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Urban Health and Wellbeing in the Contemporary City

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This paper explores and debates the intricate connection between our built environment and an increasingly technocentric approach to distinguish health and wellbeing from a multidisciplinary perspective. The authors profess the dire need for rethinking the ‘smart’ within the city by reconsidering models of urban development and focusing on the democratisation of technology for the purpose of enhancing our lived urban experience and psychophysiological wellbeing.



Key Points

- The changing role of space, technology, people, and health within today’s high-paced data-driven urbanised culture.
- Four approaches can shape our built environment and health:
 - The increasing need of developing people-centric empathic environments.
 - Establishing the fundamental relationship between space, technology, and chronic diseases.
 - Acknowledging the role of neurosciences for understanding human behaviour.
 - Articulating the role of virtual and augmented reality platforms for the vulnerable population.

Introduction

In its guide to age-friendly cities, the World Health Organization (WHO) stated that population ageing and urbanisation were the two major trends shaping the 21st century (WHO 2007). However, as recent events have shown, we can add climate change and technology to that mix of significant trends. All four of these trends have considerable implications for the way our shared futures unfold, and, as complexity science indicates, their intersectional nature compounds the challenges they pose to us. In addition, the role these trends play in the health of populations and the dynamics of population health needs to be explored in more detail, and at an accelerating rate, if we are to have healthy and sustainable future environments.

In this paper, we explore these issues from the shared perspective of an architect, two geographers, and an applied neuroscientist. All share an interest not only in technology but

in the implications of emerging technologies for vulnerable groups in the community and the established systems of care and support that societies have in place. The focus here is, therefore, on how this type of negotiated and interdisciplinary perspective might inform developing responses to the complexities associated with health and the city.

Beyond the Machine That Goes ‘Ping’

As the Monty Python skit illustrated decades ago, we have a fascination for technology such that it is often seen as independent of the functions it serves and that it can be virtuous simply because it is new or ‘innovative’. This is problematic in an ageing world where social, environmental factors such as ageism and poor design can compound the inequalities and inequities experienced by older people and other, often overlapping, categories of people such as those with disabilities, the very young and so on (Arcieri 2021).



COVID-19 has only affirmed this understanding in many contexts, including the impacts on older people, people with disabilities and people of colour across the globe (Bhanot et al. 2020).

Consequently, our perspective is that the future of design more broadly and technology design needs to more effectively address the issues confronted by ageing populations, including their wants, needs, capacities and potential limitations. As the Universal Design paradigm has indicated for some time now, design that produces liveable and manageable environments will endure because it better meets the needs of the whole

illustrates, the connectedness of smart design can be ecological in nature as functions previously separated between external and internal can be connected using the same spatial and data exchange technologies, both real and virtual (Jutra et al. 2019).

More than this, though, we have a growing capacity to monitor and respond to dynamic environmental factors that have direct, often urgent, health implications. For example, acute events such as the 2016 Thunderstorm Asthma event in Melbourne saw ten people lose their lives and hundreds more contact emergency services (Thien et al. 2018). The level

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community and any individual's needs as their life trajectory progresses (Hamraie 2017). In this context, because 'health' is an evolving and dynamic polysemic concept, the support and maintenance of health in the city of the 21st century is necessarily an adaptive process. It is not a fixed or immutable entity.

We already acknowledge that as populations and individuals age in contemporary societies, they face a variety of challenges, including changes in their patterns of physical and psychological health. These include shifts in capacity across a range of domains, many of them closely connected to neurological and neuropsychological capabilities (Cabeza et al. 2018). Recent research suggests COVID-19 may contribute to changes and growth in aspects of this pattern going forwards (e.g., dementia prevalence). While we do not endorse a purely pathological view of ageing, since people generally adapt to the realities of progressive age as best they can, the concept of being healthy should expand if we are to incorporate age-related changes into our vision of the liveable and health-sustaining city. Such changes include the more obvious factors associated with potential reductions in physical mobility, as well as sensory and cognitive impairments.

Many of the emerging design principles in this space, including those of biophilic design in which a key aim is that design supports and enhances health wherever possible, have this emphasis on technology for more than a set of functional purposes (Xue et al. 2019). This can include the external built environment but also the types of internal environments associated with hospitals, aged care facilities and the like. Here again, as BIM technology increasingly

of preparedness for this type of event appears to have been low. Confusion emerged, and people took themselves to the hospital rather than wait for an ambulance because confusion produces a behavioural response – in this case, people took action themselves. This compounded the situation at local hospital emergency departments.

As the recent IPCC (2021) reports show, we can expect as fire, flood, and related environmental emergencies grow in number, frequency, and magnitude that these scenarios are only likely to increase. Many of these will impact more heavily on vulnerable groups in the city, including labile patients who have medically managed health conditions that are sensitive to changes in the environment. Naturally, there may also be workforce implications, especially health and emergency care workers since exposure events and surge factors have scheduling and workforce availability implications. Lastly, a blockage in any one part of our health and aged care systems have flow-on effects because they are tightly coupled in ways that are elevated during crisis events. One of the fields with considerable potential for smart human-oriented cities, drawing on these interdisciplinary developments, is that of empathic environmental design.

Empathic Environments

The recent IPCC report (2021) justly attributes our deteriorating climatic condition to human doing. One of the biggest contributions which directly impacts the climate and our health and wellbeing is the act of top-down unabated urban development in the form of cities. Cities as agglomerates of quintessential services, cultural mix, job opportunities,

and prosperity have thus far attracted 55% of the global population. Expectation to touch the 68% mark by 2050 (UN 2018) is evident considering the rise of megacities with a population of over 10 million: from two megacities in the 1950s to 30 megacities today and an expected 43 megacities to be established by the year 2030 (The Economist 2015). While contributing 75% of the global GDP (McKinsey 2016), such man-made havens are also responsible for consuming 64% of global energy production; producing 70% of global greenhouse gas emissions (in 2013 alone) (IEA 2016); more than 80% increase in climate change-related disasters globally over the past four decades (Climate Centre 2020); 4

built environment can thus be considered as a complex socio-technical system, akin to an 'Ecology', or the study of interactions of an organism (in this case, the human) and its biophysical environment (both biotic and abiotic). In the case of the built environment, four interlinked components: People, Context, Technology, and Economics, and their intersections are key to understand and develop environments that are desirable, valuable, viable, and equitable. This ecology model is based on the premise that people perform actions as a response to their immediate context with the aid of technologies, and these have economic implications.

Acknowledging the fact that people are dynamic actors who

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billion tons of garbage being dumped in the oceans annually (National Geographic 2015); 4.2 million deaths due to exposure to ambient air pollution globally (WHO 2016).

Such factors, let alone the inequitable distribution of resources - a resultant of a neo-liberal mode of governance, are critical contributors to the decreasing levels of liveability and holistic wellbeing within our urban environments. Techno-centric governance approaches to solve rather complex urban issues take centre-stage, which tend to exclude socio-cultural, ethical and inequity based urban problems that are beyond the reach of technology. Understanding the 'human condition' as a critical parameter underpinning the shape of our built environment is thus typically overlooked, resulting in biased, inequitable, and non-democratic modes of operations.

Developing *empathic environments* implies embracing a bottom-up 'Person-Environment-Interaction' approach towards place-making (Biloria 2020). This implies embracing a shift from being fixated on quantified justifications of 'efficiency' to a 'wellbeing and liveability' oriented perspective for analysing, understanding, and developing our built environment. Understanding the human condition by understanding psychophysiological issues (associated with stress, anxiety, boredom, social isolation, excitement, and engagement), re-positioning technologies for deciphering human behaviour, and developing embodied intelligence within the built environment are thus critical areas that come to the fore. The Empathic Environments approach thus puts understanding the 'human' and his/her behaviour at the centre of the environment under consideration. The

change their requirements and look for improvements and innovations to impact their wellbeing should lie at the core of developing an empathic networked practice. Therefore, solutions sought at the intersection of these four components while keeping in mind the dynamic cyclic nature of evolution and thus the inherent scalability of socio-technical solutions should constitute the design solution space. Such ecosystems of implemented solutions should ultimately define how smart a city is. This mode of thinking is equally vital for developing healthy environments wherein human behaviour and our innate instinct to respond to and, in doing so, shaping the built environment to reduce the impact of environmental stressors, can come to fruition.

Experiencing pleasure - an innate human instinct, from what we observe in the built environment, is highly reliant on the way our designs focus on removing stressors by addressing various factors - urban morphology, architectural form, material use, biophilia, symmetry, noise, visual complexity etc. while promoting a sense of relaxation, safety, belonging, and social and environmental connectedness. This is primarily because of the way the human psyche is geared, making our survival instinct take precedence over our pleasure instincts. Empathic environments should thus focus on developing ways in which lived experience information can be extracted from the community, which, in turn, will aid in evidence-based decision making at multiple scales: Architectural, Interior, Infrastructural, Land-use adaptation etc., to mitigate psychophysiological stress faced by urban residents. Sociologist David Williams thus rightfully points



out that 'where we live, learn, work, and play have more to do with our health than going to a doctor'.

This shift in focus also implies a much more holistic rethinking for improving people's quality of life by using ICT in a technologically democratic fashion while adhering to the fundamental quality of being adaptive and responsive to user needs by gaining behavioural insights. IoT and sensor-based networks have already promoted large scale big data initiatives. However, the tendency to start the transitioning from big (often siloed) data sets to a linked data (relational and networked) is highly required to truly understand urban

Space, Technology and Chronic Disease

One of the major issues for urban environments is that they are fundamentally concentrations of people and the things associated with humans at scale. This includes direct health and illness factors such as the transmission of viruses and bacteria or susceptibility to naturally occurring events that can induce allergic responses, for example, thunderstorm asthma events or reactions to various allergens, both natural and manufactured. In addition, humans produce considerable quantities of biological and manufacturing waste, which must be managed. And that management has consequences in the

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dynamics from an ecology perspective. Opportunities in the form of geotagged data sets and crowdsourced data – including citizen science initiatives that are relevant to understand health behaviour, need to be explored and cultivated much more.

A big gap, however, within this gamut of IT pertains to harnessing user experience pertaining to the impact of the urban environment on the human body. Limited studies (Dritsa and Bioria 2021) have been performed in this regard and much more targeted research to extract lived experience certainly needs to be performed to promote an empathic approach towards informed placemaking to mitigate psychophysiological stress witnessed by urban residents. Fusing personalised physiological data with typical routing applications can also provide alternative ways of personalised navigation, which are beneficial to one's health, thus promoting active mobility via reduction of stress. Similarly, interior environments have a lot to benefit from by adhering to principles of neuroscience, psychology, and behavioural economics, which ultimately translate into behavioural design attributes. This fusion of disciplinary thinking is critical to creating the much-needed momentum for empathic environments. Facilities such as age care and disability centres, which are typically governed and expressly customised for maximisation of profit, could certainly benefit from a behavioural design-driven empathic environment creation where wellbeing becomes the primary focus.

smart city, including noxious smells and gases, noises, and potential irritants (Jiao et al., 2021). Recent heatwave and fire events in North America and Europe all indicate that direct and indirect factors – heat distress and particulates – are growing health problems for urban environments (Matz et al., 2020). There is, therefore, a complex of human and 'natural' (since some are induced or exacerbated by human actions) factors interacting with the health status of our increasingly ageing urban populations.

In addition, even with good planning, maintaining a balance across the complex of needs and wants of urban stakeholders of all types can be a complicated process. In the smart city context, this is both a fundamental feature of becoming 'smart' and potentially increasingly manageable not just through technological fixes (a much-critiqued focus) but through human-centred solutions using smart(er) technologies. Virtual earth software, for example, extends traditional geographic information systems technology to permit faster, scalable management of the intersection between natural and built environments and their human and animal effects (Liu et al., 2020). This leads us to the rapidly developing concept of smart urban ecologies (Colding and Bartel 2017). Here we take a more holistic view of the structural and interactional elements of the contemporary city that adds in broader environmental context and patterns. And given how much we are already relying on smart technologies

to monitor factors such as global warming and climate change, the translation of these techno-strategies to specific urban environments and their interconnected hinterlands is essential.

Where we believe this gets especially interesting and useful is in the integration of smart ecological monitoring with health and social care systems and their associated dynamics. For example, population ageing is closely connected to rising rates of chronic disease, multimorbidity and various disabilities and impairments (e.g., mobility, sensory, cognitive, respiratory, and so on). If the smart city can take a leaf from the growth in smart transport systems integration in Europe (rail and road especially), to connect patients, health services and emergency services (e.g., fire, ambulance, and police) and supports (e.g., social services, pharmacies, care workers, volunteers, and visitors etc.) the potential is substantial for not only prediction but preventative planning and surge management.

This could be strategic development for the better integration of community-dwelling patients who may be stable or labile and reactive to changes in environmental factors or who experience acute events. In addition, as factors like heatwaves increase in severity, the needs of older people who may need to stay at home during such events increase the need for more connected and responsive services. These could include food and medication deliveries, telehealth or in-person support for their conditions (while keeping the workers safe too), temporary respite (e.g., during heat and/or fire events – air-conditioned facilities, heap filters) all monitored not only in real-time but planned for based on detailed data and knowledge of the health implications of such events for patient types and segments.

amongst older and socially isolated people can be integrated into the smart city framework whereby the risks associated with loneliness could be managed more effectively by that community service, not-for-profit and associated supports.

More broadly, we know that brain function reflects the way these factors interact, and the consequences range from the neuropsychological to the physiological, including variables such as endocrine response patterns (Neale et al. 2017). In other words, as our conceptualisation of relative health status diminishes the traditional conceptualisation of health as an absolute (health as a fixed entity), the neurosciences and associated technologies increase their potential contribution to health maintenance and optimisation in urban and other environments. A variety of pilot projects have been developed by a member of this team that reflect how functional disability can be ameliorated and social interaction and engagement improved via gamification strategies.

Augmented and Virtual Reality for Vulnerable Groups

Two or three areas already stand out as offering evidence-informed potential for the expansion of technology that supports various categories of vulnerable people in urban environments. We know that, for example, virtual reality and augmented reality can provide experiences that educate care providers and support people with sensory and motor limitations in their engagement with their environments. Evidence by Garcia (2019) and colleagues indicates that gamification is another technology-informed strategy for supporting older people, for example, but producing interactive solutions that provide output data indicating clinical effects – the success of the activity (or not) and the opportunity to

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Neuroscience and the Smart Healthy City

Given that many developed countries now have anywhere from 40-50% of their populations living with long-term health conditions, factors such as cognition, sensory perception, affect, and mood need to be considered as design factors for urban environments and integrated technologies. We know that design elements can support or reduce people's response to environments, including their levels of stress and/or resilience (Korpela et al. 2018). Factors such as loneliness

refine or modify the activity.

At a perhaps more material level, the city of Graz in Austria implemented enhancements to street navigation for visually impaired people to assist in safe mobility and navigation within the urban environment through a project called ways2see (Zimmermann-Janschitz et al. 2021). The physical modifications were supported by a geographic information software-supported app that assisted the user in negotiating this informed environment (Zimmermann-Janschitz 2018).



In this context, we propose that the concept of 'technologies can effectively range from modest physical innovations through to the kind of digital applications associated with AR, VR and AI in an integrative and assistive technoscape.

This adaptive and enabling element is key to the smart city concept, as it is not simply about designing and leaving the technology interface to be used by the client group but, instead, to provide a data-informed opportunity to monitor, evaluate and modify such offerings. Thus, the smart city can be part of a therapeutic ecology where subjectivities (the user experience) and data from such systems can inform sustainable solutions that potentially improve over time. This is likely to become even more important as the adaptive needs of cities grow in order to maintain and enhance their health-supporting capabilities under climate change.

Conclusion

Clearly, these approaches acknowledge the close connections between the natural and built environments as well as the

evolving nature of our technologies. The focus on the needs of people in a broad sense, and not just as health-imposed limitations, can help us modify what the smart city means, what it looks like and how it functions. Rather than some techno-fantasy of digital connectedness, it can be about enhancing the lived urban experience of people by connecting what we know about physical and psychological health through technologies that are supportive across the lifespan. Here, we mean that not all health technology has to be curative in its focus but instead, especially where we may lack cures, it better helps us serve existing human needs in their current contexts. And because that context is changing rapidly, as the IPCC illustrates, our ideas for connecting health and the city must also change. To do this in a sustainable way that is adaptive to shifting human needs would be truly smart.

Conflict of Interest

None. ■

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