Sustainability as Promoting Well-being: Psychological Dimensions of Thermal Comfort

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Summary

The ultimate objective of sustainable development is to secure opportunities for a good life for present and future generations (SB10). At present, this future is defined, in large part, by objective indicators such as GDP, wealth, consumption, crime rate and education. We understand a great deal about material conditions but, mental illness and suicide are at there highest recorded levels and it is claimed that more than half the world's population (3.3 billion) are experiencing low levels of subjective well-being [2].

Well-being lies at the heart of the good life. If we are to build sustainable communities that nurture well-being - we need to understand people's perceived quality of life. An efficient and expedient response will require collaborative approaches. The science of well-being seeks to optimize how individuals and communities feel and function, offering us, as built environment practitioners and researchers, the opportunity to utilise thirty years of theoretical and empirical insights. This process has been initiated. However, whilst the interdependence of well-being and sustainability is more widely accepted [4,5,6,7] this relationship remains largely conceptual and enthusiasm has got ahead of the evidence [4,8]. Those investigators currently pioneering approaches draw upon pragmatic and varied conceptual models [8,9,10,11]. Measurement and intervention require a robust theoretical stance.

Utilising thermal comfort as a vehicle, this paper is a first-step in initiating a dialogue between the built environment and a positive psychology model of wellbeing. The conceptual framework is that which underpins investigation of well-being via the European Social Survey (ESS). The authors demonstrate that, theoretically, thermal comfort can be linked with well-being and how it fits with the four dimensions of the ESS model. Investigating thermal comfort through the lens of ESS, it is argued that the preventative and adaptive measures of thermal comfort are important to how people feel and function but, also that the neglected concepts of thermal delight, environmental stimulation, diversity and their associated processes are of substantial significance. The paper argues that the concept of thermal delight needs much more practical and theoretical consideration – drawing on the ESS for further psychological based comfort research. The authors stress that further research is required to establish what degree the strong and fertile ESS stance may build upon and/ or replicate existing approaches. And, as this is early research, we remain largely theoretical, rather than drawing on specific case studies.

	Personal	Interpersonal
Feeling (having, being)	Satisfaction	Belonging
	Positive affect	Social support
	Negative affect	Social recognition
	Optimism	Societal progress
	Self esteem	
Functioning (doing)	Autonomy	Social engagement
	Competence	Caring
	Interest in learning	Altruism
	Goal orientation	
	Sense of purpose	
	Resilience	

ESS conceptual model

This paper also offers the ESS model as having strong potential for additional features of the built environment. The authors believe that the ESS brings clarity and insight to relevant and up-to-date positive psychology. The model encourages developers, designers and researchers to think in terms of personal and interpersonal psychological well-being (PWB) and therefore processes for active participators and enduring effects. Furthermore, it considers personal and interpersonal subjective well-being (SWB), hedonic stimuli, for passive recipients and transient effects. In conclusion, the science of well-being presents an opportunity to conceptualise sustainability as promoting well-being - towards a more robust understanding of perceived quality of life.

Keywords: subjective well-being, psychological well-being, positive psychology, thermal comfort, thermal delight.

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1. Sustainability, Well-being and Thermal Comfort

1.1 Sustainability and Well-being

Sustainable development is continuous and controlled social change that is sought after worldwide. The ultimate objective is to secure opportunities for a good life for present and future generations (SB10). At present, this future is defined, in large part, by objective indicators such as GDP, wealth, consumption, crime rate and education. However, despite being three times richer, mental illness and suicide are at there highest recorded levels and people in the United Kingdom saying that they are “very happy” has fallen from 52% in 1957 to just 36% today [1]. This is echoed in several developed countries and it is claimed that more than half the world’s population (3.3 billion) are experiencing low levels of subjective well-being [2]. The UN estimates that 60% of these people will inhabit urban environments by 2030 [3].

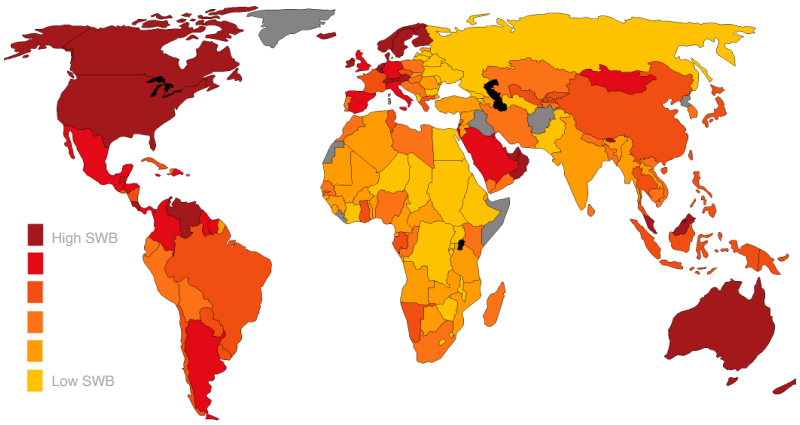

Fig 1. Global Subjective Well-being [2]

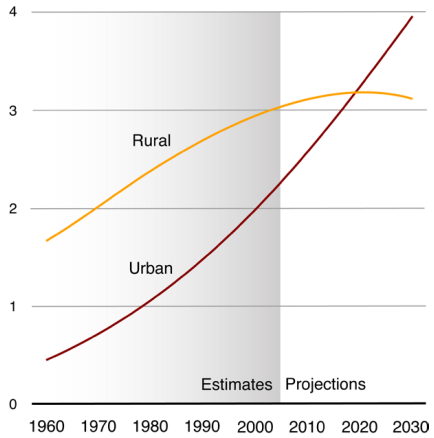

Fig 2. Urban and rural pop. (billions) [3]

Well-being lies at the heart of the good life. If we are to address these social trends effectively and build sustainable communities that nurture well-being - we need to understand people’s perceived quality of life. An efficient and expedient response will require collaborative approaches. The latest science in well-being seeks to optimize how individuals and communities feel and function. These theoretical and empirical insights offer us, as built environment practitioners and researchers, the opportunity to understand and utilise more than 30 years of research. This process has been initiated. However, whilst the interdependence of well-being and sustainability is more widely accepted [4,5,6,7] this relationship remains largely conceptual and enthusiasm has got ahead of the evidence [4,8].

Within the built environment - architects, developers and designers are beginning to present ‘design for well-being’ in abstract terms, stating design benefits with no evidence or user opinion [8]. While their intentions are good, we cannot make a genuine difference to people’s enduring experiences of well-being without a valid and reliable evidence base. Exceptions within this UK are Inclusive Design for Getting Outdoors (I’DGO) - investigating, primarily, elderly samples and Greenwich Primary Care Trust, studying all age groups within, largely, residential neighborhoods. This research has established links between the built environment and well-being but, measurement and intervention require a robust stance and, to date, each approach has drawn upon pragmatic and varied conceptual models [8,9,10,11].

1.2 Thermal Comfort as a Vehicle

This paper represents a first step in a theoretical dialogue - exploring the potential application of a rigorous model from Positive Psychology to the built environment. The conceptual framework is that which underpins investigation of well-being via the European Social Survey (ESS). To make the task mangable and explore well-being indepth, within the scope of this paper discussion is limited to thermal aspects of built environments. The key vehicle is that of thermal comfort, which, in itself is a major sustainability issue as it is extremely energy intensive to maintain current standards of technologically derived comfort [12].

Investigating thermal comfort through the lens of ESS, the authors suggest that the preventative and adaptive measures of thermal comfort are important to how people feel and function but, also that the neglected concepts of thermal delight, environmental stimulation, diversity and their associated processes are of substantial significance. The paper offers the ESS model as having strong potential for important research gaps in thermal comfort, as well as, additional features of the built environment.

2. Well-being – Overarching Perspectives

Broadly, there are two perspectives on well-being: hedonia and eudaimonia. The first – hedonics - is more commonly known as subjective well-being (SWB) and the second – eudaimonia – as psychological well-being (PWB). The two overlap but, are also divergent in crucial areas.

2.1 The Hedonic View (SWB)

SWB refers to how people feel pleasure, enjoyment and happiness. The concept can be traced back as far as Artippus in the fourth century B.C. Hobbes, DeSade and Bentham all, at intervening stages, have picked up the baton and championed the idea that the pursuit of sensation and pleasure is the ultimate goal in life [13]. In 1999, Kahneman defined hedonic psychology as the study of ‘what makes experiences and life pleasant and unpleasant’ [14]. Most recently, and for the purposes of this paper, Huppert et al (2009) refer to SWB as the presence of positive emotions, the absence of negative and satisfaction [15]. Hedonia is about being a passive recipient and is more closely associated with transient experiences of well-being.

2.2 The Eudaimonic View (PWB)

The second perspective of well-being is based on Aristotle’s eudaimonia; the life well-lived and human potentials being realised when people flourish. This viewpoint departs from hedonia, in the sense that, momentary subjective experiences of pleasure are not as important as fulfilling those needs that are rooted in human nature. Eudaimonic theories maintain that not all desires yield well-being and that, as well as subjective experiences, there are objectively valid psychological needs - that we require to flourish as well as encounter enduring levels of happiness [16]. These intrinsic or essential human needs are about how people function. Instead of the passive experience of attaining pleasure, PWB is about an active process ‘well-doing’, being holistically engaged, being challenged and exerting effort [17]. To date, it is has been demonstrated that there are three innate positive psychological needs that humans require: autonomy, competence and relatedness. These constructs are discussed in more detail in section 3.

2.3 The Overlap and Feedback Loops

PWB and SWB overlap. For instance, those people who can be considered eudaimonic also, often, as a byproduct, experience positive feelings. However, another person might be functioning equally as well but, may not necessarily feel as good. And, a person having positive short-term feelings - may not actually be functioning very well. The position adopted for this paper is that SWB can be

used as an operational definition of well-being but the authors endorse eudaimonic view of what fosters SWB [13]. In the end, it is most important that people function well, realize their potential and, where possible, feel good for sustained periods of time.

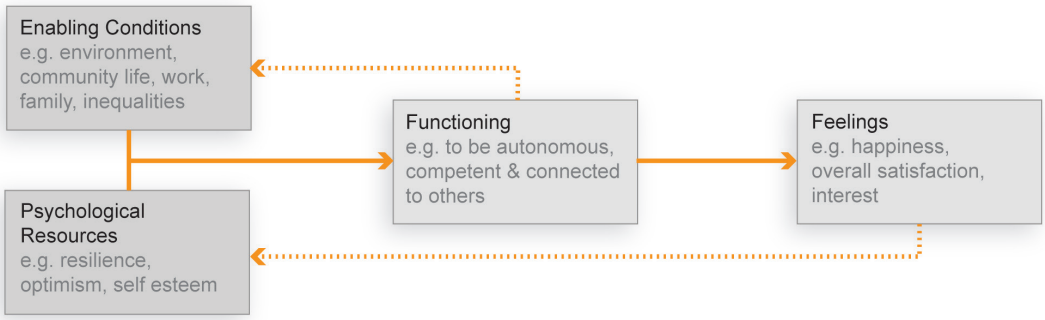

Fig 3 - diagramatic representation of well-being process

3. The European Social Survey

3.1 Background and Conceptual Framework

One of the most systematic attempts to offer a comprehensive well-being conceptual framework is that developed for round three of the European Social Survey in 2006. The ESS project, initiated by Europe's main national academic funding agencies, the European Science Foundation and the European Commission, is dedicated to understanding changes in Europe's social, political and cultural fabric. Integral to this pursuit has been the improvement of methods of quantitative social measurement – such as well-being.

As part of the third round, the survey united the perspectives of SWB and PWB for both personal and interpersonal scenarios. As a result, the survey contributed a great deal to understanding people's subjective experience of their lives. The conceptual model is set out below.

	Personal	Interpersonal
Feeling (having, being)	Satisfaction	Belonging
	Positive affect	Social support
	Negative affect	Social recognition
	Optimism	Societal progress
	Self esteem	
Functioning (doing)	Autonomy	Social engagement
	Competence	Caring
	Interest in learning	Altruism
	Goal orientation	
	Sense of purpose	
	Resilience	

Fig 4 - ESS conceptual model

The following sections describe the underlying concepts of personal and interpersonal well-being for both feeling (rooted in hedonics) and functioning (from eudaimonia).

3.2 Personal and Inter-personal Feelings (SWB)

The way people feel lies at the heart of well-being. Within positive psychology, SWB has a well established research history. The past 20 years have seen psychologists demonstrate a number of factors that contribute independently to overall SWB. These feelings can be organized in temporal

terms - as the past, present and future. They can also be ordered in terms of personal and interpersonal well-being - as individuals rarely live in isolation from others [18].

As mentioned earlier, SWB includes life satisfaction, the presence of positive emotions and the absence of negative emotions [19]. Peoples' personal feelings are usually regulated or controlled for characteristics that predispose them to high levels of well-being. This can include positive feelings of achievement, optimism and self-esteem. Once these aspects are taken into consideration, direct evaluations of peoples personal feelings might include: the absence of negative mood such as feeling lonely, sad, depressed, restless, anxious and bored. Evaluation of positive feelings includes enjoyment, absorption, energy levels, tranquility and happiness [18].

Satisfaction materializes when an individual's experiences match their expectations. However, a high level of satisfaction will be reported both by people who have very positive experiences and by people who have less positive experiences but low expectations [18]. Also, fulfillment is not only a general question of people's life satisfaction - it should be considered across and between domains. For instance, work, home and work-life balance.

Interpersonal feelings or social well-being are about the quality of interactions with others. Extensive work has demonstrated positive relations influence all aspects of health and functioning [20,21]. Positive interactions are; being fairly treated (perception of balance between what someone gives and receives), the feeling of respect, support, recognition, care and belonging. Each of these can be considered in relation to the dynamic between immediate family, neighbours or wider community [18].

3.3 Personal and Inter-personal Functioning (PWB)

In developing countries it has been demonstrated that poverty, poor health care and a lack of opportunities can undermine peoples ability to function [22]. However, evidence from developed countries suggests that external circumstances (including the built environment) account for approximately 10% of the variation between individuals in measures of happiness [23]. It has been proposed that a far greater amount of variation can be explained by what people do with their lives [18].

Building for PWB in individuals and communities is how we are more likely to create enduring levels of well-being - rather than the more transient or fleeting impacts - associated with hedonics. However, the nature of PWB necessitates people doing things for themselves. In other words, it is unlikely that a significant increase in well-being is achieved whilst on 'autopilot'. As built environment practitioners, facilitation of individual's or communities' 'intentional activities' are the key output.

Recent research indicates that there are three intrinsic positive needs that the built environment must facilitate. Huppert et al. analysed the PWB data on a large UK sample and shown that there are 3 basic dimensions: autonomy, competence and relatedness. Autonomy is the universal urge to be causal agents of our own life and act in harmony with our integrated self. However, this doesn't mean to be independent of others [24]. Competence refers to being effective in dealing with the environment a person finds themselves [25]. Relatedness is the universal want to interact, be connected to and experience caring for others [26] and therefore covers all three of the ESS interpersonal constructs (see table).

It is increasingly clear that these needs can be universally applied. However, some may be more salient than others at certain times and will be expressed differently based on time, culture or experience [27]. In addition, some investigators have shown that a sense of purpose or meaning in life is strongly related to PWB, which is, in turn, closely related to people's goal orientation [28]. An interest in learning and curiosity are also thought to be central to individual's PWB but, it is less clear how significant they are,

Importantly, inter-personal functioning differs from interpersonal feelings because it not about being

the recipient of what other people do. Instead, the emphasis is consideration of what the individual does for other people or their community and inadvertently cultivates social capital. This is what has been referred to as pro-social behaviour and has been demonstrated to increase the well-being of the person behaving pro-socially and those people they interact with [29]. Inter-personal functioning is not just about the values people have but what they actually do. It can be assessed in relation to pro-social behaviour such as caring, volunteering, social participation and altruism [18].

4. Thermal Comfort

4.1 Thermal Comfort Paradigms

There are two main conceptualizations of thermal comfort. The first, a physiological heat-exchange model underpins conventional thermal comfort research. Thermal comfort, it is argued, is achieved by balancing the body's heat gains and losses [30]. Comprehensive laboratory climate chamber experiments form the basis on which neutral, 'comfortable', thermal conditions of subjects are founded. The aim of the conventional comfort paradigm has been to define the 'comfort zone' for which building interiors should be designed and maintained to ensure occupant comfort.

In the 1970s, the adaptive thermal comfort paradigm emerged in reaction to the narrow physiological scope and deterministic comfort zone of conventional comfort theory [31]. The adaptive paradigm conceptualises occupants as actors in achieving thermal comfort, not unresponsive passive subjects: "if a change occurs such as to produce discomfort, people react in ways which tend to restore their comfort" [32]. Here, behavioural, physiological, and psychological adaption are the major mechanisms that enable people to be comfortable in a much wider range of thermal conditions than suggested by the physiological model [31].

Both paradigms are founded on the commonly accepted definition of thermal comfort, provided by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and Fanger: "that condition of mind which expresses satisfaction with the environment" [30]. However, both have not significantly dealt with 'the mind', the psychological construction of comfort. Scholars working within the adaptive model have highlighted the need to comprehend the psychological aspects influencing thermal comfort. Such aspects have been highlighted as major, if not the main, gap in thermal comfort knowledge and to which this paper aims to contribute.

4.2 Thermal Delight

Conventional and adaptive thermal comfort research is underpinned by a motivation to reduce, or minimize, thermal discomfort. The aim of both is to produce built environments where occupants live in thermal neutrality. Thermal neutrality is conceptualized as comfortable. Referring to ASHRAE standards, Heschong [33] notes that:

"there is an underlying assumption that the best thermal environment never needs to be noticed and that once an objectively "comfortable" thermal environment has been provided, all of our thermal needs will have been met. The use of our extremely sophisticated environmental control systems is directed to this end-to produce standard comfort zone conditions".

Very little theory or practice has sought to positively, actively, contribute to occupant well-being, reflecting both the primary focus on office buildings and workplaces as well as economic and political pressure to adopt air-conditioning [12].

But what about celebrating the thermal environment? What about thermal diversity rather than thermal monotony? Is our goal to create uniform thermal environments? Such were the goals of the seminal text Thermal Delight (1979) by Lisa Heschong. Using historical references from a wide variety of socio-cultural contexts, Heschong vividly illustrates the link between thermal conditions, lifestyles and the physical environment. However, while Heshchong's argument is engaging, it remains a

series of carefully selected anecdotes and lacks a clear evidence base. It offers no guidance on 'thermal well-being' today, on what designers can do to support thermal wellbeing in modern built environments.

Heschong's *'Thermal Delight'* is now 40 years old, yet during these years very few studies have continued it's line of inquiry. Why has it not been adopted? Why has thermal comfort research remained squarely focused on the prevention of discomfort? Why has the last 40 years focused, along the lines of the adaptive model, on highlighting adaptive actions to 'restore comfort' rather than on those actions, rituals and behaviours that challenge the notion of thermal neutrality as the central goal?

The authors argue that thermal comfort research lacks a clear theoretical framework from which to study these rituals and behaviours and thus has failed to investigate them in-depth. While psychological aspects of thermal comfort are repeatedly cited as potentially the most significant dimension in thermal comfort research it remains a feature that requires much more research. The authors believe that this may be, in part, because researchers lack a clear framework from which to integrate behaviours, well-being and thermal comfort. Furthermore, thermal aspects are not easily separated from other aspects of lifestyles. This paper goes some way in initiating a conversation about a framework and methodological options for such future comfort research.

5. Thermal Comfort – Through the Lens of ESS

The following section offers a brief exploration of thermal comfort and thermal environments via several of the ESS conceptual constructs.

5.1 Thermal Comfort and Delight for Personal and Inter-personal Feelings (SWB)

As previously outlined, extensive work around comfort has provided an understanding of what reduces thermal dissatisfaction. This is important work in achieving thermal neutrality and also in light of ESS's hedonic construct of the absence of negative affect. This concept of satisfaction - as neutrality has, largely, been realized through modern heating and cooling.

It has been argued that it is not natural for mankind to live, work and play in a space that has a constant thermal condition, it has never been the case in human nature, nor was it so for any other living thing on earth [34]. Not only is thermal symbolism now obsolete but the modern emphasis on central heating systems, it is often argued air conditioning and hermetically sealed buildings have actually damaged our thermal coping and sensing mechanisms, as well as our negatively impacted on our health. Is it possible that modern technological approaches to thermal well-being compromise fundamental well-being needs? As well as providing uniformity, can technologies also be used to enrich the experience of the inhabitant?

When considered via the lens of ESS, the motivation in seeking thermal delight may be interpreted as, primarily, for the passive hedonistic experience. For example, Finnish people going to the sauna and then running into a cold lake. The stark contrast in sensation is most likely sought for the experience of energisation and delight. Similarly, people who choose to attend outdoor Christmas markets in freezing temperatures may experience thermal delight as they sip hot mulled wine and huddle amongst other market-goers and around large ovens. However, in this case, the positive feelings are likely to be a mixture of the ritualistic feelings associated with Christmas as well as social enjoyment. It may also be a collective feeling of belonging, social support and recognition, especially if the market produce and attendees are local.

Until recently, Christmas markets In the UK were quite rare. They have become increasingly common as people actively seek, amongst other things, thermal stimulation via temperature contrasts. To what extent are people tolerating thermal stresses for the sake of positive social feelings and/or to what extent are they choosing the unique feeling of 'cosyness' or thermal delight? People have a choice

of environments that offer such social connectedness, for example a pub, or a concealed area of the same Christmas market. But the outdoor market, with what conventional comfort research would say has uncomfortable thermal conditions, is chosen by many people instead.

Thermal comfort has typically ignored our past thermal experiences and the delights that enriched our lives physically, emotionally and psychologically [33]. The markets are an exception to this contemporary outlook and make for a highly positive public realm intervention. The success of which is, at least in part, thermally driven. Experimental research could test whether principles of thermal delight can be replicated at smaller scales in residential neighbourhoods. For example, barbeques in public spaces, or manageable fires and large-scale fondues. As in case of the markets, such interventions may facilitate both personal and interpersonal feelings.

5.2 Thermal Environments that Promote Personal and Inter-personal Functioning (PWB)

As well as the passive feelings outlined in 5.1, the ESS framework requires that thermal environments are considered in terms of satisfying intrinsic functional needs and psychological growth. In other words, thermal environments that support people as 'active participators' and the 'well-doing' they experience. As outlined earlier, PWB crosses over with SWB in the sense that positive functioning may bring about positive feelings, but this is not a prerequisite. When PWB does bring about hedonic feelings they are more stable and enduring [35].

Adaptive comfort can therefore be considered as supporting at least two dimensions of PWB: autonomy and competence. The adaptation renders people as determining their own behavior and/or experience control of the environment and being able to reliably predict outcomes [13]. For instance, people working in office or leisure environment who are able to open a window, remove an item of clothing or alter room temperature. This is important if an individual is to have a sense of control over their life and the environment – rendering themselves comfortable in a wide range of thermal conditions. It can also be argued that thermal adaptation fosters social engagement and caring as it enables colleagues to consider and act on behalf on each other.

Proper consideration of the ESS raises further important questions – to what extent is the subjective well-being or the passive experience of thermal delight a product of the doing or active processes involved? Anecdotally, most people can relate to the clear sense of well-being men experience when in charge of a barbeque. Is this sense of control, competence, purpose, and social engagement - encountered by the grill-master at the garden party, in anyway similar to the functional experience of the market traders at the Christmas markets?

For some, the markets provide the opportunity to grow, cook and sell their products. It is likely that, to those people involved in a small business such as a market stall - these processes bring a strong sense of meaning, effective functioning and control. Each output can be deemed an indication of realizing potential (PWB). For attendees of the markets, crowded together around the hot stalls, the markets not only facilitate intimacy and the possibility of social engagement, pro-social behaviour, but also the possibility of learning. This may involve amassing knowledge on German and Polish sausage varieties or, the diverse range of preparation techniques on display.

6. Conclusions

Utilising thermal environments as a conduit, this paper is a first-step in initiating a dialogue between the built environment and positive psychology. The authors have made a modest attempt to demonstrate that, theoretically, thermal comfort can be linked with well-being and where it fits in with personal and interpersonal dimensions. Investigating thermal comfort through the lens of ESS, the authors suggest that the preventative and adaptive measures of thermal comfort are important to how people feel and function but, also that the neglected concepts of thermal delight, environmental stimulation, diversity and their associated processes are of substantial significance. It is suggested that the concept of thermal delight, which has remained dormant for more than four decades may be re-ignited by the ESS – prompting further research in psychological based gaps in knowledge.

This paper also offers the ESS model as having strong potential for additional features of the built environment. The authors believe that the ESS brings clarity and insight to relevant and up-to-date positive psychology. For example, whilst the interdependence of well-being and sustainability is more widely accepted [4,5,6,7] this relationship remains largely conceptual and enthusiasm has got ahead of the evidence [4,8]. Those investigators currently pioneering approaches draw upon pragmatic and varied conceptual models [8,9,10,11]. Measurement and intervention require a robust theoretical stance. The model offers this possibility and, encourages both practitioners and researchers to think in terms of processes for active participators and enduring effects, as well as, the more traditional, hedonic stimuli for passive recipients and transient effects.

The science of well-being and the ESS present an opportunity to think of sustainability as promoting well-being and to work more imaginatively, with greater efficiency and expediency - towards a more objective understanding of peoples perceived quality of life. The authors stress that further research is required to establish what degree the robust and fertile ESS stance may build upon and/or replicate existing approaches. And, as this is early research, we remain largely theoretical, rather than drawing on specific case studies.

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