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The SALIENT Checklist: Gathering up the Ways in Which Built Environments Affect What We Do and How We Feel

Paul Dolan *, Chloe Foy † and Sophie Smith †

London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK; C.A.Foy@lse.ac.uk (C.F.); S.Smith13@lse.ac.uk (S.S.)

* Correspondence: P.H.Dolan@lse.ac.uk; Tel.: +44-20-7955-7237

† These authors contributed equally to this work.

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Abstract: In recent years, behavioural science has emerged as an additional tool to explore the impact of built environments on behaviour and wellbeing. Recognising the potential for further research in this field, we have sought to better understand how built environments affect what we do, as well as how they make us feel. We began this process through a review of the behavioural science literature, and have brought together evidence to develop a checklist for design with wellbeing in mind. In this paper, we present Sound, Air, Light, Image, Ergonomics and Tint as the mnemonic SALIENT, which forms a checklist. We outline an example where elements of the checklist have been applied in a real-world setting to examine subjective wellbeing (SWB). We present this example to illustrate how the SALIENT checklist could potentially be applied more extensively to measure the impact of built environments on wellbeing.

Keywords: environment; design; wellbeing; SALIENT

1. Introduction

For centuries, many have believed that built environments influence behaviour and wellbeing [1,2]. In recent years, behavioural science has provided further substance to this belief. Behavioural science teaches us that human behaviour is highly context dependent and that even the smallest changes to our surrounding environments can influence behaviour [3]. Most importantly, such changes affect us in mostly automatic and unconscious ways [3]. For example, simply changing the music played in a supermarket to French or German music can significantly influence purchases of French or German wine respectively without shoppers being aware of the effect the music had on them [4]. Similarly, introducing citrus scents to indoor environments can act as an unconscious cue to increase hand washing [5].

This insight on the powerful effects of environment and unconscious behaviour has received considerable attention from policymakers and governments around the world [1] It has led many to propose that policymakers seeking to change behaviour must recognise the influence of immediate environments on behaviour and design policies that go "with the grain" of behaviour rather than against it [1]. In their influential book *Nudge*, Thaler and Sustein refer to this type of intervention as a "nudge" policy [6]. Interestingly, they borrow from design terminology to describe the environment in which decisions are made as "choice architecture". This focus on "architecture" in industries involved in behaviour change is indicative of a wider understanding of the power and influence of built environments on behaviour.

It is within this context that we have been exploring how behavioural science research can be systematically considered in design. Academics often frame their studies in ways that cannot easily

be applied to design and designers don't necessarily have the tools to adequately assess users' needs and behaviour. We seek to bridge this gap by gathering the most robust evidence through a review of the behavioural science literature in a mnemonic and checklist—SALIENT. We give greater weight to studies establishing causal effects than we do to those providing only correlational information on how an element of SALIENT relates to behaviour or wellbeing. In this paper, we present the SALIENT checklist and outline relevant evidence from our review of the literature. We then present an example where SALIENT research has been applied in a real-world setting where the focus was on wellbeing. We finish by highlighting key considerations for future research on how built environments affect what we do and we how feel.

2. The SALIENT Checklist

Checklists are a highly efficient and useful behavioural intervention and they are used extensively across a range of settings, including clinical surgery and aircraft operations [7,8]. Checklists bring us back from our "inattentional blindness"—focussing on one thing whilst being unaware of others [9]. Inattentional blindness often results in the obvious being overlooked and checklists bring attention back to the important and obvious.

The SALIENT checklist identifies seven important elements that can be used to explore the design of built environments with wellbeing in mind: Sound, Air, Light, Image, Ergonomics, Nature and Tint (see Table 1). Below, we outline research pertaining to the seven elements. What we present is indicative of the research and an insight into the possibilities of exploring behavioural science for built environment design, however, it is not an exhaustive list.

Table 1. SALIENT—key insights.

SALIENT	Key Insights
Sound	Our Attention is drawn to unpredictable and attention seeking sounds
Air	We are affected by air flow, temperature, source and scents
Light	Our behaviour is influenced by the source and brightness of light
Image	We are stimulated by certain imagery and affected by clutter
Ergonomics	We do not adapt well to poorly designed furniture and equipment
Nature	We are affected in largely positive ways by exposure to natural elements
Tint	Our behaviour is affected by the presence of different colours

2.1. Sound

For decades, sound, in particular noise, has been the focus of much research in the field. Namely, in their study of the impact of noise on educational attainment amongst children living in urban areas conducted in the 1970s, Cohen *et al.* [10] found that children residing on the lower floors of apartments had poorer reading scores than those on higher, quieter floors. Similarly, university students in a study by Jahncke *et al.* [11] were less motivated and more tired in noisy environments. In workplace settings, a number of studies have examined the trade-off between greater interaction amongst colleagues *versus* increased exposure to sound in open-plan offices [12,13]. In response, studies have also examined how to promote concentration and calmness, not just by reducing noise, but also through sound interventions, for example sounds of nature have been linked to higher levels of concentration [14]. Also, music is a powerful mood intervention [15] and there exists a wealth of research in the music therapy literature [16–18]. One significant earlier study pertaining to sound is Weinstein's [19] examination of the impact of traffic noise produced by a newly built highway. The results of the study found traffic noise to be particularly distracting for the local residents, and most importantly, the residents did not adapt to the noise over time. Weinstein's findings relate to the behavioural science literature, which indicates that our attention is drawn to things that are unpredictable and attention seeking; in this case, the sounds of cars passing at unpredictable intervals [20].

2.2. Air

The effects of air flow, temperature, source and scents have also been explored in the literature. In workplace settings, good ventilation has been linked to staff being able to think more clearly and improved performance on work tasks [21]. In addition to having a negative effect on wellbeing [22], higher room temperatures have been found to result in reduced cooperation [23] and productivity [24]. Furthermore, the source of air—natural *versus* heating, ventilation and air conditioning systems (HVAC systems)—has implications for wellbeing [25]. In their study of air ventilation, Preziosi *et al.* [26] found exposure to HVAC systems to be strongly linked to sick absences from work, as well as greater use of health care services. As with the citrus and hand washing example mentioned above, a number of different scents have been found to affect our unconscious behaviour [27]. For example, in an experiment that involved eating a biscuit, some participants were exposed to the scent of an all-purpose cleaner. Those in the scent condition unconsciously made more attempts to clean up their biscuit crumbs than those in the no scent condition [28].

2.3. Light

Research from the behavioural science literature on the effects of different types of lighting on behaviour can be drawn on to inform design. Namely, our behaviour is affected by the source and brightness of light. For example, natural light has been identified as the preferred source of light over artificial lighting [29], and the impact of natural daylight over artificial light on behaviour, such as cognitive performance, has been explored [30]. On the brightness of light, dim environments have been found to increase creativity [31] and even reduce calorie intake [32], whereas bright environments have been shown to improve alertness and reported happiness [33], enhance concentration [34], improve adjustment to night shift work [35] and increase public self-awareness [36]. Furthermore, in a study of light and behaviour, Chiou and Cheng [37] conducted a series of experiments to examine the impact of lighting on ethical behaviour. In one of their experiments, university students participated in a dictator game and were randomly assigned to three lighting conditions: high, medium and low. At the end of the experiment, participants were given extra money and asked to make sure they had received the money "they deserved". The authors found the return of the extra money to be positively associated with the high light condition.

2.4. Image

Imagery has been a focus of wellbeing research for a number of years [38–42]. For example, in their study of innovation and wellbeing, Dolan and Metcalfe [39] note that creative environments stimulated by visual art or prints serve to actively promote health and wellbeing. Although the use of images in built environments offers opportunities for interventions, some studies have highlighted that the use of too many images—or clutter—may result in high levels of distraction [40]. That is, we are both stimulated by certain imagery and affected by clutter. For example, Fisher, Godwin and Seltman [41] found children in highly decorated classrooms had higher levels of distraction and reduced learning gains compared with those in classrooms without decorations. Similarly, Stone and English [42] assert that the presence of posters in workplaces can increase perceived workload. These findings relate to a behavioural science insight that humans have limited attentional energy, and that distractions require switching attention and using our limited attentional resources [43].

2.5. Ergonomics

Although there is research on ergonomics and behaviour and wellbeing [44], there is a lack of good causal evidence on large samples. That being said, what we have taken from the literature is that we do not adapt well to poorly designed furniture and equipment. Some adaptation has been documented over time, such as the use of uncomfortable safety equipment, but it has also been asserted adaptation is not always possible and re-design is required [45,46].

2.6. Nature

Nature has a profound effect on wellbeing. For example, it's now well established that indoor plants bring considerable benefits. Aside from reducing CO_2 in indoor areas [47], plants have been found to increase attention capacity [48], absorb toxins as well as reduce the effects related to Sick Building Syndrome (SBS), such as stress, fatigue, coughs and headaches [49,50]. Moreover, links can be drawn between nature and the other SALIENT elements. As noted above, studies have examined the influence of the sounds of nature on behaviour and the effects of natural air and light. Additionally, the use of images of nature has been explored [51,52]. Furthermore, one area of design research looks at the impact of natural elements not just through sounds, air, light, images and plants, but also the use of natural-looking furniture [53]. These studies collectively illustrate that we are affected in largely positive ways by exposure to natural elements. There is also a link in the nature evidence to adaptation. For example, examining the impacts of working in windowless offices, Bringslimark, Hartig and Patil [54] note that employees in offices without windows were five times more likely to bring plants into work in comparison to those with windows. The study participants were also three times more likely to bring in images of nature to the office.

2.7. Tint

We present colour as tint here. Behavioural science tells us that colours can act as a powerful prime—they affect our behaviour on an unconscious level [55,56]. Some research on colour is not particularly robust, however, interesting empirical research has been conducted for red and blue. For example, in a study examining the results of the 2004 Olympic boxing and wrestling competitions in which competitors are randomly assigned red or blue uniforms, Hill and Barton [57] note those in red uniforms won approximately twice as many times as those in blue. Additionally, in a series of experiments looking at the effects of red and blue on behaviour, Mehta and Zhu [58] found that red enhances performance on detail-oriented tasks and blue increases performance on creative tasks. In one of the experiments, 42 participants were presented 20 shapes (triangle, circle, *etc.*) and asked to design a toy for a child with five of the 20 shapes. Half the participants were given the shapes in red and the other half in blue. The participants' designs were then converted into black and white images and judged on their creativity and attention to detail. The toys in the red condition were rated as more appropriate and practical as well as less novel and original than those in the blue condition.

3. SALIENT in Action

In 2014, we worked with the Chelsea + Westminster Health Charity to measure subjective wellbeing (SWB) in the hospital's accident and emergency (A&E) waiting area. The project also examined the impact of certain elements of the interior environment and design in the A&E waiting area on relaxation and calmness amongst visitors. The SWB of patients, patients' relatives and friends completed a survey which included questions asked by the Office for National Statistics (ONS) to measure SWB in the UK, which address life satisfaction, worthwhile activities, happiness yesterday and happiness today [59,60]. Additionally, pain was also considered, and questions were included to measure the impact of certain SALIENT elements in the A&E waiting area—for example, sounds and images—on the relaxation and calmness of visitors. The rating scales used were from 0 (not at all) to 10 (completely). In total, 301 people took part in the survey, of which 270 provided valid data. The participants ranged in age from 14 to 104; 52% were female and 48% male.

The analysis involved comparing the survey results and the ONS general population SWB data. The study participants reported lower positive SWB (happiness, life satisfaction and worthwhileness), as well as significantly higher negative SWB (anxiety) in the A&E waiting area—4.5 out of 10 compared to 3.1 out of 10 for the survey and ONS data respectively. Most importantly, the analysis also looked specifically at elements of the A&E waiting area interior environment and design. Based on a multiple

regression analysis, music was found to increase calmness amongst study participants ($P = 0.00 < 0.05$); the relationship between artwork and pain reduction was also statistically significant ($P = 0.00 < 0.05$).

Given the evidence presented above on the SALIENT elements, many of the effects of built environments on behaviour occur at an unconscious level. As a result, it is problematic to directly ask people how a specific element in a built environment makes them feel. The aim of this project was to examine how people were feeling at the time of the survey in order to account for their subjective experiences on wellbeing as well as their feelings of relaxation and calmness in the A&E waiting area. The project offers an example of how all the SALIENT elements can be considered, and measured, in studies focused on wellbeing. Moreover, the results provide an insight into how the SALIENT evidence can potentially be applied to interventions that aim to promote wellbeing in healthcare settings, in particular the evidence on sounds and images.

4. Concluding Remarks

Our key aim for developing the SALIENT checklist is to bring together behavioural science evidence on how built environments affect what we do and how we feel. Some of the points raised in this paper might seem obvious, but it is the obvious that is often overlooked [7–9]. With so much information available in design research, applying the evidence can be a daunting task. The SALIENT checklist is aimed to serve as an informative and practical tool for design, especially when assessing or seeking to improve the wellbeing of the occupants of built environments.

If ever the statement "more research is needed" was appropriate, it surely applies to the role that the environment has on our behaviour and wellbeing. Behavioural science teaches us that the effects can be quite large for very small changes but we are yet to pin down some of the important specifics of this general observation. It is important to emphasise that the evidence is stronger for some elements than for others. Sound and light have the most robust evidence from which causal inferences can be made.

As we gather more and better evidence on the other elements of SALIENT, we should look to properly account for adaptation processes. We have mentioned the role of adaptation for sound, ergonomics and nature. We know from behavioural science research that adaptation is about attention. Humans adapt incredibly well to negative life events—such as paraplegia and weight gain [61]—and to positive ones too—such as winning the lottery and pay rises [62,63]. We have what is referred to as a 'psychological immune system' that helps us to adapt by withdrawing our attention to a given stimuli [20]. There is much more adaptation happening than we anticipate and realise—but it is not universal. Stimuli that are novel, surprising, variable, uncertain or cannot be explained are attention seeking, and can remain so [20]. Further research on adaptation will help us to better understand studies brought up above. Firstly, on sound, it allows us to differentiate between the impact of random, unpredictable and loud sounds, such as the traffic noise in Weinstein's [19] study, and a constant, ticking clock, which does not affect most people for very long. It also provides insights into why adaptation to poorly designed furniture and equipment and clutter of images and artwork can be problematic for wellbeing.

We present the project conducted with Chelsea + Westminster Health Charity in this paper to illustrate how the SALIENT elements could potentially be explored more extensively in wellbeing research. The project is limited in its application and analysis of the SALIENT elements, however, we plan to extend analysis to all SALIENT elements for similar projects and research in the future. Furthermore, in addition to gathering more evidence on the SALIENT elements, it is also our aim to further our research by engaging in projects with larger samples sizes and across a range of contexts.

Finally, given the emphasis on patient experience in the UK, as well as the booming wellbeing at work industry, the need for more research to support these developments is more important than ever. It is critical we develop a process to better assess how built environments affect what we do and how we feel. We hope that the SALIENT checklist will act as a tool for this process and that it will enable

healthcare professionals, workplaces and design practitioners to design built environments with better behaviour and improved wellbeing in mind.

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