

Veteran-Centered Investigation of Architectural and Space Design Considerations for Post-Traumatic Stress Disorder (PTSD)

Health Environments Research
& Design Journal
1-10
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DOI: 10.1177/1937586720925554
journals.sagepub.com/home/her


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Abstract

Aim: This study sought to investigate architectural and space design considerations for veterans with post-traumatic stress disorder (PTSD). **Background:** Anecdotal evidence suggests that urban design features could have a positive impact on the mental well-being of individuals suffering from PTSD. However, evidence-based architectural and space design guidelines for PTSD are largely absent. **Methods:** Semi-structured interviews were conducted with 17 veterans diagnosed with PTSD to gain insights into their personal experiences with physical indoor and outdoor spaces, and to inquire about their needs and expectations for future architectural design. Transcripts were analyzed thematically. **Results:** Architectural design features including windows, entrances and exits, walkways and hallways, open space, defensible space, and green space; interior design features including furnishings and color; and ambient features including light, air quality, and noise levels were identified as most influential design features. **Conclusions:** Our results underscore the first important step to developing comprehensive architectural and space design guidelines for veterans with PTSD. Work is in progress to solicit more feedback from veterans.

Keywords

PTSD, mental health, architecture, veterans, space design

Post-traumatic stress disorder (PTSD), a debilitating mental condition experienced after exposure to a traumatic event such as war or combat (Watkins et al., 2018), is prevalent in military personnel and veteran populations (Reich et al., 2019; Reisman, 2016; Steenkamp et al., 2015). According to the U.S. Department of Veterans Affairs (n.d.), between 11% and 20% of Iraqi War veterans, 12% of Gulf War veterans and 30% of Vietnam War veterans suffer from PTSD. Symptoms of PTSD include intrusive memories (e.g., flashbacks, nightmares), avoidance (e.g., avoiding

situations reminiscent of the traumatic event), negative thoughts and beliefs (e.g., feeling hopeless about the future), and hyperarousal

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symptoms (e.g., being easily frightened; Boffa et al., 2017). These symptoms lead to significant functional impairment (Boyd et al., 2018; McCaslin et al., 2016).

Current treatment options for PTSD are psychotherapy, which includes methods such as cognitive behavioral therapy (CBT), pharmacotherapy, which uses medications, or both (Hetrick et al., 2010; Hoskins et al., 2015; Watkins et al., 2018). CBT, the most effective treatment option (Lee et al., 2016), focuses on identifying PTSD triggers and confronting maladaptive behaviors (Schnurr, 2017). However, CBTs, limited to in-person sessions, do not enable clinicians to observe PTSD patients or their surroundings between sessions, thereby limiting the understanding of contextual factors that trigger PTSD (Khanade et al., 2018).

PTSD hyperarousal events might be triggered by environmental (e.g., loud noises), social (e.g., large crowds), or urban design (e.g., lack of exits, narrow pathways) elements (Ulrich et al., 2012; Wagenfeld et al., 2013). Indeed, interior and exterior architectural design interventions have been linked to low to medium levels of social interaction among mental health patients (Jovanović et al., 2019; Ulrich, 2006). PTSD patients, like other mental health patients, can benefit from supportive environments designed to help them cope with stressors that mediate and trigger episodes (Ulrich, 1991).

Design of indoor spaces can optimize patients' response to therapy (Ulrich, 1991; Ventimiglia & Seedat, 2019; Willis, 1980). Mental health facilities designed with stress-reducing features such as reduced crowding (e.g., lower social density, communal areas with movable seating), environmental considerations (e.g., noise reduction design), and positive distraction (e.g., accessible gardens, higher daylight exposure, windows with views of nature) foster positive social interaction and improve mental health outcomes (Ulrich et al., 2018). Ambient features, including color, are known to play an important role in achieving therapeutic objectives for mental health patients (Connellan et al., 2013; Karlin & Zeiss, 2006; Papoulias et al., 2014).

Design of outdoor spaces can help in the rehabilitation of patients with PTSD (Ventimiglia & Seedat, 2019; Wagenfeld et al., 2013). Green space, a vegetated variance of open space (Taylor & Hochuli, 2017), has been linked to reduction in air and noise pollution exposure, attention restoration, psychological stress recovery, improvement in physical activity, and facilitation of social interaction among mental health patients (Beyer et al., 2014; Cohen-Cline et al., 2015; Nutsford et al., 2013; Nutsford et al., 2016). Recommendations from recent studies suggest that eliminating environmental features that trigger trauma-related memories, improving the design of windows and green spaces, and providing better wayfinding by clearly labeling entry and exit points could optimize therapeutic objectives for mental health patients (Golembiewski, 2013, 2017; Jovanović et al., 2019).

While much research has focused on the quality of life, and functional impairment of PTSD patients across various domains including occupational and social interactions (e.g., Boffa et al., 2017; Vanyo et al., 2017; Vogt, Erbes, et al., 2017; Vogt, Smith, et al., 2017), in line with a recent review by Gharib et al. (2020), research on the possible influence of architectural and space design features on the health outcomes of mental health patients remains a general gap. In particular, there is a paucity of architectural design guidelines for veterans affected with PTSD. Despite anecdotal evidence suggesting that these features can reduce maladaptive behaviors and improve the quality of life (Ulrich et al., 2018), veteran-centered approaches to elicit and document such contributors are largely absent. To address this gap, our recent efforts have used data-driven approaches to not only better understand the contexts and triggers associated with PTSD but also to propose potential technology-based interventions to support veterans (Rodriguez-Paras et al., 2017; Khanade et al., 2018; McDonald et al., 2019). As part of this broader effort, we also investigated architectural and space design considerations. This article documents the findings from semi-structured interviews with combat veterans who are diagnosed with PTSD on specific

design elements that resulted in triggers, as well as veterans' indoor and outdoor design preferences.

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Method

Participants

Seventeen participants (15 males, 2 females, mean age = 40.5, $SD = 6.22$ years) from different military branch affiliations were recruited during an event organized by Project HERO, a nonprofit organization that provides bicycle challenge activities for veterans and first responders diagnosed with PTSD. A dedicated Project HERO research coordinator announced the opportunity to participate in this research to all event participants via email. Project HERO then recruited a convenience sample of potential participants. The mean veterans affairs disability rating for the sample was 82.3% ($SD = 14.88$, minimum = 70% [occupational and social impairment, with deficiencies in most areas], maximum = 100% [total occupational and social impairment]). No requests to withdraw from the study or dropouts occurred. The study was approved by the authors' affiliated institutional review board.

Semi-Structured Interviews

The interviews were conducted as part of a broader study that sought to investigate the occurrence of PTSD in veterans. Anecdotal data obtained from prior interviews with PTSD veterans informed the development of the interview guide in this study. Based on the framework

developed by Kallio et al. (2016), participants were asked about major triggers associated with design of general buildings, rooms, doors, hallways, and the layout of both public and private spaces. Participants were also asked about an ideal living area for PTSD patients and for their suggestions to improve current architectural designs. Follow-up and probing questions were asked to elicit feedback in more detail.

Procedure

Two interviewers (both male PhD students) with training and experience in facilitating interviews with veterans conducted all interviews. Both interviewers had participated in other Project HERO events and may have been known by some of the recurring event participants as "university researchers"; however, no relationships were established between the interviewers and the participants prior to the study commencement. The one-on-one interviews took place during the spring and fall of 2019. To maintain participants' privacy and for the reason of opportunistic data collection, demographic data were not collected. Only the researcher and the participant were present at the time of data collection. At the beginning of the sessions, participants' informed consent was obtained. Interviewers took field notes during the interview and further expanded their notes after the interview. Interview duration ranged between 30 and 45 min with no further repeat interviews. After each event, interviewers met to discuss data saturation and the need for additional interviews. Audio recordings were transcribed by the research team and later analyzed using MAXQDA Version 12.0 (VERBI Software, Berlin, Germany), a qualitative data analysis software. Since no contact information was collected, transcripts were not returned to participants for additional comments and/or corrections.

Data Analysis

Thematic data analysis was conducted using the Braun and Clarke's (2006) framework that involved six phases: familiarization with data,

Table 1. Themes, Subthemes, and Codes From the Thematic Analysis.

Theme	Subtheme	Codes
Architectural design features	Windows	Large and low windows, views of nature
	Entrances and exits	Identifiable entrances and exits
	Walkways and hallways	Wider walkways and hallways
	Open space	Open floor space
	Circular space	Circular layouts, no blind corners, no sharp turns
	Green space	Open space with vegetation, gardens
Interior design features	Furnishings	Furniture, fittings
	Color	Wall color
Ambient features	Lighting	Soft light, ample daylight
	Air quality	Good ventilation, neutral odors, scent, smell
	Noise levels	Sound-absorbing walls, low noise

generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Interview questions were removed from the transcripts to enable the first coder (JN, an experienced PhD and project management professional) to focus on the primary purpose of the research. This coder employed an open coding approach by developing and modifying codes as he worked through the coding process. The codes and themes were discussed with an experienced (PhD) qualitative researcher (FS) and consensus was reached through discussion.

Results and Discussion

Thematic analysis of interviews yielded three main themes: architectural design features, interior design features, and ambient features. Themes, subthemes, and codes from the thematic analysis are shown in Table 1.

Theme 1: Architectural Design Features

General design features are the general characteristics of the built environment that impact PTSD patients' experience. Architectural design features are relatively permanent aspects of the built environment that are expensive and often difficult to alter (Harris et al., 2002). Six subthemes emerged from the analysis: windows, entrances

and exits, walkways and hallways, open and circular spaces, and green space.

Windows. There were mixed results about utility of windows. Ten of the 17 participants expressed multiple, large, and low windows with views of nature as a valuable design feature that helps them be aware of their surroundings. Large windows with a view of nature have been found to lead to positively toned moods in mental health patients (Ergan et al., 2018; Ulrich et al., 2012). In particular, windows provide daylight exposure and have been shown to reduce psychological and physiological stress in mental health patients (Brown et al., 2013; Ulrich, 1991). However, 4 of these 10 participants stated that windows that cannot be opened can trigger episodes.

... more windows, so you could see an onset. So what happens when I get hyper aroused is like, I can't visually see everything that's going on. (Participant 5, female)

... I prefer large and low windows, I really want to know what is happening outside. (Participant 11, male)

(If) windows can't open, just to feel that air, not feeling natural air can trigger a panic attack... (Participant 2, male)

Two of the 17 participants expressed reservations about having windows. This may be due to hypervigilance and feelings of danger or of being

under attack, which are experienced by some PTSD patients (Cameron & Mamon, 2019).

...I would rather not have windows than to have windows. If I were to do counseling, I would prefer not to have windows because I would keep more track of those things [visible through windows] than being focused on treatment. (Participant 9, male)

Entrances and exits. Thirteen of the 17 participants expressed concern about being unable to identify points of entrances and exits in their environment. They mentioned that awareness of points of ingress and egress is important to prevent feelings of being trapped. Indeed, improved wayfinding has been shown to decrease perceived stress in mental health patients (Ulrich et al., 2010; Wagenfeld et al., 2013).

...I'm always aware of entrances, exits, where they're at and things of that nature. Where's the entrance? Where's the exit? Which way the windows face? (Participant 9)

And to me a big thing is exits. Knowing how to get out of places. Not that I need to flee or panic but I just... I want to know. I want to know how many options there are, how many ways there are to get out. (Participant 6, male)

Walkways and hallways. Twelve of the 17 participants mentioned the need to reduce obstructions and increase maneuverability within their environment. These participants expressed preference for wider walkways and hallways. These features are related to reducing inadequacies in the configuration of the physical environment that constrain mental health patients' ability to seek privacy and to regulate their relationships and degree of openness with others. This result is consistent with those of prior studies (e.g., Ulrich et al., 2010; Ulrich et al., 2018; Ulrich et al., 2012), which suggest built environments with crowding stress-reducing features might improve mental health outcome.

Make sure if there were hallways, they were just a little bit wider. So there's room to get through where you don't have to bump into people. (Participant 3, female)

...narrow hallways suck. Narrow walkway is like inner city stuff, it is a nightmare for me. (Participant 7, male)

These features are related to reducing inadequacies in the configuration of the physical environment that constrain mental health patients' ability to seek privacy and to regulate their relationships and degree of openness with others.

Open and circular spaces. Veterans with PTSD have the propensity to experience a sense of control of their environment (Wagenfeld et al., 2013). Feeling in control is essential to veterans, and they feel that losing control is losing their autonomy. Eleven of the 17 participants expressed preference for open floor plans. This was associated with improved awareness and visibility of surroundings and feelings of security for some participants. Five of the 17 participants claimed cramped spaces were reminiscent of their living conditions during combat. Three of the 17 participants responded that they felt safe and in control of environments that promote wider and maximal visibility. They indicated the need to have spaces that are circular and those that are devoid of sharp turns and blind corners. Such defensible environments foster a sense of safety and control (Newman, 1996).

I like an open floor plan, where I can see now see what's going on... where I'm not feeling enclosed draft. (Participant 2, male)

I like an open space area... We lived cramped for so long that I like open areas. (Participant 5, female)

...make it all circular room, round circular rooms, put a door on each side of the circle, nobody has a back turned to anybody, we can see everybody, everything is circular... (Participant 15, male)

I prefer spaces with fewer turns. I hate sharp corners. (Participant 9, male)

Feeling in control is essential to veterans, and they feel that losing control is losing their autonomy. Eleven of the 17 participants expressed preference for open floor plans.

Green spaces. Green space references open space with vegetation. Previous research (e.g., Barton & Rogerson, 2017; Beyer et al., 2014; Brown et al., 2013) has highlighted the importance of green spaces for mental health. Green spaces could optimize therapeutic objectives for mental health patients (Jovanović et al., 2019). Nine of the 17 participants in our study expressed preference for areas covered with grass and trees and found these spaces to be calming.

I like a forest area with a lot of acreage. (Participant 8, male)

I like to see plants, trees, anything green outside . . . that calms me down. (Participant 15, male)

Theme 2: Interior Design Features

Interior design features refer to the less permanent features of the built environment that are relatively easy and inexpensive to alter (Harris et al., 2002). In the present study, two subthemes emerged under interior design features: furnishings and color.

Furnishings. Furnishings, a less permanent feature of the built environment, have been highlighted as an architectural feature of consideration within a psychiatric hospital design (Karlin & Zeiss, 2006). Eleven of the 17 participants in our study also expressed discomfort with spaces cluttered with furniture and claimed they were more comfortable with fewer furnishings. Prior research suggests that providing movable furniture in shared spaces improves mental health patients' ability to regulate personal space and interactions with others (Ulrich et al., 2012).

If it's cluttered with furniture, then I'm not comfortable. (Participant 7, male).

I feel kind of depressed when I am in a room with a lot of furniture, fittings, and decorations. (Participant 17, male)

Color. Color is recognized as an essential feature in wayfinding and changing human experience in interior spaces (Hidayetoglu et al., 2012). Consistent with findings from Karlin and Zeiss (2006), 7 of the 17 participants in our study recommended

brighter colors over monochromatic bland color palettes.

. . . a little more vibrant colors, instead of plain light walls, mellow color mood . . . (Participant 11, male)

One participant singled out the color green:

I notice colors. Green, it makes me feel calm. When I was in Fort Bliss, there was no green, it was just brown and that made me feel depressed. (Participant 13, male)

Theme 3: Ambient Features

Ambient features are the least permanent features in the built environment that influence people's comfort and health (Harris et al., 2002). Three subthemes emerged: lighting, air quality, and noise levels.

Lighting. Prior research suggests that buildings designed to provide higher exposure to natural light reduce depression (Ulrich et al., 2012). Poor lighting levels have been proved to trigger stress (Ergan et al., 2018). In line with previous research, 12 of the 17 participants mentioned that they preferred natural lighting over artificial lighting. Two of the 12 participants commented on artificial lighting and mentioned that inappropriate levels of it can be depressing.

. . . lighting is key. More natural lighting is better than artificial lighting. (Participant 5)

Sometimes the lighting, like artificial lighting, is strangely a depressing kind of feeling. (Participant 16, male)

Air quality. Generally, air quality is known to affect the health and well-being of mental health patients (Salonen et al., 2013). Six of the 17 participants were concerned about poor ventilation in the built environment. The veterans did indicate that poor air quality can trigger PTSD episodes. Two of the six participants mentioned that environmental odor can evoke traumatic memories. This is in line with Daniels and Vermetten's (2016) findings that showed certain odors can

precipitate fear-related memories and consequently trigger PTSD episodes.

... how many times per hour do they turn over the air in the room? ... (If it gets stale ... that can trigger people. (Participant 3, female)

I don't like the smell of smoke around me ... I prefer neutral odors, any smell of heat reminds of Iraq. (Participant 14, male)

The veterans did indicate that poor air quality can trigger PTSD episodes.

Noise levels. Previous research shows that loud noise is a known PTSD trigger ([Anonymous, 2018]; Ulrich, 1991; Ventimiglia & Seedat, 2019; Willis, 1980). Similarly, 13 of the 17 participants expressed concern about noise levels. Six of the 13 participants mentioned that they were startled by unexpected noise and recommended built environments with soundproofing. Built environments with noise reduction design features also foster positive social interaction, which contributes to improved mental health outcomes (Ulrich et al., 2018).

I hate noise, especially unexpected noise ... it just freaks me out. I like spaces and buildings with sound absorbing walls. (Participant 13, male)

Good soundproofing ... so there is not a lot of outside noise. (Participant 1, male)

Conclusion

The objective of the present study was to investigate architectural and space design features that influence PTSD triggers. To identify such features, semi-structured interviews were conducted with 17 combat veterans who suffer from PTSD. Despite the relatively small sample size and potential variability in living styles, our results showed several architectural design features including windows, entrances and exits, walkways and hallways, open space, circular space, and green space; interior design features including furnishings and color; and ambient features including light, air quality, and noise levels that

are indeed PTSD triggers. Given the general lack of knowledge base for the architectural design for PTSD patients, this study highlights the importance of such factors for veterans' overall quality of life and may serve as the preliminary step to developing comprehensive architectural and space design guidelines for veterans with PTSD. More work is needed to elicit feedback from a large and more varied sample of veterans as well as specific living conditions. While this research elicited general design requirements, future work should investigate specific design criteria for both living spaces as well as healthcare facilities.

Implications for Practice

- Urban design features could impact the mental well-being of individuals suffering from PTSD.
- Consideration for architectural design features includes large windows with a view of nature, clearly labeled exits, wide hallways, and open and circular spaces.
- Interior design considerations include minimalist designs with less furniture and light colors.
- Ambient features include the usage of natural lighting, avoiding triggering odors, and noise proofing.

Acknowledgments

We thank Kunal Khanade and Jason Patrick Williams for their help in data collection. We also thank project HERO for their help with recruitment and for facilitating the study. We thank Jacob Kolman for providing proofreading and editing assistance for this article.


Declaration of Conflicting Interests


The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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