen based on divergent patterns (e.g. distance between them, length of love relationship and prior experiences with sharing a flat) in order to gain a wide spectrum of answers while keeping the number of participants small. Three heterosexual couples were recruited ranging in age from 23 to 27, with an average distance of 165 km between them (70–325 km) and approximately 8.6 days spend together per month. The first couple (C1) was together since 1.5 years, never lived in the same city and only met each other at weekends. Couple two (C2) experienced both residing together and being separated across country boarders within their 5.5 years as a couple. The third couple (C3) (together since 0.5 years) was in a transition phase at the study's point in time because he just moved to another city.

The study was conducted in two phases and required three appointments with participants. In the beginning, participants were introduced to the study and equipped with the first package. After 7 days to fill out the material participants were met again

for the first interview. Afterwards, the second phase started with handing out the second cultural probe package. The couples had 10 days to test the pillow and were then met for the final 30-min interviews.

4.2 Results

Results from the first study phase confirmed the assumptions made about LDR couples: While being separated, physical aspects were missed most and difficulties of planning shared activities occurred. The partner was mostly missed in the evenings (56 %) and mainly due to situations that would usually be experienced together. Two of the three couples follow a ritual pattern to communicate while being apart: C2 uses Skype every evening and keeps the video connection open the whole night while sleeping. C1 uses text messages in the evenings and reported that sometimes an almost synchronous chatting unfolds, whereas other messages were not read until the next morning. This ritual behavior was important for both couples. Yet, C1 thinks that the text messages themselves could be replaced by any other medium, whereas C2 reported that the video connection was too important to be replaced and that e.g. a phone call would not create the same sense of presence in absence. C3 was newly challenged with living in a LDR and did not show established routines yet.

In the second phase the pillow prototype was deployed. In summary 60 messages were exchanged over the pillows, hence approximately 10 messages per participant. The average length of messages was 00:29 min with the shortest message being only one second and the longest message lasting 02:38 min. A tendency was found that messages got longer over time.

The interviews of the second phase revealed that the basic interaction concept of the pillow worked for participants. They particularly emphasized the cozy interface and reported that they felt invited to calm down and to cuddle the pillow. The interaction concept of lying down on the pillow in order to trigger message playback and to hold it tight for the purpose of recording a message was reported as well-translated. Participants enjoyed the interaction with the pillow and particularly stressed the importance of the LEDs' visible feedback responding to the user's applied pressure as well as the tactile vibratory feedback. Furthermore, the low sound volume and the fact that the pillow was exclusively used among the couple were mentioned to support intimate communication. The going-to-bed setting was another important factor, because this limited context attached further meaning to the messages: Participants reported that they were able to immerse into the situation captured by their partners.

All these factors build the basement for three types of unique experiences participants made with the pillow (identified by affinity diagramming): slow movement, moment capturing and reflection. Participants reported that due to the soft interface, the low sound volume and the timing, they felt slowed down and focused on the partner. They consciously tried to prevent potentially disturbing factors, e.g. an enabled TV, in order to not compromise the ambiance. Additionally, besides taking time for oneself to record a message, it was also meant to spend a dedicated moment in time while listening to the partner's saying. Not being able to intervene the partner was reported as beneficial. On the one hand it is a matter of respect and devotion, on the other hand it

facilitates the opportunity to capture a moment in which one can immerse. One participant explained: "*I can't exercise influence on what she is saying. Therefore, it is something, it shall not sound too enthusiastic, but it is something monumental that you can't influence this moment. [...] [The message] was like a small glass of compote, which you filled and then you can simply open it and then due to these scents, to carry this metaphor further, through these scents or this taste, you were able to immerse into this situation*" (C2, male, 27).

Furthermore, having time to phrase a message was believed to support reflective behavior. The participants' messages were thought through and they took a significant amount of time to compose a valuable and meaningful message before sending it to their partners. They tried to put themselves in the partner's place to figure out what content would be enjoyed most. The playback mechanism of a recorded message before being able to send it fostered this behavior. One participant explained that this mechanism would be advantageous in disputes. Instead of reacting too emotional, it would help to calm down before responding hastily and improperly.

Regarding the content of messages, different topics and purposes could be identified. There were messages meant to keep the other one on track about daily activities and to verbally express love and care. Other messages were more creative (e.g. containing songs or bedtime stories) and considered as more special. Furthermore, the meaning of a message was believed to be increased by well-considered timing, like an up-cheering message in the night before an important exam. Besides effort being demonstrated by time and emotional investment, one participant indicated the physical investment of applying pressure to the pillow while recording a long message. In his opinion it further underlined the effort and thus the dedication for one another, again increasing meaningfulness. Generally, messages were interpreted as small gifts, rather than as a source of information. Joyful curiosity was reported before lying on the pillow to hear a new message. Accordingly, participants claimed that no negative messages should be transmitted through the pillow, since it would ruin the caring experience. In this context one participant explained: *"The pillow [suppresses unfriendly utterances] because it is so soft. It gives you closeness and as a child you also had this cuddle-pillow. That is something familiar, where you seek for solace"* (C2, female, 26).

In response to questions about the perceived level of connectedness, a range of responses was elicited. C1, who was used to exchange text-based messages, reported an increased sense of connectedness using the pillow due to voice transmission as well as the cozy overall situation and exclusivity of messages. This view was echoed and expanded by C3, who particularly referred to the physical aspects of the pillow when giving reason to higher perceived connectedness. Although C2 appreciated the tactile interaction experience as well, they both agreed that the pillow could not replace their daily Skype ritual in the matter of perceived connectedness. The main reason was the lack of direct synchronous communication that they were used to. However, most participants indicated that the pillow had or would have helped them to overcome moments in which they missed their partners. Advantageous was the fact that the pillow could be used as a proxy when the partner was not directly available. Participants reported that in contrast to smartphones and computers, the soft texture was more human-like and that a feeling similar to cuddling with the partner evoked by interacting with it.

During the testing period, most participants required time to make themselves comfortable with using the pillow. Speaking to a pillow, listening to one's own voice and thinking about pleasant content was unfamiliar and constituted an inhibition threshold that needed to be overcome. Furthermore, some participants were initially concerned about the pillow's trustworthiness and felt insecure if their message would please their partner, since they did not get a direct reaction to it in response. However, all of these initial concerns diminished over time. Receiving a message in response eased the feeling of uncomfortableness and the couples fell into a routinized pattern.

Finally, participants were asked if they could imagine themselves using the pillow again over a longer time span. Half of them agreed to this question, whereas two answered with yes, but felt unsure about possible wear-out effects and only one participant explained that he would not need to use the pillow again, because of his already successfully established Skype ritual that was more beneficial in his opinion.

4.3   Discussion

Although results do not allow for universally valid statements due to the small group of participants, the combination of cultural probes and semi-structured interviews led to profound insights about the target group, their opinions and attitudes towards the pillow concept. The pillows are supposed to provide an intimate setting in which meaningful messages are exchanged aiming at a greater sense of connectedness. In the following it is discussed how well the concept was able to meet these requirements.

Since the pillow was exclusively used among designated partners and locally limited to the bedroom, a sufficient sense of privacy evolved to transmit intimate messages. This was further supported by the low sound volume that did not expose the partner. However, in the beginning an inhibition threshold was identified. On the one hand, participants felt unsure about the trustworthiness of the device, which might be due to its novelty and the lack of prior experiences with comparable products. On the other hand, using the pillow is an act of self-disclosure. As it is explained by the intimacy model [4], this kind of interaction requires an equivalent response to provide reciprocity. This leads to the assumption that initial inhibition thresholds result from intermittently delayed feedback (and might be higher compared to a synchronous communication). Furthermore, this can also explain why participants felt much more comfortable about sending messages after they received a similar message or positive feedback of their partner. Accordingly, we observed an increasing length of messages over time.

In respect of meaningfulness the chosen going-to-bed setting and the matching pillow shape can be identified as important facilitators. Participants stated that they inherently associated the pillow with relaxation, which explicitly invited them to take time for their messages. Thus, results indicate strong tendencies of reflective behavior: It was considered what kind of content would be delightful and in what kind of mood the other might be when receiving the message. Furthermore, participants appreciated the implemented play-back function and revised their messages before sending them off. Similar to findings about handwritten letters [11], we assume that taking time to choose the right words intensified the meaning of messages. Another important aspect

was the familiar environment in which messages were recorded, since it allowed participants to immerse in the situation and to experience a sense of taking part in this moment. This not only fits to results stated by King et al., who assume that a shared experience is often related to a specific location [7], but also fosters the approach to experience joint actions based on a specific individual moment rather than on time. Accordingly, this promotes the assumed potential of asynchronous techniques to mediate intimacy and closeness over a distance.

Generally, the pillow was less seen as a tool to communicate with each other, but rather as a device to demonstrate love, awareness, care and appreciation due to its gift-giving character, which moreover allowed immersion into a specific moment. Furthermore, the pillow acted as a proxy for the distant partner to some extent, which led to a feeling of being warm and safe and therefore completed the overall ambiance. Based on the discussion above, we conclude that the pillow concept works. However, that does not give evidence to its general suitability for every type of couple. Regarding everyday applicability, the three divergent couple manifestations indicate that prior experience of using technology to mediate intimacy and connectedness influences the likeliness of establishing a ritual framework. When being used to communicating synchronously, the pillow might not be sufficient to create a greater sense of connectedness due to its asynchronicity. However, all participants identified the tactile experience as well as the embedding into a specific context as added values. This seems to be a supplement and the major advantage towards common tools.

5   Conclusion and Future Work

The qualitative evaluation of the pillow concept with couples in LDRs led to reasonable initial findings proofing the general concept and supporting its applicability in the tested field. The pillow's distinctive characteristics like the soft and cozy tangible interface, it's embedding into the specific, intimate application context of the going-to-bed ritual and the hug-alike interaction mechanisms result in reciprocal acts of self-disclosure and great perceived connectedness. Hence, those features distinguish the device from commonly existing communication tools and provide additional value regarding meaningfulness and intimacy. Though the pillow device is not sufficient to replace synchronous communication between partners, it is supposed to be a valuable complement to enrich interaction, to retain love despite physical separation and thus to support the quality of human relationships. While results from the initial evaluation display predominantly positive resonance, future long-term comparative studies should be conducted that also include quantitative methodology in order to further elaborate on the pillows' effects and the potential advantages and disadvantages compared to other communication tools, particularly in situations such as disputes or moments of great yearning for the partner. Furthermore, an experimental comparison with other objects, which are for example less soft or which are deployed in other home-settings, can be conducted to prove benefits of the pillow shape and the bedroom setting.

Besides, the pillow concept is supposed to be applicable to other target groups of separated loved ones as well. While LDRs were focused in the study at hand, parent-child relationships might also benefit from the device in case of physical separation.

Social support and care are particularly needed in serious situations such as illness and significantly help in regard to well-being and health [25, 26]. Accordingly, we initially tested the pillow with a family who was physically separated due to cancer therapy of one child, as well. Within this serious context, the pillow appeared to have a positive effect in providing support and care, and its consolation character was emphasized. The mother claimed that she would like to use the pillow when her children feel sad and seek for solace while she is unable to be physically present. Yet, the trial revealed that the simple pillow shape seemed to be less appropriate for children. Hence, we suggest a teddy bear shape and an additional focus on more playful interaction methods to further engage children as well. Future research in this field will follow to investigate the pillows' applicability in other context than LDRs and to particularly prove its benefits regarding coping strategies for loneliness in hospitalized settings.

References

1. Maslow, A.H.: Motivation und Persönlichkeit. Rowohlt Taschenbuchverlag, Reinbeck bei Hamburg (2005)
2. Baumeister, R.F., Leary, M.R.: The need to belong: desire for interpersonal attachments as a fundamental human motivation. Psychol. Bull. **117**(3), 497–529 (1995)
3. Hendrick, S.S., Hendrick, C.: Liking, Loving and Relating. Brooks/Cole Publishing Company, Pacific Grove (1992)
4. Jiang, C.L., Hancock, J.T.: Absence makes the communication grow fonder: geographic separation, interpersonal media, and intimacy in dating relationships. J. Commun. **63**(3), 556–577 (2013)
5. Neustaedter, C., Greenberg, S.: Intimacy in long-distance relationships over video chat. In: CHI 2012 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 753–762. ACM, Austin (2012)
6. Vetere, F., Gibbs, M.R., Kjeldskov, J., Howard, S., Mueller, F., Pedell, S., Mecoles, K., Bunyan, M.: Mediating intimacy: designing technologies to support strong-tie relationships. In: CHI 2005 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 471–480. ACM, Portland (2005)
7. King, S., Forlizzi, J.: Slow messaging: intimate communication for couples living at a distance. In: DPPI Designing Pleasurable Products and Interfaces, Newcastle upon Tyne, pp. 452–454 (2007)
8. Lim, H., Suh, B.: Now here or nowhere: conflict resolution strategies for intimate relationship in diverse geographical contexts. In: CSCW Companion 2014 Proceedings of the Companion Publication of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing, pp. 197–200. ACM, Baltimore (2014)
9. Yarosh, S., Abowd, G.D.: Mediated parent-child contact in work-separated families. In: CHI 2011: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 1185–1194. ACM, Vancouver (2011)
10. Kirk, D., Sellen, A., Cao, X.: Home video communication: mediating "closeness". In: Proceedings of the 2010 ACM Conference on Computer Supported Cooperative Work (CSCW), pp. 135–144. ACM, Savannah (2010)

11. Lindley, S.E., Harper, R., Sellen, A.: Desiring to be in touch in a changing communications landscape: attitudes of older adults. In: CHI 2009 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 1693–1702. ACM, Boston (2009)

12. Hassenzahl, M., Heidecker, S., Eckoldt, K., Diefenbach, S., Hillmann, U.: All you need is love: current strategies of mediating intimate relationships through technology. ACM Trans. Comput. Hum. Interact. **19**(4), 1–19 (2012). Article 30

13. Kaye, J., Levitt, M.K., Nevins, J., Golden, J., Schmidt, V.: Communicating intimacy one bit at a time. In: CHI 2005 Extended Abstracts on Human Factors in Computing Systems, pp. 1529–1532. ACM, Portland (2005)

14. Wei, J., Cheok, A.D., Nakatsu, R.: Let's have dinner together: evaluate the mediated co-dining experience. In: ICMI 2012: Proceedings of the 14th ACM International Conference on Multimodal Interaction, pp. 225–228. ACM, Santa Monica (2012)

15. Nawahdah, M., Inoue, T.: Virtually dining together in time-shifted environment: KIZUNA design. In: CSCW 2013 Proceedings of the 2013 Conference on Computer Supported Cooperative Work, pp. 779–788. ACM, San Antonio (2013)

16. Kwok, T.C., Huang, M.X., Tam, W.C., Ngai, G.: Emotar: communicating feelings through video sharing. In: IUI 2015 Proceedings of the 20th International Conference on Intelligent User Interfaces, pp. 374–378. ACM, Atlanta (2015)

17. Schmeer, J., Baffi, T.: Touch trace mirror: asynchronous, collaborative messaging as a concept for creating a relatedness experience. In: TEI 2011 Proceedings of the Fifth International Conference on Tangible, Embedded, and Embodied Interaction, pp. 303–304. ACM, Funchal (2011)

18. Lotan, G., Croft, C.: ImPulse. In: CHI 2007 Extended Abstracts on Human Factors in Computing, pp. 1983–1988. ACM, San Jose (2007)

19. Teh, J.K.S., Cheok, A.D., Peiris, R.L., Choi, Y., Thuong, V., Lai, S.: Huggy pajama: a mobile parent and child hugging communication system. In: IDC 2008: Proceedings of the 7th International Conference on Interaction Design and Children, pp. 250–257. ACM, Chicago (2008)

20. Norman, D.A.: The Design of Everyday Things. Basic Books, New York (2002)

21. Chien, W.C., Diefenbach, S., Hassenzahl, M.: The whisper pillow: a study of technology-mediated emotional expression in close relationships. In: Design: Cultural Probes, pp. 51–59. ACM, Newcastle upon Tyne (2013)

22. Gaver, B., Dunne, T., Pacenti, E.: Cultural probes. Interactions **6**, 21–29 (1999)

23. Crabtree, A., Hemmings, T., Rodden, T., Cheverst, K., Clarke, K., Dewsbury, G., Hughes, J., Rouncefield, M.: Designing with care: adapting cultural probes to inform design in sensitive settings. In: Proceedings of OzCHI 2003, New Directions in Interaction Information environments, Media and Technology, pp. 4–13. ACM, Brisbane (2003)

24. Martin, B., Hannington, B.: Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions. Rockport Publishers, Beverly (2012)

25. Spiegel, D., Kraemer, H.C., Bloom, J.R., Gottheil, E.: Effect of psychological treatment on survival of patients with metastatic breast cancer. Lancet **2**(8668), 888–891 (1989)

26. Matire, L.M., Lustig, A.P., Schulz, R., Miller, G.E., Helgeson, V.S.: Is it beneficial to involve a family member? A meta-analysis of psychosocial interventions for chronic illness. Health Psychol. **23**(6), 599–611 (2004)