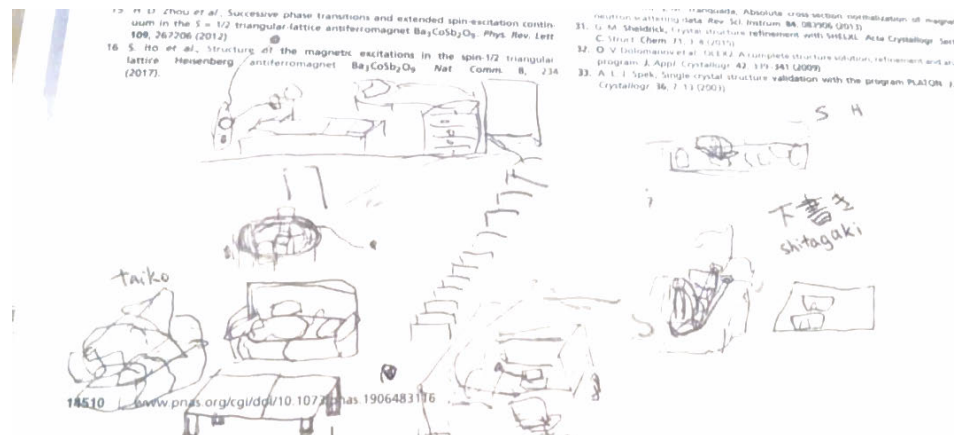# Small Spaces, Many Places: A Phenomenological Analysis of Technology-Mediated Placemaking in Small Spaces

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Figure 1: One of our participant's self-perception of their place was drawn on the only sheet of paper they could find—a page from a textbook. The participant noted: " *...this is all I can cram in on my piece of paper. It's gonna be really weird because I started somehow on one perspective and I ended up in another.*" This thought is a metaphor for our study: in small spaces, our participants start off in one place, and usually end up in another

ABSTRACT

This paper explores the concept of placemaking within small, constrained spaces, challenging implicit assumptions in past human-computer interaction work that creating meaningful "places" requires large spaces. Our study focuses on individuals living in settings like van homes, co-living spaces, and other environments characterized by their limited physical dimensions and the creative use of technology within these confines.

We examine the phenomenon of individuals employing technology to transform their environments into multi-functional "places" that reflect personal significance and utility. We used a phenomenological method: data collection through semi-structured interviews and a diary study; reduction to approach this phenomenon with a sense of openness and curiosity; and finally, investigating the meaning our participants attribute to their spaces in the act of placemaking. Through this method, we identified four elements—boundaries, temporality, mastery, and future-thinking—that contribute to placemaking in small spaces. Additionally, we outline seven distinct types of places that emerge in these environments, such as leisure places and work places. Our findings suggest that even in physically restricted settings, individuals can effectively create diverse and meaningful places through the strategic use of technology and spatial arrangement. This paper contributes to broader discussions on human-building interactions and offers insights for designing technologies that enhance placemaking in various spatial contexts.

CCS CONCEPTS

• **Human-centered computing** → **User studies**.

KEYWORDS

domestiCHI, small space, placemaking, minimalist living, places

1 INTRODUCTION

The space in which technology is used fundamentally influences the user experience. The concept of place—"a space which is *invested with understandings* of behavioural appropriateness, cultural expectations, and so forth" [21, p. 69]— is critical for understanding how individuals ascribe meaning to these spaces (i.e., engage in placemaking). Dourish [13] encourages researchers and designers

to consider both space and place when studying human-building interactions to create more meaningful and context-aware experiences and technologies. Past research has highlighted that a variety of spaces can lead to a multiplicity of places, and this variety is not always limited to the physical boundaries of the space. However, this past work often has a common assumption of ample spatial availability. Often, multiple rooms or buildings are thought of as allowing for this multiplicity, and technological design decisions often rely on assumptions rooted in the traditional notion of a North American single-family home [11].

We explore the phenomenon of placemaking in smaller, spatially constrained spaces. For a variety of reasons, including economic challenges, rising housing costs, and the popularity of minimalism, people are engaging in alternative lifestyles like van living, co-living, and smaller homes, as well as modern office work-styles that include spaces like games areas and wellness spaces. But, do these heavy constraints prevent placemaking, or can people still achieve a rich multiplicity of places within these constraints? Furthermore, what is the nature of the placemaking experience in these small, constrained spaces and what is the role of technology in this experience?

We investigated placemaking in an environment where our participants described their spaces as "small." Our phenomenological study examines the technological practices individuals employ to create meaningful "places" within these small spaces. An illustrative example of this interactivity can be seen in kitchens, which often transform into multi-functional spaces as people arrange them based on specific contexts, incorporating both individuals and their belongings [20]. In a manner analogous to Desjardins and Wakkary [12] and Rizvi et al. [44], our work uses the distinction, tension, and overall relationship between place, physical space, and technology. In this paper, technology refers to digital artifacts found in domestic settings, such as televisions, ovens, and gaming consoles. Our participants defined "technology" based on their own interpretations, typically encompassing digital technology and electricity-powered appliances.

We used interviews, self-drawings of participants' spaces, and a diary study to enable participants to express how technology influenced their daily experiences, ranging from mundane to celebratory, restless to restful. Our data collection was followed by a phenomenological analysis [7] and a mind-mapping exercise to establish connections between technology, emotions, and common places we defined based on participant descriptions.

Following our analyses, we describe four elements that characterize the creation of places in constrained environments: *boundaries*, *temporality*, *mastery*, and *future-thinking*, each contributing to the multiplicity of places within a single space. Additionally, we identify seven distinct types of places emerging in these settings, including places of leisure, shared places, and unfamiliar places, among others.

Our research challenges assumptions about the spatial requirements for effective technology usage and placemaking, expanding the understanding of how space and technology interact within small, constrained spaces. This is crucial for human-computer interaction (HCI) research, who often considers the context of technology use but may not fully account for the variability in spatial constraints faced by users. Our findings have direct implications for

the design of technologies and environments that support varied human activities in constrained spaces. For HCI researchers and practitioners, this translates into designing better products and interfaces that accommodate the needs of users in small or shared living and working environments, such as those in co-living spaces or modern offices.

Through this paper, we encourage HCI researchers to consider alternative lifestyles and non-traditional living arrangements when designing and testing technologies. This is particularly relevant in a world where economic factors, environmental concerns, and urbanization are pushing more people towards smaller living spaces and shared environments.

2 RELATED WORK

The exploration of placemaking within constrained spaces intersects with various domains of research, particularly in environmental psychology, HCI, and urban studies. Prior studies have laid a foundation for how physical environments influence human behaviour, the role of technology in shaping our interaction with spaces, and the psychological and cultural significance of "place." This section will review the relevant work that contributes to our understanding of space and place, the influence of technological interventions, and the adaptation strategies individuals employ in limited living or working environments. By synthesizing these perspectives, we aim to highlight gaps in the current discourse and position our study within this broader academic context.

2.1 Theoretical Foundations of Space and Place

We use a phenomenological approach to understanding the difference between space and place as proposed by Casey [7] who argues that, as perception shapes a place and humans are always perceiving, humans are just as much "of place[s]" as we are "in [them]." In our work, we build on the notion that human affections shape and build places. As no two perceptions are guaranteed to be identical, no two formats of place are guaranteed to elicit the same impact on a person. This is especially true of placemaking—a uniquely personal experience no matter the spaces. In a similar vein, Malpas [35] aims to theorize space in terms of time, place, bounds, extensions, and emergence. While detailed, we do not rely on this definition within our work, rather focusing on the narrower but well developed theoretical foundation for placemaking through technology provided by Dourish [13].

The area of human-building interaction (HBI) has also previously explored technology use and its connection to space [1, 3], where the papers identify three interconnected aspects of the experience: physical-material, spatial-configuration, and social-cultural. We focus on the spatial-configuration realm, expanding the understand of how space-technology interactions drive feelings of place.

2.2 Other Perspectives on Placemaking

Placemaking in a domestic context requires certain thoughts and activities around configurations and perspectives of people living in various spaces. Oogjes et al. [39] report on the "values, practices, and perspectives" of people willingly living in atypical homesteads. Their work considers different ways to design technology for alternative homes; it examines different locations for a "home", different

curations and concepts of home, and apparent differences in physical, virtual, and social boundaries between alternative homes and greater communities. We can also extract people's motivations behind adopting alternative definitions of the home, as well as its consideration of potential technological innovations and the social limitations such creations could circumvent. More closely to our study, Desjardins and Wakkary [12] document the experience of turning a van into a camper van for a nomadic lifestyle called vanlife. This study directly showcases placemaking in the context of a way of living, practical design, and technological needs of such a nomadic lifestyle. This study emphasizes the adaptations necessary in the van space, as well as "ubiquitous computing, home automation, smart homes, and the Internet of Things." Overall this study shows a deep relationship between the person and their created environment, a theme we build upon as placemaking.

In a similar vein, architecture of spaces and placemaking are often intertwined. This was explored by Bachelard [2], who discusses the influence of architecture on daily life. He considers the uses and purposes of architectural and spatial amenities such as drawers, cellars, and corners, and urges against their implicit inclusion in space. Instead, he argues their inclusion on an as-needed basis, accounting for personal and emotional responses to a given space. This approach views the space as it is used in real life, as opposed to formatting it to fit a theoretical ideal. Such an approach targets the most practical and convenient arrangement of a space in each place. Crabtree [10] focuses on technology used in the home, and its mobility between the workplace and home. The study examines communication within homes using digital and physical technologies. It analyzes the organizational architecture of the home, identifying ecological habitats, activity centres, and coordinate displays that facilitate systematic communication. This architecture-based classification helps draw parallels between placemaking through architecture and placemaking through technology.

Building on these insights, our research seeks to extend the understanding of how spaces, when combined with technological interventions, can foster a deep sense of place even within limited space. Expanding on the work of Crabtree [10], we investigate how technology not only facilitates interaction but also supports the transformation of spaces into "places" imbued with personal significance and utility. This synthesis of architecture and technology illustrates the dynamic interplay between the physical and digital, underpinning our broader examination of placemaking.

2.3 Role of Technology in Spatial Adaptation

The intersection of technology and spatial adaptation is a growing area of interest within HCI research, reflecting an increased recognition of how digital technologies shape our perception and utilization of space. A review of recent HCI literature reveals a focus on how devices such as smartphones, smart home systems, and portable computing technologies extend the utility of confined spaces, allowing for greater flexibility and efficiency in daily activities. One notable example is the use of augmented reality (AR) to visually expand interiors without physical renovation, as explored in studies such as those by Lee et al. [31], which demonstrated how AR can alter the perception of space to make interiors feel larger and more open. Similarly, Cook et al. highlights the potential of

HCI to facilitate more intuitive and efficient use of space through a new research area called Ambient Intelligence.

Together, we build on cross-disciplinary literature on placemaking and expand it to placemaking with technology in small spaces.

3 METHOD

In this section, we outline our approach to data collection, analysis, and reporting. To capture the essence of placemaking in small, constrained spaces, we adopted a descriptive phenomenological (DP) approach as outlined by Giorgi [17]. This choice was aimed at accessing the core experiences of individuals living in small spaces. Unlike other qualitative methods commonly employed in human-computer interaction (HCI) research, such as reflexive thematic analysis (RTA), which focuses on identifying themes, or grounded theory, which seeks to construct a theory from data, descriptive phenomenology is uniquely suited to our study's goals to help describe a lived experience.

DP concentrates on describing the lived experiences of participants without presuppositions. This method allows us to delve into how participants experience their space and the role of technology within it, aiming to articulate the "essence" of these experiences. Such an approach is invaluable in studies like ours in HCI, where understanding the deep, subjective interaction between humans and their technological environments can lead to more empathetic and effective design solutions.

While phenomenological methods are gaining traction within HCI [19, 22, 50], the specific application of DP offers a direct route to comprehend the foundational aspects of human-building interactions. This methodological choice ensures that our findings illuminate the intrinsic characteristics of placemaking in small spaces, providing insights that might be overlooked by more theory-driven or thematic approaches. This focus is crucial for developing technologies and spaces that genuinely resonate with the lived realities of users in compact living conditions.

3.1 Participants & Recruitment Strategy

Following approval from a university ethics committee, we recruited our participants using on-campus posters and mailing lists. We stopped our recruitment based on prior knowledge of drop-offs (anticipating a 50% drop-off rate), with the aim to get between six to twelve participants. This was based on previous research that noted that "the most profound insights with in-depth reflections [are discovered with] ...about six to 12 cases as 'windows' to, and illustrations of, a phenomenon. There is danger in choosing a sample that is too large." [51, p. 79]

We initially recruited fourteen participants, of which eight participants signed the consent form, attended the interview, and submitted at least one diary study artifact. After the initial interview was completed, the participants were compensated with $10 in their local currency for their time. Every time participants provided pictures or media (for the diary study), they were given tickets to a draw for a $500 Amazon gift card. Table 1 provides a breakdown of participant demographics.

	Pseudonym	Reported Occupation	Income Level	House Size	Recruitment Method	Comments
P1	Jack	Software Industry	30,000 USD	65 m^2	Previous Study Participant	Lives with Amy
P2	Amy	Administration Professional	30,000 USD	65 m^2	Previous Study Participant	Lives with Jack
P3	Anya	Online Marketing	40,000 USD	37 m^2	On-campus mailer	
P4	Hudson	Student	15,000 USD	28 m^2	Previous Study Participant	28 m^2 in a shared space
P5	Faith	Consultant	N/A	56 m^2	On-campus mailer	56 m^2 in a shared space
P6	Milo	Student	N/A	46 m^2	On-campus mailer	
P7	Morgan	Student	20,000 USD	46 m^2	On-campus mailer	
P8	Jaime	Software Developer	N/A	37 m^2	On-campus mailer	

Table 1: List of participants (with pseudonyms for each) in our study.

3.2 Interview and Diary Study

Participants were invited to take part in one-on-one, semi-structured interviews over Zoom for around an hour each. At the start of the call, we confirmed that the participants still lived in "small" spaces. We did not explain or define what "small" could mean. We then obtained informed consent for the study. We then asked participants to sketch their spaces, using the following prompt:

> Draw your living space—in any way you would like. It could be a floor plan, impressionist, in the style of Monet, or whatever you feel like. Don't worry about the quality of your drawings, just draw what you feel.

To spark creativity and encourage diverse representations of space, we used the words "floor plan," "impressionist," and "in the style of Monet", and the order was varied with each interview. One participant drew a 3D sketch, and all others drew a floor plan. Participants were given uninterrupted, unlimited time to complete their sketches. A few sketches are presented in Figure 2.

Once participants completed their sketches, we continued with the semi-structured interview. As a part of this interview, participants often referred to their sketches, either by asking the interviewers to view it in email, or by holding it up to their camera and pointing. The interview was designed to elicit three components of the participants' lived experience: a deeper understanding of any technological adaptations to their space, emotions that their spaces and technology would occupy, and any external elements that impacted their use of the space. Once the interview was complete, demographic information was collected. A sample of the initial (structured) questions that prompted deeper conversations include:

- Where would you relax? or work?
- Do you reconfigure your space as technology changes?
- What spaces are your happy places?

Most of these were followed up by a question around specific situations they mentioned, and the technology use or adaptation. For example, the question about "happy places" was followed up by a deep dive on how the space and technology worked together to create that place. This was unstructured, but for three participants it went as follows:

- What are you doing when you are in your happy place?

- Ok, so <device mentioned> seems to help you feel happy doing <activity>, is it always in <space>?
- Where else would <device> get you to feel the same way?
- Could you do <activity> on a different device and get to the same feeling?

We did not explicitly ask about competence or familiarity with technology so as to not ground the participants' perception that this was of importance to the research team prior to their diary study; however, we found that all participants had at-least one cell phone and one laptop, most participants ($n = 6$) discussed their tablets, and some ($n = 4$) discussed either their own or shared televisions. Only one participant mentioned a shared gaming console (a Nintendo Switch).

After the interview, we requested the participants send one picture or video of their space and technology usage every day for a week, along with a narrative describing the media. Four participants provided seven or more images, three participants provided five, and one provided four. None sent videos.

3.3 Analysis

Our approach, descriptive phenomenology, is described as: "an inductive qualitative research approach that is rooted in the philosophical proposition that researchers can gain valuable insight into the structure of how people understand their experiences" [5]. Furthermore, Frauenberger et al. [15] states that "phenomenology provides the designer with a framework for studying user experience by affording an intrinsically contextual view of the way we interact with things around us."

Specifically, Giorgi [17] describe the steps of DP as follows (enumeration added): "For the scientific level of analysis, …"

(1) "one first obtains descriptions of experiences from others, …"
(2) "then one enters into a scientific phenomenological reduction while simultaneously adopting a psychological perspective, …"
(3) "then one analyzes the raw data to come up with the essential structure of the experience, …"
(4) "which is then carefully described at a level other than that of the original description."

(a) Faith   (b) Anya   (c) Amy   (d) Jaime
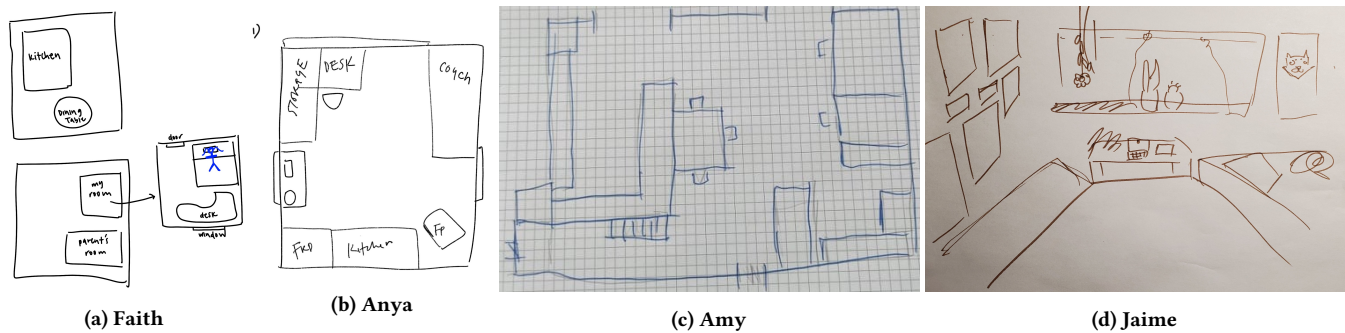
Figure 2: Our participants' portrayals of their spaces. All followed a similar view of their spaces, sticking to a familiar top-down floor plan view. Each of the participants talked through their spaces, and described considerations for how they placemake within them.

The first step has been described in our sections on the interviews and diary study, and we describe the remaining steps in the following sections.

3.3.1 Phenomenological reduction. This step involves setting aside presuppositions and assumptions about the world, including scientific, psychological, and philosophical theories, in order to focus solely on the phenomenon of placemaking in small spaces. This process allowed us to approach this phenomenon with a sense of openness and curiosity, free from the constraints of preconceived ideas or beliefs.

By suspending judgment and adopting a stance of phenomenological neutrality, our goal was to explore the essential structures and meanings of lived experiences of placemaking. Through this step, we aim to access the pure, unmediated experience of phenomena, uncovering their essential features, and the underlying structures that give rise to them. In this step, we analyzed the three textual data sets: interview data, captions of images provided, and researcher notes, as well as visual data from the floor plans and the images provided by the participants. Through this process, we found that we could analyze the data to derive two sets of findings: elements contributing to the act of placemaking; and the places created by our participants.

3.3.2 The Essential Structure of Placemaking in Small Spaces. To uncover the essential structure of placemaking, we investigated the meaning our participants attribute to their spaces in the act of placemaking. In DP, Giorgi highlights that "the interrogation of each meaning unit was to express, in a more satisfactory way, the implications of the life-world descriptions given by the participants" [17]. Meaning units in DP loosely correspond to themes in RTA.

Meaning units are segments of the text that contain a single thought or a coherent piece of information related to the phenomenon being studied. For instance, a participant's description of how they arrange technology to create a sense of separation between work and leisure areas in a single small room was a meaning unit. Each meaning unit was then analyzed to extract its core meaning, focusing on how it contributes to the understanding of placemaking in small spaces. This was done by abstracting and synthesizing the essence from each unit while discarding any redundant or irrelevant information.

3.3.3 Structure. The essential meanings derived from the individual units are integrated into a description of the lived experiences of our participants. This synthesis aims to reveal the underlying structures of the experience, such as spatial boundaries, temporality, and the role of technology, as identified in the study. We then grouped the meaning units into themes, which are grouped into two sections: in section 4, we talk through the elements that contribute to placemaking in small spaces (themes in sections 4.1 to 4.4); in section 5, we discuss the places created by our participants (themes in sections 5.1 to 5.7). The places reflected affectations or meaningfulness that the participant derived from their spaces. We have edited participant quotes for clarity, including modifications, where appropriate, to ensure that space and place are represented accurately.

4 ELEMENTS OF PLACEMAKING IN SMALL SPACES

This section details the elements that facilitate placemaking in small, constrained spaces; as identified through our phenomenological analysis. The interplay between physical limitations and the creative utilization of technology emerges as a central theme in defining and enhancing the functionality and affective resonance of these spaces. Through our analysis of participant experiences, we identified four elements in the transformation of spaces into places. These elements provide a framework for understanding the nature of placemaking in small spaces. Each plays a distinct role in how our participants used technology to alter how they perceived and interacted with their environment, impacting their ability to create places that not only fulfilled practical needs but also supported their emotional and psychological well-being. As we explore these elements, we consider both the individual's interaction with their physical and technological environments and the broader cultural and social implications of their placemaking strategies. This exploration not only highlights the adaptability and resilience of individuals living in small spaces but also offers insights into the
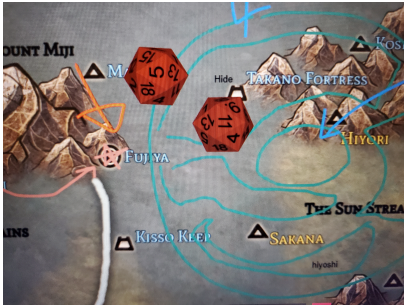
Figure 3: Milo's image shows how their technology works with time to transform their space into a place of connection.

potential for technology to facilitate meaningful spatial experiences in any living arrangement.

4.1 Boundaries

A distinction between "my space" and shared spaces was well-defined for participants living in shared spaces, while those living in small spaces of their own still have some sense of such boundaries. For example, Jack and Amy live in the same space, but Jack considers the entire small space to be both Jack and Amy's, while Amy only considers part of the space to be belonging to them (Amy). The connection between various spaces and a sense of belonging has been shown in previous studies from social spaces [18] to women-only swimming pools [32]. We found that the distinction between shared spaces and one's own space doesn't take away from a sense of belonging. Participants are finding ways of homing (as defined by Lynggaard [34]) within shared spaces.

Our participants usually drew spaces that they felt connected to, even if they lived in a larger space. Most of their personal technology use (laptops, phones, tablets) was confined to these spaces. Three of our participants lived in either multi-generation households or shared living spaces, and only identified a part of the space as their 'own'. For example, Faith drew only part of their house (Figure 2a):

> "The places I drew out, like the different rooms, or the different places in my house that are the most, I guess, prominent for me."

Interestingly, their space wasn't confined to a continuous area:

> "Sometimes I would go to my grandparents room just to talk to them and make conversation... sometimes I would go to my garage because our oven is in the garage like we have a smaller oven because we don't want to stink up the place when we cook stuff."

Participants would also engage in what we call "anti-homing," where those with agency over spaces would make them friendly to co-occupants to provide them with a greater sense of belonging. Faith, for example, would leave only shared food on tables in common spaces. If she wanted to signal that she was either preparing or consuming the food item, she would often leave her phone with a YouTube video next to the container. As in this instance, the intrinsic connection between space and belonging opens up a number of avenues for places of belonging to be created through technology.

4.2 Temporality

Place is temporal, and technology can mediate temporality in any space. Feelings of place being temporal was repeated across our participant pool, with everyone connecting a feeling of time with particular aspects of the places they make. This theme showcases the importance of temporality in making a place out of a space, and is reflected in shared activities that invoke a feeling of a specific time, or a specific time to carry out an activity. Odom et al. [37] brought together researchers to discuss research and design initiatives related to temporality, looking at time and the speed of temporality, and showcasing how design could enable placemaking for subjective experiences of time. Similarly, Rahm-Skågeby and Rahm [43] explored the design space of human-computer interaction (HCI) within deep time design thinking. The concept of place provides a sense of grounding for people (whether or not they have agency in the space) to understand time and temporality. As noted by Irvine [26] there are interactions between humans, technologies, and geological temporalities—the concept of place brings them together in one construct.

One of our participants, Milo, would convert their space into a place of social connection every Saturday. They connected this feeling of temporality to their screen (as shown in Figure 3, an image they shared of a computer screen with a pair of dice).

> "Typically one of the bigger highlights of the week, Saturday is marked by the Dungeons and Dragons session that marks the later half of my afternoon and evening. Even though we only play for around 5-6 hours a week, I think about the game throughout the week, running through scenarios, trying to solve problems, fiddling around with mechanics, or writing and developing characters. We've been playing for around three or four years. I can fall into some hermit lifestyle habits, and this day is usually where I get my socialization quota, unwind after a workweek, and catch up with friends."

Overall, temporality in space allows the creation of places that tie in time with the specific space to the user, teleporting them to different worlds (which Milo may appreciate as a power in their D&D game). Placemaking can thus enable effective anticipation for a new shared future (for example through shared calendars [14]) or while reminiscing about the past.

4.3 Mastery

Mastery can be obtained through creating autonomy and competence within spaces. While both these concepts are related to each other, we wanted to split them up for clarity. Autonomy and competence are presented in the following sub-sections:

4.3.1 Autonomy. Spatial autonomy is often inter-related with concepts of independence, self-governance, accomplishment and well-being [29, 49]. This is reflected in our participants', where autonomy and space are interrelated. In a similar vein, Murray et al. [36] found that "how learners imagine a space to be, perceive it, define it, and articulate their understandings transforms a space into a place, determines what they do there, and influences their autonomy."

While describing their space (Figure 4), Hudson said that:

Figure 4: Hudson's image of a clean, almost empty room reflects their sense of imperfection if there was any 'stuff' scattered around. This space, while imperfect in their own eyes, also allowed Hudson to develop a stronger sense of autonomy and agency within their space.

> *"Like mine won't look that great. And I will tell you right now, I'm a perfectionist. So I will probably hate it."*

In the same discussion, they provided more context around their space:

> *"Having blocked off the side of the room with my study table, being a bit of a perfectionist, feeling a bit over-whelmed due to the amount of things I need to do, and having another table, which is currently available for me to use with larger window and directly facing greenery in this space, are all factors which led me to believe that I do not need to rush myself with the cleaning process, and figuring out where everything should go. I have also surprisingly found myself open to the idea of re-arranging things after I decide to put them in one place. This is surprising for me personally as I was not a fan of moving things around as much in the past. The way I used to see it, things had one place where they would go, they didn't need to move around so much, (or at all really), once they had their place."*

The juxtaposition of a lack of competence, thus, did not translate into a lack of mastery in the same space. The space that created a sense of imperfection also allowed Hudson to develop a stronger sense of autonomy, thereby creating mastery within their space. This tension is usually resolved through creative use of technology—from phones to stand mixers.

4.3.2 Competence. Technology has the ability to create feelings of competence in their users. A lot of the time, this feeling is directly related to the task being performed, as shown when Jack talked about their small kitchen appliances (Figure 5):

> *"The idea is that I can feel comfortable when trying to make more elaborate meals. Because I have this tool, which makes it easier for me, instead of something that technically could do it. But it would take a lot of time. And the result wouldn't be as good as if I had done it with this sort of more professional specific tool."*

Figure 5: Amy and Jack's Space. For Jack, this space reflected a sense of mastery through their electronic appliances. For Amy, this was a place of utility and creativity in their food.

Keeping smart, application-focused appliances in a space has the effect of creating a sense of competence for Jack. A few of our other participants ($n = 4$) had similar feelings about their kitchens in general, and appliances in particular. It is interesting to note that everyone who built a place of competence through kitchen appliances liked cooking. There is a demonstrated link between perceived competence and enjoyment [6]. Creating places of competence would, through an improvement in perceived competence, create enjoyment. Thus, there are ways to mediate spaces to create places of perceived competence.

4.4 Future-Thinking

There is a distinct connection between a current place and longing for a future state. Our participants were always placemaking for the future. Whether it be for a future partner, a future move, or a future work opportunity, our participants have made place for it. There has been prior work on reminiscing in HCI which uses space as a cue [53]. Another line of inquiry has been work in history museums that connect the past to the museum space, to people through technology [8].

While temporality and space are intertwined in how they are imagined, most of these experiences reflect placemaking through prior experiences. For our participants, spatial design was focused on imagined futures (represting technology from laptops to televisions). In one instance, Anya positioned their couch on the basis of a forward-thinking thought:

> *"I placed my couch here so that I could have it to the side. And, um, I use the table to watch Netflix on my laptop, and I wanted the couch to feel accessible not just to me, but to a future partner as well. I placed it here so that he and I could watch movies and cuddle. If we felt tired, we could just go right up to the bedroom."*

To emphasize their point, Anya drew another image of their space, this time a floor plan in profile shown in Figure 6.

In conclusion, our findings show how our participants leverage their physical confines and technological resources while sense-making and creating places. The four elements each contribute to the enhancement of functional and affective aspects of these spaces.

Figure 6: Anya's image of the profile view of their space, showing a couch where they would spend time with a future partner.

(a)   (b)
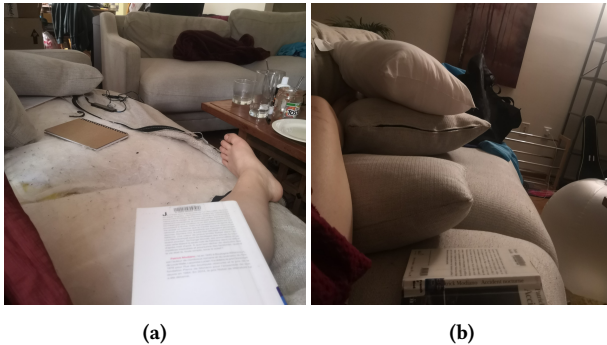
Figure 7: Jaime's pictures of their Places for Leisure.

Boundaries, for instance, help delineate personal space and manage privacy, while *temporality* underscores the transient and evolving nature of space. *Mastery* reflects the competence and autonomy in managing one's environment, and *future-thinking* provides a lens for imagining potential futures.

5 PLACES CREATED IN SMALL SPACES

In exploring the concept of placemaking within small, constrained environments, our study identifies seven distinct types of places that participants consistently described as emerging within their limited spatial settings. These places, each independent of a specific type of space within their homes or immediate environments, illustrate the versatile and dynamic nature of placemaking, even under spatial constraints. This section elaborates on each of these places, revealing the unique ways in which individuals utilize and transform these spaces into meaningful places that serve multiple purposes and evoke diverse experiences.

5.1 Places for Leisure

These are the places at the centre of our participants' "down time." Primarily, three devices form these places: cell phones, tablets, and televisions. Henderson and Frelke [23] have previously explored the relationship between space and the creation of place related to the theorized meanings of leisure for individuals and groups, and found that placemaking affects the overall quality of people's leisure experiences. Our participants used their phones or televisions to get to this place, showing that technologies for leisure create a sense of home, discovery, and belonging. The primary emotions are togetherness, relaxation, reminiscing, and desire for the future.

One participant, Jamie, described their leisure place (Figure 7) in their diary notes on multiple occasions:

> Day 3: *dying at midnight on the same sofa. Taking a very long pause from reading to watch YouTube videos on the sofa. Dying because it's very hot (30 °C). Can't go upstairs because upstairs is even hotter. Won't go to the basement because there's nowhere to sit there so I'm stuck on this sofa periodically changing the cushions I'm propped against to get the 'cool sides'. This continues for many hours until the house and I finally get cool enough to fall asleep.*

> Day 4: *drinking and eating snacks while watching a classic shojo anime with my roommate (still on the same sofa LMFAO I literally don't move). Not pictured is a large bag of tortilla chips on the sofa that I'm snacking from.*

5.2 Places for Work

Our participants had a place for work at the centre of their professional and social lives. Seven out of our eight participants were working from home (as opposed to a strictly work-oriented space), but for all eight, these places also became the centre of their social lives. Thus, places for work morphed into places of connection, work, productivity, and togetherness—showing that transforming space to places of work enables collaboration of all types. This finding also supports the theory in Harrison and Dourish [21], that the distinction between place and space could be successfully applied to collaborative work. While this phenomenon has been noted before as a blurring of boundaries [38], we argue that it is a *removal* of boundaries. This place affords designers immense freedom in creating technologies to make work more social (thereby reducing subjective stress [16]), or to create moments of social engagement between moments of work. Our participants primarily used laptops and cellphones to mediate these places. Anya used their place for work in multiple ways:

As their "happy" place in their house:

> "So I like that I can leave all my things out. And that my chair is comfortable. And then I like that I can get work done here. So I'm usually happy in this space."

To talk to friends:

> "I usually tend to either be sitting at the desk because I have thoughts that I know I can rest my phone ... if I'm doing a video chat with a friend"

To start their day:

"I think it's because the desk is a good height and the chairs are comfortable, but I do I start my day"

For another participant (Jack), the app *Slack* mediated a sense of a place for work wherever they were. Designers can design technologies that afford a sense of place for work in office places, autonomous cars, or even outdoors. Some examples could be virtual spaces for connection that can be combined into places for work once activated (like Slack, or Discord), or even forward-looking technologies like holographic telepresence systems [4].

5.3 Places for Proficiency

Our participants created places for proficiency through utility. No matter the activity, this place helped our participants feel more competent. For some, it was manifested through being able to practice self care, for others, through the creativity in the food they made. While it is known that space design can lead to increased feelings of mastery [24, 52], for our participants these places fit into daily rituals in a way that other places cannot. These places were mediated through small appliances, laptop computers, games, and gaming consoles.

Putting users in such places will enable easier completion of goal-based tasks in environments such as education, research, and unboxing experiences. For example, creating proficiency through small known tasks in new input technology could help users overcome learning curves. Similar applications in education may lend themselves to digital high performance simulator training in fields where skills build upon each other, like skilled trades, driving, or even flying planes.

5.4 Places for Comfort

Places for comfort are usually the most personal of places in multi-function spaces, and hold the most tension of all the places we identified. They are do-nothing or do-everything places—enabling positive inaction, rather than the negative themes usually associated with inaction [46]. This, in turn, helps reduce negative feelings in cases of negative outcomes [30]. These places are mediated through either a lack of technology or an abundance—two participants included two or more screens (tablet, cell phone or television). Interestingly, while Jack and Amy were interviewed separately, neither put their places for comfort into their drawings. Jack stated:

> *"Generally because ... the most interesting part of our apartment was just this main room. Because again, it's a combined sort of living room, office space and dining room. And the <place for comfort> is literally just that guy."*

For Milo, their place for comfort held more meaning:

> *"It's pretty much just like a comfort sort of, like coping place for me. Like, if I'm tired, I go to bed. If I'm sad, I go to bed. And if I'm like, feeling like okay, I have nothing else to do. I just lie in bed."*

Creating places for comfort through technology can help reduce anxiety and regret in cases where there could be perceived negative news or consequences, and could help assist with meaningfulness and meditation. Use cases of abundance of technology to reduce anxiety promise to be an exciting area for further study.

5.5 Shared places

These places allow multi-generational families, co-habitating friends, or couples to interact face-to-face and accrue memories. All shared places had a sense of familiar community, which usually led to tech-free zones or connection zones where technology was used as an augmentation. Shared places appear in HCI literature as spaces with tabletop (or similar horizontal) displays for collaboration and reminiscing in HCI literature as well with everything from multi-modal decision making [45] to rich personal storytelling [47]. Three examples of shared places are:

> Milo: *"Okay, so this is the dining table. So initially, this is a seafood one day. So like I was putting all my work and stuff here, but one day I found a bunch of food on my work and I was like, bro, who?... So some people like some things just are convenient to have on that table."*
>
> Anya: *"So does it move the chair in but I do um, if I wanted to have people over I would take my desk out and use it as a table probably in the middle of the room."*
>
> Faith: *"[My parents] always bring the food out onto the dining table, they never put it back in the fridge. Just because that they don't want my grandparents to, you know, fumble through the fridge and stuff. So putting it out there in the open, like tells them that there's food and they can eat from it."*

Shared places are versatile, and there is something unexpected every time you encounter one. This feeling of mystery and wonder makes them a place for familiar community, hanging out, relaxation, or implicit communication. Technologies that create shared places would enable the next generation of digitally mediated social interaction—one that doesn't feel mediated, but blends into the background, like a table under a feast. These places could be built through collaborative tabletop games (like the Infinity Arcade table [25]), audio games using voice agents; or interactive, asynchronous notes to exchange information.

5.6 Familiar places without a sense of belonging

Our participants constructed familiar places where they had no sense of ownership or agency, were very perceptive to changes, and found both beauty and disgust. Our participants ($n = 2$) sent us images of bugs instead of technology use, and attached affective responses to the pictures. While creatures (animals or insects) are not technology, these images reflect a reverse anthropomorphization—these living creatures are placed in the same category as digital tools as modes of companionship. Our participants had a number of familiar spaces close to their homes, as seen in Figure 8.

One of the common themes in this space was a sense of experimentation and growth based on the tensions between familiarity and a sense of lack of control. Paulos and Goodman [40] used a concept similar to familiar places to study interpersonal interactions. They used such spaces with 'familiar strangers', and built technologies to enhance interactions with strangers. Finally, familiar spaces could act as living laboratories for technology in motion, for example, using mobile-phone based exergames for anxiety reduction [54] within a space that becomes a familiar place over time,

(a)   **(b)**
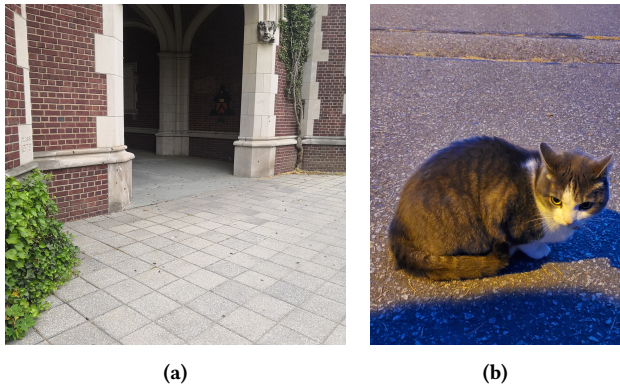
Figure 8: Our participants had a number of familiar spaces close to their homes. Quotes reproduced from the captions provided with the media. (a) Milo said *"Walking to work and there are [sic] a COPIOUS amount of dead cicadas on the ground (all the black dots). They're hanging off plant stems and walls as well. I even found one squirming on my doormat as i [sic] stepped out in the morning. It was gross gross gross."* **(b) Jaime said** *"Since quarantine, my siblings and I have found more time to take more walks around the neighbourhood. It helps combat the sedentary habits we've developed, and it's [sic] also tends to help scratch the itch to pet something furry, since we sometimes encounter a few of the neighbour's animals or strays."*

or applying geo-location based technology to augment spaces to create familiar places.

5.7 Unfamiliar places

Unfamiliar places are new and dynamic places that manifest themselves as places for problem-solving when our participants solved otherwise mundane problems in them, or as places for cautious discovery when they learn something within such places. Our findings add a new dimension to previous studies that have considered nature and the outdoors as a space for recreation [27], or in the context of elder adults and their anxieties around such places [41, 42]. One participant (Hudson), for instance, felt a sense of accomplishment when they were able find their way in a new city:

> *"I actually have been using Google Maps to find the grocery stores that I need to go to or like the nearest one. And I've been using my phone like I had to get my roommate to call an Uber for me the other day just because I had too much stuff that I bought at the store."*

An unfamiliar place helped Milo catch up on his media:

> *"I actually quite like commuting, and it can be one of my more relaxing parts of the day. Because the pandemic had drastically cut my travel, a combination of distrust and the sad fact of having nowhere to be, I've found myself too restless sometimes to sit down and just listen to the podcasts and new playlists, or read the e-books that I typically use to fill up the time I'm transiting. Now that I'm working again, and therefore*

> *commuting, it's been a chance for me to catch up on media I've been falling behind on"*

Unfamiliar places allow for cautious discovery, media consumption, and problem solving. Putting children, for example, in unfamiliar places while in a familiar space (classroom) may promote learning and discovery. Such tools could build on prior work [48] that has looked at building self-guided discovery models for education. Where leisure places are safe places for consumption and discovery, unfamiliar places act as places for either consumption of known content or cautious discovery of new content. Mediating these two places through technology can assist in changing engagement patterns—for example, for social media or media streaming sites. Finally, creating wonder and accomplishment through technology like smartphone applications in an otherwise unfamiliar space holds a lot of promise for improving the well being of older adults.

To summarize, this section provides insight into how small, constrained spaces do not necessarily hinder the creation of meaningful and multipurpose places, but rather, show that technology can enhance the creativity and utility of such spaces.

6 DISCUSSION

In this section, we discuss the implications of our findings for both theoretical frameworks and practical applications in design and technology.

6.1 Revisiting the Concept of Space and Place

Our study challenges the traditional assumptions that diverse placemaking needs big spaces. We demonstrates that even in constrained spaces, individuals can effectively create multi-functional and meaningful places. The emergent places identified—ranging from places of leisure to places for proficiency—showcase the versatility of small spaces when complemented by thoughtful technological integration and personal adaptation. This supports the assertion by Dourish [13] that understanding the interplay between space and place can lead to better-designed human-building interactions.

6.2 Design Implications

Technology plays a pivotal role in transforming mere spaces into vibrant places. The use of digital and electronic devices not only facilitates various functionalities but also helps in defining the emotional and behavioural contours of a place. For instance, the transformation of a kitchen countertop into a mastery place emphasizes the role of appliances in enhancing personal competence and autonomy. Similarly, the temporality aspect highlighted by our participants—where a single space serves multiple purposes at different times—underscores the dynamic nature of placemaking facilitated by technology. Recognizing that small spaces do not hinder placemaking but rather modify its expression, designers and architects can innovate more effectively within the constraints of modern urban living. Additionally, technology designers can consider how devices and interfaces can be optimized to support multipurpose use and emotional richness, enhancing the sense of place within limited areas.

6.3 Future Research Directions

While our study provides a foundational understanding, it also opens several avenues for further research. Future studies could explore the role of sensory experiences (e.g., sound and lighting) in placemaking, particularly in small spaces. Moreover, the impact of emerging technologies such as virtual reality (VR) and the Internet of Things (IoT) on the perception and utilization of space warrants closer examination. These technologies could potentially redefine the boundaries of place and alter the landscape of placemaking in profound ways.

Examples of research directions include:

- **Placemaking Deep Dives:** We have presented seven that our participants created while placemaking. Each place, however, could span an entire body of research. As an example, the place for leisure would benefit from additional research around technology that helps people create these places. Each paper builds on both this work, and previous work in HCI around placemaking [1, 3].
- **Changing Places:** In this study, we focused understanding the elements that enable placemaking in small spaces. As such, we learned that there are active changes between places in the same space, expanding on previous work that considered physical configurations of space [39]. Changing place through technology using a combination of the elements from section 4 holds promise in further understanding placemaking as a whole.
- **Fictional Futures:** Placemaking lends itself well to the concept and practice of fictional design [33]. Each place or situated constraint can be further explored through a series of fictional design studies, which would then point to a fictional future. These studies would be revealing within situations including human-robot interaction and intelligent agents, among others.
- **Negotiating Boundaries and Ownership**: Our study did not consider ownership of either place or space. Kuzminykh and Cauchard have laid a foundation for HCI research around ownership, and understanding how occupants of a space negotiate ownership of place would be an exciting new avenue to understand complex ownership issues in both— the digital and the physical realms.

6.4 The Role of Technology in Placemaking

The primary insight from our study advances the discourse on HBI [1, 3] and Ambient Intelligence [9], suggesting that effective placemaking is less about the physical size of a space and more about how technology can be leveraged to maximize the space's potential. For instance, consider a single small room with a table and chair (similar to a part of Hudson's space). This room can morph from a place for work to a place for leisure through a combination of a laptop and temporal factors, like the time at which work usually ends. The same space can then be transformed into a place for proficiency by removing digital technology and adding baking appliances and ingredients. In our study, the participants formed most places through a combination of smartphones and laptop computers. In addition to phones and computers, participants used appliances when forming places for proficiency. There were two

counter-intuitive findings that merit further investigation: places for comfort were formed either through an abundance of technology, or a complete absence of it; and, tablet computers were only discussed in the context of places for leisure or comfort despite six out of eight participants discussing having one. Overall, this paper illustrates how digital technologies and appliances can redefine space, enabling multi-functionality and adaptability even in the most constrained settings.

7 CONCLUSION

This study has explored placemaking within small spaces. Our findings reveal that, despite the challenges posed by limited space, individuals are capable of creating a rich multiplicity of places that reflect their personal needs, aspirations, and cultural practices. Our research contributes to the broader discussion on human-environment interactions by challenging conventional wisdom that equates larger spaces with greater potential for placemaking. We demonstrate that small spaces, when augmented with technological interventions and personal agency, can support the creation of dynamic and versatile places.

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