Exploring Healthful Spatial Interface with Bodystorming: A Case Study from the Vertical Workspace Workshop

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ABSTRACT

The wide spread of artificial intelligence and spatial computing is driving the emerging development of healthful spatial interface (HSI), which requires new paradigms for generating relevant designs. In this paper, we present a case study on exploring tools and methods for ideating HSI concepts based on bodystorming. Specifically, we set out a workshop utilizing office vitality as the research context to investigate interactive elements in a vertical space for individual workers. We developed a real-size vertical space mockup capsuled with some tools, as well as a co-creation workflow to support bodystorming activities of this workshop. Based on a pilot study with nine participants, we obtained some qualitative data to reflect on the effectiveness of our workshop in facilitating design ideations of HSIs. Moreover, we found the proposed approach helped us quickly explore how HSIs could be designed and vertically arranged for increased office vitality. We conclude with implications and discussions for future work.

CCS CONCEPTS

• **Human-centered computing**; • **Interaction design**; • **Interaction design process and methods**; • **User centered design**;

KEYWORDS

Healthful Spatial Interface, Bodystorming, Vertical Workspace, Workshop, Toolkit

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1 INTRODUCTION

The prevalence of sedentary behaviors have produced adverse effects on metabolic health and mental wellbeing, which can significantly increase the risks of developing various chronic diseases [14]. To address this issue, extensive human-computer interaction (HCI) technologies and interventions have been developed to reduce sedentary behaviors and increase lightweight physical activity [2, 3]. Recently, a growing body of work has developed interventions at the spatial level to support movement behaviors [1]. For example, an interactive wall inspired by Tai Chi can guide users to engage in upper-body movements indoors [4]. "Fontana" is an interactive public installation designed to stimulate human physical activity in urban outdoor spaces [5]. These projects suggest the possibility of utilizing spatial interactions to keep people physically active.

On the flip side, the emergence of healthful spatial interfaces (HSIs) demands for new methodologies for designers to better ideate design concepts in HSI projects [6]. For instance, HSI commonly facilitates bodily interactions at spatial levels, where the embodied experiences should be stressed even at the early design phase [15]. As such, soma design such as bodystorming may have some potentials to help designers dive into the design context and efficiently verify their ideas, through embodied explorations [13]. However, to our knowledge, there lacks tools and methods to facilitate bodystorming as an effective approach for the early ideation of HSI. Therefore, we wanted to utilize a case study to generates some preliminary insights into supporting bodystorming for HSI.

Taking office vitality as a research context, this paper presents the design of a bodystorming-based HSI workshop, called the vertical workspace workshop (VWW), and its pilot study with nine participants. VWW focuses on investigating new workspace design for individual office workers, which allows users to interact with some spatial elements arranged vertically to promote a healthy workflow. To facilitate VWW, a real-size vertical workspace mockup with related tools and a co-creation workflow have been proposed and developed. The objectives of this paper are to explore potential HSIs of the vertical workspace using our proposed toolkit and co-creation workflow, as well as to understand how bodystorming could be leveraged to efficiently support the early design phase of HSI.

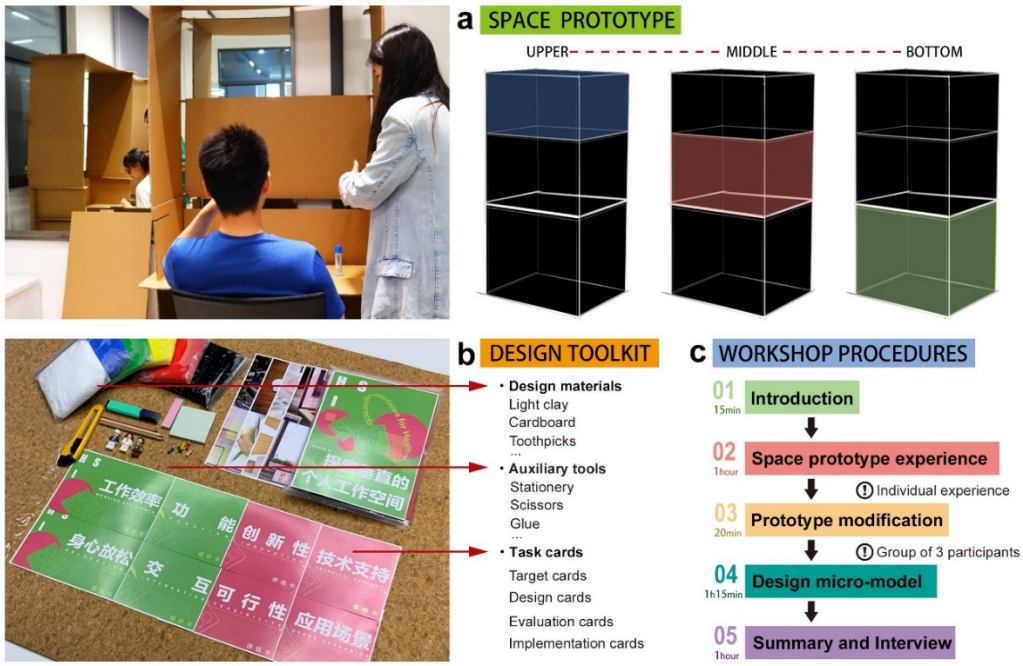

Figure 1: Vertical Workspace Workshop. a. The life-size vertical space mockup for bodystorming b. Design Toolkit for modification and development c. The procedures of VWW workshop.

2 VERTICAL WORKSPACE WORKSHOP

2.1 Themes

The theme of our VWW is "Vertical Workspace", and the background is based on (1) the low utilization rate of vertical space and the limitations of spatial scale in modern office spaces, (2) the growing demands for office vitality among companies and individuals, and (3) the needs of personal physiological and psychological factors, such as privacy, physical activities, social interaction, etc. The purpose of the VVW is to explore users' perception, behavior and needs for different spatial areas in the "top-middle-lower" workspace, and to support designers' divergent thinking and conceptual design in the early stages of design. Our findings will validate the performance of the toolkit and method we provide in supporting the HSI field for bodystorming.

2.2 Materials

2.2.1 Life-size vertical space mockup for bodystorming. Prior studies have confirmed the positive significance of embodied experience and cognition in inspiring designers' creative thinking [7]. For example, Segura et al. proposed embodied sketching to support the generation of ideas in the co-located environment [8].

To enable participants to experience the vertical workspace through bodystorming, we created a set of **life-size vertical space mockups** using corrugated paper. The tabletop could be easily disassembled and moved, thus creating upper, middle, and lower working areas (see Figure 1a). Participants were encouraged to interact with the mockups with full body and gain insights into the physically active workflow in simulated situations. Furthermore, the embodied experiential mockups allow participants to challenge existing concepts, iterate on the current mockup and inform the design process.

2.2.2 Design toolkit. To elicit feedback during bodystorming, it is essential to get participants to capture and reflect on their perceptions and thoughts in time. So, we also developed a card-based generative design toolkit, which is the most commonly used design tool in workshops, and has been proven to provide guidance on ideating and evaluating in an effective way [9, 10]. For instance, Ren et al. developed Perswedo cards to support flexible use of persuasive principles in creative design [11]. The categories of our cards included target, design, evaluation and Implementation dimensions to guide the design concept generation and co-creation of this workshop (see Figure 1b).

Additionally, we also provided some **design and auxiliary materials**, including light clay, colored cardboard, toothpicks, thread, scissors, glue, etc. Using these tools, participants could easily transform their ideas into physical prototypes [12], resulting in discussion and iteration.

2.3 Participants

We recruited 9 participants (3 males and 6 females), aged between 22 and 26 years old (M=23 , SD=1.1). All of them were students in the field of design and art, including industrial design, digital media, and product design. They were representative users because

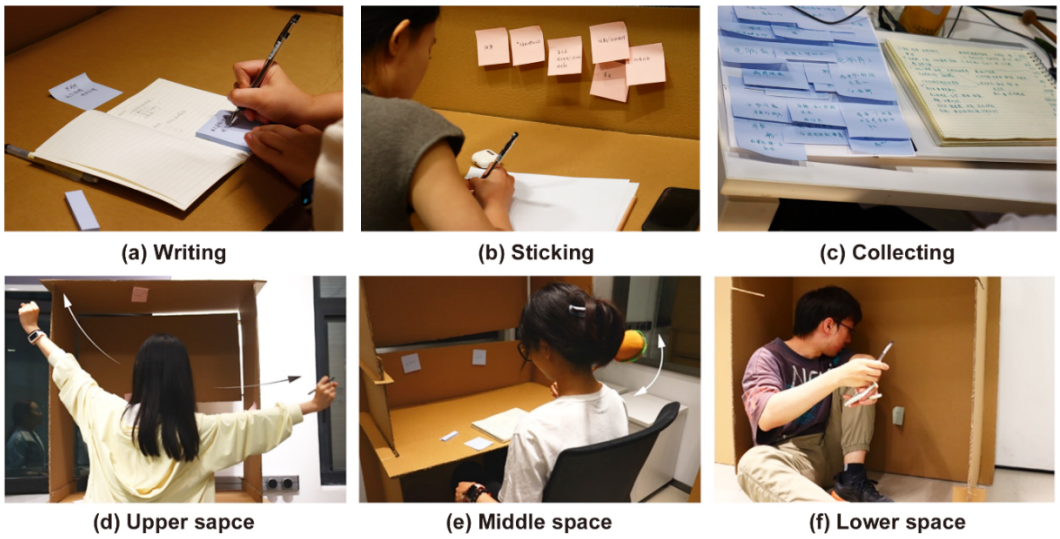

Figure 2: The process of bodystorming. Participants recorded their inspiration on the corresponding spatial interfaces.

as designers, who were familiar with common design processes and methods.

2.4 Procedures

This is a half-day workshop which consists of six stages as follows (see Figure 1c).

- **Opening and Introduction** (15 min): 9 participants were invited to the laboratory, and then we briefly introduced the background, theme and schedules of this workshop. All participants were divided into 3 groups, with each group distributing a design toolkit.
- **Bodystorming** (60 min): We have developed three life-size vertical space mockups and each group possessed one. During the bodystorming session, all participants were encouraged to engage in work-related tasks, relaxation, leisure activities, and any other tasks they would like to perform in the upper, middle, and lower workspaces. Meanwhile, they needed to write down their expectations and needs for particular areas and stick them on the mockups. Each group had one researcher for guidance, observation and recording, (see Figure 2).
- Coffee Break (10 min)
- **Design Concept** (30 min): The group members would explore potential design opportunities and express design concepts through collaboratively redeveloping and optimizing the space mockups, (see Figure 3). Afterward, the groups presented their preliminary design concepts and exchanged ideas with each other.
- **Co-Design** (60 min): Informed by new ideas from the bodystorming experience and design concept stage, participants further designed and implemented their prototypes using design toolkit. All groups were required to create miniature and video to demonstrate their design considerations and final concepts.
- **Presentation and discussion** (20 min): All groups presented their design prototype and video. In the end, the researchers and participants discussed the details of this workshop from the perspectives of design concept, workflow, design toolkit, and so on.

2.5 Data Collection and Analysis

Firstly, we collected the functional needs and design concepts generated by participants in the bodystorming, vertical space mockup redevelopment, and final co-design stages. We also collected the design achievements of each group, including design prototype, video, as well as photos that captured the meaningful moments during the co-creation workflow. After the workshop, we conducted semi-structured interviews with each participant. The interviews included their attitudes and expectations towards the VWW, the user experience of the life-size vertical space mockup, the influence of bodystorming on their ideation and creation, and suggestions for the workshop process and methods. All the interviews were audio recorded and we conducted qualitative analysis of interview data through manual coding.

3 RESULTS

3.1 Possibility of the vertical workspace as healthful spatial interfaces

Most participants appreciated the vertical workspace for supporting physically active workflow. Participants indicated that they could change their working postures without leaving their personal workspaces. Compared with moving to another area, this solution was more convenient. The easy accessibility could be effective in engaging users in microbreaks and lightweight physical activity.

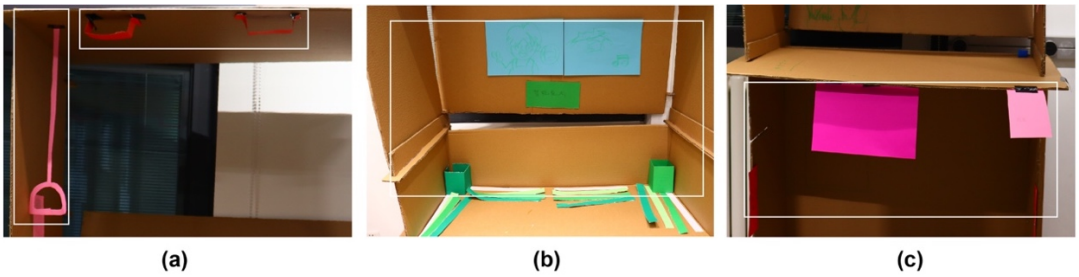

Figure 3: Design concept based on space mockup redevelopment. a. Group 1 b. Group 2 c. Group 3.

Participants have some consensus on specific interactions corresponding to different workspaces (see Figure 4). Most participants considered the upper workspace as both physically and socially active areas. For instance, *"When I stand up, I would naturally do some gentle stretching exercises and interact with others."* Regarding the middle spatial interfaces, participants particularly emphasized working productivity and performance. As one of the participants indicated, *"When I tackle the important tasks, I tend to choose normal postures in the middle space."* Therefore, they mainly focused on multi-screen collaboration and whiteboard recording. Moreover, the middle workspace was the most frequently used area. So, participants suggested employing health monitoring and intervention systems to prevent sedentary behaviors. For the lower workspace, leisure and relaxation were the most frequently mentioned functions. They highlighted the potential of lower spatial interfaces in providing an immersive and private environment for stress relief and sensory experience. They also proposed soft materials, and the multi-sensory atmosphere can help people gain more relaxation in the lower workspace.

We also observed the obvious gender-related differences in participants' attitudes. Female participants had higher acceptance in the lower working area than male participants. They commonly described this area as 'immersive, private and safe', where they tend to relaxation and microbreaks. However, male participants normally considered it 'narrow and crowded' due to the limited physical space and the sense of being wrapped up. On the other hand, male participants showed more interest in the upper space, where they enjoyed engaging in physical activities.

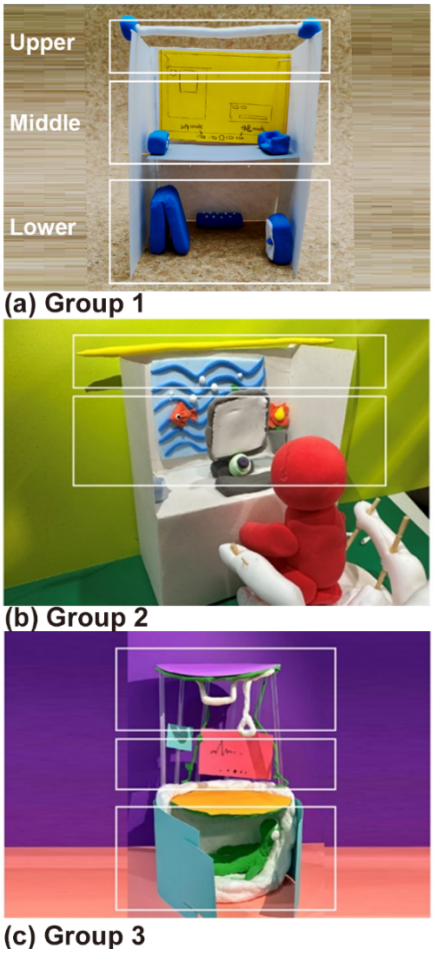

Figure 4: Design outputs. All prototypes added tension rods in the upper space, additional screens in the middle space, and the lower space focused on relaxation.

3.2 Bodystorming as an effective method for HSI design

Most participants expressed positive attitudes towards the life-size vertical space mockup and embodied experience. They expressed their experience as "novel, interesting, and inspiring". Furthermore, embodied experiences allow them to be more engaged in spatial interactions for ideation and creation. Due to the large-scale nature, many aspects of the spatial interface were hard to access and understand following traditional design processes and methods, e.g., sketching. They indicated that the life-size vertical space mockup we provided to support them in bodystorming for a better embodied experience, which effectively bridged this gap. Also, they could quickly present, test, and iterate their solutions and gain dynamic experiences simply by intuitive movements and actions. For example, one participant said, *"When I sit in this space mockup, it allows me to interact more directly with it and stimulate my creativity"*.

Most participants indicated that the card-based generative design toolkit was effective in guiding and evaluating each stage of their

co-creation. However, it needs to be accompanied by prompts and guidelines, otherwise they may forget to use it. And they also expressed that auxiliary materials were very helpful for transforming their spontaneous ideas during bodystorming into space mockups. They also suggested adding more modular elements to design creative prototypes conveniently.

Finally, with the exception of two participants who suggested further optimization of waiting time for each stage. They all reported that the organization and tasks for each stage of the workflow were reasonable and effective in guiding co-creation.

4 DISCUSSION & CONCLUSIONS

In this paper, we present the design and evaluation of VWW as a case study to tryout the new methodology to support bodystorming for design ideations of HSIs. To better enable embodied experiences and body-based explorations for vertical workspaces, we developed a set of life-size vertical space mockups with some tools and conducted a bodystorming co-creation workshop with nine participants. Our results demonstrated the potential of proposed workflow and toolkits in facilitating the early design phase of HSIs, in terms of idea generating and concept iterations. We believe the approaches and results of our VWW workshop can be applied to empower the research and development of HSI in the future.

Additionally, due to our study, we suggest that the embodied experiences should be emphasized for improving designers in generating concepts of spatial interfaces for health promotion. For instance, prior studies have suggested that full-body interaction benefits creative thinking [13], which in lines with our study results. Our interviews revealed that bodily experimentations could have promoted participants' engagement and active minds in the design process, thus increasing their behavioral and perceived effectiveness. Thus embodied experience is of great value in the research field of interaction between human and environment.

The study presented in this paper also provides some new research insights into technology for office vitality. Previous work has proposed software- and hardware-related systems and artifacts to support healthy work, thus attracting people to switch between different working environments and postures [3]. In this paper, we extend previous work by establishing meaningful and evidence-based relationships between different spatial elements and particular tasks, according to users' psychological needs and behavioral habits reflected by embodied experiences. We argue these correlations could be served as a rational basis for defining functional and technical application of different workspaces to support healthful spatial interaction. Therefore, extra quantitative experiments should be done to validate our qualitative findings from this case study.

4.1 Limitation and future work

Our study has several limitations. Firstly, the number of participants is relatively small, and their similar academic backgrounds may influence the results. Secondly, the space prototype, which is a rectangular tangible space, has certainly restricted participants' embodied explorations and emanative design. Hence, the workshop process and design toolkit would need further optimization.

In future work, we will iterate the design toolkits and the processes through duplicating VVW workshops. In addition to participants' subjective feelings, future work can employ more quantitative methods and expand the sample size to identify the actual effects of bodystorming on designing spatial interfaces. We also plan to transform the current toolkits into the virtual reality environment and explore the similarities, differences and effectiveness between tangible and virtual spaces in supporting designers ideating HSI concepts.

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