

PATIENTS' DISSATISFACTION VERSUS TARGET VALUES FOR INDOOR ENVIRONMENTAL QUALITY: RECONSIDERING RESEARCH METHODOLOGIES

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Abstract

Objective – To reduce the gap between patients being dissatisfied about hospitals' indoor environmental quality (IEQ) and hospitals achieving target values for IEQ parameters, this paper aims to identify possible improvements of applied research methodologies.

Background – Buildings' IEQ affects users' comfort, productivity, and well-being. Especially in hospitals this is crucial. A high IEQ contributes to patients' healing process and staff efficiency. However, even if target values for IEQ indicators are achieved, users are often not satisfied. Applied research methodologies should be reconsidered to address this gap.

Research question – The paper investigates how IEQ research and research about healing environments (HE) address people's experience of the indoor environment and how both views interrelate.

Methods – A scoping review was conducted. Methodologies applied in research concerning hospitals' IEQ and HE were studied critically, as well as the underlying philosophical assumptions and theoretical stances.

Results – IEQ and HE research adopt a different approach towards 'the environment', its 'perception' and its 'experience'. The mind-body problem lies at the heart of these differences. IEQ research considers mind and body as different in nature, while HE research views them as unified. Related to this, IEQ understands 'the environment' as the physical world that exists independently of subjects, while HE research investigates the lived world in which subject and building features are interrelated. IEQ treats perception as a causal, passive process, while HE research considers the epistemic act. In IEQ research experience is more than perception. The focus is upon having sensations at the level of individual senses. In HE research perception is coupled with action and cognition, thus perception and experience are inseparable. Sense perception, obtained by perceptual systems, as well as sensations, resulting from people's multi-sensory experience, are investigated. These assumptions are reflected in the applied methodologies and methods. IEQ research combines sensor measurements with surveys in order to relate, within a certain probability, values of objective physical quantities to subjective responses. HE research gathers in-depth data about people's lived experience. However, regardless of whether mental states can be described completely by brain states, both seek to understand how the built environment, existing independently of subjects, can be designed in a well thought out way.

Conclusion – As the purpose of IEQ and HE research corresponds and views upon 'experience of the environment' are complementary, they can mutually benefit from each other's approach when their methods are appropriately combined in a mixed methods research. IEQ research can inform about continuously changing fluxes and generalized subjective responses, HE research about information fluxes carry and individual differences. Incorporating these insights in future methodologies may contribute to reducing the gap between dissatisfied users and achieved target values.

Keywords: *Architecture | Healing environment | Hospital environment | Indoor environmental quality | Mixed methods*

Introduction

How people experience the indoor environment affects their physiological and psychological health, comfort, productivity, and well-being. Especially in healthcare facilities improving health and comfort through the built environment therefore requires attention. Hospitals rated with a high indoor environmental quality (IEQ) enhance patients' healing process and staff efficiency [1]. However, even if indoor environmental target values are achieved, users are often not satisfied [1,2]. Addressing this gap requires reconsidering applied research methodologies.

In hospitals the quality of the indoor environment is studied by IEQ research and research about healing environments (HE). Both domains investigate people's experience of the environment differently. **IEQ research** searches

epistemologically objective knowledge within a certain probability about how the world ‘really’ is. In line with a mechanistic ontology, the world is considered as a system with causes and effects and deterministic connections between them [3]. This approach is based on physics and the ‘information processing theory’ of cognitive psychology. Physics strives to grasp the nature of the world reduced to its essential constituents of force, energy, and matter [4,5]. The information processing theory regards the human mind as an information processor: information is received from the senses as input, processed by the brain, and an output is delivered [6]. IEQ research focuses on the relation between environmental quantities – the input – and people’s comfort – the output.

On the other hand, **HE research** is mainly inspired by the ecological approach of perception. This approach tries to understand the continuously changing relationship between a person-as-knower, who is a knowing-agent and not just as physical or biological object, and the environment-as-known. This is an attempt to ‘ecologize’ physics – to interpret physical phenomena in the light of their relevance to psychological phenomena [6]. Ontologically the interrelations cut across the dichotomy of subjective-objective [7]. Epistemologically this view has at least a subjective element in it, although objective knowledge about ontological subjective phenomena can exist [8]. How people’s subjective and multi-sensory experience is addressed is influenced by post-phenomenology. The focus upon the environment’s healing effect emanated from research inspired by Evidence Based Design (EBD), pioneered in healthcare architecture by Ulrich [9]. EBD-inspired research investigates how specific physical characteristics impact on health and comfort.

Based on a scoping review, we identified several themes concerning ‘experience of the environment’ which both research domains address differently. As they take other ontological and epistemological positions, which connect with researchers’ theoretical stance, methodology, and methods applied [10], the difference is present on all these levels. For each identified theme we analyse how the two research domains relate to each other at these different levels. After explaining our methodology, we describe the mind-body problem, followed by what is understood as ‘the environment’, its ‘perception’, and its ‘experience’. The discussion focusses upon how this analysis informs about how both research domains can complement each other, and how patients’ experience of, including their satisfaction with, indoor conditions can be improved by basing design decisions on findings of research which makes use of this *complementarity*.

Methodology

To reconsider applied research methodologies, we focused on the questions ‘how do IEQ and HE research address people’s experience of the indoor environment?’ and ‘how do both views interrelate?’ A scoping study seemed most convenient since it allows for conceptual mapping, i.e., establishing how a particular term is used in the literature, including literature with a variety of research designs, authors, research objectives, sources on which the research is based and types of evidence used [12,13,14,15]. Articles were searched via the authors’ university’s search engine, which includes the following databases: Directory of Open Access Journals; Medline (Proquest & Pubmed); OneFile (Gale); ProQuest Central; ProQuest Health & Medical Complete, ProQuest Research Library; Pubmed Central; ScienceDirect Journals (Elsevier); Scopus (Elsevier); Science Citation Index Expanded (Web of Science); and Social Sciences Citation Index (Web of Science). Since the aim was to explore the issue rather than synthesize all literature available on the topic, no inclusion criteria were predefined, but an iterative reading process was chosen. In a first phase of the study, the extent, range, and nature of applied IEQ and HE research activity were examined. Through this an understanding grew of the used methodologies and differences between them. In a second phase literature about underlying philosophical assumptions and theoretical stances was targeted. The stages of each phase are based on Arksey and Malley’s framework [13], and its further enhancement by Levac et al. [12]. Figure 1 gives a more detailed overview.

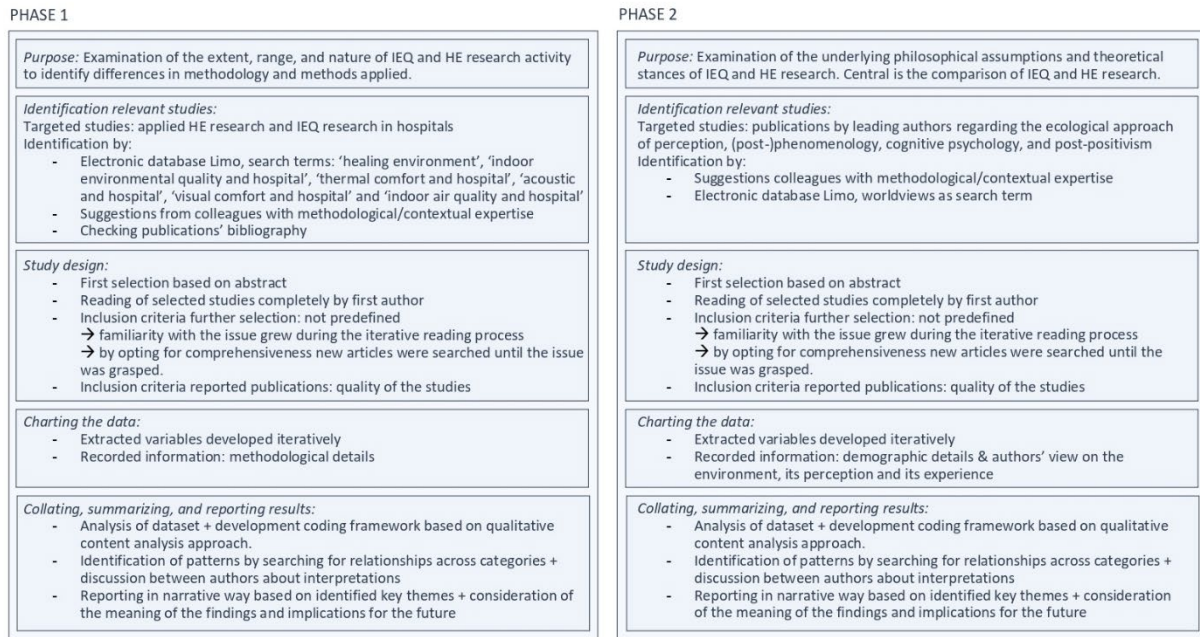


Figure 1. The two research phases and their stages, based on [12,13]

Key themes

The authors identified several themes which IEQ and HE research approach differently. These themes are summarized in Table 1 and are further explained below. For HE research the table has two columns: while mainly based on the ecological approach, for subjective sensations it falls back on post-phenomenology.

	IEQ research	Research about healing environments	
		Ecological approach	Post-phenomenology
Mind-body problem	Dualism	Monism	Monism
The environment	Physical world	Lived world	
Perception of the environment	Causal process	Epistemic act	
	Passive	Active	
Experience of the environment	Experience > perception	Experience = perception	
	Having sensations	Sense perception	Having sensations
	Sensory experience	Perceptual systems	Multi-sensory/whole-body experience

Table 1. Key themes which IEQ research and HE research address differently

Mind-body problem

At the heart of the differences between IEQ and HE research lies the philosophical mind-body problem, i.e., the question whether consciousness and intentionality can be found in the quantum-electromagnetic-gravitational field [16].

IEQ research supports Cartesian dualism: mind and body are thought to be different in nature [6]. Physical processes of the material world can be explained by physics, and mental processes by cognitive psychology's 'information processing theory' [4].

HE research is based on monism: humans are considered as unified organisms of great complexity and varied functioning, composed of a mind and a body which interact [17]. This stance is taken by both the ecological approach [7,18] and post-phenomenology [18].

Neither IEQ nor HE research requires an answer to the mind-body problem. Both are interested in people's experience of the environment and the physical environment itself, regardless of whether mental states can be described completely by brain states. However, the mind-body problem influences what is understood under the 'environment', its 'perception', and its 'experience', and consequently how research is conducted.

The environment

In **IEQ research** the term ‘environment’ refers to the physical world, which is ontologically objective. Reality is taken to be structured in various ways [5] and can be studied on different levels [19]. IEQ research focuses on fluxes such as energy fluxes (e.g., light, noise) and chemical substances (e.g., odour), broadcasted by a source and present in the environment. Focussing on fluxes acknowledges that the environment changes continuously. The fluxes can be described. A set of perspective projections, a field of sound waves, or the diffusion field of a volatile substance are perfectly objective physical facts [19].

In IEQ research the use of sensors reflects the view that the environment exists independently of subjects. Sensors gather data about the fluxes disposed by the physical world. The importance of using validated instruments and avoiding bias shows the wish to understand the world ‘as it really is’.

HE researchers do not deny that a physical world exists independently from subjects, but understand the term ‘environment’ as ontologically interrelated with the ‘animal’ (e.g., the person) living in it [18]. An environment exists only in relation to the being whose environment it is [4,5]. Both are even mutually constitutive [20,21], or a meshwork – a term Ingold uses to bypass that mutuality still involves a separation of the elements whose constitution is at issue [4]. Baggs and Chemero stress the difference between the environment as it exists for a typical member of a species, and how it exists for a particular animal with its own abilities [5]. Interrelations with elements at the terrestrial scale, like objects and surfaces, are studied. The fundamental constituents of any environment are ‘affordances’ [19,22]: the possible facilitations or hindrances that the environment - the substances, surfaces, objects, and other living creatures surrounding the animal – provide in the immediate context of its current activity [4,20]. Affordances are properties of things taken with reference to an observer, but not properties of the observers’ experience exclusive of the things. Therefore the debate whether values are physical or phenomenal, in the world of matter or only in the world of mind, does not apply to affordances [19]. HE researchers investigate the affordances of hospital environments.

Perception of the environment

1. Causal process versus epistemic act

In **IEQ research** perception is treated as a causal process (see Fig. 2). Like in information processing theory, physical objects or events in the world are considered the distal (external) stimulus. They modulate ambient energy and propagate it to the receptor organ, where it gives rise to a proximal (sensory) stimulus. The computational task of the brain is determining the distal stimulus from information contained in the proximal stimulus [23]. At the sensory level of processing, physical energy is detected and transformed into neural energy and sensory experience. At the organizational level, brain processes organize sensations into coherent percepts. At the level of identification, percepts of objects are compared with memory representations in order to be recognized as familiar and meaningful [23]. This results in a perceptual experience as part of the agent’s state of phenomenological awareness [6].

This view underlies the methods of IEQ research. Sensors located near subjects are comparable with subjects’ senses, and the data generated with people’s proximal stimuli. People’s subjective response, which arises from the stimuli, is questioned with questionnaires [24]. The survey results are comparable with the result of brain processes at the sensory level. Comparable with the brain processes at the organizational level, researchers define sometimes one total IEQ index by adding up the level of satisfaction with different IEQ parameters multiplied by their weighting factor [25].



Figure 2. Perception as causal process

HE researchers do not deny that a causal process takes place. However, they focus on perception as an epistemic act: an act of apprehending the properties of the message conveyed rather than the properties of the medium by which they are conveyed [6] (see Fig. 3). The act of perceiving is mediated neither by the physics of the energy propagated (e.g., light, sound) from object to receptor system in the surroundings, nor by the properties of the medium, i.e., the physiology of the neural transmission from receptor to cortex [6]. The contact between the knowing-agent and the ecological significant properties of the world is epistemic rather than mechanical or causal in nature. ‘What’ the nature of processed information is receives attention [6].

This view underlies the methods applied in HE research. Document analysis informs about the physical environment at the level of stimulus information instead of stimulus energy. People’s experience and how they apprehend the world is probed with open-ended questions, allowing them to describe what the physical as well as the social and cultural environment affords them.



Figure 3. Perception as epistemic act

2. *Passive versus active*

In **IEQ research** perception is treated as passive and imposed. The way in which sensors work relates to the senses as passive receptors. Passive receptors respond each to the appropriate form of stimulus energy, which varies along dimensions like intensity and frequency, and have measurable thresholds [19]. Sensors located close to a person, as advised in ISO 28802:2012 [24], can approximately register the stimulating fluxes. ISO 28802:2012 recommends to measure for thermal comfort the air temperature, radiant temperature, air velocity, and absolute humidity; for acoustic comfort the A-weighted sound pressure level and equivalent continuous A-weighted sound pressure level; for visual comfort the horizontal illuminance; for air quality the CO₂ level; and for vibration the acceleration in vertical, horizontal, and fore-and-aft directions. The stimulation targeted does not depend on subjects' own act of perceiving and is therefore imposed [19]. Rating the environment with 'right-now' questionnaires [24] considers people's perception as an accumulation of 'snapshots' taken from any number of points of rest.

HE research considers perception as an active process. According the ecological approach perception is fundamentally about movement [4,19]. First, people perceive and respond to permanent properties of the environment although sensations vary constantly [19]. Constant perception depends on active perceptual systems, which search out stimulus information in the array of ambient stimulus energy. To this end people orient the classical sense organs to the environment by moving the body, and use the organs actively by adjusting them and letting them explore. The obtained stimulus information is unlimited and of higher order than stimulus energy. It varies along innumerable complex dimensions which are not all amenable to physical measurement.

Second, stimulus energy varies across place and time as the individual goes about her business in the environment. People do not accumulate observations taken from successive points of rest, but perceive along a continuous itinerary of movement [4,19]. Shapes and forms of environmental objects are revealed by changes along this path.

Thirdly, next to picking up environmental information, stimulus input can be used to control the own, active movement of organs, called proprioceptive feedback [4,19]. The receptors therefore receive an intermixture of externally produced and activity-produced stimulation. However, people do distinguish between intrinsic stimulation (i.e., results of their own actions) and extrinsic stimulation (i.e., results of events other than their actions) [19].

Architecture is lived space and not just physical space [26]. People respond to architecture's extrinsic stimulus information with a bodily reaction causing activity-produced stimulation, and this as a consequence of actions the built environment implies. It is this lived space that HE research investigates. Defining contributing parameters is impossible, but, based on phenomenology, the essence of a conscious experience, or, based on post-phenomenology, the multi-stability (i.e., the differences in how people experience something) is described. To gain an understanding of someone's lived experience, in-depth data are gathered dealing with an extended period of time. Sometimes even walk-along interviews are conducted (e.g. [27]). Thus, people's perception is not taken as an accumulation of separate observations.

Experience of the environment

1. *Experience versus perception*

IEQ and HE researchers are interested in people's 'experience' of the environment, but understand it differently. For **IEQ research** ISO 28802:2012 recommends to include in questionnaires: a perceptual (How do you feel now? e.g., hot), affective (How do you find it? e.g., comfortable), preference (How would you prefer it to be? e.g., cooler), acceptance (acceptable/unacceptable) and tolerance (Is the environment tolerable?) Likert scale [24]. Thus, perception is assumed to be a part of people's subjective response.

In **HE research**, perception is not considered as the achievement of a mind in a body, but coupled with action as discussed earlier. Moreover, perception and action should not be set off from cognition: meaning is drawn from skilled subjects' productive engagements with the environment's 'affordances' [4,22] and can be directly perceived. The entanglement of perception, action, and cognition seems to make it impossible to let someone reflect on their perception alone. This may be the reason why in HE research the word 'experience' and 'perception' are used interchangeably.

2. *Having sensations versus sense perception*

When discussing people's experience of the environment with a focus on its sensory characteristics, Gibson distinguishes between having sensations and sense perception [19]. The former relies on the channels of sensation as the sources of conscious qualities of experience, the latter on perceptual systems as the sources of knowledge.

In **IEQ research** the focus is on people's sensations, i.e., the different modes of conscious qualities of experience which result from fluxes falling into passive senses. Modes of conscious qualities that are considered as having the main impact on people's subjective response include thermal comfort, indoor air quality (IAQ), lighting, acoustics, and sometimes vibration, but no agreement exists [1,24,28]. This disagreement resembles the debate about ways to categorize the (passive) senses. Traditionally five senses were distinguished – sight, hearing, touch, taste, and smell [19,29]. Over the years also other classifications are proposed (e.g. [26,30,31]).

For thermal comfort IEQ research refers to the Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) [32,33,34,35]. Dissatisfaction can be caused by general and/or local discomfort [36]. IAQ relates to the amount of harmful substances and bad odour in the air [34,37]. Visual comfort considers illuminance levels and the absence of side effects like glare and blinding [34]. For acoustic comfort 'noise' refers to unwanted sound. For vibration, as for other environmental components, attitudes to what the person thinks is the source influence the response [34].

The relationships between people's subjective survey response and measured fluxes are analysed statistically. Generalized results enable to set up target values for which a certain percentage of people is assumed to feel comfortable.

Gibson considers inventorying modalities impossible because it includes neither proprioceptive feedback, nor perceptions obtained by the senses when they are active - when they adjust and explore so as to obtain information - instead of passive [19]. If one focuses on sense perception a catalogue of sensations is not needed. Sensations are only occasional accompaniments of sense perception [19]. Gibson distinguishes between five perceptual systems – the orienting, auditory, haptic, taste-smell, and visual system – classified by modes of activity instead of modes of conscious quality. In contrast to the way IEQ research understands the process of having sensations, perceptual systems do not consist of a specific set of nerves and neurons. **HE research** studies sense perception as well as the sensations accompanying it.

3. *Sensory versus multi-sensory experience*

Most frequently **IEQ researchers** treat IEQ parameters separately [24]. Attention can facilitate processing relevant stimuli and suppress processing irrelevant ones [23]. However, recent years have seen a growing understanding that the senses work together and influence each other [29]. For example, a higher thermal comfort is often associated with higher IAQ [32]. People are thus not always aware of which parameters influence their reaction and may have difficulty to isolate one sensory quality from another [38]. In IEQ research ways are searched sometimes to express people's overall comfort experience into one IEQ model or index, rating system, or scoring system [25]. Weighting factors represent each comfort factor's independent contribution to the overall comfort. The total IEQ index adds up the products of each IEQ parameter and its weighting factor – just like the brain is thought to sum the sensations resulting from different proximal stimuli.

Although the separate treatment of the senses does not correspond exactly with people's experience, it enables setting up target values for each type of flux. Moreover, in the context of human-technology relations it is argued that contemporary technology mediates what was previously 'unperceived' and what unmediated is directly 'imperceptible' [39]. Related with this sensors are able to single out, quantify and make perceptible one type of flux (e.g., the exact temperature of a room), while humans cannot.

In **HE research** interviews start with broad open-ended questions, allowing people to talk about their overall experience. Of interest are both people's sensations and sense perception. Concerning sensations, people's multi-sensory, whole-body, and embodied experience are discussed in (post-)phenomenology. Phenomenologists assume that as long as people are conscious, they continuously perceive multi-sensorially. Although they can switch attention from one sensation to another, what remains continuous is a whole-body experience. People can selectively focus upon one sensation, but cannot turn the other sensations off [40]. Moreover, the senses work together. For example, distance and spatial depth would be impossible if sight was detached from touch [4,26]. Furthermore, the information carried by the simultaneously transmitted fluxes is more than the sum of the separate fluxes. What is perceived too is the network of adjacent and successive relationships in which the individual components participate [6].

Concerning sense perception, the ecological approach argues that perceptual systems are not mutually exclusive, and work as a whole by cooperating in varying combinations [19]. When systems pick up the same information, this information is redundant for sense perception but not for experienced sensations. The problem of perception is no longer how equivalent sensations resulting from different stimulus energies are associated, but how the fluxes that specify an object or event are discriminated from all the other fluxes. Furthermore, it is hypothesized that a subject perceives an affordance more easily than its properties in isolation. What is 'meaningful' is the invariant combination of properties, not any single property [19].

Discussion

Although IEQ and HE research approach ‘experience of the environment’ differently, their view is not conflicting. Both acknowledge that experience results from different senses working simultaneously, that it is interlinked with the fluxes an individual obtains, and that a physical and material environment exists independently of subjects. Moreover, regardless of whether mind and body are different in nature, both domains are driven by a similar purpose. In essence, both want to improve people’s experience of the built environment by designing the environment that exists independently of subjects in a well-thought-out way. Because of this similar purpose and differences in their representation of reality, both research domains can complement each other in a mixed methods research design. Making use of this complementarity in research allows improving the understanding of which indoor conditions are comfortable and which are not. We expect that, based on this improved understanding, design decisions can be made that lead to a more comfortable experience and less dissatisfied patients when indoor environmental target values are achieved.

IEQ research can contribute to HE research. Sensor measurements inform about which fluxes are potentially the input for experience and how they vary in time and space. Combining measurements with surveys and the possibility to generalize results allow to formulate recommendations for building design and systems. Furthermore, HE researchers seek to interrelate people’s experience and their environment. At the level of building features, plans and building information can be used, but for sensory experiences they rely on (post-)phenomenological subjectivity. Sensor measurements can restore the missing link between subjective responses and fluxes, as well as between building features, fluxes, and people’s subjective response. In addition, sensors can show that objects and building features are not static, as HE researchers currently assume, but also continuously in flux. By combining HE research with IEQ research in this way, stronger theoretical frameworks can be developed. These improved frameworks can enable designers to understand patients’ experience of indoor conditions better. We expect patients’ comfort to be higher in designs informed by this improved understanding.

HE research can be of added value for IEQ research since it can explore, e.g., why people experience the environment in a certain way, differences in experiences between people, which user requirements are important, how building characteristics - at the terrestrial scale - influence subjective responses, how people’s multi-sensory experience can be understood, and which environmental parameters influence sense perception and whole-person experiences. Related to the latter, it can be argued that the fluxes measured by IEQ research are a selection of all available fluxes. The external world as explained by physicists is therefore only one representative model [29]. Rich qualitative data can allow IEQ research to engage more with the lived world and provide insight into how sensors can be further developed to become more accurate. Furthermore, criticism on the dualist perspective of cognitive psychology’s ‘information processing theory’ fuelled new approaches such as situated, embodied, or distributed cognition [41]. In IEQ research these new approaches are not integrated yet. HE research can contribute to this since the new approaches align with the ecological and (post-)phenomenological approach. We expect that combining IEQ research with HE research in such a way will provide insight into reasons for discrepancies between (dis)comfort predictions based on target values and actual (dis)comfort. This insight is expected to allow improving IEQ design methods, which in turn is expected to result in a higher patients’ satisfaction with indoor conditions.

However, it may be argued that the qualitative and quantitative methods are incompatible due to differences in the worldview adopted in both research domains [3,42,43]. Most frequently, researchers get around this problem by taking pragmatism as stance [3,10,44]: rather than the particular philosophical assumptions started from, of primary importance are the research questions asked, and the use of multiple methods of data collection to inform the problems under study [3,10]. However, as Biesta argues, pragmatism should be seen not as the philosophical foundation for mixed methods research, but rather as philosophical support [3]. It only emphasizes that different knowledge claims result from different ways of engaging with the world. Thus, ways of gaining knowledge can be mixed, but pragmatism should not be used as reason for not needing to consider the underlying philosophical assumptions of the mixed research approaches. As this paper suggests, the philosophical assumptions help to understand the reason for applied methodologies and methods, and how research domains can complement each other. This may support data integration – something that often leads to difficulties in mixed methods research [43,44,45].

Due to their complementarity, combining both research domains in a mixed methods research design may yield a more complete understanding of how to relate people’s experience of buildings’ (e.g., hospitals’) indoor environment more accurately to measurable IEQ indicators, and how to reduce the gap between buildings achieving target IEQ values and dissatisfied users. The strengths of one research domain can offset the weaknesses of the other.

Conclusion

The scoping study revealed that although IEQ and HE research view ‘the environment’, its ‘perception’, and its ‘experience’ differently, their views do not conflict. Influenced by their worldview and theoretical stance, their methodology and methods rather investigate another aspect of people’s perception and experience. IEQ research focuses on perception as a passive, causal process and sensations people have. Surveys inform about people’s subjective response to particular indoor conditions. Quantitative sensor measurements offer an understanding of the physical environment surrounding them and changes in the indoor conditions across time and space. The combination

of surveys and sensor measurements allows developing target values that allow predicting subjective responses within a certain probability. HE researchers view perception as an epistemic act. They consider sense perception as well as having sensations, the latter in the context of people's whole-body, multi-sensory experience. Qualitative, in-depth data provide insight into people's real life experience.

Both research domains can mutually benefit from each other's approach when their methods are combined appropriately in a mixed methods research design. To relate people's experience of buildings' (e.g., hospitals') indoor environment more accurately to measurable IEQ indicators, occupants' active perception and their multi-sensory and whole-body experience need to be integrated into IEQ research. Improving occupants' satisfaction through developing user-centric indoor environment solutions requires in-depth data about users' lived experience over an extended period of time. This will allow to take into account contextual, psychological, and emotional aspects, to consider the combined effects of IEQ parameters, to attend to the dynamics in IEQ parameters across time and space, and to combine often qualitatively described user experience not only with building features, but also with objectively measurable physical quantities like energy fluxes and chemical substances.

The insights reported in this paper can help raise IEQ and HE researchers' awareness of how they approach 'experience of the environment' and how combining IEQ and HE approaches may result in a more complete understanding of how indoor conditions are experienced by patients. This can inform future mixed methods research designs. In turn, the results can allow developing more accurate building standards and guidelines, and thus contribute to reducing the gap between buildings achieving target values and dissatisfied patients.

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