



Figure 1. The crafted prototypes we built as interactive design artefacts for people in home isolation.

# Together Apart: Exploring Remote Tangible Co-Dining Interactions During the Pandemic

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## Abstract

Dining is a chance to connect with friends and family, but during the isolation of the COVID-19 pandemic, physical co-dining (physically dining together) becomes less accessible. In this pictorial, we explore the uses of smart materials for promoting tangible connectivity between physically separated individuals. We aim to address the question: "How can we connect individuals living apart for the goal of enhancing the dining experience and increasing social health during the pandemic?". We engaged 10 participants in a co-designing study before building 5 prototypes of interactive dining artefacts to deploy in their homes in a second study in-the-wild. A combination of user interviews and autoethnographic methods revealed insights such as the importance of shared conversation, and provoking curiosity in interactions that begin from interactive domestic artefacts. The results imply that maintaining relationships and healthy dining habits can be enhanced through co-awareness and tangible connection.

## Authors Keywords

E-textiles; Making; Prototyping; Smart Spaces; COVID-19; Wearables; Design; Co-Dining.

## CSS Concepts

Human-centered computing;

## Introduction

Interactive spaces offer opportunities to create immersive enriched user experiences through tangible and tactile interactions using smart materials [18]. In the context of material-centered interaction design, tangible interactive everyday things provide a rich design space to unpack entangled practices within people's homes [38][15]. This includes the design of interactive dining spaces, where researchers enhance participant's experience through interactions with food and the dining room atmosphere and culture [14][17]. In many cases, positive experiences of dining are influenced by social factors, such as sharing food or eating with family or friends (see figure 2). A subset of research in the area is dedicated to the remote co-dining experience, or the experience of dining with others in a physically distanced situation. In this design research, we look into the potentials of interactive everyday things designed with crafted materiality that augments people's isolated domestic dining experience to feel 'Together Apart'.

**Related work** To investigate what and how interactive everyday things around the home can have a positive impact on isolated individuals, we explore this area through the lenses of domestic experiences with tangible interactions and interactive dining research literature equally.

**DOMESTIC EXPERIENCE** — Various studies have explored the use of interactive design for the domestic experience. For example, research has applied slow interaction [21], or design meant to slow down a person's daily activity, to increase interaction between the user and the interactive object. Homeware made in using the slow design methodology (such as products with hybrid usages like a fruit basket/juicer product) encourages mindfulness and consciousness, while allowing people to gain a deeper understanding of the product [22][11]. Furthermore, textile-based interaction has been shown to be better accepted in a smart home environment than traditional interfaces such as remote controls [4]. Participants responded positively to textile feedback and appreciated the integration of controls into the shape and fabric of their surroundings. In fact, it was even found that the aesthetic properties of the textile interfaces have a higher impact on user acceptance than functional properties [4]. As shown by 'ActuEaters' [17], actuating table runners which respond to touch, incorporating technology into everyday decorative objects in the home allows them to have a meaningful interaction with an object they otherwise might not notice. The research highlighted the importance of non-focus demanding and non-disruptive technology as a means of enhancing the social experience.

**INTERACTIVE DINING** — Past research has explored co-dining experiences by enabling shared dining activities and exploring how shared sensory experiences impact individual and shared dining experiences. For instance, interactive systems can connect people in different locations through shared dining activities with CoDine, an interactive multi-sensory system for remote dining [32]. Additionally, the Singing Carrot [31] explores the interaction between humans and food, specifically how the sounds of food increase the palatability of the meal. For instance, amplifying food sounds provides a better understanding of one's mealtime behaviours and decreasing food sounds allow for meditation practices. Others used mobile phone interactions to create disruptive experiences during pre-COVID family meals [25][12] and lone diners geographically dispersed or time-shifted [10][20]. While some work has been done on connecting distributed diners using cameras and projectors [3], others [16][17][14] have shown how tangible interactions on a dining table can create richer and more immersive experiences to facilitate the asynchronous co-dining experience and support intimacy [37].

**DINING DURING COVID-19** — Isolation and social distancing increased as the COVID-19 pandemic began. Numerous countries have implemented measures to reduce the size of social circles to the absolute minimum and curb the spread of the virus. Across the globe, many people are confined to their homes, alone or with family. This has led to people feeling alone and has had a detrimental impact on mental health [1][30]. Using dining

as a tool to enhance social connectivity, we hypothesized that an interactive dining system would decrease feelings of isolation in individuals living apart from their families. Our paper thus hopes to provide insight on the domestic dining experience during a pandemic and how an interactive dining room may influence a socially distanced dining experience.



Figure 2. The impact of COVID-19 lockdowns on the social nature of eating. Togetherness, interaction and engagement are replaced with sense of loneliness.

We ran two user studies to bolster our understanding of what elements create a pleasant dining experience. Using this data, we aimed to merge light, sound, and touch into non-invasive objects and decor involved in the dining process. Our goals for this research project were to engage participants in the design experience, and facilitate the asynchronous co-dining experience as naturally as possible. This pictorial will elaborate upon the design process, the products themselves, and the results of the participant study, in which our designs were tested in-situ.

## Research through Design Process

Through this design project, we address the issues of increased anxiety and feelings of isolation, especially during the COVID-19 pandemic, by seeking to connect family and friends through a remote co-dining experience. The process of the Together Apart study loosely follows the research through design approach. We follow the phases of research, ideation, design, testing and reflection typical of a design cycle in order to gain insight into our goals [8][37].

(1) We started this research by **observing trends of increased loneliness and loneliness.**

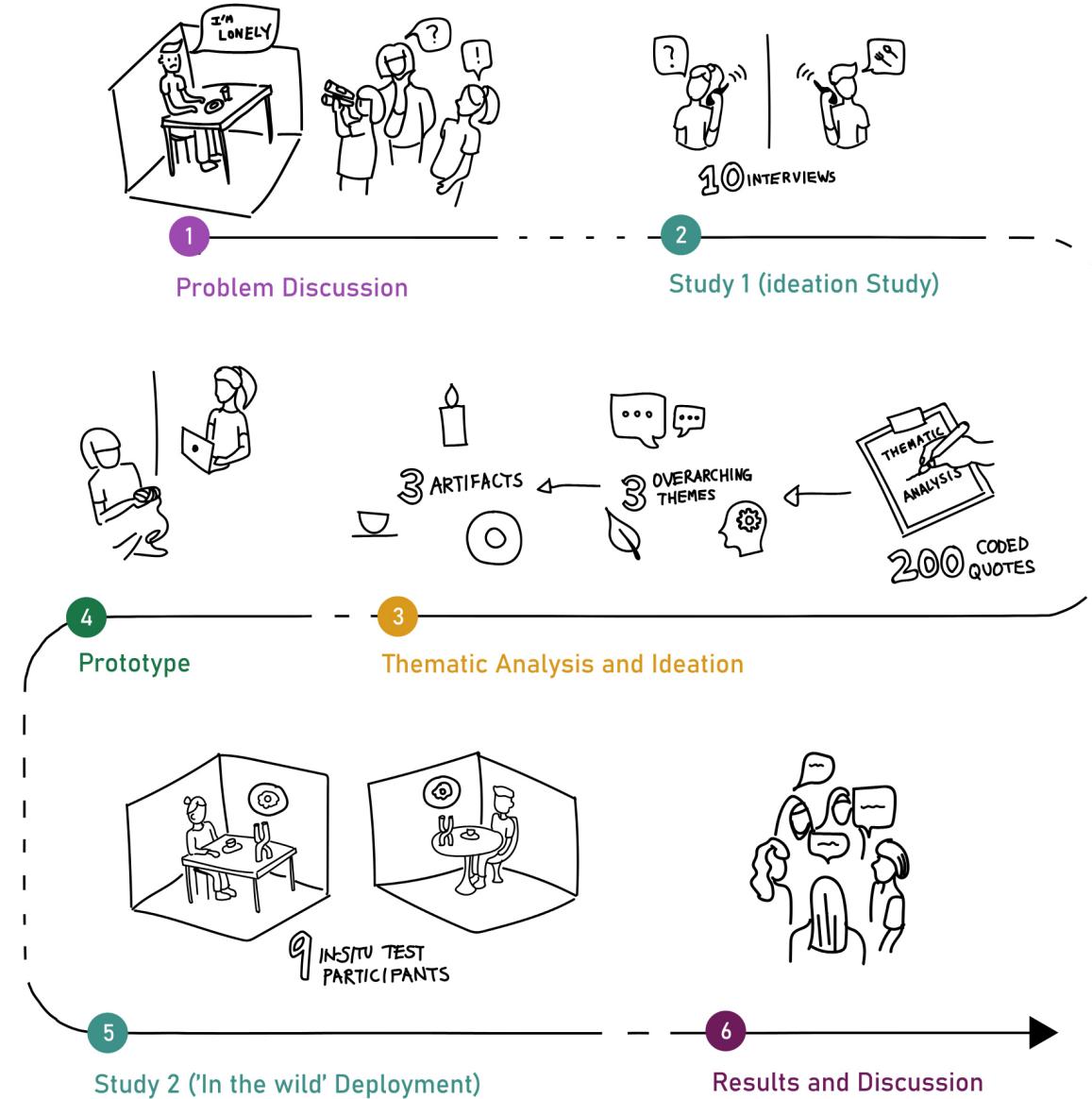
(2) We then conducted **preliminary semi-structured phone interviews** with 10 individuals about their dining habits and how they connect with others during the pandemic.

(3) The participant's answers (their transcripts) underwent a **thematic analysis process that highlighted 200 insightful quotes about the remote dining experience. Three overarching themes** were synthesized by the data which factored into the design of **three interactive interior artifacts.**

(4) We realized our ideation artifacts by building **high fidelity prototypes with smart materials** in order to further explore the three themes.

(5) The prototypes were released 'In the wild' to **test how our interactive decor would be received by users.**

(6) Finally, the gathered data was **analyzed and reflected upon.**



## Study 1: Co-design ideation

Our first study unpacks the ideation phase where we conducted 20-30 minutes semi-structured interviews with 10 participants (6F, 4M; age ranges 20~60) using a mix of online platforms (Zoom and MS-Teams) to understand people's challenges, preferences, and dining habits while being isolated from their friends and family members.

These interviews were transcribed into 13200 words and analyzed into over two hundred insightful quotes during the thematic analysis. Seven overarching themes were formed from the interviews and these were then further refined in an iterative process (done separately by 5 researchers in our team) into 3 major themes and goals. The three overarching themes in this study emphasize balancing communication and personal time, adopting a biophilic design aesthetic to connect the user to the outside environment, and combating unhealthy habits formed in isolation.



### Communication to self and others

**Importance of presence** Participants valued the presence of others at the dining table and found immense joy eating with friends and family. Eating together is a method of maintaining relationships, for instance, P1 said, “[dining] kinda brings people together” and that eating together “lets me check in with my friends and my roommates [and know] what's going on.”

**Alone but not lonely** Sometimes, participants needed time to relax and eat on their own. P1 found that there were times when, “I don't really want to see people”. Talking about heavy topics seemed to be a pain point for some participants, for instance, P4 found that they needed a break from, “eating with my family and talking about like politics”.

**Sharing experiences** The concept of sharing is closely tied to participant's meal time experiences. Participants enjoy food, conversation, or even online videos they found that were interesting.



### Connection to the environment

**Sensory interaction** The sensations, such as visuals, sounds and feelings of the dining space tend to impact the quality of dining for the participants. Participants generally preferred a dining area that have background sounds and natural, dim lights as well as soft and warm items. For instance, P4 preferred, “some candles, some ambient music, just dim lights”.

**Connected spaces** Participants liked being connected to activities happening external to their own dining experience. For instance, P1's ideal dining space is connected to other rooms. They say, “it's like the dining area should be in the kitchen.” P6 also said, “I like the idea of being able to see business around”, and “I prefer [sitting next to] the window[to see others].”

**Biophilia** Being connected to the outdoors was implied by many of the overt design choices chosen by participants such as natural shapes, lights, and sounds. Participants also preferred plants or flowers in the dining room itself[P2] [P8][P10], often as centerpieces [P6].



### Combatting unhealthy habits formed in isolation

**Unhealthy feelings/behaviors** Participants talked about a few unhealthy feelings/behaviours. Many were increasingly lonely during the pandemic. They were spending more time alone and eating with friends significantly less. For instance, P6 said, “entertainment comes in just to feel less alone” and P8 said, “I miss having like a meal companion”. This led to some unhealthy behaviours, for instance, P8 said “I probably eat more quickly which I dislike”. Participants would skip meals if not eating with others [P6]. P8 also stated, “You do lose track of time, [it's] easy to work away and blow through meal times”

**COVID induced fear** After the onset of the Covid-19 pandemic, participants reported a fear of touching items as well as going out to eat, even after restrictions were lifted. For example, P1 said, “I don't like to put my cutlery on the table anymore.” Additionally, P7 stated, “nobody really wears masks outside or like at restaurants so it's just really not safe like in general.”

## Design Artifacts

With feedback from interviews and research, we came up with three designs during the ideation process: a connectivity candle, a pressure sensing placemat, and a yarn concert wall art piece.

To explore the three design themes, we apply design methodologies such as Slow Design by combining multiple functionalities within one product, for instance, decoration, communication, and interaction, with the goal of stimulating greater reflection and time spent with the items. For instance, visual techniques from biophilic design can "bring the outside indoors" and relax users [39]. We also create a calmer method of communication that does not detract from the dining experience itself by designing items that function in both the center and periphery of dining [33].

### Playful Placemat

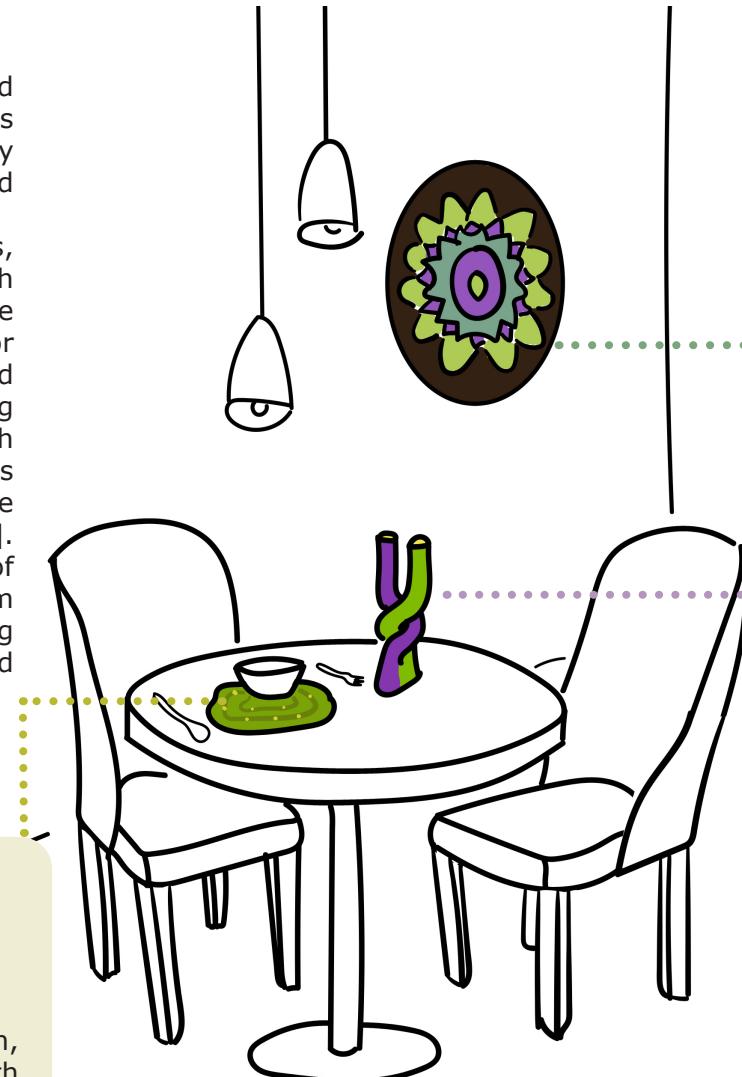
Placemat that lights up when foods are placed on the mat



Biophilic design: Use of brown, lavender and green, with imagery of a flower.



Habits: Encourages diners to focus on the dining experience itself and to encourage mindfulness.



### Yarn Concert

Wall tapestry that plays different music depending on which petal is pressed



Connection: Comes in a pair for two remote co-diners and is meant to stimulate conversation prompted by music.



Biophilic design: Use of brown, lavender and green, with imagery of a flower.

### Connectivity Candle

A candle that provides a visual indication of another remote co-diner's presence



Connection: Artifact comes in a pair, 1 for each remote diner. If diner 1 (purple candlestick) is having dinner, then the purple prong for both artifacts will light up.



Biophilic design: Use of lavender and green, organic curved shapes.



Habits: Multifunctional design of being a decorative centerpiece, presence notifier and light provides users a tool kit to reflect and improve mealtime habits.

## Materiality

In order to incorporate concepts such as presence and interactivity we began experimenting with smart materials such as yarn, single-board computers, 3D printing, and microcontrollers.

The two pronged connectivity candle explores the concept of indirectly communicating presence through a sensory detection system. On the other hand, the Yarn Concert allows users to interact with the yarn wall art and produce a soundscape. Finally, the Playful Placemat is designed to emulate food sharing and mindful eating, as LED lights on a crochet mat respond to the pressure of the plates placed on itself. This was contrasted with our exploration of traditional materials such as paint and yarn in the exterior design as participants found them soothing and homely. We additionally used traditional material for their soft, organic shapes that seem more organic and pleasing to the eye.

### DESIGN

#### Connectivity Candle



The centerpiece design is 3D printed with PLA and PETG plastic. Plastic was chosen to mimic the translucent qualities of traditional wax candles.

### TOOLS AND HARDWARE

#### Yarn Concert



Threaded punch needle with wool yarn.



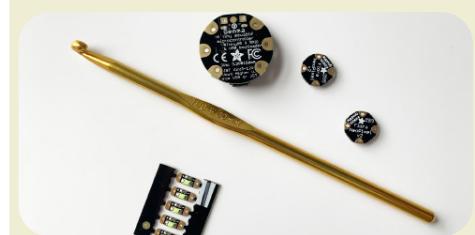
The Bare Conductive Touch Board surrounded by various punch needling materials.

### AESTHETICS

#### Playful Placemat



Yarn and conductive thread intertwined with two varieties of LEDs powered by the



5mm crochet hook, GEMMA v2 wearable microcontroller, Flora RGB neopixels, white LED



Brushes, soft sponges, and rough sponges were used to apply Acrylic paint to mimic grass and plant textures.

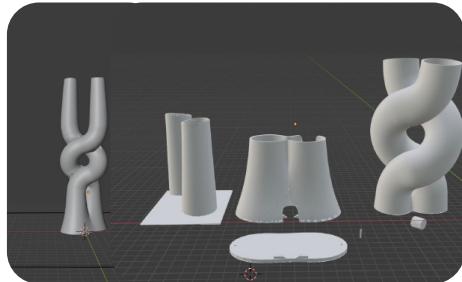
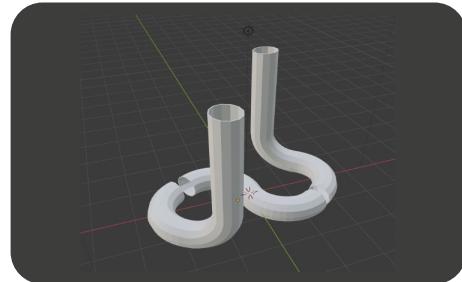
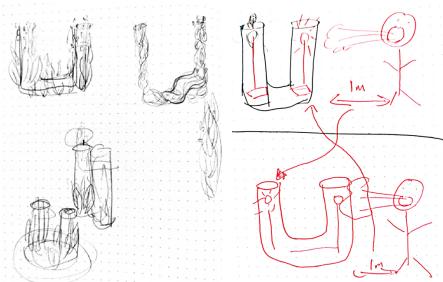


Collection of wool, ranging in colour and thickness.



Green yarn in our biophilic colour scheme to coordinate with Yarn Concert.

## Implementation: Connectivity Candle



### 1. IDEATION SKETCHES

The sketches above focus on candle forms and user interaction diagrams.

### 2. MODELING

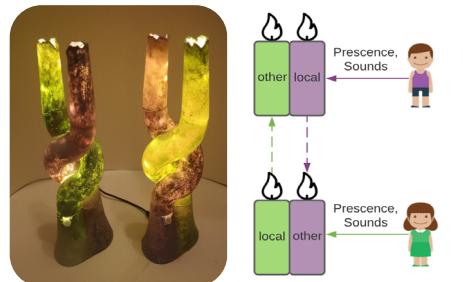
The first design model on Blender was not technically feasible with the hardware.

### 3. FINAL DESIGN

The 3D model of a shared base and intertwined stick portrays a visual representation of conversation and interaction.

### 4. 3D PRINT

The candle structure was printed in three parts (refer to step 3).



### 5. COLOR PLAN AND SHADOW TESTING

(A) The color testing process was done in Adobe Illustrator.  
(B) The light filtering through the translucent PLA material stresses the marks made by the brushes, rough sponges and soft sponges.

### 6. PLAYING WITH TEXTURE

(C) Textured layers were applied using soft and rough sponges, creating natural analogues to moss [24]. Humans generally prefer rich, textured haptic feedback rather than smooth surfaces [34].  
(D) A soldering iron was used to melt the tips to create the natural melted wax texture and shape.

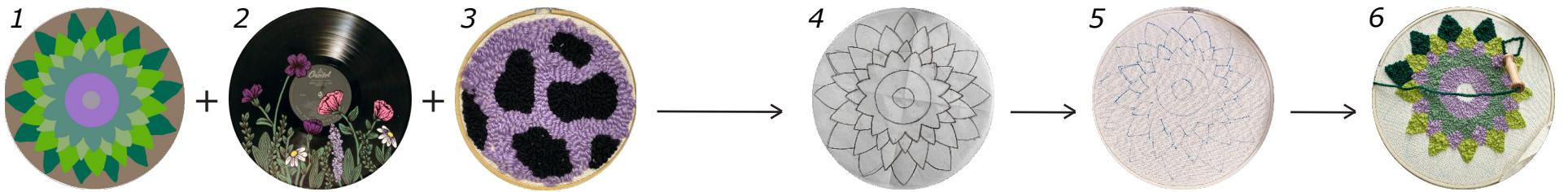
### 7. HARDWARE AND ASSEMBLY

The LEDs are connected and tested with the hardware configuration on a python program that sends information through a web service to the other candle. The LEDs are then assembled within the 3D printed candle.

### 8. FINAL PROTOTYPE

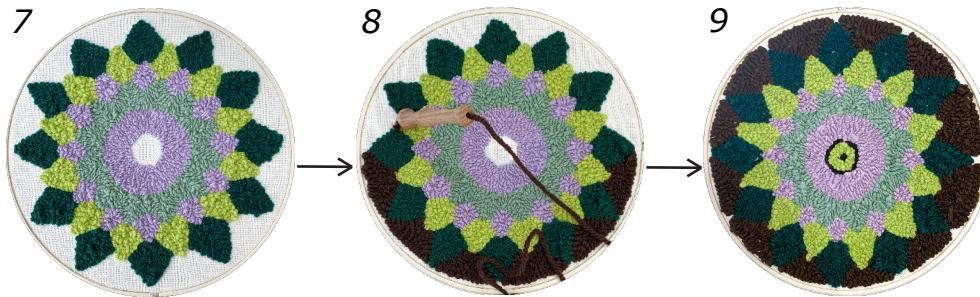
Each household is associated with one colored candle. When the candle detects presence, the corresponding candle representing the house lights up in the remote candle set. Sounds such as laughter and talk are sensed and converted into brighter candlelight flickers.

## Implementation: Yarn Concert

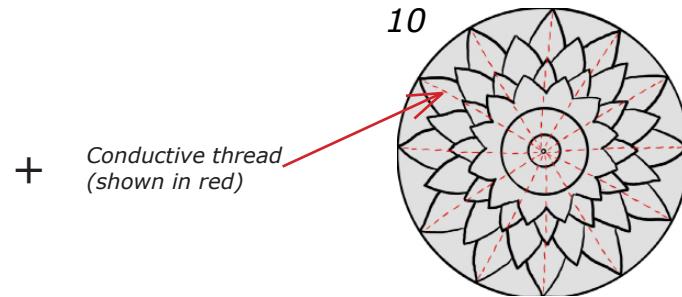


**1. PRELIMINARY** Digital design sketch on iPad (1) inspired by a musical record (2). Prototype punch needling piece (3).

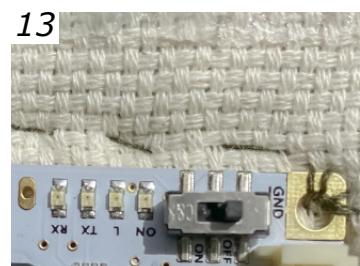
**2. BEGINNING PUNCH NEEDLING** After tracing the design on parchment paper (4), it was transferred to Monk's cloth on a 12 inch punch needling hoop (5), in order to follow the pattern when beginning punch needling (6):



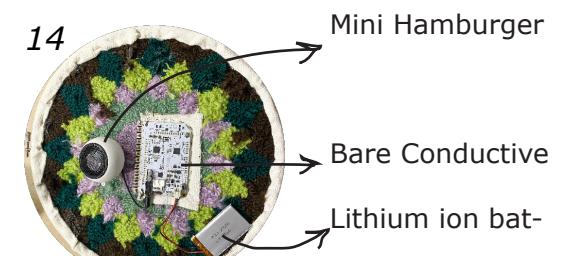
**3. PUNCH NEEDLING PROCESS** The design was filled in using varying colours and thicknesses of wool, such as Bernat Softee Chunky Wool in dark brown.



**4. CONDUCTIVE THREAD** Hand sewn into the design and hot glue was applied to the ends to prevent fraying.



**5. CONNECT** Conductive thread is tied to the electrodes on the touch board (11) and then soldered to prevent movement (12). The touch board has been loaded with mp3 files which play when an electrode is activated via touch. The touch board was then sewn onto Monk's Cloth to prevent interference between the threads beneath the board and the board (13).



**6. FINALLY** The mini hamburger speaker and lithium ion battery are attached to the piece using velcro.

## Implementation: Playful Placemat



**1. STARTING POINT** inspired by these home artefacts from one of the interview subjects [4].

**2. INITIAL PROTOTYPE**  
Beginning to integrate home and tech design.

**3. BEGIN CRAFTING**  
I learned to crochet a granny circle by watching Youtube tutorials[5][6]. My initial attempts had issues like the yarn curling up and dropped stitches.

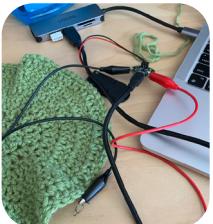
**4. MINI TEST**  
Has a cozy home look.



**5. COMBINING ELEMENTS** Figuring out the best way to incorporate conductive thread. At first, they were intertwined and crocheted together. Final design was to sew the conductive thread into the complete crochet granny circle.



**6. TECHNICAL IDEATION** Planning exactly what should happen when the user interacts with the placemat. Determining input and output.



**7. PROGRAMMING GEMMA** Testing pressure sensing and setting a threshold. Using alligator clips for testing. Using code to assign input and output pins for GEMMA [12].

**8. SEWING** attaching the microcontroller, and LEDs into the placemat with conductive thread.

**9. FINISHING TOUCHES**  
Adjusting LEDs, trimming conductive thread. Ensuring that no technology is visible.

## Study 2: In the Wild Deployment

In this second study, we deployed the 5 prototypes in 5 different households into the wild for in-situ testing. We found that insights from this study provided both additional details and feedback to the major themes of study 1. However, many unexpected interactions were also found in study 2. Six participants (P2, P7-P10, P12) took part in this study in addition to the first three authors (A1~A3) who were all asked to record their observations and communication about the prototypes in textual format. The 8300-word gathered data were analyzed for each artefact and across each other for generalizable take-aways.

**CONNECTIVITY CANDLE** – The connectivity candles were placed in an in-situ environment; one candle was placed in the dining room of a married couple both in the technology sector (1F, 1M) and the other was placed in a researcher's dining room in another city approximately 300 km away. All participants are part of the same family. This setup allowed for in-depth user and auto-ethnography studies to be conducted over 2 weeks. Daily journal entries and a final user interview were assessed at the end of the study.

 **Ambient, peripheral connectivity**  
The candles preserved a connection throughout the entire dining experience. For instance, at the end of a phone call, there is a distinct cut to the communication, while Connectivity Candle was always on and provided constant company. Participants were delighted when both the



purple and green prongs lit up, indicating

that both parties were at the dining table.

**Tangible presence at the dining room**  
The candle increased mutual reciprocity in the relationship. Participants felt feelings of anticipation when they started eating as they subconsciously expected the other candle prong to light up. When participants saw that the remote candle had lit up, they were motivated to enter the dining space and begin eating. Participants also used the candle as a wellness notifier. P2 felt at peace while viewing the remote light on after dark, indicating that their family is safely at home. Historically, light has been used as a method of notifying others of safety [28].

 **Aesthetic interaction** Participants were appreciative of the rounded shape, colors and splattered texture of the paint. The design reminded P12 of (small plants)/mossy surfaces. When the candle is lit up, there is an increased sense of ambiance in the rooms. P12 said, "the color looks warm and nice especially when lit up"

**Connection with other spaces** The notification system of the candle made participants feel like they are connected to physical happenings of the 'hustle and bustle' of the other household. The author reported in their journal, "when I see the candle flicker more, it's a visual indication of my family talking."

**YARN CONCERT** – Yarn Concert was studied in-situ across two groups. Group A consisted of two professional musicians (1F, 1M), (P7-P8). Group B consisted of a married couple (1F, 1M) with backgrounds in public service (P9-P10). The two groups are neighbors in an attached living space and have been in isolation together. One Yarn Concert piece was given to each group and participants were briefed on the usage and left to explore for one week, logging daily updates via text. Participants were able to discuss their experiences and share a meal together. A post-study interview was conducted and transcribed for analysis.

 **Ambient, peripheral connectivity**  
When used by the groups individually, P10 described Yarn Concert as "lyric-free company", while Group A loved the cafe background noise, as it provided them



with a sense of connection to the outside world. Groups A & B enjoyed a joint dinner and Yarn Concert "set the mood"

(P9). Each musical selection fostered discussion and storytelling, and allowed participants to bond over certain sounds.

 **Aesthetic interaction** Yarn Concert's aesthetics strongly appealed to participants. P7-P8 love that there's a handmade aspect to it not made in China. "I love the specific look of the art and that there's a handmade aspect to it". The 'Analog' appeal of the design allowed participants to take a break from their digital devices. P7-P8 reported screen fatigue during covid because of the amount of meetings done virtually and how all activities are becoming virtual, so much so that, "people have to get the blue light glasses to make sure that they don't have a headache." The non-interface form of connection helped them focus on the dining experience itself rather than other people's faces on the screen.

**Connection with other spaces** Yarn Concert triggered memories and the emotions associated with past travels. P7 remarked that playing the ocean soundtrack "every time I hear the ocean it's like instantly [being transported to] Miami". P9 felt that "every time we turned it on, it brought back happy memories or things we'd like to do". P7 loved the cafe background noise, as it provided them with a sense of connection to the outside world.

 **Changing habits** Having the artifact in the dining room changed the dynamic of conversations and improved the mood of dining everyday. P9 and P10 reported, "if the music was fancy dinner music and light hearted then the meal lightened up." P9 and P10 enjoyed the ease of use as well as the

proximity to their dining table. Their interactions became automatic, and they deliberately chose music based on their mood.

**PLAYFUL PLACEMAT** – The Playful Placemat was used as a place setting for a casual, weekday dinner. The original plan was to have a dinner party and watch the guests interact with the prototype. Due to



changing COVID-19 restrictions, this could not be done and autoethnography was used instead. A single participant set the placemat up at the kitchen table for a solo meal. In order to stay present, reflective notes were taken after dinner had concluded.

**Unexpected interactions and outcomes** The slow design of the handmade placemat made dining seem more of a ceremony and more valuable. Dinner is often thought of as a task you must complete before moving onto the next one, especially when time is tight to get something done by the end of the day. Having interactive

décor drew attention to the moment. The user felt more present during the meal and less distracted. The Playful Placemat added whimsy and excitement to the atmosphere and transformed a task to an experience. The author noted in their journal, "It felt like a treat to sit at a set table and eat dinner". The author was motivated to take more steps to make the experience more enjoyable, such as putting on a playlist. Over time, she believes using items such as the interactive mat would increase self-care. In addition, the playful placemat encouraged



reflection. The user recounted various plastic placemats used as a child, and more formal place settings used during family holiday meals. This brought on a wave of nostalgia and memories of big Thanksgiving dinners. It also prompted a mental note to call home soon and check in with everyone.

**OVERALL INTERPRETATION** The author felt the placemat was unintrusive in the dining environment and added a level of formality and purpose to the meal. It created the feeling that dinner was an experience, and not simply something that had to be done.

## Discussion and Conclusion

Results from both studies 1 and 2 reveal that ambient communication and slow technology can be used to communicate without the pressure of forcing conversation. On the other hand, slow interaction helped generate deeper reflection about people's relationships and allowed them to reach out to family and friends about meaningful topics. Additionally, items that blend in to the environment, and make metaphors to the outdoors make people feel comfortable. In reaction to the three design artifacts, participants are eating healthier, reframing dining as more of an important event, talking about food with others and spending time with food as opposed to digital screens. Nevertheless, our studies do not suggest these artefacts as exemplary interactive domestic artefacts that solve isolation problems. Instead, our exploration unfolds existing tensions and challenges that could be tackled through initiations of tangible interactive design artefacts to enrich people's experience.

Through a series of design methods: interviewing, researching and ideating, we created functional prototypes that encouraged presence and inquiry [27]. Combining the practices of autoethnography and in-situ user studies, we gained rich insight and deeper understanding into the use of interactive decorative artefacts in severe conditions. Though the artefacts are unique, thematic analysis of the in-the-wild study yielded common findings. All three artefacts were considered "conversation pieces"; they provoked discussion, provided another avenue for users within a relationship to connect, and encouraged users to reflect upon their dining



environment. The pieces themselves provided company and "filled the space" by appealing to the senses through light, sound, and touch. Users went through the stages of curiosity, exploration, familiarity, and preference while interacting with the artefacts. The biophilic design of our artefacts was well-received by the users, as they spend whole days on screens due to COVID-19. Overall, the pieces had an emotional impact on users, and rather than being a part of the background, encouraged a more mindful dining experience.

Further design iterations should focus on longevity (improved power source and more sustained interaction) and inter-artefact connection. For instance, Yarn Concert could connect wirelessly to its partner piece, further bridging the physical space between their

users. Moreover, future user studies could be evaluated in other environments such as long-term care homes, between long-distance partners, or in other contexts where loved-ones are living separately. Specifically, we discovered that these artefacts have high potential for use with senior citizens where tangible interaction, crafted elements and remembrance are valued more than short-term mass-produced gadgets. Participants noted that the ease of use and lack of visible technology provide interactive artefacts with increased accessibility and inclusivity to participants of different ages. We believe that there is space to extend the interior and interaction design community to solve new problems and challenge the norms of focus-demanding and connectivity-promoting interfaces.

## REFERENCES

- [1] Angus Reid Institute. (2020, May 15). Worry, gratitude & BOREDOM: As COVID-19 AFFECTS mental, financial health, who fares better; who is worse? <https://angusreid.org/covid19-mental-health/>.
- [2] Naomi Boyd. (2021, February 3). Kitchen Objects [Photograph]. Vancouver.
- [3] Pollie Barden, Rob Comber, David Green, Daniel Jackson, Cassim Ladha, Tom Bartindale, Nick Bryan-kinns, Tony Stockman, and Patrick Olivier. 2012. Telematic Dinner Party: Designing for Togetherness through Play and Performance. In Proceedings of the 2012 Conference on Designing Interactive Systems (DIS'12), 38–47. Retrieved from <https://doi.org/10.1145/2317956.2317964>
- [4] Philipp Brauner, Julia van Heek, Martina Ziefle, Nur Al-huda Hamdan, and Jan Borchers. 2017. Interactive FURNiTURE: Evaluation of Smart Interactive Textile Interfaces for Home Environments. In Proceedings of the 2017 ACM International Conference on Interactive Surfaces and Spaces (ISS '17). Association for Computing Machinery, New York, NY, USA, 151–160. DOI:<https://doi.org/10.1145/3132272.3134128>
- [5] Crochet: How to crochet a flat circle coaster | easy tutorial by crochet and tea [Video file]. (2020, April 25). Retrieved March 05, 2021, from <https://www.youtube.com/watch?v=vItcjc8nJ9o>
- [6] Crochet made easy - how to make a solid circle (tutorial) pearl gomez [Video file]. (2016, December 27). Retrieved March 01, 2021, from <https://www.youtube.com/watch?v=dFj0PR02fp0>
- [7] William Gaver, John Bowers, Andy Boucher, Andy Law, Sarah Pennington, and Nicholas Villar. 2006. The history tablecloth: illuminating domestic activity. In Proceedings of the 6th conference on Designing Interactive systems (DIS '06). Association for Computing Machinery, New York, NY, USA, 199–208. DOI:<https://doi.org.proxy.queensu.ca/10.1145/1142405.1142437>
- [8] William Gaver. 2012. What should we expect from research through design? In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12). Association for Computing Machinery, New York, NY, USA, 937–946. DOI:<https://doi.org/10.1145/2207676.2208538>
- [9] Jean Gregoire. (2015). Lovebox [Photograph]. lovebox. <https://www.thegrommet.com/our-makers/lovebox>
- [10] Catherine Grevet, Anthony Tang, and Elizabeth Mynatt. 2012. Eating Alone, Together: New Forms of Commensality. In Proceedings of the 17th ACM international conference on Supporting group work (GROUP '12), 103–106. Retrieved from <http://dx.doi.org/10.1145/2389176.2389192%0A%0A>
- [11] Barbara Grosse-Hering, Jon Mason, Dzmitry Aliakseyeu, Conny Bakker, and Pieter Desmet. 2013. Slow design for meaningful interactions. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13). Association for Computing Machinery, New York, NY, USA, 3431–3440. DOI:<https://doi.org.proxy.queensu.ca/10.1145/2470654.2466472>
- [12] Alexis Hiniker, Sarita Y Schoenebeck, Ann Arbor, and Julie A Kientz. 2016. Not at the Dinner Table: Parents' and Children's Perspectives on Family Technology Rules. In Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16), 1376–1389. Retrieved from <https://doi.org/10.1145/2818048.2819940>
- [13] Karen Johanne Kortbek and Kaj Grønbæk. 2008. Communicating art through interactive technology: new approaches for interaction design in art museums. In Proceedings of the 5th Nordic conference on Human-computer interaction: building bridges (NordiCHI '08). Association for Computing Machinery, New York, NY, USA, 229–238. DOI:<https://doi.org.proxy.queensu.ca/10.1145/1463160.1463185>
- [14] Rohit Ashok Khot and Jung Ying Lois Yi. 2020. GustaCine: Towards designing a gustatory cinematic experience. TEI 2020 - Proceedings of the 14th International Conference on Tangible, Embedded, and Embodied Interaction: 757–770. <https://doi.org/10.1145/3374920.3375010>
- [15] Kyung-ryong Lee, Somi Ju, Temirlan Dzhoroev, Geonil Goh, Moon-hwan Lee, and Young-woo Park. 2020. DayClo : An

- Everyday Table Clock Providing Interaction with Personal Schedule Data for Self-reflection. In Proceedings of DIS'20, 1793–1806.
- [16] Robb Mitchell, Alexandra Papadimitriou, Youran You, and Laurens Boer. 2015. Really Eating Together: A Kinetic Table To Synchronise Social Dining Experiences. In Proceedings of the 6th ACM Augmented Human International Conference (AH'15), 173–174. Retrieved from <http://dx.doi.org/10.1145/2735711.2735822>
- [17] Sara Nabil, Aluna Everitt, Miriam Sturdee, Jason Alexander, Simon Bowen, Peter Wright, and David Kirk. 2018. ActuEating: Designing, Studying and Exploring Actuating Decorative Artefacts. In Proceedings of the 2018 Designing Interactive Systems Conference (DIS '18). Association for Computing Machinery, New York, NY, USA, 327–339. DOI:<https://doi.org/10.1145/3196709.319676>
- [18] Sara Nabil, David S. Kirk, Thomas Plötz, Julie Trueman, David Chatting, Dmitry Dereshev, and Patrick Olivier. 2017. Interioractive: Smart Materials in the Hands of Designers and Architects for Designing Interactive Interiors. In Proceedings of the 2017 Conference on Designing Interactive Systems - DIS'17, 379–390. <https://doi.org/10.1145/3064663.3064745>
- [19] Sara Nabil and Richard MacLeod. 2020. Peace: Projecting Dual-Identities on Interactive Furniture. In Proceedings of the Fourteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '20). Association for Computing Machinery, New York, NY, USA, 837–848. DOI:<https://doi-org.proxy.queensu.ca/10.1145/3374920.3375006>
- [20] Mamoun Nawahdah. 2013. Virtually Dining Together in Time-Shifted Environment: KIZUNA Design. In Proceedings of the 2013 conference on Computer supported cooperative work (CSCW '13), 779–788. Retrieved from <https://doi.org/10.1145/2441776.2441863>
- [21] William Odom, Richard Banks, Abigail Durrant, David Kirk, and James Pierce. 2012. Slow Technology: Critical Reflection and Future Directions. In Proceedings of the Designing Interactive Systems Conference on - DIS '12, 816–817. <https://doi.org/10.1145/2317956.2318088>
- [22] William Odom, Abigail J. Sellen, Richard Banks, David S. Kirk, Tim Regan, Mark Selby, Jodi L. Forlizzi, and John Zimmerman. 2014. Designing for Slowness, Anticipation and Re-visitation: A Long Term Field Study of the Photobox. In Proceedings of the 32nd annual ACM conference on Human factors in computing systems - CHI '14, 1961–1970. <https://doi.org/10.1145/2556288.2557178>
- [23] L.ex Pott. (2020). Twist Candle [Photograph]. Lex Pott. <https://www.lexpott.nl/work/69-twist.html>
- [24] Ryan, Catherine O., William D. Brown-ing, Joseph O. Clancy, Scott L. Andrews, and Namita B. Kallianpurkar. (2014). Biophilic design patterns: emerging na-ture-based parameters for health and well-being in the built environment. Arch-Net-IJAR: International Journal of Architectural Research, 8(2), 62.
- [25] Hasan Shahid Ferdous, Frank Vete-re, Hilary Davis, Bernd Ploderer, Ken-ton O Hara, Rob Comber, and Gere-my Farr-wharton. 2017. Celebratory Technology to Orchestrate the Sharing of Devices and Stories during Fam-i ly Mealtimes. In Proceedings of the 2017 CHI Conference on Human Fac-tors in Computing Systems (CHI '17), 6960–6972. Retrieved from <https://doi.org/10.1145/3025453.3025492>
- [26] Becky Stern. (2014, August 20). Serial debugging With GEMMA. Retrieved March 20, 2021, from <https://learn.adafruit.com/serial-debugging-with-gemma>
- [27] Urban Outfitters. Leo Horizon Tufted Wall Hanging [Photograph]. <https://www.urbanoutfitters.com/en-ca/shop/leo-hori-zon-tufted-wall-hanging?quantity=1>
- [28] Konrad Tollmar and Joakim Pers-on. 2002. Understanding remote pres-ence. In Proceedings of the second Nordic conference on Human-comput-er interaction (NordiCHI '02). Associa-tion for Computing Machinery, New York, NY, USA, 41–50. DOI:<https://doi.org/10.1145/572020.572027>
- [29] Vanska. (2021). Loops Demi IV [Photograph]. Vanska. <https://vanska-sea-sons.com/products/loops-demi-iv>
- [30] Daniel Vigo, Laura Jones, Rich-ard Munthali, Julia Pei, Jean Westen-berg, Lonna Munro, Carolina Judko-wicz, Angel Y Wang, Brianna Van den Adel, Joshun Dulai, Michael Krausz, Randy P Auerbach, Ronny Bruffaerts, Lakshmi Yatham, Anne Gadermann, Brian Rush, Hui Xie, Krishna Pendakur, Chris Richard-

- son. (2021). Investigating the effect of COVID-19 dissemination on symptoms of anxiety and depression among university students. *BJPsych open*, 7(2), e69. <https://doi.org/10.1192/bjo.2021.24>
- [31] Yan Wang, Zhuying Li, Robert Jarvis, Rohit Ashok Khot, and Florian 'Floyd' Mueller. 2018. The Singing Carrot: Designing Playful Experiences with Food Sounds. In Proceedings of the 2018 Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts(CHI PLAY '18 Extended Abstracts). Association for Computing Machinery, New York, NY, USA, 669–676. DOI:<https://doi-org.proxy.queensu.ca/10.1145/3270316.3271512>
- [32] Jun Wei, Xuan Wang, Roshan Lalitha Peiris, Yongsoon Choi, Xavier Roman Martinez, Remi Tache, Jeffrey Tzu Kwan Valino Koh, Veronica Halupka, and Adrian David Cheok. 2011. CoDine: an interactive multi-sensory system for remote dining. In Proceedings of the 13th international conference on Ubiquitous computing (UbiComp '11). Association for Computing Machinery, New York, NY, USA, 21–30. DOI:<https://doi-org.proxy.queensu.ca/10.1145/2030112.2030116>
- [33] Mark Weiser, John Seely Brown. 1997. The Coming Age of Calm Technology. In Beyond Calculation. Springer, New York, NY. [https://doi.org/10.1007/978-1-4612-0685-9\\_6](https://doi.org/10.1007/978-1-4612-0685-9_6)
- [34] Mikael Wiberg. 2016. Interaction, new materials & computing – Beyond the disappearing computer, towards material interactions. *Materials & Design* 90 (2016), 1200 – 1206. DOI: <http://dx.doi.org/10.1016/j.matdes.2015.05.032>
- [35] Hannah Perner-Wilson, Leah Buechley, and Mika Satomi. 2010. Handcrafting textile interfaces from a kit-of-no-parts. In Proceedings of the fifth international conference on Tangible, embedded, and embodied interaction (TEI '11). Association for Computing Machinery, New York, NY, USA, 61–68. DOI:<https://doi-org.proxy.queensu.ca/10.1145/1935701.1935715>
- [36] Hannah Perner-Wilson and Leah Buechley. 2010. Making textile sensors from scratch. In Proceedings of the fourth international conference on Tangible, embedded, and embodied interaction (TEI '10). Association for Computing Machinery, New York, NY, USA, 349–352. DOI:<https://doi-org.proxy.queensu.ca/10.1145/1709886.1709972>
- [37] Huizhong Ye, Zengrong Guo, and Rong-Hao Liang. 2021. Asynchronous Co-Dining: Enhancing the Intimacy in Remote Co-Experience Through Audio Recordings. In Proceedings of the Fifteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '21). Association for Computing Machinery, New York, NY, USA, Article 60, 1–6. DOI:<https://doi.org/10.1145/3430524.3442468>
- [38] Ce Zhong, Ron Wakkary, Xiao Zhang, and Amy Yo Sue Chen. 2020. transTexture Lamp: Understanding Lived Experiences with Deformation Through a Materiality Lens. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, 1–13. <https://doi.org/10.1145/3313831.3376721>
- [39] John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research through design as a method for interaction design research in HCI. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '07). Association for Computing Machinery, New York, NY, USA, 493–502. DOI:<https://doi.org/10.1145/1240624.1240704>
- [40] 14 patterns of biophilic design. Retrieved July, 31 2021, from <https://www.terrapinbrightgreen.com/reports/14-patterns/>