Reconfiguring the Home: Co-Designing the Future of Adaptive Domestic Environments

Serena Ge Guo
Information School
University of Wisconsin-Madison
Madison, Wisconsin, USA
gguo28@wisc.edu

Raquel Cañete
Engineering, Universidad Loyola Sevilla
Universidad Loyola Andalucía
Dos Hermanas, Sevilla, Spain
rcanete@uloyola.es

Jenny J Yu
Cornell University
Ithaca, New York, USA
jy865@cornell.edu

Gilly Leshed
Information Science
Cornell University
Ithaca, New York, USA
gl87@cornell.edu

Ian Walker
Dept. Electrical/Computer Eng.
University of Wyoming
Laramie, Wyoming, USA
iwalker2@uwyo.edu

Keith Evan Green
Human Centered Design; Mechanical & Aerospace Engineering
Cornell University
Ithaca, New York, USA
keg95@cornell.edu

Abstract

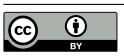
As domestic environments are increasingly required to meet diverse and changing human needs within constrained spaces, physical reconfigurability offers a promising solution. We developed a full-scale, manipulable room prototype as an exploratory co-design instrument, enabling participants to bodily explore and reflect on reconfigurable living spaces. Through 12 sessions with 30 participants involving brainstorming, bodystorming, and interviews, we identified spatial design patterns and elicited perspectives on reconfigurable domestic environments. Our findings contribute a design pattern catalogue for reconfigurable spaces, alongside insights into the lived experience of reconfigurability. We also discuss design principles, three affordance-based design dimensions that capture value tensions: empowering vs. restrictive, utilitarian vs. hedonic, and futuristic vs. practical, as well as lessons from co-design with a room-scale prototype. We demonstrate agile, room-scale prototyping as a methodological approach for spatial HCI research, advancing toward human-computer *habitation*, where interactive systems become inhabited built environments that support human values, creativity, and autonomy.

CCS Concepts

• **Human-centered computing** → **Empirical studies in ubiquitous and mobile computing**; *Ubiquitous and mobile computing design and evaluation methods*; **User studies**.

Keywords

Reconfigurable Environment, Spatial Interaction, Embodied Interaction, Whole-Room Prototyping, Co-design, Robotics



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CHI '26, Barcelona, Spain
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ACM ISBN 979-8-4007-2278-3/26/04
https://doi.org/10.1145/3772318.3793557

ACM Reference Format:
Serena Ge Guo, Raquel Cañete, Jenny J Yu, Gilly Leshed, Ian Walker, and Keith Evan Green. 2026. Reconfiguring the Home: Co-Designing the Future of Adaptive Domestic Environments. In *Proceedings of the 2026 CHI Conference on Human Factors in Computing Systems (CHI '26), April 13–17, 2026, Barcelona, Spain.* ACM, New York, NY, USA, 22 pages. https://doi.org/10.1145/3772318.3793557

1 Introduction

In 1890, American poet Emily Dickinson wrote, "I dwell in Possibility [23]." Dickinson's imagination transformed her modest bedroom into a universe of possibilities: an interior space that was continuous and transactional with herself and the outside world, much like a Möbius strip. Following in Dickinson's footsteps, other literary figures, artists, architects, scientists, and engineers have envisioned rooms that physically transform—spaces that adapt seamlessly to different functions, whether as a workspace, a creative haven, or even a fantastical retreat [77]. While writers and artists have provided the conceptual blueprints for such reconfigurable spaces through their words and images, and architects and engineers have developed foundational elements for reconfigurable environments, the realization of a fully operational, room-scale adaptive system remains a challenge.

Recent societal trends have intensified the urgency of this inquiry. Homes have long been multipurpose, supporting not only rest, sleeping, and socializing, but also informal work, caregiving, and hobbies [22, 65]. The COVID-19 pandemic further accelerated this shift, with many households suddenly relying on their homes as offices, schools, gyms, and even performance venues [3]. A survey of U.S. CFOs found that 74% of companies have permanently shifted employees to remote work [9], underscoring how the home must now accommodate functions once distributed across public and private infrastructures. At the same time, rapid urbanization and shrinking housing footprints pressurize dwellings to do more with less [74, 79], while sustainability concerns encourage compact living through the "tiny house movement" [25]. To accommodate the growing number of urban dwellers, homes are getting smaller: in New York City, dwellings now average, per person, 414 sq. ft., in

Paris, 388 sq. ft., and in Hong Kong (where home prices have tripled in a decade) 160 sq. ft. and, for subdivided apartments, a mere 48 sq. ft. [79]. Together, these forces highlight the critical need to reconceptualize domestic environments not as fixed backdrops but as adaptable interfaces, reconfigurable to support changing lives.

Prior work in architecture and HCI has addressed reconfigurability through a range of interventions. Dynamic architectural systems such as MIT Media Lab's *CityHome* [60] and *Escape Pod* [50, 61] provide important precedents for HCI, showing how sensing, actuation, and embedded computation can work together to transform compact apartments over time. Other projects have explored kinetic walls for aesthetics [47, 84], partition walls for collaboration [64], and robotic furniture or surfaces for functional adaptability [32, 69, 80]. While these systems have advanced mechanisms and control, they often center on discrete elements or specific scenarios rather than examining the broader spatial design patterns and holistic reconfiguration of a room as an inhabited unit. Equally, less attention has been given to how everyday people themselves configure and reconfigure such spaces, and how they envision, negotiate, and create meaning within these adaptive environments. Understanding this human–environment negotiation is essential if we are to articulate the broader design space of interactive domestic environments that should guide future interactive domestic systems.

To pursue this understanding, we adopted a research-through-design approach and created an agile, room-scale prototype, *"RobotRoom,"* measuring 80 sq. ft.—an area reflecting the minimum permitted for a bedroom under many building codes [48] and comparable to average living spaces in dense urban areas such as Hong Kong, Tokyo, and in Singapore. The prototype is intentionally manually reconfigurable and physically intuitive: walls and floors can be pushed, pulled, folded, and rearranged directly by hand (Figure 1). We employ the prototype as an exploratory, co-design instrument, enabling participants to discover through embodied interactions possibilities for reconfigurable living and to uncover experiential, social, and emotional dynamics before sensing and automation are introduced. Two key specifications for our physical prototype were that it was (1) full-scale (i.e., a room) and (2) easily reconfigurable (i.e., agile), allowing participants to physically explore the design space rather than through mediated experiences like VR or screen-based simulations. Our research questions are:

(1) What is the design space of a reconfigurable room?
(2) How do people experience and make sense of living within a reconfigurable room?

Across 12 exploratory co-design sessions with 30 participants (each lasting 2 hours), we uncovered a rich design space of adaptive living environments. Through analyzing participants' full-scale configurations, we derived spatial design patterns of configuration and reconfiguration that show how walls, floors, ceilings, corners, and furniture arrangements are composed and transformed to support everyday activities. From participant interviews conducted after the co-design sessions, we further characterized how people experience reconfigurability in relation to stability and routine, emotional anchors and personalization, control and effort, comfort and safety, and the sharing of authority in multi-user households. These insights illuminate how people might inhabit reconfigurable homes and how interactive domestic environments can be designed to balance functional demands, playful exploration, and human autonomy.

In this paper, we contribute to HCI, design, and architecture by articulating this emerging design space of interactive domestic environments and by framing it as a foundation for subsequent interactive, sensing, and robotic implementations. By shifting attention from technical novelty to participatory exploration, we frame the room as an interface that shapes action, meaning, and social relations [38, 39]. The spatial design patterns and experiential accounts we identify reveal not only how a room might transform, but when, why, and under whose control, offering experience-driven requirements for the next generation of interactive domestic systems.

2 Related Work

Interest in interactive environments and designing small spaces has grown, as evident in the literature and practice [6]. In this section, four main areas related to reconfigurable rooms are considered: historical visions, reconfigurable furniture, robotic walls, and co-designed domestic living environments.

2.1 Historical Visions of Responsive Environments

Early visions of responsive architecture laid the conceptual groundwork for reconfigurable rooms. In *Soft Architecture Machines* (1975) [63], Nicholas Negroponte imagined "intelligent" environments that could sense, learn, and adapt to their inhabitants — building on Gordon Pask's notion of a "reactive environment" forming a human–building mutualism [72]. Pask identified Negroponte and Christopher Alexander as among the few design researchers to make a credible start toward this vision [72]. Alexander et al.'s *A Pattern Language* [2] introduced the idea of "compressing" multiple spatial patterns into a single room, effectively anticipating the possibility of one room transforming into "many places."

These early provocations are increasingly realizable today, thanks to advances in sensing, actuation, and embedded computation. They have inspired a line of work at the intersection of architecture and HCI, from workshops such as "ArchiBots" [35] and "Arc-CHI-tecture" [17, 18] to recent efforts under the umbrella of Human–Building Interaction [1, 73]. However, much of this work has focused on discrete components (furniture, partitions) or conceptual frameworks. Research has yet to examine, the design space of a full-scale reconfigurable room and how might it respond to the everyday rhythms and desires of its inhabitants — a gap this paper seeks to address.

2.2 Reconfigurable Furniture

The increasing prevalence of small homes, driven by mass urbanization and sustainability concerns, has brought attention to the challenges and benefits of living in confined spaces. Small homes encourage sustainable living practices and reduced consumption while fostering stronger local relationships [52]. However, during the COVID-19 pandemic, these confined spaces were pushed to their limits. Studies show that smaller living environments, particularly those under 645 square feet, led to increased stress and



Figure 1: The exploratory 80 sq. ft. "Robot-Room" prototype: Left–two people manually reconfiguring it; Right–the prototype's configuration to create a playspace for small children and caregivers.

depressive symptoms, especially for those working from home without designated office spaces [3]. The rapid shift to remote work environments blurred boundaries between personal and professional lives, highlighting the need for adaptive home designs that accommodate diverse daily activities in small spaces [67, 83].

The growing demand for flexible, multifunctional spaces has resulted in various design innovations, from manually adjustable furniture like *Murphy beds*, foldaway tables [13, 26, 52], to motorized, automated systems. *Ori Living*, for instance, produces robotic furniture that retracts beds and closets into walls or ceilings, allowing one space to function as a bedroom, living room, or workspace at different times of day [70]. Similarly, *Bumblebee Spaces* offers ceiling-mounted storage and furniture systems that move vertically, reclaiming floor space and turning the room into a transformable volume rather than a fixed layout [59].

These solutions address space constraints by transforming furniture to accommodate multiple functions within a single space. While smart furniture integrates technologies to adapt to user needs [54], they remain primarily focused on individual furniture units rather than the entire spatial environment including its envelope. Our research furthers this approach to smaller spaces, proposing the design space for a fully reconfigurable living environment, adapting to human needs and wants beyond the limitations of individual furniture.

2.3 Robotic Walls: Transforming the Envelope

While the reconfigurability of facades has been extensively considered in architectural theory and practice, the reconfigurability of interior walls to dynamically shape domestic routines is a growing area of exploration. Early examples of kinetic walls primarily focused on aesthetic and artistic expressions, such as the interactive architecture by *Studio INI* [47] and the dynamic façade of the *Kiefer Technic Showroom* [84]. Other works, such as those by Hosseini et al. [45] and Li et al. [56], leveraged kinetic walls to optimize energy consumption.

Recent research has expanded beyond energy efficiency and aesthetics to consider how shape-changing elements can enhance user comfort, collaboration, and well-being in shared spaces. This includes studies such as Nguyen et al.'s [64], which explore partition walls in workplaces to support diverse needs and improve interpersonal dynamics. This work aligns with the broader fields of "Robotic Environments" [5] and "Architectural Robotics" [34], which integrate sensor-actuator mechanisms to enable responsive building environments. Foundational efforts in robotic surfaces have introduced innovations like "morphing ribbons" [81, 85], which bend, twist, and adapt in real-time to shape human activity.

Additionally, research on reconfigurable micro-spaces and shape-changing furniture provides a rich context for understanding domestic reconfigurability. For example, Gonzalez et al. [32] introduced constraint-driven robotic surfaces capable of human-scale transformations, while Suzuki et al. [80] explored *LiftTiles*, constructive building blocks for room-scale shape-changing interfaces. Similarly, *WaddleWalls* by Onishi et al. [69] presents a swarm of robotic partitions for interactive spatial partitioning, and *KirigamiTable* by Grønbæk et al. [36] demonstrates how shape-changing elements can support proxemic transitions. These studies illustrate the potential of reconfigurable components to support multifunctional domestic environments, though their primary focus remains on discrete furniture or room components (e.g., a single wall) rather than the full-scale reconfigurability of a room's entire envelope: floor, ceiling, walls, and furniture.

Room-scale systems such as *CityHome* [60] and *Escape Pod* [50, 61] further exemplify how interior walls and envelopes can be robotically actuated to multiply the uses of a small dwelling, often within highly instrumented living labs or demonstration apartments. Their contribution to HCI lies primarily in showcasing integrated, functioning prototypes of deformable space that tightly couple sensing, actuation, and compact living. In contrast, our work takes the room envelope as a co-design instrument: *rather than optimizing a particular robotic mechanism, we study how non-expert inhabitants configure and reconfigure a full-scale room by hand, and how they experience such transformations.* This approach surface experiential and social requirements for future interactive and adaptive systems.

2.4 Co-designed Domestic Environments

Co-design has become a critical method in smart home research [24, 42], helping align technology development with users' needs

and preferences [87]. Previous co-design efforts for smart homes have encompassed end users in multiple stages of the design process, including interviews [49], spatial layout design [24], storytelling [4], and user enactments of loosely-defined scripts [68]. These methods have been essential in understanding how people live in, interact with, and envision future smart environments. For instance, Garg et al. explored social contexts in smart homes, highlighting the importance of user-driven configurations for personalized spaces [27]. Fitton et. al. presented a design process that involved participants initially scripting exchanges with a smart home on paper and then making high-fidelity prototypes [24]. Similarly, storytelling approaches have demonstrated the benefits of considering daily routines and activities in envisioning future technologies and environments [4, 15, 19], benefits that are enhanced by integrating it with the design of the artifact, tangibly and materially, through design making [28, 41, 76]. Closer to our concerns, Desjardins and Wakkary's *Living in a Prototype* examined what it means to inhabit a reconfigured apartment over time, using an autobiographical "living in" methodology to study how residents appropriate and negotiate a transformable, prototype space in everyday life [21]. Their work foregrounds lived experience, breakdowns, and adaptations when a domestic environment itself is experimental.

Building on these methods, we integrated a full-scale, physical prototype in our co-design sessions, allowing participants to physically experiment with room configurations and explore future living scenarios. This hands-on approach provides valuable insights into how people might engage with adaptive, reconfigurable spaces, particularly in small, multi-functional homes.

3 The Robot-Room Prototype

Following design considerations of control, fidelity, and attention [68], we developed a full-scale prototype for co-design activities that is "agile"–easy to manipulate (Figure 1)–but not yet a robot. Rather than focusing on "implementation" prototypes, our emphasis was on exploring what the system might do for users and what forms of interaction it could enable [46].

The prototype provided an 8-by-10-foot floor area with an 8-foot ceiling (Figure 2), dimensions that reflect both the minimum permitted bedroom size under many building codes [48] and the compact living areas common in dense urban environments and university dormitories. Our goal was to create a full-scale environment that allowed participants to explore this constrained design space experientially. Compared to small-scale models [20], or VR and screen-based simulations, participants gained a more authentic and embodied understanding of the space.

The prototype's structural frame was built from extruded aluminum members and surfaced with white corrugated plastic sheets that had been laser-scored to fold and shift into different arrangements. This scoring system allowed walls, ceilings, and floors to be pushed, pulled, and reconfigured by participants into a variety of layouts. Our team had digitally modeled several potential configurations with the prototype (Figure 3), and also built corresponding scenarios with the physical prototype (Figure 4). We intended the scored panels to extend far beyond these initial examples, opening space for participants to explore new arrangements during the sessions. To keep interaction direct and tactile, panels were supported with Velcro attachments, plastic joints, and a thread-and-bar mechanism reminiscent of marionette puppetry.

Two of the four walls were left unpaneled to suggest fixed domestic anchors: entry doors, windows, and access to kitchen, bathroom, or closet services. These elements grounded the exercise in the realities of small living spaces while leaving the remaining surfaces available for manipulation.

Building on our prior work [40], different scoring strategies were used to vary how surfaces could be transformed. Walls and floors were "striated," with wider intervals that permitted rigid, 90-degree folds, while the ceiling was "smooth," scored more densely for continuous, curved transformations. These contrasting behaviors prompted participants to reflect on the affordances and limitations of different forms of adaptability within the room.

4 Method

We conducted 12 two-hour co-design sessions with 30 participants that included bodystorming activities.

4.1 Participants

Using the university participant recruitment system, we recruited 30 undergraduate and graduate students (22 females, 8 males, age M=21.1) for 12 sessions, each with 2-3 participants. Participants were compensated, choosing a $40 gift card or 4 course credits. Table 1 in Appendix provides an overview of the demographics and self-described living conditions of our participants. Despite the limitation of recruiting university students for this study, the majority of them currently live or have lived in the past in a university dorm – a single room, often with multiple residents, that serves multiple purposes and that is about 50-70 sq. ft. per person [14].

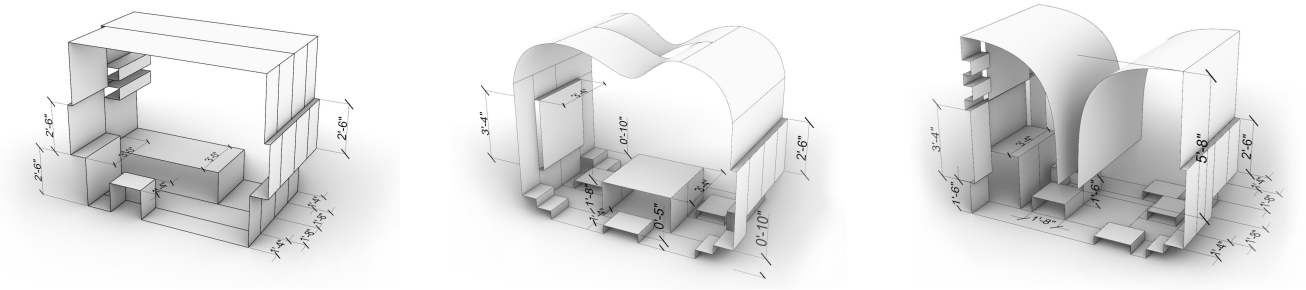
4.2 Procedure

Our procedure started with obtaining informed consent and demographic information. We then presented photos showing people living in confined domestic environments (e.g., 48 sq. ft. rooms in Hong Kong) to help participants understand the context. The session had three parts: (1) introductory brainstorming activities, (2) bodystorming activities [71] with the full-scale Robot-Room prototype [68], and (3) a closing reflection interview about the co-design experience and thoughts about future reconfigurable spaces.

(1) *Brainstorming domestic activities & space in Robot-Room (40 minutes).* Groups were initially prompted with one of three randomly selected scenarios [10, 51]: (1) "A study room you and your roommate will need to share"; (2) "A bedroom that you will use during the evening and night"; or (3) "A living room when your friends will visit." Participants spent 10 minutes individually brainstorming potential activities happening in the scenario (Figure 5 - a). Subsequently, they were asked to consider the tools and furnishings supporting these activities, organizing these into an Activities-Tools-Space matrix (Figure 5 - b). This process was designed to gradually guide participants to connect their domestic activities to the room's spatial design. Participants were then briefed on the Robot-Room layout to help them better understand the practical organization of this reconfigurable living environment.

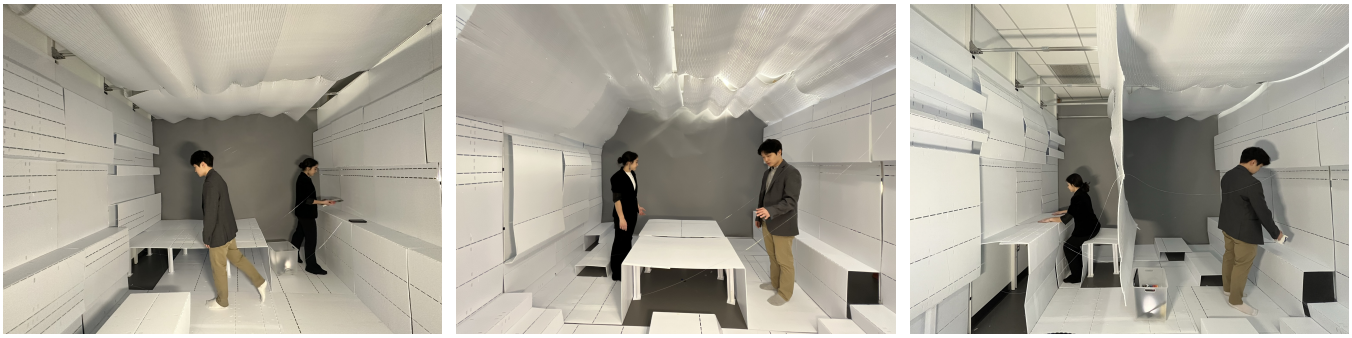


Figure 2: Photos showing the construction of the Robot-Room prototype.



a . Bedroom **b . Living room** **c . Study room**

Figure 3: Three of many digital models we developed, illustrating potential configurations for the prototype.



a . Bedroom **b . Living room** **c . Study room**

Figure 4: Full-scale physical prototypes that mirror digital models, translating abstract scenarios into embodied spatial configurations.

Finally, as a group, participants spent 20 minutes selecting activities and sketching their space design ideas on a provided floor plan and perspective views of the Robot-Room (Figure 8 and Figure 5 - c). They were also prompted to consider if they wanted to reconfigure the room into still other configuration(s); if so, they were invited to draw those on additional plans provided to them. All of the groups in the end designed at least two physical states (configurations) of the room.

(2) *Bodystorming and role-playing (50 minutes).* Participants then entered the Robot-Room to physically form the space. During this process, they worked together to directly manipulate the walls and floors by pulling or pushing on the hinged panels with assistance from the research team, as needed. After they achieved the desired room configuration, participants were asked to role-play the intended activities in the configuration they created. Due to the time limit for reconfiguration in the physical Robot-Room prototype, we asked participants to describe and act out how they want the Robot-Room to be reconfigured to fit other needs, if they designed so in the previous stage. The entire process was video recorded from the front of the Robot-Room.

(3) *Reflecting on the future vision of reconfigurable rooms (25 minutes).* In the final part, participants watched a video showcasing the research team's vision for Robot-Room as the same full-scale used in the study moves between four different configurations. (The video is provided as a supplemental document supporting this paper.) Participants were then asked a series of questions to understand their perception of our team's vision. The discussion focused on how participants made sense of the future vision for Robot-Room. Questions included prompts such as "Use one word to describe your impression of it," "Which scenarios do you see this being useful in, both inside and outside domestic settings?" "What are your concerns?" and "How should the system be controlled?" We audio-recorded this discussion. As part of this final interview, participants marked areas on a printed, perspectival view of the room where they believed reconfigurable robotic surfaces should and should not be located (Figure 8 - d).

4.3 Data Analysis

We collected data in two categories: (1) design outcomes, including documentation of the artifacts from the introductory brainstorming and bodystorming, and (2) reflection data, including audio recordings from the closing interviews and results from the shading activity. Our data analysis was collaborative and iterative: three co-authors met twice per week over 3 months to discuss, share ideas, categorize, and reach agreement on emerging themes and insights.

4.3.1 Design Outcome Analysis. To analyze the design outcome data, we focused on understanding how participants configured and reconfigured the Robot-Room during both the sketching activities and the full-scale bodystorming. Our design outcome data included (1) the introductory brainstorming outputs, including domestic activity lists (Figure 5-a), the "Activities-Tools-Spaces" matrix (Figure 5-b); (2) perspectives (Figure 5-c) and plan drawings (Figure 8) illustrating multiple room states; (3) photographs documenting the physical configurations participants constructed (Figure 6).

We first collated all artifacts onto a shared Miro board, with each group represented in a row and each design stage in a column (*brainstorming*, *planning*, *bodystorming*, and *shading*). Following the annotated portfolios approach [29], three researchers independently annotated each sketch and configuration. For each design element, we annotated its function (e.g., "work corner," "privacy shield," "sleep pod," etc.), the activity it supported (e.g., "Leisure," "vanity," "storage," etc.) and position in the room (e.g., "wall–floor intersection," "central floor," "ceiling").

We then collaboratively reviewed and clustered these annotations. Recurring patterns emerged around the spatial position of elements and the corresponding activities they supported. Based on these patterns, we decided to group interventions primarily by position (for example, *corners*, *ceiling*, *central floor*) and then examine the range of activities associated with each. As the process deepened, certain clusters were reorganized to reflect more meaningful distinctions across groups. For example, we initially grouped all codes referring to the middle of the room—such as *open center for movement*, *rug for sitting on the floor*, and *large central table*—into a single category. However, comparing groups revealed a clear conceptual difference: some intentionally kept the middle empty to preserve versatility, while others built large horizontal surfaces across the center to host collective activities. We therefore split this early category into two distinct themes: "central-floor as open, versatile space" and "void middle space utilized by creating large horizontal surfaces". Through similar rounds of refinement, eight configuration themes emerged, capturing how participants used walls, floors, ceilings, corners, and windows to support daily activities. These themes are reported in the first part of the Findings section 5.1.1.

In parallel, we analyzed how participants imagined the room changing over time. We placed each group's plan drawings and physical configurations side-by-side and identified each shift between layouts as a reconfiguration event. We inductively coded what changed (e.g., "central table collapses," "desk turns into bed," "screens rise from floor") and the activities supported for the change (e.g., "chill to party," "work to rest," "individual to collaborative work"). These codes were then grouped into two scales of adaptability: whole-room transformations and furniture-specific adaptations. Over several rounds of synthesis, these clusters stabilized into three whole-room reconfiguration patterns and four furniture-scale patterns, as detailed in the Findings section 5.1.2.

This analysis provided insight into our first research question: *What is the design space of a reconfigurable living environment?*

4.3.2 Design Reflection Analysis. To analyze the interview data, we focused on how participants imagined and interpreted living with the Robot-Room. We transcribed the interview recordings using Otter.AI, cleaned the transcripts, and organized responses by question in a spreadsheet.

The same three co-authors conducted inductive coding [82] of the interview transcripts. First, we independently annotated approximately 33% of the dataset by highlighting key quotes and generated open codes capturing participants' concerns, emotional responses, and justifications. Through collaborative discussions, we merged overlapping codes, split overly broad ones, and clarified boundaries between similar concepts. For instance, the early code "comfort" was subsequently divided into more specific codes such as material softness, bodily restfulness, and safety around movement. This process produced an initial pool of 21 open codes.

We then applied the refined codes to the remaining data. Each transcript was independently coded twice by different researchers and then reviewed through collaborative discussions to ensure interpretive consistency. Codes of the transcripts and annotations of the photographs were tracked in a shared spreadsheet, linking each artifact to emerging concepts. During this process, we iteratively added, modified, and merged the list of codes until no new ones emerged. After repeated consolidation, we arrived at a final codebook containing 10 analytic codes, each with finer-grained subcodes (Table 2 in Appendix). We then revisited all transcripts to recode them.

Once coding was completed, we organized all coded excerpts in a shared document and grouped related codes into initial themes. We examined patterns within and across codes to identify higher-level experiential themes. During this process, some codes were reinterpreted. For example, "Static Elements" initially referred to walls or corners that participants preferred not to move. As analysis progressed, it became clear that participants rarely valued these

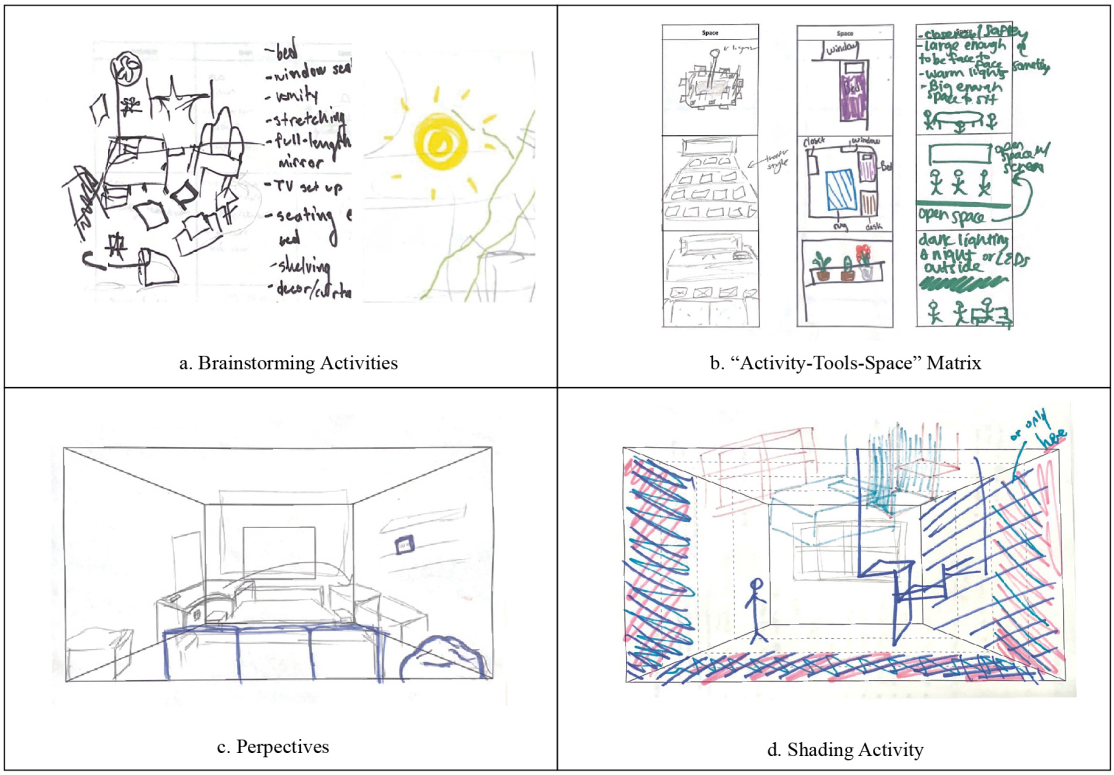


Figure 5: Design Outcome Examples - a. Brainstorming activities, b. Activities-Tools-Spaces matrix, c. Perspectives, d. Shading activity.

elements only for structural reasons; instead, they described them as emotional anchors, such as places to display photos, maintain continuity, or preserve a sense of self. As a result, "Static Elements" was merged with codes related to personalization, warmth, and identity expression, forming the theme "Emotional anchor and personalization". In a similar way, other codes were regrouped and abstracted into five experiential themes, which we report in Section 5.2.

Finally, we analyzed the shading activity data showing where participants would like reconfigurable surfaces. We traced these regions in Figma to create a composite heat map of preferred locations for robotic adaptability across all participants. As this exploratory analysis did not directly address our research questions, the findings will be reported in a separate paper.

This analysis provided insight into our second research question, *How do people experience and make sense of living within a reconfigurable room?*

5 Findings

While participants were initially prompted with three different scenario (*study room*, *bedroom*, and *living room*), our analysis revealed that participants' approaches to spatial reconfiguration were consistent across scenarios. Although specific furniture configurations varied, the underlying strategies for linking activities to spatial configurations remained the same regardless of the initial prompt. We therefore present our findings consolidated across the three scenarios to provide a comprehensive understanding of the reconfigurable design space.

5.1 Spatial Design Patterns

We examined the design space of a reconfigurable room by analyzing participants' drafted plans and physical prototypes, focusing on two key themes: *configurations* and *reconfigurations*. *Configurations* capture how participants shaped the space to meet their specific needs. *Reconfigurations* capture participants' transformation of their initial design (i.e., configuration) to achieve some other physical state (a subsequent configuration) of the same environment that addresses new needs and wants. Essentially, the findings in this section represent a spatial design pattern catalogue for configurable and reconfigurable rooms. The design principles derived from these patterns are discussed in Section 6.1.

5.1.1 ***Configurations.***

Figure 6 shows the configurations made by the twelve groups. Through the analysis of these configurations, we identified eight key themes of how space can be configured to support different activities and needs (Figure 7).

Wall-Floor Juncture to Form Large Functional Furniture. The juncture of walls and floors emerged as crucial areas for large functional furniture, with all groups (n=12) utilizing this space for



Figure 6: Design Outcomes: Physical configurations of our room-scaled prototype as formed by the 12 groups in the bodystorming activity.

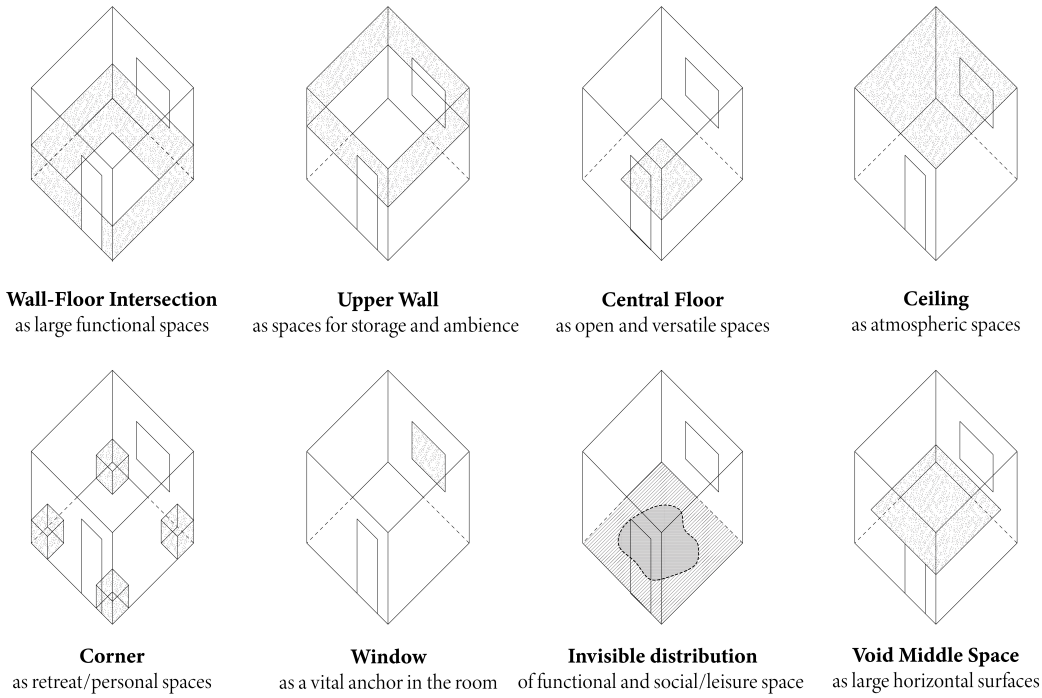


Figure 7: Eight key design themes synthesized from the configurations created by the 12 groups.

essential items like desks, beds, and couches. For example, Group 5 placed a side table and bed at this intersection (Figure 6-f), while others used the space for large desks suitable for studying (G1, 4, 7, 10) or L-shaped sofas designed for social events (G6, 8, 9, 12). This suggests that participants view the wall-floor juncture as a foundational element in creating functional, versatile living spaces.

Upper-Wall as Spaces for Storage and Ambiance. The upper wall space was predominantly used for storage, with over half of the groups (n=7) incorporating designs like shelves (G2, 4, 5, 7, 9, 10) and clothing racks (G5, 6). These elements typically remained static throughout the session. Additionally, some participants enhanced the room's ambiance through the use of lighting fixtures, such as disco lights for parties (G6) or ambient movie lighting (G9), and, in one case, a basketball hoop for casual play (G10). This use of upper wall areas suggests that participants valued these spaces both for their practical storage potential and for their ability to contribute to the room's recreational and aesthetic functions.

Central-Floor as Open, Versatile Space. The central floor space was intentionally left open by several groups (n=4) to maintain versatility, to support both personal and social activities. For instance, Group 5 kept the floor open to accommodate ad hoc relaxing furnishings like beanbags, while Group 7 envisioned this space as a physical exercise area for "yoga, stretching, practicing dancing." This open floor plan facilitated dynamic use of the space, such as the designs of Group 6 and Group 8, which featured a central rug where friends could "sit on the floor for gossip, eating, playing games, and chilling" (Figure 8-b and Figure 8-c). These examples suggest that maintaining an open center space is key to an accommodating confined space, affording a wide range of activities without the need for multiple, fixed furnishings.

Ceiling Area Providing Atmosphere. Although the ceiling was not a primary design focus for most groups, three groups (n=3) utilized it to create specific atmospheres or environments. Group 6 designed a disco ball for parties; Group 1 installed a partition wall to define distinct workspaces for two roommates; and Group 7 added a curtain hung from the ceiling to serve as a Zoom background. The relatively low design engagement with the ceiling suggests that participants overlooked the opportunity to utilize it to support daily routines. However, after watching our team's video (late in the two-hour session), we observed that many participants discovered and expressed a newfound appreciation for its potential to shape the atmosphere of the living space. As noted by Group 11, *"I really didn't think about using the ceiling, or like changing the shape of the ceiling to match the vibes in real life. If you want the room to feel a bit more homey and cozy...(P27)."*

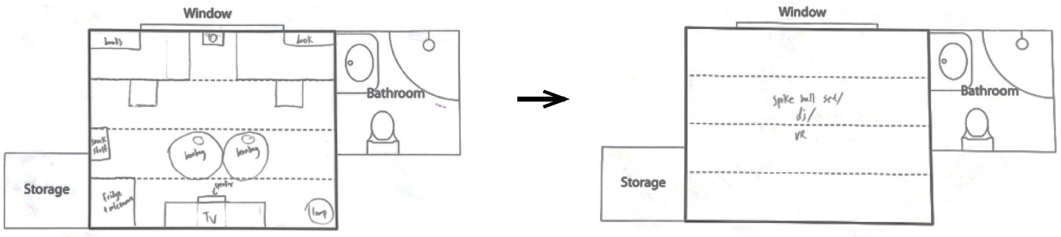
Corners as Retreat and Personal Spaces. Corners were often associated with personal retreat and relaxation, as demonstrated by several groups (n=5). For example, a self-identified neurodivergent participant in Group 1 designed a "fidget" corner to spend time with her cat (Figure 6-a), while Group 11 created a reading nook. P30 from Group 12 designed a personal retreat corner to use when *"my wife is socializing with her friends and I could take a rest here. I think a very comfortable self-corner is very important. So currently this...bit of the sofa is my corner because I have a side table where I put my coffee. I have lighting here..."* Descriptions of these spaces often included terms like "soft," "intimate," and "cozy," reflecting a broader trend of viewing corners as intimate, private areas that offer comfort and a sense of personal space within a room.

Windows as Vital Anchors. Windows emerged as pivotal anchors in the design process for several groups (n=5), often serving as starting points around which other elements were arranged. The natural light and views provided by windows were highly valued when participants to start their design (G2, 4, 5, 7, 8). People place beds or seating nearby to maximize these benefits, such as *"I keep my bed next to the window because I like sunlight coming in (G5)."* Some participants also placed plants near windows to enhance their connection with nature (P12 in G5). Others highlighted the social aspect, saying, *"Me and my roommate will sit...so we can share the window view (P9)."* This preference indicates that natural light and outdoor views enhance both the functionality and the emotional appeal of a living space.

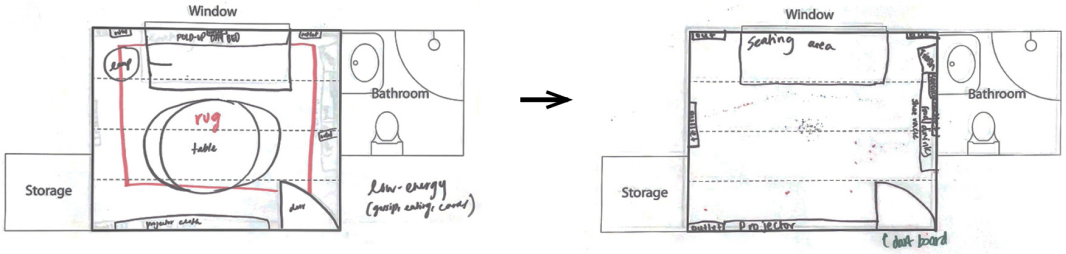
Invisible Distribution of Functional and Social/Leisure Spaces. Groups also demonstrated a clear preference for placing functional furniture around the room's periphery, reserving the center for social and leisure activities. This tendency was evident across all groups, with peripheral furniture including shelves, cabinets, desks for working, beds, couches for resting, and additional devices like fridges or vanities. In contrast, central areas were designed for social and leisure activities, such as a center table for social gatherings (G3, 6, 9), a large table for a hot pot (G12), and a day bed for friends to lie down on together (G10).

Participants valued the flexibility of central spaces for dynamic, casual gatherings: *"Some people sit on the floor, some people grab a bean bag or a chair from dining–you find that configuration that is...comfortable for you (P30)."* The importance of setting a diagonal body relationship during these interactions was also highlighted: *"Because [in this way] you're more intimate, and at the same time you still have that eye contact: you're close rather than sitting in front of each other. Thinking about the interactions I normally have, when you're in front of someone, I feel like I need to answer some questions(P30)."* Another participant noted, *"It's easier to talk to people when it's...arranged in a half circle; that's why I think having more chairs is better than having a super long sofa. Eye contact, and talking to each other, and also just easy to see the TV so it can be nice to have something that has different directions (P18)."* These insights suggest that while peripheral areas of the Robot-Room were often used for goal-driven tasks like work or sleep, the central space, where people could naturally arrange themselves diagonally, played a key role in fostering social interactions.

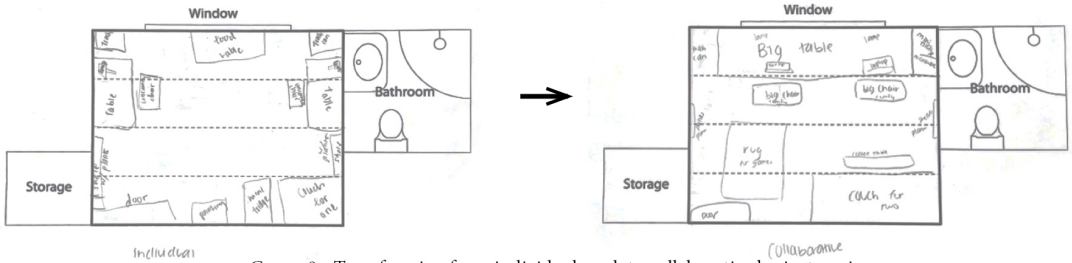
Void Middle Space Utilized by Creating Large Horizontal Surfaces. In response to the challenge of limited space, several groups (n=4) innovated by creating large horizontal surfaces in the middle of the room to accommodate a range of activities. For instance, Group 12 designed a large center table that could span the entire room for a hotpot dinner for eight people (Figure 8-e), while Group 6 envisioned a couch stretching across the room for group hangouts. Additionally, Group 7 designed large desks that could be joined together if two roommates wanted to brainstorm collaboratively, and Group 10 designed a big bed for friends to lie down on, chat, or watch TV together (Figure 6-j). These creative uses of space demonstrate a strategic approach to maximizing functionality within a confined area by effectively utilizing the empty middle space.



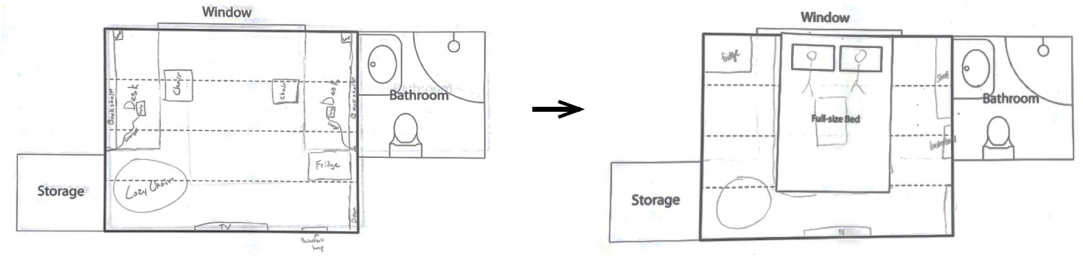
a. Group 4 - Transforming from work to physical exercise.



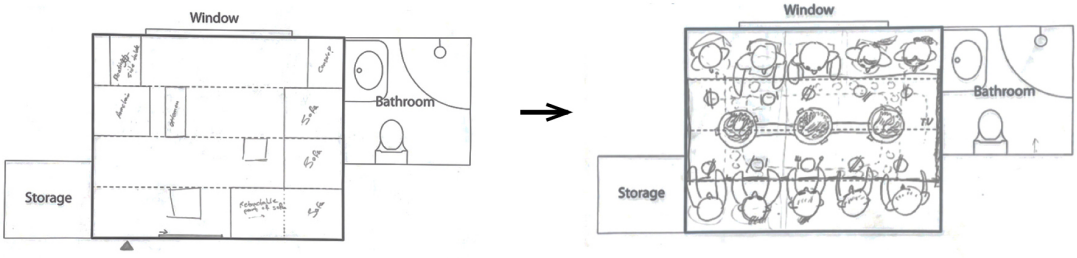
b. Group 6 - Transforming from casual sitting on the floor to lively party.



c. Group 8 - Transforming from individual work to collaborative brainstorming.



d. Group 10 - Transforming from individual work to social leisure.



e. Group 12 - Transforming from casual hangout to enthusiastic dinner.

Figure 8: Design Outcome Examples: Participants illustrating room state transformations (reconfigurations) on plans.

5.1.2 ***Reconfigurations***.
Reconfigurations involve participants modifying their initial design to explore other physical states of the same space. By encouraging participants to develop additional plans for a given scenario, we examined how they adapted and reimagined the room's configuration to accommodate evolving activities and contexts. When exploring reconfigurations, participants approached the concept on both a whole-room scale and a furniture-specific scale, illustrating different levels of adaptability within the designed spaces.

5.1.2.1 Whole-Room Scale Reconfiguration. When prompted to design for potential reconfigurations, eight groups conceptualized changes at a whole-room scale. Three main types of transitions emerged:

Chill to High-Intensity Social Activities. Groups (n=4) envisioned scenarios where the room's atmosphere would shift to accommodate different social dynamics. Group 6, for example, imagined a situation where friends initially sat on the floor, "chilling" (i.e., in a low-intensity state) and gossiping in a relaxed environment. This state could then transform into a lively party setting with projectors playing videos and music while people danced around the room (Figure 8-b). The physical configuration would change to support this transition, with a large central table collapsing to create open space for dancing, while lighting and a sidebar with drinks and snacks would form along the room's edge to facilitate the party. Similarly, Group 12 envisioned a room that could shift from a casual hangout to an enthusiastic hotpot dinner (Figure 8-e). In this scenario, friends would initially be in a chill state, sitting or standing around sofas and couches, chatting casually. As the gathering transitioned into a dining event, the side tables and couches would collapse, and panels would come together to form a large table spanning the room's center, allowing everyone to sit and enjoy hotpot together.

Rest-Work Transition. Groups (n=4) focused on the room's ability to accommodate both work and rest. Group 7, for instance, designed a bedroom space that could serve as a study and workout area during the night. They envisioned that when it was time to sleep, the large desk and chair would collapse, transforming into a full-size bed. This concept was also applied to shared spaces; Group 10 envisioned an individualized working area where each roommate would take one side of the room, working back to back. When they decided to relax, the workspace would collapse, forming a central large couch where both could lie down, relax, and watch TV together (Figure 8-d). Group 4 extended this idea to an extreme - when people finished working for relax, the furniture would be entirely cleared out, leaving the room entirely open for activities like spike ball, DJing, or VR gaming (Figure 8-a).

Individual-Collaborative Work Transition. The third type of transition involved shifting from individual to collaborative work settings. Group 8, for example, designed a study room where roommates could initially work on their own tasks independently. However, when teamwork was needed, the desks could be rearranged to form a large shared workspace, allowing for collaborative drawing and brainstorming (Figure 8-c). Similarly, individual couches could be joined together to create a larger, shared seating area, transforming the room into a collaborative environment that supports collective work and interaction.

5.1.2.2 Furniture Scale Reconfiguration. In addition to whole-room reconfigurations, several groups (n=6) explored reconfiguration at the furniture scale, envisioning various ways furniture could adapt to meet changing needs. These designs were categorized into four key themes:

Space-Saving. Similar to techniques applied in tiny houses [25], several groups focused on practical approaches to space-saving in small environments. For example, Group 5 proposed a bed that could expand at night and a table that could collapse when not in use, effectively freeing up space when it wasn't needed. Similarly, Group 3 designed a height-adjustable dresser, providing flexibility in storage options. Other space-saving solutions included sliding tables, such as a snack table (P18, G7), and a collapsible couch (G9) to accommodate varying numbers of people.

Comfort. Comfort was another key consideration in furniture-scale reconfiguration, where participants aimed to enhance relaxation. For instance, participants suggested a 90-degree surface that could be converted into a curved leaning surface when someone needed to rest (P22, G9). Group 9 also envisioned a collapsible ottoman for flexible seating that adapts to body needs, while yoga mats were integrated into the designs of Groups 2 and 5 to support stretching exercises.

Privacy and Social Need. Furniture reconfigurations also addressed the need for both privacy and social interaction. Group 1, for instance, envisioned screens that could rise from the floor to create temporary room divisions, offering privacy when needed between two people sharing a space, while still allowing for eye contact. Additionally, extendable tables were proposed by Participant 29 in Group 12 to increase surface area for collaborative use, enhancing social engagement during activities like dining or working together.

Adapting to Mood. In some cases, participants (P15, G6) simply suggested moving furniture around by reconfiguring them in different locations when people have different moods or want a different atmosphere. This flexible approach allowed the space to be easily modified to suit the inhabitants' emotional states.

5.2 Experiencing Reconfigurable Room

We examined how participants experienced and made sense of living within a reconfigurable room by analyzing their interview reflections. Across the data, five experiential themes emerged: *stability, routine, and feeling at home*; *emotional anchor and personalization*; *negotiating control, effort, and fatigue*; *comfort, safety, and trust in a moving room*; and *sharing authority and managing social connection*. These themes characterize reconfiguration not as a purely technical capability, but as a lived, ongoing negotiation between flexibility and groundedness.

5.2.1 ***Stability, routine, and feeling at home***. Many participants linked "home" to stability and familiarity. They were wary of a room that changed too often, worrying that it would interfere with routines and make everyday movement more demanding. One participant explained, *"I get really used to my living conditions. So I think it would bother me to have it...changing all the time. I would probably lose things a lot, and...I think I would keep bumping into stuff because I don't know where it is (G3)."* Another described a strong preference for arrangements that help maintain their routine: *"In*

real life, I actually...love my routines. I love fixed stuff. If that is my place, I get used to that place, and for the next five years, I want to sit in that place every day (G12)."

The timing of reconfiguration mattered as well. Participants emphasized that after a long day, they did not want to think about layouts or navigate a new configuration. As G3 put it, *"When I'm really really tired, I just want to… go to a place that I know."* Others imagined using reconfiguration only occasionally rather than every day. G5 suggested that *"the most often [I would reconfigure the room] seasonally [at most]…,"* highlighting that frequent change might be exciting initially but would likely fade into a stable default.

5.2.2 ***Emotional anchor and Personalization***. Participants described particular areas and elements of the room as emotional anchors that helped them feel at ease, recognized, and "at home." Fixed walls, ceilings, or corners provided dependable places to display objects and preserving meaningful traces of life. For example, the ability to keep certain displays in view—photos, posters, or cherished objects—was what made a space feel emotionally safe. G2, for example, imagined leaving a far wall unchanged so that *"a picture that you just want to keep up"* could remain visible, while G9 talked about using a wall to *"hang a picture, a poster, you could mount a tv… there are elements that are nice to have something permanent."* P22 similarly highlighted that their existing room felt emotionally charged because *"our walls have the same photos they've always had."* Participants extended this logic beyond the domestic setting: P15 suggested that a patient's room could *"make it feel more homey, based on their personal preferences,"* treating emotional anchors as especially important in vulnerable situations.

These anchors were tightly linked to self-expression. Participants wanted the room to carry their history, values, and taste, not just to change shape on demand. P27 described home as *"your permanent living space… It should be...an extension of yourself,"* and P28 added, *"I would like some things to be about me… That's what I associate 'at home' with,"* expressing the sense of belonging. Reconfigurability, in this view, was compelling when it could *"show your style" (P9)* and allow people to put *"their little touches, like color, change the vibe,"* so that *"it becomes homey and cozy" (P14)*. At the same time, several participants worried that a strongly tech-driven aesthetic might crowd out these emotional signatures. P10 remarked, *"I don't know if I like tech-oriented spaces. I think it's more about the art pieces you put up that expresses your personality,"* while P8 said, *"I want my furniture to be like old furniture. I don't want robot...aesthetics."*

Visual and material qualities played an important role in whether configurations could function as emotional anchors. Participants repeatedly described the all-white prototype as cold or anonymous. P13 felt that *"maybe because it's all white, it kind of gives off coldness to it, like maybe if there was a pop of color...you could customize"*; and P7 emphasized, *"if you have different furniture from...different brands with different materials, it adds variability. But I guess with this system, everything looks the same."* For participants, a preferred configurations included colors, textures, and accumulated objects that hold emotional meaning and signal "this is my place," rather than simply demonstrating the technical ability to move walls and surfaces.

5.2.3 ***Negotiating control, effort, and fatigue***. Participants also framed configurations as sites of negotiation between control and effort. They liked the idea of having agency over the room, especially in contexts where people typically lack control. P30, for example, imagined Robot-Room in a hospital setting, lending the patient "a sense of autonomy" in shaping the patient room for themselves. Similarly, P11 remarks, *"It's fascinating to see how I would design the room if I had...all the freeness [of a Robot-Room] to do it (P11)."*

At the same time, participants were acutely aware that exercising their agency demands some physical work and mental planning. For some, the prospect of reconfiguring large pieces multiple times a day felt unrealistic. G3 imagined having to shift between "a working space,a bedroom, a playroom," concluding, *"I think I would get tired."* G5 described reconfiguration as "constant labor," especially when beds were involved: *"There's constant labor involved, moving your bed. How many times are you willing to change your room? 3, maybe 4 times a day is a lot of work."*

The cognitive overhead of configuration also came up. G5 contrasted nudging a single table with rethinking the whole layout: *"It's hard enough to just go 'oh, I'm going to move this table over here.' But this is...redesigning the whole room. There's a certain effort that goes into that."* G3 wondered whether they would need instructions for each configuration or be expected to *"think about it on the fly."*

Automation and presets emerged as one way to maintain control while reducing fatigue. G11 noted that *"if it's automated–you can just press a button–I'd be redesigning [the room] a lot more."* At the same time, participants were concerned about the practical details that automation would gloss over—such as whether blankets or objects left on surfaces would jam the mechanism. G12 pointed out that *"if it comes with a system that you can pre-arrange a couple of things, so that you press a button and certain arrangements takes place…,that may...make sense; but then the details of that get too crazy like, have you taken off the blanket or not before you press the button? Would it jam the system?"* It shows that participants valued the autonomy Robot-Room could provide, but only when the work of achieving and maintaining configurations remained manageable in everyday life.

5.2.4 ***Comfort, safety, and trust in a moving room***. Comfort and satisfaction with the room were inseparable from whether participants trusted it to move safely around them and their belongings. Several participants raised concerns about bodily risk. P4 asked, *"what if while it's changing, you get squished?,"* and G9 imagined pinch points where someone could *"lose a limb if it's under a table and the table goes down."* G5 emphasised wanting a stationary bed, saying, *"I like the idea of my bed being stationary… I wouldn't want anything around my head to be able to move or anything like that, just for my comfort and safety."* Others worried about children and pets; G6 commented that *"my dog would freak out. She's also very small, so everything is big to her."*

Materiality and bodily feel also influenced how restful configurations appeared. G11 compared the prototype bed to conventional furniture: *"Beds look homey and cozy, but this bed is just a slab, so it's hard to visualize yourself sleeping on it."* G12 wondered whether panels could *"transform into a squishy material,"* imagining transitions between hard tables and soft, textile-covered seats.

Personal belongings introduced another layer of vulnerability. G3 described the friction of having to clear surfaces before changing

layouts: *"if I have like stuff on top of it… if I were to change the configuration, I need to move everything somewhere. It basically needs to be like furniture without anything on it, for it to be super easy."* Others worried about where mattresses, blankets, or fragile objects would go during transitions, or how the system would cope with everyday clutter.

5.2.5 ***Sharing authority and managing social connection.*** Finally, participants' responses showed that reconfiguring a room is a social as well as spatial act. In shared living situations, changing the room meant changing how people encountered one another, what they could do at the same time, and who had to do extra work. Participants worried about unilateral decisions that ignored others' needs. P23 remarked, *"You don't want to act like, 'Oh, I changed the room,' and they were blindsided by it,"* emphasizing the importance of communication and shared decision-making.

Division of labor was a recurring concern. Participants imagined that reconfiguring a shared room would often fall on the shoulders of the person most willing or able to clean, move objects, and reset the space. P22 drew a sharp contrast between living alone and sharing responsibility: *"If I were living by myself, it might actually be really nice. I'm the only person responsible for making sure it's clean and able to move around. If it was fully automated, I could see it being super useful."* Implicit in this comment is the worry that, in a shared household, the same person might still be expected to keep the space "able to move around," even if everyone benefits from the transformation.

Participants envisioned reconfigurable rooms as creating both tensions and opportunities for social connection. On one hand, reconfigurable zones could carve out pockets of privacy or focus in limited space. On the other hand, they could also make conflicts more visible—for example, when one person wanted "work mode" while another wanted "social mode" at the same time. Participants imagined using reconfiguration to temporarily prioritize one occupant's needs (e.g., creating a quiet workspace while others socialized elsewhere), while acknowledging that these trade-offs would require ongoing negotiation and could occasionally be contested.

6 Discussion

In this paper, we employed the robot-room prototype as a full-scale co-design instrument, enabling participants to directly manipulate and reimagine spatial configurations through embodied engagement. As everyday life grows more dynamic and space becomes increasingly constrained, the capacity for rooms to flexibly adapt emerges as a crucial dimension of design.

This work extends HCI's trajectory from desktop computing [8] to ubiquitous computing [8] by proposing human-computer *habitation*, where interactive systems become the inhabitable environment itself. Our study builds on earlier provocations such as Negroponte's "soft architecture machines" [63] and Mitchell's vision of a "robot for living in" [62], reframing them both in terms of reconfigurable domestic settings. These future living spaces may morph around us quietly, enabling fluid transitions between rest and work, intimacy and sociability, or solitude and gathering.

The implications of reconfigurable space extend beyond the home. Some of these were identified by participants during co-design sessions: spaces for wellbeing (spaces adaptive to mental and cognitive challenges, e.g., in older adults), working life (adaptive, interactive workspaces), and medicine (supportive patient rooms).

Our process yielded insights into (1) design principles for reconfigurable rooms, (2) qualities of reconfigurable spaces that constitute a sense of "home," and (3) methodological reflections on co-designing with full-scale, manipulable prototypes. We discuss these below, emphasizing how reconfigurable space design should balance flexibility with stability, personalization, and user control.

6.1 Design Principles for Reconfigurable Spaces

Our findings point to core principles for designing reconfigurable environments.

6.1.1 Providing Functional Anchors. Structural intersections and corners should be treated as primary anchors for reconfiguration. Participants consistently appropriated the wall–floor intersection for essential furniture such as desks, beds, and couches, taking advantage of its stability and capacity to host large, multifunctional items. Similarly, corners emerged as personal and intimate zones, supporting activities of retreat, self-regulation, or reading. These patterns suggest that robotic reconfiguration systems should leverage architectural anchors not only as static boundaries but as strategic sites for stability, privacy, and reliability.

Effective reconfiguration requires anchoring certain elements (e.g., fixed walls, windows, or structural corners) while allowing others to flexibly adapt. Inhabitants used fixed elements to orient themselves and relied on movable pieces to create variation. Robotic environments should therefore be designed to balance these qualities, using stable anchors for orientation and safety, while ensuring that movable elements can flexibly adjust around them to support evolving activities.

6.1.2 Considering Vertical Spatial Layers. Reconfigurable systems must address the vertical stratification of space, where each layer affords different opportunities. The upper wall supported storage and ambient features, such as lighting and decorative elements. The ceiling, although less frequently engaged, was used to create atmosphere, shape mood, or divide spaces through hanging structures. Finally, the void middle space was often converted into large horizontal surfaces for meals, collaborative work, or collective rest. These practices underscore the importance of designing reconfigurable systems that can dynamically orchestrate activities across multiple vertical layers, rather than focusing solely on the floor plan.

6.1.3 Maintaining Dynamic Open Space. Open and adaptable central areas are crucial for supporting diverse uses. Participants used the central floor as an unconstrained space, enabling flexible configurations for exercise, stretching, or informal social gatherings. Participants also highlighted social geometries, such as diagonal or semi-circular arrangements, which facilitated intimacy and casual interaction. For robotic environments, this principle highlights the need to support fluid transitions between functional and social uses, and to accommodate embodied patterns of sociability.

6.1.4 Multi-Scale Adaptability for Work, Rest, and Sociality. Participants engaged in reconfigurations at both the whole-room and furniture scales. Some reimagined the entire layout, clearing floors or merging desks, while others focused on individual furniture elements that collapsed, expanded, or shifted to serve new functions. Reconfigurable systems should therefore operate at multiple scales—offering macro-level transformations for atmosphere and group activity, while also supporting micro-level adjustments of furniture for comfort, privacy, or task-specific needs.

Participants envisioned reconfigurations that aligned with shifting rhythms across the day and week—such as turning workstations into beds at night or transforming a lounge into a hotpot dinner space. Robotic reconfiguration systems should explicitly support these temporal rhythms, enabling environments to flexibly respond to changing contexts of productivity, relaxation, and collective gathering.

6.1.5 Integrating Emotional and Social Flexibility. Reconfigurations were not only functional but also affective: participants modified furniture and layouts to reflect mood, enhance comfort, or mediate privacy and sociability. Some suggested screens to carve out temporary retreats, while others rearranged couches to create more intimate geometries. This highlights the importance of designing reconfigurable systems that go beyond task support to actively shape atmosphere, mood, and social connectedness.

6.2 Affordance-based Design Dimensions

As previous home and design researchers have noted, designed artifacts can "directly involve users in imagining, reflecting on, and telling design stories through material exploration" [4], and tangible materials help participants probe *functionality*, *interaction*, and *aesthetics* in detail [28, 76]. In our study, participants' reflections reveal that reconfigurable rooms are not only spatial systems but experiential ones; the meaning of the environment emerges through what actions it affords or constrains [31, 66]. Building on the experiential themes in Section 5.2 and the spatial patterns in Section 5.1, we use *functionality*, *interaction*, and *aesthetics* as organizing lenses, and synthesize three overarching affordance-based design dimensions that capture how people navigated value tensions when imagining reconfigurable living. These dimensions—empowering vs. restrictive, utilitarian vs. hedonic, and futuristic vs. practical—constitute a design space that links physical adaptation with lived experience. They clarify how the same spatial mechanism (e.g., movable walls) can afford autonomy for one user, labor for another, and discomfort or delight depending on context.

6.2.1 ***Empowering vs. Restrictive:*** *Affordances for Agency vs. Self-Expression.* This dimension foregrounds the *aesthetic* lens, drawing together our findings on emotional anchors and personalization: participants cared not only about what the room could do, but about whether its visual and material character could carry their history, tastes, and values. For many participants, the reconfigurable room clearly afforded agency. Compared to "regular rooms" that felt institutional or standardized, a robot-room was imagined as something that could be actively shaped: walls that move, surfaces that fold, and layouts that shift with mood, task, or social situation. These affordances were not only about spatial efficiency, but about being able to decide when the room would become a workspace, a lounge, or a retreat. This sense of empowerment was especially vivid in contexts where people usually lack control. Several participants, for instance, imagined long-term hospital patients using a reconfigurable room to pull light closer, create a small alcove for visitors, or soften the space around the bed. Even a modest ability to change the environment was described as giving patients "a sense of autonomy" and the feeling that they still "have the power to" make meaningful decisions about their surroundings, rather than being entirely dependent on staff or fixed architecture. Here, reconfigurability acts as a tool for self-authorship, aligning with work showing that spatial customization supports identity formation and well-being [16, 33].

However, the very same mechanisms could feel restrictive. Participants repeatedly drew a line between moving architectural elements and the "meaningful things" that make a place feel like home. It is a valid worry that an "everything is a system" aesthetic might impose a homogenized look and diminish the expressive richness found in collected objects, various brands of furniture, and the small traces of everyday life [58]. Automated walls and furniture, while flexible, could constrain the kinds of meaningful, idiosyncratic cues found in static homes, such as "family photos pinned to a wall" or "the specific spot where coffee and books accumulate" that carry personal history.

This tension suggests that agency is not only about what can be changed, but also about *what is allowed to remain unchanged*. This implies that reconfigurability should not replace personal anchors; it should frame and support them. For designers of adaptive environments, this means supporting a continuum of user control, from rapid, on-demand transformations to areas that are deliberately stable over time, so that residents can both act on the room and let the room hold their identity and emotional grounding.

6.2.2 ***Utilitarian vs. Hedonic:*** *Affordances for Function vs. Atmosphere.* This dimension articulates the *functional* lens, connecting to our findings on stability, routine, and feeling at home: participants wanted reconfigurability to help them manage overlapping programs and temporal rhythms, without constantly reinventing their everyday life. Participants also navigated a clear tension between utilitarian and hedonic affordances. On the utilitarian side, Robot-Room was seen as a way to support efficient living in small spaces where a single room must serve as office, bedroom, gym, and social space. Here, reconfiguration affords functional clarity and efficiency. Participants wanted the room to help them separate "work mode" from "rest mode" in environments where those blur easily. Some even extended this across life stages: a room that starts as a children's play area, then later reconfigures into a laundry zone or study space as the child grows. These affordances spoke directly to contemporary needs for hybrid living and tiny-house strategies, which stretch the utility of a fixed footprint [12, 25].

At the same time, participants clearly valued hedonic affordances: the room as a source of play, atmosphere, and emotional refresh. Many of their scenarios centered on social pleasure, such as friends sitting on the floor around a central rug, a large table that appears only for hotpot dinners, or a couch that stretches across the room for late-night movies. These observations align with work in somaesthetic and affective design, which argues that environments

can shape emotional tone and embodied experience [44, 57]. Others imagined the room transforming into a cinema, a jungle gym, or a game space with dynamic lighting and sound, or extending beyond the home into offices that turn into ping–pong areas or entertainment pods after hours, and commercial venues like high-end performance stages, playrooms, or gaming cafés that constantly reconfigure to surprise visitors. The "success" of the room is not only whether it fits more activities into a footprint, but whether it can support moments of delight, togetherness, and reset. This view echoes Hassenzahl's distinction between pragmatic and hedonic qualities, where systems are also evaluated for how they stimulate, express identity, and shape emotional experience beyond instrumental goals [43].

This dimension illustrates that affordances are not only about what a room can do, but about facilitating *ritualized temporal shifts*: the room visibly switches from work to play, from ordinary time to special time, and from everyday functionality to staged moments of shared enjoyment. Designing reconfigurable environments, therefore requires sensitivity to when and how these transitions occur, so that functional changes in layout are coordinated with affective shifts.

6.2.3 ***Futuristic vs. Practical:*** *Affordances for Imagination vs. Everyday Maintenance.* The third dimension foregrounds the *interactional* lens, tying back to our findings on negotiating control, effort, fatigue, and shared authority: participants used Robot-Room to think through how future systems should share control with them, and what kinds of interaction would feel manageable in everyday life. On the futuristic side, the Robot-Room was often treated as a speculative platform for radically different forms of living. Several design scenarios extended beyond current apartments to high-density urban micro units and even space habitats. In these visions, fully automated, continuously transforming shells were imagined as the key to making extremely compact dwellings viable: a single robotic envelope would orchestrate work, leisure, sleep, and social life within a footprint that would otherwise feel uninhabitable. Dynamic automation, in this sense, affords both novel experiences and the imaginative leap to future housing infrastructures [34].

However, participants also raised practical concerns of everyday domestic life. Across groups, concerns clustered around the cost of installation and electricity, the safety of moving structures around children and pets, and the possibility of structural or electrical failures during reconfiguration [7]. Participants worried about dust, spills, and everyday clutter interacting with moving panels, about who would maintain and repair the system, and about whether older adults or non–tech-savvy residents would manage complex controls. The material panels themselves were questioned: could one surface realistically be comfortable enough as a bed, robust enough as a table, and durable enough for years of daily use? From this perspective, manual or semi-automated mechanisms afford familiarity, legibility, and ease of maintenance.

This dimension illustrates that affordances are not only about how many transformations a room can support, but about how *predictable* and *legible* those transformations are. Designers must decide which transformations genuinely benefit from sophisticated automation and which are better served by slower, manual, or semi-automated actions that keep the system understandable, maintainable, and compatible with long-term domestic appropriation.

6.3 Reflections on Co-Designing with Agile Prototyping at Room Scale

Co-design has been widely used to surface how people imagine and negotiate smart homes, often through scripts, storyboards, layout plans, and enactments in existing domestic settings [4, 15, 19, 24, 68, 87]. Desjardins and Wakkary's *Living in a Prototype* pushed this further by asking what it means to inhabit a transformable apartment over time, treating the home itself as an ongoing design probe [21]. Our study builds on this trajectory but repositions the co-design "material" as a full-scale, agile, reconfigurable room: instead of only talking about future homes or living long-term in a fixed prototype, participants bodily rearranged the architectural envelope in short, intensive sessions.

6.3.1 From Conceptual Scenarios to Embodied Reconfiguration. Previous studies on adaptive architecture and smart environments have often relied on digital simulations or tabletop prototypes to explore design possibilities [37, 53, 55, 75]. Co-design methods in smart home research often follow a similar trajectory: participants script interactions with future systems on paper and then create artifacts or storyboards that capture desired behaviors [4, 24]. These approaches are powerful for mapping expectations and high-level scenarios, but they offer only a limited sense of what it feels like to inhabit and physically manipulate a transforming room. While these tools are effective for early ideation, they fall short in capturing the embodied, spatial experiences of interacting with a full-scale environment. We addressed this gap by providing a tangible, physical interface that participants could inhabit and manipulate directly. Participants did not simply specify where walls "should" move; they pushed, folded, and repositioned surfaces with their own bodies, negotiating circulation, sightlines, and proximities in real time. For a detailed analysis of these embodied board-manipulation practices, see Guo et al. [40]. This direct manipulation enabled them to discover constraints and opportunities that rarely surface in two-dimensional plans. The ability to physically adjust wall and floor panels encouraged participants to experiment with creative furniture arrangements and explore transitions between states, such as work-to-rest reconfigurations. In contrast to Desjardins and Wakkary's long-term "living in" methodology [21], which foregrounds appropriation over months, our sessions foreground short, intensive episodes of exploration with diverse participants. The two approaches are complementary at different stages of design: long-term inhabitation reveals how people live with and around a working prototype, while our agile and low-fidelity prototype enables people to use their bodies to search, debate, and negotiate possible configurations before any particular implementation is fixed.

6.3.2 Prototype Geometry Shapes What Can Be Imagined. Co-design literature has argued that tangible materials and "making" activities help participants think through functionality, interaction, and aesthetics in detail [4, 28, 76]. Our findings suggest that at room

scale, the prototyping medium does not just support reflection, it actively structures which futures can be explored.

The foldable grid of walls and floors in our prototype afforded quick, safe manipulation and made the system legible. Participants could try out many configurations within a short session and see how the room responded. At the same time, they quickly became aware of what the prototype would not do for them. Fixed fold intervals made it impossible to tune dimensions to specific furniture or body sizes with fine precision; the rectangular grid pushed them toward orthogonal layouts and made circular or more organic social arrangements difficult to realize. Comments about wanting "curved" edges or more granular control were not just feature requests, they were reflections on how the discretization of the prototype constrained their ability to express certain ways of living.

This suggests that room-scale co-design tools for reconfigurable environments are not neutral carriers of participants' ideas. Their materials, and geometric constraints "preset" what kinds of rooms are easy to imagine and build. These reflections underscore the potential for future prototypes to integrate more granular adjustments and non-linear configurations to support both functionally and socially supportive room layouts.

6.3.3 Reconfiguration Work as Household Governance. The co-design process not only amplified participants' voices but also fostered a collaborative atmosphere in which diverse perspectives could converge. This iterative and inclusive approach facilitated the emergence of a spatial design pattern catalogue, capturing recurring themes and strategies for reconfigurable design.

Co-design studies of smart homes and automation have shown that control and authority in multi-user households are rarely evenly distributed: the person who installs or configures a system often ends up with disproportionate power over settings and data [27, 30, 78, 86]. Our co-design sessions brought a complementary aspect into focus: who is responsible for the physical and cognitive work required to keep a space reconfigurable? Because participants had to move panels themselves, clear imagined clutter off surfaces, and think through sequences of change, questions of fairness and labor appeared early and concretely. When groups worried about "blindsiding" housemates by changing the room, they were not only talking about social courtesy; they were implicitly asking who would be responsible for resetting the space, navigating the surprise, and managing the risk of things breaking or getting in the way. Concerns about older adults, children, pets, and "non–tech-savvy" people were likewise framed in terms of both safety and effort: would everyone in the household be equally able and willing to operate a robotic, moving room?

Seen in light of prior work, this suggests a slightly different emphasis for co-designing reconfigurable environments. Rather than treating "who holds control" and "who gets data access" as the only axes of empowerment [27, 30, 78, 86], our findings point to effort, fatigue, and maintenance as equally central for future interactive systems. Elements such as manual and semi-automated mechanisms, presets, and shared protocols for when and how a room changes are become part of the governance of the home. Co-design at room scale, then, is not only a way to elicit preferred layouts; it is a way to prototype and critique the social contracts and labor arrangements that would accompany any future robotic implementation.

6.3.4 Interactivity and Adaptation Beyond the Current Prototype. Lastly, our prototype is manually manipulated, which limits our ability to investigate core aspects of interactivity and adaptive feedback, such as sensing, inference, and real-time system responses, which typically require higher-fidelity robotic implementations. However, the study still points to several specific requirements for interaction in future robot-rooms. By having participants push, fold, and reposition panels themselves, we effectively asked them to "play the role" of the control system: they decided when to reconfigure, how far to move elements, and which anchors must remain stable. Their stories of physical and cognitive fatigue indicate that some transformations (for example, recurring work–rest transitions or daily routines) are strong candidates for automation, perhaps with "presets" that reduce planning burden, whereas fine-grained adjustments of emotional anchors and social geometries are better left under direct manual control for spontaneous change. Concerns about safety, trust, and being "blindsided" by change also translate into concrete interaction requirements informing smart home research [7, 11, 30, 78]: future systems will need slow previews of motion, legible trajectories, and mechanisms for multi-user consent, not just simple opaque, fully autonomous acts.

At the same time, our prototype does not yet speak to (a) how a robot-room should balance sensing and inference about occupants' states against explicit commands, and through which modalities (for example, voice, gesture, or app-based control, etc.), (b) how interfaces should represent configuration options, histories, and "who changed what," or (c) how adaptive behaviors unfold and are appropriated over weeks and months, as explored in "living in" studies of reconfigurable homes [21]. Addressing these questions will require higher-fidelity prototypes with embedded sensing and actuation, as well as new co-design strategies that let participants not only configure spatial states but also script and simulate adaptive behaviors, and examine over extended everyday use when the room should change, what triggers those changes, and how the system communicates its actions.

7 Limitations and Future Work

First, the Robot-Room prototype is deliberately low-fidelity and manually reconfigurable. Its all-white panels, uniform hardness, and lack of embedded sensing or actuation constrained the kinds of judgments participants could make about comfort, materiality, and long-term interaction. The prototype was well-suited for surfacing spatial design patterns and embodied strategies, such as how people push, pull, and compose walls, floors, and furniture at room scale, but it could not capture how people would actually live with an automated, sensing system over time, nor how issues such as breakdown, misrecognition, and adaptive feedback would shape the interaction once the system becomes interactive. Future work will therefore involve building higher-fidelity, partially automated versions of Robot-Room that integrate sensing and actuation, and evaluating how our identified spatial patterns and experiential dimensions translate when transformations are triggered by algorithms rather than purely by hand.

Second, our participant pool consisted largely of university students, most of whom lived in dorms or shared rentals. As a result, the design strategies and concerns we observed likely reflect the rhythms and constraints of young adult, often transient living situations. Reconfigurable domestic environments, however, are especially consequential for user groups who rely heavily on home space: older adults, children, and people with limited mobility or chronic conditions. Our data already hints at these contexts, for example, participants imagined uses for long-term hospital patients or families. But these were speculative rather than grounded in lived experience. A next step is to conduct targeted co-design studies with families with young children, older adults aging in place, and users with accessibility needs to understand how reconfigurability intersects with care work, safety, and long-term routines.

Third, while our sessions involved small groups, we did not systematically recruit intact households or cohabitants who already share a home and negotiate space together. Conflicts and cooperation around furniture, smart devices, and shared routines are central to how reconfigurable environments will actually be used. Prior work has shown that control in home automation is unevenly distributed among cohabitants and that co-design can surface tensions around empowerment and authority [86]. Building on this, future studies with Robot-Room will recruit existing cohabitants and use the prototype to probe how shared authority, division of labor, and conflicting modes (e.g., "work" vs. "relax") are negotiated when the entire room can move. This will allow us to extend our current, primarily individual- and small-group findings toward household-level patterns and interaction mechanisms.

These limitations mean that our present contribution should be read as an exploratory mapping of spatial and experiential design spaces, rather than a definitive account of how all households will live with fully robotic rooms. Informed by the results of co-design exploration, we will realize a working Robot-Room at full scale and begin evaluating interactions with it with human participants. We expect the full-scale prototype will be equipped with sensing, including both contact and non-contact sensors to allow comparative evaluation of those modes in sensing and responding to human wants and needs. Sensor-based control algorithms for the robot surfaces will be synthesized, implemented, and evaluated via user testing. By iterating on the fidelity of the prototype and diversifying participants, especially across age, ability, and household composition, we aim to refine these early patterns into design requirements that can more directly inform the next generation of interactive, sensing, and robotic domestic systems.

8 Conclusion

In 1890, Emily Dickinson wrote "I dwell in Possibility," transforming her small bedroom into a universe of creative potential. Today, as homes shrink while accommodating ever more functions—office, school, gym, social space—this vision of adaptive domestic environments has become an urgent necessity. Human-computer "*habitation*" represents the next frontier where interactive systems become the inhabited architectural space itself.

Through early, exploratory co-design sessions with a full-scale, manipulable Robot-Room prototype, we make three key contributions to the future of adaptable spaces. First, we provide design patterns for reconfigurable interactive systems: participants consistently used wall-floor intersections as functional anchors, corners for intimacy, and central areas for social interaction, while engaging both whole-room and furniture-scale reconfigurations to support daily rhythms and unexpected scenarios. Second, we contribute three affordance-based design dimensions–empowering vs. restrictive, utilitarian vs. hedonic, futuristic vs. practical–that capture value tensions in adaptive environments and provide tools for designers of interactive spaces. Third, we demonstrate agile, room-scale prototyping as a methodological approach for exploratory spatial HCI research.

This work extends HCI's evolution from desktop computing to ubiquitous computing toward interactive physical environments: physically reconfigurable, habitable systems. While our study focused on domestic contexts, the implications extend to work, leisure, and learning spaces where environmental adaptability is critical, especially as urban migration and rising land costs drive spatial constraints.

We hope our findings inspire future work that advances not only the technical implementation of reconfigurable spaces, but also the human-centered values that should guide their evolution.

Acknowledgments

This work was supported by the U.S. National Science Foundation under awards IIS-2221215 and IIS-2446893. We thank our research assistant Huong Pham for her contributions to the user study, data analysis, and video production; Jinmo Huang, Hsingming Chao, and Riya Guttigoli for their assistance with prototype construction; and Daniel Lee and Yating Chen for their support with the user study and video production. We also thank the reviewers for their thoughtful and constructive feedback, which greatly improved this paper.

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APPENDIX

Table 1: Study participants, demographics, and self-described living conditions.

Group	Prompt	ID	Gender	Age	Living Condition
G1	Study room	P1	F	19	Dorm, one female roommate.
		P2	F	28	3 bedroom house + large basement, 2 additional housemates.
G2	Bedroom	P3	F	21	2 bedroom apartment, one housemate.
		P4	F	21	3 bedroom apartment, 2 housemates.
		P5	F	19	Sorority house with shared bathrooms and living and study spaces, one roommate.
G3	Living room	P6	M	23	Single dorm room in a 5-person suite.
		P7	F	20	Single room in a 3-bedroom apartment, with 2 housemates.
		P8	F	19	Dorm, one female roommate.
G4	Study room	P9	M	20	Dorm, one male roommate.
		P10	M	19	Dorm, one male roommate.
G5	Bedroom	P11	F	21	Studio apartment, no roommates.
		P12	F	20	Dorm, one female roommate.
		P13	F	20	Dorm, one female roommate.
G6	Living room	P14	F	19	Single dorm room in a 5-person female suite.
		P15	F	19	Dorm, one female roommate.
		P16	F	21	Sorority house, one female roommate.
G7	Bedroom	P17	F	18	Dorm, one female roommate.
		P18	F	22	Single room in a 3-bedroom apartment, 2 housemates.
		P19	M	22	Studio apartment, no roommates.
G8	Study room	P20	F	19	Sorority house, one female roommate.
		P21	F	20	Single dorm room in a 5-person suite.
G9	Living room	P22	M	21	5-bedroom apartment, 4 housemates.
		P23	F	19	Dorm, one female roommate.
		P24	F	20	Dorm, one female roommate.
G10	Study room	P25	F	19	Dorm, one female roommate.
		P26	M	20	Double dorm room in a suite, one male roommate.
G11	Bedroom	P27	F	21	One roommate.
		P28	F	21	House, seven female housemates.
G12	Living room	P29	M	31	2-bedroom apartment with partner.
		P30	M	31	2-bedroom apartment with partner.

Table 2: Codebook for analysing the Interview Data (Part 1 of 2)

Code	Subcode	Description	Example Quote
Flexibility	Spatial flexibility	Ability to morph the room into different spatial layouts (corners, edges, openings, bunk beds) to support different activities.	"Transform a restaurant into a bar... anything multipurpose... just being able to use your space more efficiently (G5)."
	Temporal flexibility	Using reconfiguration to adapt across time (day / night, weekday / weekend, or different phases of life).	"Even just day versus night, I thought it was very cool that it could be adapted to what I need throughout the day (G5)."
	Granularity of folds	How the density and spacing of fold lines afford more fine-grained or coarse changes in surfaces and shapes.	"Because there's so many little marks where we can bend it, it was more flexible… if there were smaller or more lines to bend it at different levels it would be easier (G9)."
Materiality and Comfort	Softness and bodily comfort	Desire for surfaces that feel soft, warm, and comfortable against the body rather than like bare slabs.	"Beds look homey and cozy, but this bed is just a slab, so it's hard to visualize yourself sleeping on it (G11)."
	Transformable materiality	Imagining materials that could change between structural and soft states (e.g., table - sofa, hard - squishy).	"If the panels could transform into a squishy material, it would be better… how can you change from a table for hot pot to a sofa with textiles? (G12)."
	Durability and robustness	Concerns about whether reconfigurable elements can safely bear weight and withstand everyday wear.	"Durability and weight-bearingness… tables are fine, but if it's a bed or something, it might be dangerous (G1)."
Visual Appeal	Sterile / cubic impression	Perceiving the prototype as sterile, cubic, or one-dimensional rather than cozy or lived-in.	"I would say sterile… I get very much cubic vibes. A room is a comfortable space, you have soft, round surfaces, color (G11)."
	Warmth and variety	Desire for color, texture, and visual variation to counteract the uniform white and repeated modules.	"Maybe because it's all white, it kind of gives off coldness… maybe if there was a pop of color and you could customize that (P13)."
	Spectacle and "wow" factor	Enjoyment of the system as something impressive or futuristic to show to others.	"The advantage of reconfigurable… I think it'd be cool to show people, show your friends. They're like, 'that's crazy' (G4)."
Customization and Personalization	Static decor and memorabilia	Using long-lived items like photos, posters, or art to make a space feel personally meaningful.	"Static rooms are definitely more personalized. Our walls have the same photos they've always had (P22)."
	Expressing identity through objects	Seeing art pieces, old furniture, and collected things as truer expressions of personality than built-in tech.	"I don't know if I like tech-oriented spaces. I think it's more about the art pieces you put up that express personality (P10)."
	Variety vs. sameness	Concern that one integrated system makes everything look the same, reducing opportunities for personal taste.	"If you have different furniture from different brands with different materials, it adds that variability. But with this system, everything looks the same (P7)."
Daily Routine	Preference for stability	Wanting layouts to stay relatively constant so routines feel effortless and things are easy to find.	"I get really used to my living conditions, so I think it would bother me to have it changing all the time… I would probably lose things and keep bumping into stuff (G3)."
	Occasional / seasonal change	Imagining reconfiguration as something done occasionally (seasonal reset, big life change), not every day.	"If I were to change it often, the most often would be seasonal… least would be never, or just once a year (G5)."
Static Elements	Fixed anchors for orientation	Keeping some walls, ceilings, or corners unmoving to provide a sense of safety, orientation, and predictability.	"I need to have some space that I feel safe. At least I know those panels don't move, so when I stand there I know those panels don't move (G12)."
	Surfaces for decoration and fixtures	Static walls as necessary surfaces for mounting TVs, shelves, and decorative items.	"If it's this system, you probably can't just stick a nail in it… [so] having a static wall you could put picture frames, you could personalize it (G11)."
	Home as consistency	Linking static elements to a sense of home as a permanent, self-reflective environment.	"A home is your permanent living space… it should be like an extension of yourself… having it be consistent is very personal (P27)."

Table 3: Codebook for analysing the Interview Data (Part 2 of 2)

Code	Subcode	Description	Example Quote
Practical Concerns	Safety and bodily risk	Worries about people or pets being pinched, crushed, or hit while things move.	"What if while it's changing, you get squished? (P4)."
	Material durability and failures	Concerns about structural failure, electrical hazards, or heavy objects falling during reconfiguration.	"I can see potential hazard with electricity behind it… could break or catch a fire or something (G1)."
	Cost and feasibility	Questioning whether the system's complexity, installation, and upkeep are worth the benefits.	"So then the question becomes, is this entire system worth the one-time renovation… maybe if it's not everything that is flexible, then that would be more practical (G12)."
	Maintenance and service	Uncertainty around who maintains or repairs the system and how quickly issues get fixed.	"Who do you call when there's a problem with the system? Is there a quick service? (G6)."
Space Management	Multipurpose layouts	Using the same area for different functions at different times (work, sleep, socializing, exercise).	"In our daily lives, even just day versus night… it could be adapted to what I need throughout the day (G5)."
	People, belongings, and clutter	Managing extra people (guests, kids) and deciding where belongings go during transitions.	"If I could just put up the bed, I'd open up so much more space and the room just feels more open (G5)." "Belongings – where to store them when the room is in the process of reconfiguring (G1)."
Control of the System	Automation and presets	Desire for automated motions and presets to reduce effort for frequent changes (e.g., nightly bed routine).	"If it's automated, like you can just press a button and stuff, I'd be redesigning a lot more (G11)."
	Control modalities (button, remote, voice)	Preferences and concerns around different input modes, including accidental activation or mishearing.	"Like a remote control… you can decide how far you are out. I think that'd be nice (G3)." "Voice activation… I feel like I'd accidentally say something and then it'd move (G6)."
	Shared authority and negotiation	Social negotiation over who decides configurations in shared rooms and how to avoid surprising others.	"You don't want to act like, 'Oh, I changed the room,' and they were blindsided by it (P23)."
	Autonomy in constrained contexts	Using control over space as a source of autonomy and dignity in settings like hospitals or small apartments.	"When you're sick… being able to take some small control is probably good… [Robot-Room] gives them a sense of autonomy (G10/P30)."
Fascination and Engagement	Initial play and curiosity	Strong curiosity and enjoyment of experimenting with different layouts when the system is new or for short stays.	"If I were to live here for one or two days, I would have a blast changing it up… but maybe not for life (G12)."
	Diminishing novelty over time	Expectation that, after an initial period, people would settle into a few stable configurations or one default.	"If I had one, I'd play with it for a short initial period before resorting to increasingly less configurations… just let it resort to one state (G2)."
	Trendiness and "target users"	Seeing the system as trendy or suited for certain demographics or commercial settings (e.g., hotels).	"As a hotel I could imagine a lot of people… the modular hotel room, everyone's talking about it (G12)."