Shaping Romance: Mediating Intimacy for Co-located Couples

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AALBORG UNIVERSITY
STUDENT REPORT

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Abstract:
Technology greatly influences the mediation of intimacy for couples in long-distance relationships and is a well-researched area within HCI. However, mediating intimacy through technology for co-located couples is relatively unexplored, and is often portrayed as having a negative influence on intimacy. This project presents a longitudinal study consisting of 13 co-located couples using a technology probe for a period of two weeks. The study aims to understand how technology can mediate intimacy for co-located couples. Our findings show Shaping Romance was successful in mediating intimacy through active participation, reflection, and activities. Further, we present implications for designing for intimacy practices and research.

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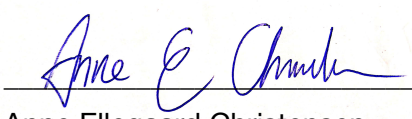

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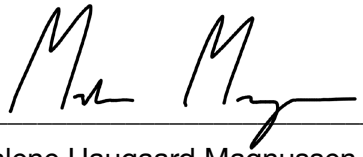

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By signing this document, each member of the group confirms participation on equal terms in the process of writing the project. Thus, each member of the group is responsible for the all contents in the project.

SUMMARY

In our master thesis, we have studied the topic of technology-mediated intimacy for co-located couples. Technology can both positively and negatively influence the intimacy of a romantic relationship. Technology supports communication, herein assisting in facilitating and mediating intimacy in long-distance relationships. Contrary, technology can act as a source of conflict and decrease intimacy for co-located couples. In order to study how intimacy can be mediated through technology for co-located couples, we constructed the technology probe, Shaping Romance.

In this paper, we present the design and study of Shaping Romance. The concept consists of an input and output interface. For the input interface, three intimacy-related parameters are displayed: togetherness, physicality, and disclosure. The partners individually input their current desires by placing a slider. The higher the slider is placed, the higher the desire. For the output, three shaping-changing objects convey the joint desires of the couple, one for each parameter.

We conducted a longitudinal study with 13 couples for a period of two weeks, with the probe to study how intimacy was mediated. Here the couples were asked to assign their own meaning to the probe and answer a digital diary daily using a chatbot. The data were analysed with a thematic analysis using an inductive approach, which resulted in a thematic map consisting of three themes: meaning-making of probe, influence of probe, and potential of probe.

Firstly, our findings showed intimacy can be mediated through technology for co-located couples, however, it was evident that not all couples experienced an increase in intimacy. The couples who experienced influence from the probe saw an influence on either the relationship, themself, or their joint activities. Our findings indicate intimacy can be mediated for co-located couples by facilitating active participation, reflection, and activities. Secondly, our findings showed most of the couples were able to make meaningful interpretations of the shape-changing objects. Though some did have difficulty interpreting the objects in the beginning, meaning their interpretation developed over time. Furthermore, we present future implications for designing and researching for co-located couples and intimacy.

Shaping Romance: Mediating Intimacy for Co-located Couples

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ABSTRACT
Technology greatly influences the mediation of intimacy for couples in long-distance relationships and is a well-researched area within HCI. However, mediating intimacy through technology for co-located couples is relatively unexplored, and is often portrayed as having a negative influence on intimacy. This project presents a longitudinal study consisting of 13 co-located couples using a technology probe for a period of two weeks. The study aims to understand how technology can mediate intimacy for co-located couples. Our findings show Shaping Romance was successful in mediating intimacy through active participation, reflection, and activities. Further, we present implications for designing for intimacy practices and research.

Author Keywords
Co-located couples; Intimacy; Technology probe; Origami; Shape-changing interface;

INTRODUCTION
Technology has become a big part of our everyday life and influences how we carry out daily activities and practices. The topic of this project focuses on mediating intimacy through technology in romantic relationships. Intimacy has many definitions in the literature, but it is often referred to as a sense of closeness or connectedness between two individuals [1, 2].

The integration of technology in everyday lives leads to both positive and negative effects on romantic relationships. On one hand, technology has made it easier to develop and sustain a romantic relationship [1, 2]. For example, technology has provided an ease of communication, making it possible to mediate intimacy and facilitate long-distance relationships [1, 2, 3]. On the other hand, technology can distract interactions and conversations, leading to the other partner feeling neglected, resulting in a decrease in intimacy [1, 2, 3, 4]. These negative effects pose a problem, as intimacy is linked with relationship satisfaction [5, 6].

Mediating intimacy through technology is not unfamiliar in the field of Human-Computer interaction (HCI), and over the past decades, multiple technologies have been designed for couples [7]. However, the majority of academic research on mediating intimacy for couples concerns maintaining and supporting intimacy in a romantic relationship over distance (i.e. [1, 2, 8, 9, 10, 11]). These examples concern how technological solutions can support physical intimacy by e.g. simulating a touch or a kiss. Contrary, there is little research for couples who are co-located, and this is still a relatively unexplored area. Branham et al. [12] and Clawson et al. [13] suggest that technological solutions can be beneficial for the intimacy of co-located couples too. In their work [12] with marriage and family therapists, they found that positive intervention through reflective activities, reconnecting, and developing new understandings of oneself and one's relationship, can be beneficial for most couples, not only those seeking therapy.

Focusing on technology for mediating intimacy of co-located couples posed the research question: *"How can we use technology to mediate intimacy for co-located couples?*". Within the research question, our aim is to examine how a technology probe [38] can be used to mediate intimacy of co-located couples.

In this paper, we present a technology probe, Shaping Romance, designed to study how intimacy for couples can be mediated through technology. The structure of our paper is as follows. First, a review of the related work, followed by a description of our technology probe. Then we will present our findings from a two-week study. Lastly, the findings from the study are discussed and applied for implications of design and research.

RELATED WORK
Following is a brief outline of the theory of intimacy, and a presentation of academic papers and commercial products relevant for co-located couples. Lastly, an outline of shape-changing interfaces, as it is a part of our prototype.

Intimacy
Intimacy is regarded as a specific quality of personal relationships and is linked with improved mental and physical health, lower levels of depression, and less severe responses to stress [15, 16]. Currently, there is no unanimous agreement of what parameters constitute intimacy in a romantic relationship. However, recurrent parameters consist of self-disclosure, non-verbal communication, physical intimacy, commitment, mutuality, and trust [17]. All these parameters can be present at varying levels in different kinds of relationships, such as acquaintances, colleagues, friends, and family, where all

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parameters are regarded as fully present in a romantic relationship [15, 18, 19].

Within HCI, research on intimacy for co-located couples are less common than for couples in a long-distance relationship (i.e. [8, 9, 10, 11]). In the following paragraphs, papers concerning co-located couples will be presented, followed by commercial applications developed for co-located couples.

Branham et al. [12] present a design titled 'A Diary Built for Two' consisting of two digital diaries with a function for sharing selected sections with their partner, encouraging both self and mutual reflection. Herein the design mediates self-disclosure between the partners. Clawson et al. [13] present 'Digital Kick in the Shin', the design enables partners to send subtle cues through vibrations to prompt an action. Herein the design mediates and enhances non-verbal communication between the partners.

The application 'Fix a Fight' provides tools for repairing relationship ruptures after an argument [20, 21]. The application is used on one device and is passed between the partners. This application mediates self-disclosure, which otherwise could be perceived as difficult by the couple. 'Kindu' is an application with the purpose of the partners exploring their common desires [22]. Each partner is presented with an activity, which can be marked as desirable, un-, and maybe. The common desirable- and maybe-activities can then be viewed afterwards. This application partially mediates self-disclosure, as desires are revealed on the basis they are shared by the partners.

Shape-changing Interfaces

Objects being able to change shape are often found within nature and design, however, technology often has a solid and rigid structure [23, 24]. The research area of shape-changing interfaces aims at using these organic qualities and shapes to enhance interaction. In the current research, shape-changing interfaces have been applied for both input and output, where change is seen in physical form [23, 24, 25] and colour [25]. Shape-changing interfaces have been realised using deformable matter [23], programmable shape-changing alloys [24, 26] actuators [27, 28], embedding technology in fabrics [25], and origami [29, 30, 31]. The following paragraphs present papers based on shape-changing interfaces. They are highlighted as the context of use is indoors, and present a study of how people interpret shape-change, and how it can be used as output.

Ripple is a thermostat controlled as a rotary knob [32]. The knob increases in size whenever the user sets the temperature outside of an energy-saving interval. The small knob is related to submissive behaviour or contentment, and the larger knob is related to having a dominant behaviour or being angry. Additionally, the increased size made it difficult to turn and control the knob. Herein the thermostat makes the user aware of the increased expenses, by changing its physical form.

Office Plant #1 is a robotic plant that uses AI techniques to analyse and label the emotional and social state of the user's email stream [26]. Even though the movements represent the email stream, they are ambiguous and requires interpretation and contemplation from the user. Herein the user is required to interpret the plant's changes in appearance and physical form.

OUR CONCEPT

Shaping Romance is designed for two people in a romantic relationship for mediating intimacy at home. To achieve this, three shape-changing objects convey intimacy-related desires: togetherness, physicality, and disclosure. These desires were chosen by us based on results from a previous project [17].

The concept consists of an application with an input and output interface. The partners individually input their desires using the three sliders (see Figure 1). The higher the slider is placed the higher the desire is. After the desires have been set, they are submitted by pressing the red button (see Figure 1). When one or both partners have submitted their desires the three objects start to change in relation to the couple's summed desires (see Figure 2 & 3): the bigger the change, the bigger the summed desire.

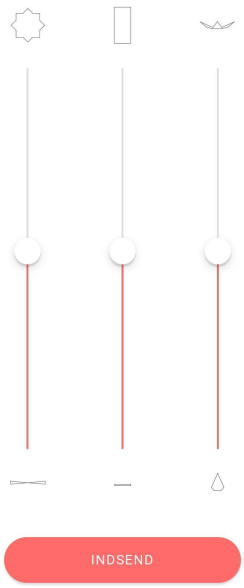

Figure 1. The three sliders representing the desires (from left to right): togetherness, physicality, and disclosure. The red button is used for submitting the desires.

The objects displayed in the output interface are based on origami patterns. Origami was selected to ensure control of how each object would change shape. We experimented with different origami patterns in order to have distinct shapes and movement, we used metaphors and symbols to convey each desire. Another aspect of the design was to ensure that the objects were kept abstract, as not to create negative or positive connotations between specific desires and potential activities (i.e. [32, 33, 34, 35]). The final objects, metaphors, and symbols for the desires can be seen below.

- Togetherness refers to the desire to engage in activities together with one's partner. The object (see Figure 2A & 3A) uses the metaphor of 'coming together' where two sides are expanding and their edges are coming together, becoming one whole.
- Physicality refers to the desire to be physically close or intimate with one's partner. The object (see Figure 2B & 3B) uses a phallic symbol where a tube expands and becomes taller.
- Disclosure refers to the desire to share something personal or intimate with one's partner. The object (see Figure 2C & 3C) uses the metaphor 'opening up to your partner', where the tips of the object move away from each other as to open up the object.

After the couple has set their desires using the sliders, they must then interpret the shape-change and translate it into an activity meaningfully matching their desires.

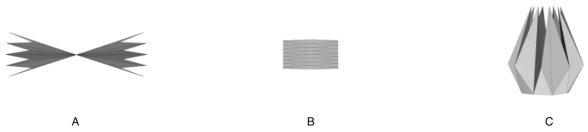

Figure 2. The three objects at a low joint desire. A: Togetherness, B: Physicality, and C: Disclosure.

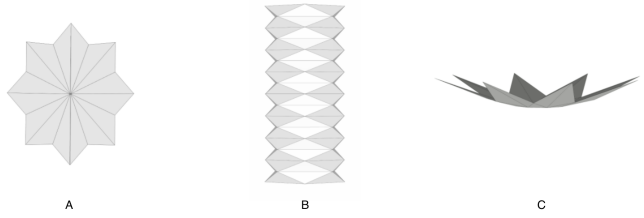

Figure 3. The three objects at a high joint desire. A: Togetherness, B: Physicality, and C: Disclosure.

Technologies

Shaping Romance was developed utilising the JavaScript library React [36]. React enabled us to develop interactive interfaces in the form of a progressive web app (PWA). PWA provided no restrictions for a specific operating system, thus not limiting possible users. Equally, users are not required to download anything, and can only bookmark the PWA to their phone. Furthermore, Google Firebase and Google Analytics were used. Google Firebase was used to handle user authentication and acted as a realtime database, whereas Google Analytics provided information concerning the users' logged data in our application. The origami objects were made using an origami simulator [37], where it was possible to record GIFs of different folding sequences.

METHOD

A longitudinal study was conducted, in order to gain insights into how technology can affect couples' intimacy practices in a real use context [49]. For this purpose, Shaping Romance was used as a technology probe [38]. The probe allowed us to collect data about how it was used by the couples, and what impact it had on their intimacy practices. The study was conducted for two weeks, where the participants used the probe at home. Furthermore, the study was carried out during the COVID-19 lockdown in Denmark.

The following sections present the participants, how the longitudinal study was conducted, and how the data were collected and analysed.

Pilot Study

Prior to the study, we conducted a pilot study with one couple for five days. The couple is not represented within the 13 couples from the longitudinal study. The purpose was to test the probe for any software issues and test if the couple experienced any uncertainties during the pilot study. Furthermore, the pilot was performed to refine and adjust the diary and interview guide.

Participants

13 couples (26 people) participated in the study (see Table 1), all Caucasian young adult couples with ages ranging from 21-28, who self-identified as heterosexual. The couples were recruited through Facebook posts and our own network of acquaintances. During the screening for couples, we required that the couples were in a romantic relationship and lived together. Additionally, there were no restrictions on marital status, nationality, and sexuality.

Couple	Age	Time in Relationship	Time Living Together
C1	25 & 24	1 year	1 year
C2	23 & 21	3 years 6 months	1 year
C3	28 & 25	1 years 6 months	1 year
C4	25 & 26	9 months	2 years 6 months
C5	25 & 23	5 years 6 months	8 months
C6	23 & 22	6 years 6 months	6 years 6 months
C7	23 & 23	4 years	3 years
C8	23 & 25	4 years	3 years
C9	25 & 24	2 years 6 months	1 year 3 months
C10	25 & 24	3 years 6 months	1 year 6 months
C11	25 & 26	7 years	6 years
C12	28 & 26	2 years	1 year 6 months
C13	26 & 27	9 months	8 months

Table 1: Overview of age, time in a relationship, and time living together for each couple in the study.

Procedure

At the beginning of the study, the couples were introduced to the probe and received the probe to set up on their devices. Hereafter, the couples were instructed in the use of the probe, mainly concerning the sliders and their connection to the shaping-changing objects.

On the last day of participation, the couples were debriefed with a semi-structured interview, in order for us to better understand the effect of the probe, how they understood and acted on the sliders and shape-changing objects.

Data Collection

The data were collected through logged data, a digital diary [39], and a semi-structured interview [40].

The logged data concern: (1) where each partner placed the sliders, (2) time and date for submitting desires, and (3) time spent on setting the sliders and viewing the shape-changing objects.

Each partner was given a digital diary of five predefined questions about their day and the influence of the probe, which they were prompted to fill out once a day. The diary was set up as a chatbot on Facebook Messenger [41], and all data were automatically logged in a Google sheet document. Moreover, the participants were asked to send a picture of the context they used the probe.

In relation to the semi-structured interview, an interview guide was developed. Each couple was interviewed together over Whereby, an online video conferencing software, ranging from 15 to 30 minutes, where the data were collected through audio recordings. The interview guide consisted of five main questions with related sub-questions (see Appendix 1), covering how the couples used and understood the probe, and how they experienced the influence of the probe on their intimacy.

Data Analysis

The logged data were reviewed and then used to support the interview and diary data. The diary entries and interviews were analysed inductively using thematic analysis, for identifying themes within the entire dataset [14]. Due to the inductive approach, the data was coded without a pre-existing coding framework. The interviews were first transcribed and subsequently coded individually by each group member, whereafter, the codes were collated and then revised to ensure consistency within each code. Lastly, through an iterative process (see Appendix 5), the codes were grouped into themes, resulting in a final thematic map consisting of three themes with five sub-themes.

FINDINGS

The thematic analysis led to three themes: Meaning-making of Probe, Influence of Probe, and Potential of Probe, including associated sub-themes (see Table 2). The findings from the analysis of the diary and interviews will be presented in the following sections. All the participants are anonymised and will be referenced as, for example C1P1 (couple 1, partner 1) or C13P2 (couple 13, partner 2).

Meaning-making of Probe	Influence of Probe	Potential of Probe
Meaning of sliders	On relationship	
Meaning of shape-changing objects	On self	
	On activities	

Table 2. The three identified themes with their associated sub-themes.

Because of a technical error, the logged data were only logged for 9 out of the 13 couples. On average the couples submitted their desires 6.6 days out of the 14 days of the study, with the maximum of submits being 10.5 days and the minimum being 2.5 days. On average the couples had the application open for 1m 12s a day. Desires were predominantly submitted during the evening. This can be explained with the diary, as it was sent in the evening and herein acted as a reminder of the application. However, some couples (4/13) also submitted desires during the day when suitable. On average each couple submitted desires 11 times, not necessarily on different days, as the couples sometimes submitted multiple times a day.

During the interviews, each couple described their interpretation of the purpose of the probe. The majority of the couples (8/13) stated the probe was related to reflecting on and visualising desires related to their relationship. Similarly, a couple mentioned the purpose was visualising your mood as a couple, and another couple mentioned the purpose was evaluating social activities in the relationship. Whereas the remaining couples (3/13) described it as a general tool for the relationship.

Some couples (6/13) also described how they perceived the use of the probe as either positive or negative. On one hand, three couples said the probe helped with communicating their desires, while two couples said it was fun and exciting because of how the objects changed and behaved: "*Just because it was fun to play with it*" (C7P2). However, when the fun and excitement disappeared for the two couples, then the probe was perceived as unnecessary and not adding anything to their relationship because: "*It quickly felt a bit unnecessary to use it*" (C7P2). One couple also mentioned they perceived their use of the probe more as a joke because if a desire actually was high it would be awkward to use the probe rather than going directly to the partner: "*When we have used it, it has been in more in a joking sense*" (C2P2). Furthermore, three couples stated the probe itself lacked purpose, given they were constantly together and already shared their desires with each other, face to face, making the use of the probe indifferent: "*The information the app passed on to your partner, you could just do yourself*" (C7P1).

Meaning-making of Probe

The Meaning-making of Probe theme is constituted by the sub-themes: Meaning of sliders and Meaning of shape-changing objects. These two sub-themes concern the couples' interpretations, use, and understandings of the sliders and objects respectively.

Meaning of sliders

The couples described in the interviews the different ways they used the sliders. The majority of couples (8/13) stated they used the sliders individually. One couple stated that since they are two individuals with their own desires, they used the sliders separately to avoid being influenced by each other.

> "*Because then we don't affect each other's needs, you know we have different needs and if we set them individually then we can find something, a common denominator we can do together, so we are both pleased and aren't affected by what the other needs*" (C13P2)

Contrary, the remaining couples (5/13) used the sliders jointly. These couples mentioned using the sliders at the same time and they discussed how to set the sliders.

> "*Almost every time we have used it, then we have sat together and filled it out kinda individually, but have discussed why you set it the way you did*" (C11P2)

Some couples (4/13) were explicit about the ease of remembering the sliders' meaning. Other couples (4/13) had difficulty remembering the sliders' meaning, often due to lack of visible information about the sliders' meaning on the screen.

> "*I think I asked you every day, or every time we should set the sliders what is it again, what are the different ones*" (C3P2)

In relation to the couples' interpretation of the sliders, most couples (8/13) shared the same interpretation of the sliders' functionality and found the use intuitive.

> "*The higher you pulled the slider the more you wanted it, and the less you did it [pulled the slider up] the less you wanted it*" (C7P2)

On the other hand, some couples (8/13) had difficulty expressing their desires through the sliders. Some (6/13) explained it was because they had to become aware of their desires and it was a new way of expressing them.

> "*I think it was very difficult in the beginning because you suddenly became very aware of or should really sense, okay what is it actually I have a need for and sometimes I think it was difficult to figure out*" (C12P2)

In addition, one couple stated that using the sliders to communicate your desires distanced you from your partner.

> "*It was a bit awkward in some way because it felt a bit like you distance yourself from your partner when you want to know what you are feeling by doing it through an app*" (C7P1)

Concerning the three desires, two couples perceived the desires as being coherent with a romantic relationship.

> "*In some way, they go together and they describe well the feeling there is in a relationship and what feelings you have in terms of a relationship*" (C12P1)

Though some couples (7/13) mentioned the sliders physicality and togetherness were too similar.

> "*Yes in some way they [physicality and togetherness] remind of each other a bit. Yes, it is difficult having one without the other*" (C12P2 & P1)

Meaning of shape-changing objects

At the introduction of the study, the couples were told the objects reflected both of their submitted desires. However, two couples interpreted the objects as reflecting their individual desires.

> "*The more expanded they are, the larger my need is for my partner. Versus, if they were not so expanded, then I was more focused on something else*" (C4P2)

As part of the study, the objects were open for interpretation. Most couples (11/13) shared a similar interpretation of when the objects were open or closed, it indicated either a high or low of the respective desire.

> "*I interpreted it like the more together it was, it indicated a small need and when widened a larger need*" (C2P1)

> "*The more we needed something which these objects showed, the more they grew, the more they filled*" (C11P1)

In relation to the objects' interpretation, the majority (11/13) expressed to a varying degree they were able to see their desires reflected in the objects and their changes.

> "*I thought about it being a scale and that they [the objects] could be either very large, very small or a middle thing and yes, it [the objects] reflected them [the desires] very well*" (C11P1)

In continuation, some couples (5/13) stated they actively discussed the meaning of the objects to strengthen and align their interpretation, or discuss what desire the objects reflected.

> "*Then we discussed, in the beginning, like, uhh what does that mean and can we see a connection. And if we had placed it high or low*" (C8P2)

As part of the interpretation, most couples (10/13) added symbolic meanings to the objects as a way of representing their interpretation.

> "*This disclosure and it is like a flower that opens [...] and it shows the real you*" (C12P1)

> "*The one to the left looked like a butterfly, so there I thought it might be something about that you need fine clothes and drink wine*" (C1P2)

In the process of interpretation, some couples (7/13) experienced difficulties interpreting at least one of the objects, most often the object concerning physicality. This difficulty was sometimes caused by them not being able to relate it to something familiar or decode the object.

> "*It is difficult to interpret [physicality] because you had no limit to when I stopped so you didn't know if it would continue to grow or if it was the biggest it could be*" (C6P2)

> "*I really had a hard time understanding the connection between that one [physicality object] and being physically close*" (C13P2)

For some couples (2/13) the meaning of the objects developed over time in the process of using the probe more. It especially came to light in the diary as it provided an overview of the daily progress.

A B C

Figure 4: Examples of the different contexts the couples assessed the objects. A: C13 placed the phone so it was visible to both partners. B: C1 Used the probe as a basis for discussion during a virtual gin tasting C: C2 mounted the probe on the fridge.

> *"I think I can see a connection between them [submitted desires and objects], the more we submit answers"* (C8P2)

Furthermore, some couples (3/13) thought the movement of the objects was too slow and waited for it to be completed. Contrary, two out of 13 couples stated the movement of the objects was entertaining and even meditating.

> "*There was something meditating about the objects, especially that flower slowly folding out, I could just sit and look at it*" (C12P2)

Concerning the objects' movement, four couples expressed being uncertain of the objects' changes, as the changes were deemed insignificant and difficult to see. One couple even took screenshots of different stages to see if there were any changes.

> "*We started taking screenshots because we were convinced that they were placed exactly the same as last time we looked at it*" (C1P2)

The couples used the probe during different activities or in different contexts (see Figure 4).

Influence of Probe

The Influence of probe theme is constituted by three sub-themes: on relationship, on self, and on activities.

On relationship

The couples' relationship was influenced differently during the study. Two couples mentioned it made them aware of their own behaviour towards their partner. Whereas four couples saw the same effect but also used it as a base for a conversation.

> "*I think it has influenced us in a way, where it has been a good way to sit down and talk about how you are feeling in relation to each other once in a while, just to get it said aloud*" (C11P1)

One couple stated they started evaluating their day together and discussed engaging in more activities together.

> "*It has definitely had an influence in a way, that we have sat and evaluated a bit over our day and if we could try and do something more social*" (C8P1)

Three couples stated in the interviews they felt an increase in their intimacy during the study, but in the diary we saw six couples stating they felt an increase in intimacy. This was stated a total of 12 times with four couples experiencing an increase in intimacy multiple times.

> "*I definitely think the app has had an influence on our intimacy because I've become more aware of the needs we have expressed and, therefore, has become better at taking into account for us spending time together and doing some activities besides just work and other responsibilities*" (C8P2)

Four couples stated in the diary and interviews that the probe merely confirmed the intimacy already present.

> "*When we answered and physicality was the biggest visually, then it didn't matter that we stayed on the couch a bit longer because I felt assured that he wanted it too*" (C6P2)

On the other hand, 10 couples stated in the interviews they did not experience an increase in their intimacy. However, in the diary, only one couple stated the influence of the probe did not lead to an increase in intimacy.

> "*We used it, in the beginning, to see what needs there were but didn't think it had an influence on our intimacy since we already have a well established "system" for showing and talking with each other about what you need*" (C7P2)

Additionally, one couple even experienced the probe occasionally decreased their intimacy.

> "*But on the other hand, sometimes it also had a negative effect, if openness was small then we just talked even less with each other*" (C6P2)

Three couples explained the probe did not have an effect because active participation from both partners is required

before it is valuable to the relationship. One couple also mentioned when something critical happens you go directly to your partner to talk about it, as the probe would take too much time.

> "*Or that you feel everything doesn't go at all, then you don't open the app at a set 'I have high disclosure' and then say it because it's often that you say it beforehand and then you actually don't have a terribly high disclosure afterwards*" (C12P1)

On self

For some couples (5/13) the probe acted as a tool for self-reflection and created awareness of their own desires. The type of self-reflection was twofold: it was used for reflection upon one's own desires and behaviour towards their partner. The self-reflection then led to a joint discussion of the desires.

> "*It got you thinking about if you took the necessary time for your partner*" (C3P1)

> "*I think it got us thinking about how we spend our time together and we realised that we probably needed more time together which didn't involve work or other daily chores*" (C8P1)

In continuation of using it for self-reflection, the probe provided an additional way of expressing and articulating one's desires.

> "*It definitely put some different words on [your desires] using this app or using these sliders to express your needs in some other way. It definitely did something for me to get it articulated whereas before it was more like a feeling you have*" (C12P1)

On activities

In the interviews, three couples stated the probe had an influence on their joint activities, whereas the diary shows 10 couples' activities were influenced by the probe. In the diary, a total of 25 cases were identified where the lowest number of cases per couple was one and the highest five.

> "*We have talked a lot about the objects recently and I think the objects have had some sort of influence on our decisions about taking half a day out of our calendar to enjoy each other's company*" (C8P1)

However, it varied what caused the influence on the activities. One couple emphasised it was one's own consciousness about the diary answers rather than it was the objects. Another couple mentioned the discussion about the sliders having a greater effect than the objects, and some couples (4/13) thought the objects lacked purpose.

> "*I feel it's a bit I don't know what the objects are telling me, I don't know what to look for, so it hasn't been like it doesn't matter, but for me, it has been a bit like okay what is the purpose, what should I use it for, how should I interpret them*" (C9P2)

Potential of Probe

During the interviews, some couples (7/13) suggested potential ways the probe could be extended. Two couples mentioned the probe could suggest activities they could engage in or be inspired by based on their desires.

> "*I think it would be awesome if it, for example, suggested ideas for stuff to do based on what you set, and then you could do stuff based on what you need*" (C5P2)

Another couple mentioned it could be used as a planning tool by being prompted into using the probe during the day, think about their desires, and plan ahead based on one's desires.

> "*To sit down and think about what my needs actually are, or just look or talk about your needs, and then plan after that*" (C1P1)

In continuation, two couples stated the benefits of receiving a notification when one's partner submitted their desires. The partner could then act based on changes in their joint desires displayed in the objects.

> *"You could get a notification when your partner has submitted something [...] and then I could take it like a hint, okay now then there is a need for this, then I can act upon what it means for us"* (C5P1)

Another couple stated the probe ideally could be used by new couples, who are not yet comfortable disclosing their desires in the relationship.

> *"It is maybe something that is better for new couples, who are not yet comfortable opening up about these things"* (C7P1)

Likewise, one couple stated its potential for struggling relationships with major communications problems.

> *"I think it would be very good for people who might have major communication problems in their relationship"* (C13P2)

DISCUSSION AND FUTURE IMPLICATIONS

The discussion first presents implications for design regarding mediation of intimacy through technology and discusses our findings in relation to related work. Followed by implications for research identified through the analysis. Lastly, the challenges of the COVID-19 lockdown in the study and limitations are presented.

Designing for Intimacy Practices

In our findings, we saw the couples used the probe in three distinct practices for mediating intimacy: active participation, reflection, and activities. Either of these can be used when designing for intimacy. These practices were identified with practice theory [42]. Initially, we introduced the probe as a new material, and hereafter the couples assigned different meanings and developed new competences. In the following paragraphs, we will present the practices and their design implications along with how the couples' current practices have changed.

The first practice is active participation, which requires both partners actively participating in using the design for having a meaningful outcome. In the related work, active

participation was an element of design in the study of Clawson [13] and the applications 'Kindu' [22] and 'Fix a Fight' [21]. Herein it is seen the participation of both partners emerge interactions that allow the couple to find their common understanding of the relationship and enhance communication. In relation to the probe, the objects specifically require active participation from both partners for performing activities based on common desires, and being meaningful for the relationship. This point was emphasised in our findings, as it was highlighted the objects lacked purpose when the probe was only used by one partner. The couples' current practices concern sensing their partner's mood based on their behaviour and sometimes talking about their desires. So the practice of sharing desires is based on the competence of sensing and disclosing desires, with the meaning of better understanding their partner [42]. The findings showed when both partners actively participated in using the probe it provided a competence for the couples. Sensing their partner's mood was replaced with non-verbal communication of their desires, which they felt were more explicit and precise, as they sometimes would sense each others' desires incorrectly. Additionally, it helped the couples be more explicit in articulating their desires. The meaning of the practice is to better understand each other and not misinterpret a situation. However, our findings also emphasise a challenge when designing for active participation. If one partner does not wish or forget to partake in using a specific design the meaning disappears. A design should be able to motivate both partners to participate actively for mediating intimacy and considered meaningful for the relationship. For example, you could guide a dialog between the partners or you could design a shareable design requiring participation of both partners at the same time. This could potentially motivate a partner since it is something they could do for their partner or remind them of the practice.

The second practice is reflection, which concerns one partner reflecting upon their own desires and behaviour towards their partner. In the study by Branham & Harrison [12] they designed for self-reflection using diaries with a share functionality, thus also providing mutual reflection. The couple's current practice concerns saying their desires to their partner intuitively, with the meaning of sharing their current desires [42]. Our findings showed that the couples developed a competence of self-reflection with the meaning of becoming aware of their own desires, thus assisting in better articulating one's desires to their partner. The reflection was performed through the use of the diary or assessing how to place the sliders. Designing for self-reflection does not pose the same challenge as active participation, as it is not dependent on the partner's participation. A challenge that can arise when designing for reflection, is that a partner does not approach their partner with their new knowledge. Therefore, it should be considered how to establish a connection between the reflection activity and one's partner. For example, a design could prompt the couples to approach their partner or automatically share their acquired knowledge.

The third practice is activities, which concerns supporting couples in engaging in activities together. This practice can be combined with the two aforementioned practices, as it can both relate to active participation and self-reflection. The application 'Kindu' [22] uses individual voting for showing activities of common interest. The intention of the probe is also for couples to engage in activities based on common desires. The probe differs from 'Kindu', as it does not provide explicit suggestions for activities. The couples' current practice concerns planning or spontaneously engaging in activities they can think of. No new practice was identified in the findings, but this practice 'activities' is suggested by the couples. The practice could potentially provide a new meaning of receiving suggestions to activities based on common desires. For example, a design for proposing activities or inspiration thereto could help the couples when they lack an idea for an activity or want inspiration.

Designing with Ambiguity

Displaying the couples' desires using shape-changing objects presented an element of ambiguity. Ambiguity is often seen as an element of design in shape-changing interfaces (i.e. [26, 29, 45]). The theory about ambiguity presents three types of ambiguity [43], with the ambiguity of information most relevant for our design. Ambiguity of information concerns intentionally providing imprecise information which can then make it mysterious and intrigue users into using the technology and interpreting the information. Furthermore, Gaver et. al. [43] states the users' interpretation can help establish a deeper and more personal relation to the technology. Designing for intimacy with an element of ambiguity can, therefore, be beneficial, as establishing personal relations can result in the technology being used more or perceived as more meaningful for a couple. Additionally, it can be assumed that all couples have various desires and practices, and with ambiguity, the technology can be interpreted to match each individual couple.

Currently, the main focus of the research area in shape-changing interfaces is on technical inventiveness (i.e. [30, 31, 44]) with a limited number of papers studying how users interact with and interpret shape-changing interfaces, often through a single experience (i.e. [27, 28, 34]). Our findings indicate people are able to develop meaningful interpretations of shape-changing interfaces without instructing them in the intention behind the shape-change. According to our findings, the element of ambiguity allowed for many alternate interpretations matching the individual couples. However, it also showed how some couples experienced difficulties in interpreting the shapes. In the study by van Oosterhout et. al. the participants had no difficulty interpreting the shape-change [32]. However, this study differentiates from our study, as our couples had no prior understanding of the intention behind the shape-change. This could indicate some of the difficulties seen in our study would be overcome with a further description of the shape-changing objects and still leave an element of ambiguity to be interpreted. It would be recommended to

further instruct the users on the intention of the shape-change to avoid difficulties in the initial interactions and support users unable or unsure of how to interpret the shape-change.

Implications for Research

Our findings showed not all couples experienced an increase in intimacy through the use of the probe, even though it could be beneficial for all couples [12]. No correlation was identified between:

- Time in a romantic relationship.
- Time lived together.
- The amount of use of the probe by each couple.
- The couples' individual perception of their intimacy in the relationship.

To determine if there is a correlation between the couples who experience an influence on intimacy and those who do not, it is recommended to conduct further research including a larger sample size of couples and with greater diversity (i.e. length of the relationship and age). Further, research should still be conducted as a qualitative and longitudinal study, in order to identify changes in the intimacy practices.

Feeding back to the theory of intimacy

Physicality is being physically close or intimate, disclosure is sharing something personal or intimate, and togetherness is engaging in activities together. Physicality and disclosure is derived from the intimacy theory of physical intimacy and self-disclosure respectively. However, togetherness is not present within the theory of intimacy, but is an implication for mediating intimacy defined in our previous study [17].

Togetherness was introduced in the study, as being or doing things together with your partner. This caused varying interpretations as either doing activities together or just being physically present, which led to the same understanding of togetherness and physicality. Regarding the theory about physical intimacy, it entails not only physical contact, but also the physical presence of another. Therefore, the theory might explain why some couples understood togetherness and physicality as the same. This does not necessarily mean togetherness should be disregarded. In the study by Johnson et al. [46], they found intimacy increases when you are satisfied with your partner's engagement in an activity, not the length or amount of activities. Our findings support this, as it showed the couples who engaged in activities outside of their routine experienced an increase in intimacy. To avoid the same understanding of togetherness and physicality, the object for togetherness should be redesigned to better reflect the engagement in activities. Likewise, the introduction of togetherness might have been insufficient in emphasising engagement in an activity together. Our findings and related work indicate togetherness can lead to an increase in intimacy, so if designing for togetherness we recommend emphasising engagement in activities.

Using chatbots for data collection

The main purpose of the chatbot was acting as a diary for the couples [41, 47]. Overall it was deemed convenient for collecting data due to it being integrated into a familiar everyday tool like Facebook Messenger and acted as a reminder to complete the diary. When creating our chatbot we were able to use an existing chatbot tool, as it was proficient for our study.

The chatbot automatically sent the diary at a specific time and saved the data. When the diary was sent, the couples could answer when suitable, which provided flexibility to the couples. This aspect of flexibility was also seen in the study by Gergle & Hargittai [47]. They experienced the flexibility led to answers being misaligned to their questions, when their participants sent messages twice. However, this challenge was not reflected in our data, as all questions and answers were aligned.

Besides being convenient for collecting data, the findings showed the chatbot acted as a reminder of the probe, since the use of the probe mostly occurred when the couples were reminded via the chatbot. Therefore, the use of the chatbot became twofold: data collection, and as a reminder for the couples.

For studies requiring a diary as a data collection method we recommend, using an existing chatbot tool, as it is convenient for its timesaving setup and automatically sending and saving the data. Likewise, the integration into a familiar everyday tool removes the necessity of the couples having or learning a new tool. Furthermore, the chatbot can be used to remind participants of the study, if they have been inactive for a couple of days.

COVID-19 Lockdown

The COVID-19 lockdown of Denmark forced the majority of Danes to stay at home, where they had to continue their work and study. Due to the restrictions of COVID-19, our study had to be conducted online, resulting in the probe being converted from a physical design (see Appendix 4) into a digital design, meaning, the shape-changing objects were displayed as an animation. It is unknown if the interpretation of the shape-change is the same digitally and physically. The findings show the couples did not like using the application for communicating their desires, which could be different with a physical design. It would be recommended to perform a study with a physical design to see if the perception of use changes. Additionally, a study using a physical design could support the legitimacy of our findings, as the digital interface is not a true shape-changing interface in terms of the research area.

On the positive side, the lockdown contributed to us having no difficulty recruiting couples since their time had to be spent at home. It could have provided more use, as the couples had more time in the day because of the reduction of social activities and hobbies. The lockdown could also have created a larger need for self-disclosing one's desires, as the couple is constantly together. Though one could argue it is always important to self-disclose your desires for maintaining the relationship.

Contrary, the lockdown could affect the relevance of the probe in the couples' current everyday. It could have resulted in less use, as each day is particularly similar and could cause one's needs not to change, as there are limited external parameters affecting one's needs. Additionally, the lockdown has caused a great limitation in activities for the couples to engage in. Therefore, it would be interesting to perform the study again under "normal" conditions to see if the couples would engage in or come up with other activities.

Limitations

The probe was converted from a physical design (see Appendix 4) into a digital design. Converting it to digital removed the shape-changing objects 3-dimensional perspective, which may have caused the difficulties in interpretation. Due to technical constraints of the origami simulator [37], the GIFs were recorded on a plain white background, which can have made it difficult to determine the boundaries of the objects' movement.

Creating a mobile application requires the users to actively open the application for its use or be reminded through notifications. Sending notifications using PWA are limited to android users, and, therefore, it was not implemented so no notifications were sent during the day as a reminder of using the probe. This might have caused less use of the probe compared to a physical design strategically placed in the home causing constant reminders, or being a part of the daily routine: coming home i.e. from work.

CONCLUSION

In this project, we presented Shaping Romance, a technology probe for studying how technology can mediate intimacy for co-located couples in relation to answering the research question: "*How can we use technology to mediate intimacy for co-located couples?"*

Shaping Romance was deployed with 13 couples for two weeks. Through a thematic analysis, our findings were grouped into three themes: *meaning-making of probe, influence of probe*, and *potential of probe*. Our findings showed not all couples experienced an increase in intimacy. However, some couples experienced an increase in intimacy through the influence of the probe on the relationship, self, and activities. Herein our findings indicate intimacy can be mediated through technology for co-located couples when facilitating active participation, reflection or activity engagement.

As a result of the study, we make an artefact contribution [48] to the research area of intimacy and co-located couples. Further, we present future implications for designing and researching for co-located couples and intimacy.

For future work, we plan to build the intended physical prototype and conduct a new study with couples of larger diversity (i.e. nationality, sexuality, and age). Further, we consider extending Shaping Romance by providing activity suggestions.

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