frontiers | Frontiers in Built Environment

EDITORIAL
published: 27 May 2022
doi: 10.3389/fbuil.2022.918643

Editorial: Innovative Human-Centric Investigations and Technologies for Human Wellbeing and Health in the Built Environment

Francesco Salamone[1,2]*, *Giorgia Chinazzo*[3], *Clayton Miller*[4], *Sergio Sibilio*[1,2] and *Massimiliano Masullo*[2]

[1]Construction Technologies Institute, National Research Council of Italy (ITC-CNR), San Giuliano Milanese, Italy, [2]Department of Architecture and Industrial Design, Università degli Studi della Campania "Luigi Vanvitelli", Aversa (CE), Italy, [3]Department of Civil and Environmental Engineering, Northwestern University, Evanston, IL, United States, [4]Department of the Built Environment, National University of Singapore (NUS), Singapore, Singapore

Keywords: indoor environmental quality, outdoor environmental quality, built environment, users' perception, human wellbeing, human health, field-based survey, monitoring system

Editorial on the Research Topic

Innovative Human-Centric Investigations and Technologies for Human Wellbeing and Health in the Built Environment

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Edited and reviewed by:
Hazim Bashir Awbi,
University of Reading, United Kingdom

***Correspondence:**
Francesco Salamone
salamone@itc.cnr.it
francesco.salamone@unicampania.it

Specialty section:
This article was submitted to Indoor Environment, a section of the journal Frontiers in Built Environment

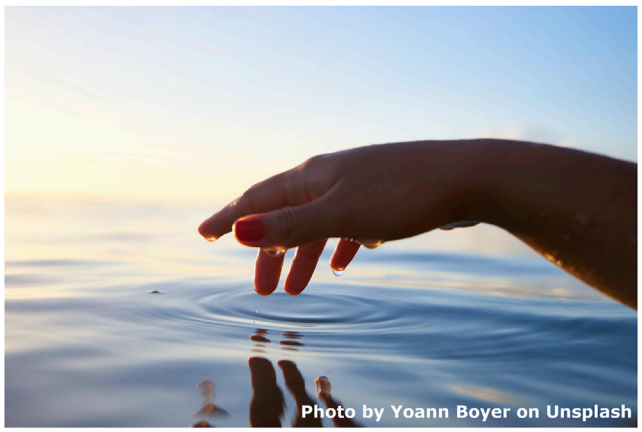
Received: *12 April 2022*
Accepted: *20 April 2022*
Published: *27 May 2022*

Citation:
Salamone F, Chinazzo G, Miller C, Sibilio S and Masullo M (2022) Editorial: Innovative Human-Centric Investigations and Technologies for Human Wellbeing and Health in the Built Environment. Front. Built Environ. 8:918643. doi: 10.3389/fbuil.2022.918643

The built environment should be designed and operated to create safe, comfortable, and productive spaces for humans. To achieve this goal, it is necessary to understand human responses to environmental stimuli including, but not limited to, thermal, visual, air, and acoustic quality stimuli. Such an investigation allows researchers to identify threshold values, indexes, and models capturing human responses to environmental stimuli, which in turn can be used to design and control buildings to achieve tailored comfortable, healthy, and productive conditions with a limited energy use. In this context, human-centric approaches are becoming increasingly popular in the scientific community due to the unique and individual nature of human responses and the fact that they can be influenced by several personal and localized factors. Emerging technologies are making it easier to conduct human-centric investigations and actual building design and operation for comfortable, usable, adaptable, and energy-efficient buildings and public spaces.

In recognition of this human-centric shift, the Frontiers Research Topic *Innovative Human-Centric Investigations and Technologies for Human Wellbeing and Health in the Built Environment* aimed at gathering recent findings related to human-centric investigations in the built environment. The seven scientific contributions accepted for publication in this Research Topic can be categorized into two groups: (1) research at the urban scale and (2) investigations related to the indoor environment. This special set of publications is found in the International Journals Frontiers in Built Environment (Indoor Environment and Urban Science Sections) and Frontiers in Sustainable Cities (Smart Technologies and Cities Sections).

Among the papers conducting human-centric investigations at the urban scale, Cummings et al. focus on a mobile monitoring method to observe the spatiotemporal distribution of particulate matter (PM) and black carbon (BC), which was implemented for 12 days between June and July 2019 in Philadelphia, Pennsylvania. A van equipped with two global positioning system (GPS) units and devices measuring PM1, PM2.5, and PM10 concentrations and BC was driven on two routes through the city. Using hot-spot analysis and heat maps, it was possible to determine times and locations where pollutant concentrations were highest for effective air quality management and sustainable urban development. Setiawati et al. analyze the current and future magnitude and spatial variability



GRAPHICAL ABSTRACT |

of urban heat islands in three cities in Indonesia, namely Medan, Surabaya, and Denpasar. The authors conduct the study through the calculations of the Universal Thermal Climate Index (UTCI), considering climate change and land cover change scenarios. This study provides a basis for planning mitigation measures in response to the projected increase of heat waves due to climate change.

The second group of papers offers insights about human-centric investigations within buildings in terms of subjective data Research Topic methods, multi-domain effects, COVID-19 prevention strategies in schools, subjective and objective data Research Topic through wearables, and current control strategies in buildings. Sheikh Khan et al. illustrate the results of a 7-months experimental campaign conducted in three office buildings to evaluate the effectiveness of a simple, non-intrusive, and accessible tangible Occupant Voting System (OVS), in collecting occupant feedback on thermal and indoor air quality, the TiAQ. The results showed that TiAQ was as reliable as a retrospective Indoor Environmental Quality (IEQ) questionnaire in representing long-term occupants' thermal comfort and discomfort. However, TiAQ was not entirely reliable in representing occupants' perception of Indoor Air Quality (IAQ) as it only had one button to indicate stuffy air. Berger and Mahdavi investigate the cross-modal effects among indoor environmental thermal, visual, and acoustic stimuli to understand whether the evaluation of one aspect of the indoor environment can be influenced by differences in the values of the other elements. For this purpose, a laboratory space with two adjacent identical office room mock-ups was used to conduct studies on a group of volunteers. A total of 296 participants were briefly exposed to three thermal conditions (23.5, 24.5, and 25.5°C), two visual conditions (with and without a source of glare), and two acoustic conditions (with and without traffic noise exposure). The results indicate that the participants' thermal responses did not indicate a cross-modal effect of visual and acoustic stimuli. Also, in the evaluations of the visual and acoustic aspects, users were not influenced by differences in the values of the other parameters. Coronado et al. describe the results of an online survey conducted during the COVID-19 pandemic, from 23 April to 8 May 2021, in two different countries to investigate the university students' health risk and health promotion perceptions of a variety of strategies promoted for returning to in-person education. The online survey, conducted with the use of rendered images of 3D-modeled classrooms and written cues, investigated four categories of strategies, namely visual connection to the outdoors, reduced occupancy, additional furnishings, and ventilation type and number of windows. The results highlight differences across the two countries in terms of perceived health risk and promotion according to the different strategies. The literature review by Abboushi et al. analyzes previous IEQ studies to identify relationships between different IEQ factors and Health Performance Indicators (HPIs) collected using wearables. The review identified the need to further investigate and collect HPIs including sleep quality parameters, heart rate, stress responses, and subjective ratings of comfort using wearables. The exploration of HPIs through wearables would allow researchers to further expand research studies and implement closed-loop control in building control systems. Finally, Hahn et al. conduct interviews with building operators with the aim of investigating current data Research Topic methods during building operation, with reference to the control system and occupants. The results of the interviews show that, so far, communication between building operators and building occupants plays a more critical role in optimizing or adapting building operations to occupant needs than the data collected by the building automation system, which is mainly used to detect faults in the building systems.

Overall, the seven papers published in this Frontiers Research Topic corroborate the essential need to conduct human-centric studies to enrich our understanding of the relationship between the built environment and occupants to achieve healthier, more comfortable, and productive indoor and outdoor spaces.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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