Abstract
A building’s internal environment is often described in terms of the degree of comfort it provides. The definition of comfort is the removal of negative sensory stimuli (that distract and disturb). There is space for a description of internal environments that would maximise their positive impact rather than minimise the negative. Wellbeing, emotions and qualia are all concepts that encompass a full range of positive experiences. Practices theory describes how preferences (for a given experience) are shaped by societal forces. Human factors theory aims to improve the human-technology interactions required to control and shape internal environments. Together they all provide different insight into the internal environments people want, how they can get it and the personal and societal factors that shape those wants.

Keywords: comfort, wellbeing, sensory design.

1. GLOSSARY

Ambient conditions: the physical world that gives rise to a sensory experience
Sensory experience: the qualia of some set of ambient conditions
Qualia: the experience of a singular moment of perception, such as pain, redness or cold.
Building experience: the experience of the building in its totality, including spatial and sensory components.
Comfort: the absence of negative stimuli
Positive affect: to induce a positive experience
Negative affect: to induce a negative experience
Positive psychology: the psychology of preferred life experiences
Affordance: an object can be read by an individual in terms of what it allows them to do; for instance a handle affords opening and a seat affords sitting.

These are working definitions and should be read with care in the text.

2. INTRODUCTION

What happens when you enter a room and experience the ambient conditions? Often the singular aim of design is to reduce discomfort (ASHRAE, 2009, Keeling et al., 2012) this encourages designers to think of the environment as something to control to minimise its negative impact. This paper critically analyses conceptual frameworks that could help designers maximise their positive impact. Each of these frameworks is useful for understanding different aspects of a person’s experience of the ambient conditions and each generate their own set of questions and answers about what is occurring.

Past conceptualisations of buildings have sometimes been positive (Clements-Croome, 2000). Architectural polemics describe the necessity, delight, affection and sacredness of different thermal experiences (Heschong, 1979) and the unique qualities of each sensory modality (Pallasmaa, 2005). There are case studies of buildings such as the KI Building in Tokyo
where varying aromas are injected into the ventilation system to stimulate work and rest cycles (Takenoya, 2006). Retail environments have been understood in terms of brand communication (Kotler, 1973) and how they affect consumers approach of an area, what attracts their attention and makes them stay for longer (Foxall, 1990); because it is easier to define and quantify a universally desirable behaviour in these environments a body of research into the effectiveness of sensory design has been more forthcoming (Turley and Milliman, 2000). There are studies that look at the physiological and subjective experience of thermal pleasure (de Dear, 2011, Cabanac, 2006) and lighting (Cajochen, 2007, Veitch and Galasiu, 2012). There are also theories of positive spaces in general such as refuge theory that suggests people prefer landscapes that give a place to hide while maintaining wide fields of vision (Appleton, 1975). Buildings have also been designed to reduce stress in general rather than just stress from the ambient conditions (Ulrich, 1991, McCoy and Evans, 2005). Together these constitute a limited evidence base for understanding positive experiences.

The concepts put forward here will be evaluated in terms of their insight into:

- human experience of the ambient conditions beyond limited concepts of comfort and negative affect;
- how ambient conditions bring about positive outcomes;
- ambient conditions in a multisensory context;
- possible practical and economical improvements to design of ambient conditions

3. DESIGNING FOR WELLBEING

Wellbeing has many definitions; the one most appropriate here is positive psychology because it provides insights into positive mental health outcomes alone. One can either look for universal attributes of positive psychology, such as to autonomy, positive affect, relationships and resilience and use these to provide cross cultural comparison (Huppert and So, 2011, Tennant et al., 2007) or develop more personal measures of wellbeing that are suitable for use in particular situations (Juniper et al., 2010, Burton et al., 2011).

Any attributes of positive psychology used or developed need to be operationalized in terms of a more measurable form such as well worded questions about personal perceptions or counting the number of social interactions that occur in a given location and time period. For instance Burton et al. (2011) develop specific wellbeing constructs for elderly people such as perceived community spirit, perception of safety from crime and incidence of falling, these are then compared to attributes on a checklist of neighbourhood features such as amount of open space and amount of traffic.

A similar approach might be used to correlate particular workplaces or workplace features and measures of wellbeing. A preliminary process of enquiry might include:

- Establish definition of workplace wellbeing
- Operationalize different aspects of it to develop wellbeing indices
- Develop measurement of key workplace features
- Correlate workplace features and wellbeing indices

A useful design method of this research would be a system of measurement for workplace wellbeing (i.e. before or after a design intervention) and an increasing understanding of what design interventions are suitable for promoting particular aspects of wellbeing.
4. DESIGNING FOR EMOTIONS

Emotions can be defined and studied in many ways, Russell and Snodgrass (1987) define mood as an emotional state, affective appraisal as a person’s judgement of a thing or situation and an emotional episode as a change of mood as a result of an affective appraisal. Using this language there is a need to understand what ambient conditions give rise to emotional episodes and what these episodes are. Theories of emotion look to understand what stimuli cause what emotions, how these motivate us and how we communicate them.

The simplest models of emotion map the commonality of emotional experiences onto two dimensional axes such as active ↔ passive and unpleasant ↔ pleasant (negative and positive affect) (Scherer et al., 2010). Discrete theories of emotion try to understand emotions in terms of a small number of basic emotions such as fear, joy and sadness. These two theories of emotions can be useful to classify what emotions occur for a particular set of ambient conditions. (This has already been done in detail regarding the elements of office environments that lead to negative affect and stress (Barling et al., 2005)).

Traditionally research into emotion either uses retrospective report, laboratory study or ambulatory assessment. These aim to understand the links between stimuli, emotion and behaviour. Standard tests can be used to reliably ascertain a subject’s nature and their emotional reaction. Self-report allows a general perspective on emotional range while laboratory tests allow a systematic analysis of variables. Ambulatory assessment offers new forms of analysis in the form of experience sampling, behavioural recording and psychophysiological monitoring (Wilhelm and Grossman, 2010). These analyses provide insight into what experience an individual is having at a given time, what behaviour this leads to. It would highlight the range of emotions that people experience in a building and isolate particular ones that may be positive or negative.

Research in this would require the following steps:

- Demonstrate peoples emotional responses to building environments (e.g. by physiological and user response methods)
- Identify features that give emotional responses (e.g. link emotional response to location and sensory information to provide emotion map)

This work would provide a method for rapidly generating emotional maps of workplaces. It would improve the knowledge of design interventions that led to particular emotions.

5. IDENTIFYING SENSORY QUALIA

Although thermal comfort has been exceedingly useful in generalising what temperature to specify and how to reduce thermal discomfort they have weaknesses when used as models of how individuals experience their thermal environment. Not all people wish to be thermally neutral, some desire to be cold while others wish to be hot (Humphreys and Hancock, 2007, Cabanac, 2006) or even sweltering (Tweed and Dixon, 2012). This idea that people may have differing and changing preferences has rarely been applied in building design.

Nutritional scientists and product designers have for many years tried to determine the constitutional components of an experience. Methven et al. (2012) get subjects to rate their overall liking, perception of saltiness and familiarity of a soup served to argue that repeated exposure affects perceptions and preferences for salt levels whereas Noble et al. (1984) details
progress in the standardisation of wine tasting terminology. These studies are typical of a field that aims to characterise and make objective the qualia of perception and relate these to known physical parameters.

Similar research could be done into the qualia people seek in buildings which might involve:

- Understand the qualia people prefer
- Categorising the diversity of the qualia
- Mapping qualia to environmental parameters
- Measuring the effect of different qualia

This work would provide a new language for designers to use when specifying internal environments.

6. HOW PRACTICE SHAPES PREFERENCES

Bourdieu (1984) explained the personal tastes of the French populace in terms of social position and education. In doing so he demonstrated that one acquires and is educated in ones preferences and that they are used to distinguish oneself from others. Many practices as a whole form a person’s cultural world. Part of his study asked people to choose from a range of adjectives to describe their ideal interior words such as easy to maintain, clean and tidy, studied, harmonious, imaginative. He found that people from lower classes tended to use more functional adjectives while those from higher classes used more aesthetic descriptions. By use of demographic statistics and semi-structured follow up interviews he showed how preferences are shaped by institutions such as the education and class system. Shove (2003) applied these ideas to thermal comfort to argue that our expectations of what is thermally comfortable is shaped by practice, such as the clothes people wear, infrastructures, such as the buildings people live in, and design institutions such as ASHRAE.

Research in practices might entail:

- Identifying the preferences for different environments people had
- Understand the practices these preferences are a part of

The work would not be particularly useful for the design of individual buildings but would be useful for understanding how one might challenge existing embedded concepts of comfort.

7. HUMAN FACTORS

Two cornerstones of traditional thermal comfort are that internal conditions should be predetermined by designers and that you can’t please all the people all the time (Fanger, 1970). It follows that predesigned positive stimuli may work for some people but distract for others. However this views building occupants as passive actors, with ambient conditions as a pre-specified product to be delivered. Others view occupants as active participants in a self-regulating system (Nicol and Humphreys, 1973). Viewed this way positive stimuli need not be pre-defined and pre-specified as long as building occupants could achieve them when they were desired.

Design interventions afford certain sensory experiences, for example windows afford a breeze and cooling, while personal task lighting afford brightness. Understanding the different
affordances building users require, should be allowed to have and how to provide them would empower occupants to choose their own personal sensory experience (Cole et al., 2008). It would focus the mind of designers on the different preferences, priorities and modes of thinking that users have.

Inclusive design is most often positioned as re-designing to enable the least able of society but there is no reason that principles of inclusive design cannot be used to enable everyone for the purpose of creating their preferred environment. The Centre for Universal Design (1997) offers seven guiding rules for universal design:

1. Equitable
2. Flexible in use
3. Simple and intuitive
4. Perceptible information
5. Tolerance for error
6. Low physical effort
7. Size and space for approach and use

Many of these factors are applicable to the present problem. Present design is not flexible enough because it doesn’t provide the affordances occupants actually desire (Hadi and Halfhide, 2009) nor is it simple enough to use and users are not provided enough information or education on the consequences of their decisions (Combe et al., 2010). Inclusive design can act as a framework to increase the control people have over their buildings; this increased autonomy could lead to greater personalisation and individualisation of environments.

To paraphrase the methods of Combe (2012) in this area, the research would entail:

- Identifying the preferences people wish to be afforded but aren’t currently
- Working out the context in which these preferences are desired
- Understand the reasons for exclusion of preference
- Work out if exclusion can be reduced
- Understand the benefit of reducing the exclusion (i.e. reduced energy consumption, improved wellbeing, better work environment, reduced stress)

The work would reconceptualization buildings in terms of how occupants interact with them. It would look to optimise the affordances people are provided with rather than the internal conditions. It re-iterates the importance of understanding the information flow between building and occupant (Clements-Croome, 1997, Wu and Clements-Croome, 2007).

8. DISCUSSION

Qualia, emotion and wellbeing use the individual as the unit of analysis. One could identify a sequence of events where a qualia, may warrant an effective appraisal, which could lead to an emotional episode and that emotional episode might affects one’s wellbeing. As one moves from qualia to wellbeing the unit of analysis moves from seconds to a lifetime and the number of factors in addition to the sensory experience moves from none to very many. As such qualia are more fundamental and would make for easier inferences while wellbeing would provide a more holistic measure of positive affect. Qualia would provide a palette of user experiences for designers to choose from whereas wellbeing would lead designers down a more prescriptive path to choosing the “optimum” building environment. They would all provide additional insight into the selection of the correct environmental parameters during design or operation.
A human factors approach concentrates on the singular tasks that would be required to control the sensory environment. It would require an understanding of the information that informs people’s decisions and the nature of the affordances required to shape their environment. Providing people with the affordances they require would need to be balanced with constraining people’s actions where appropriate (e.g. not providing operable windows in air conditioned buildings even when it is desired by occupants). The approach wouldn’t fundamentally presuppose a finite palette of experiences that people have and therefore potentially it could lead to the most diverse of internal environments.

Only the practices approach provides the opportunity for the building to be the unit of analysis. Perhaps understanding how preferences emerge within particular departments and across whole buildings could reveal why some buildings work and some don’t. Apart from this the study of societal forces is not so relevant to improving the actions of a singular designer but it could provide insight into how the building industry could be managed as a whole.

This enquiry is concerned about people’s subjective experience of the built environment. It is about advancing understanding of human experience of the built environment beyond limited concepts of comfort. It is thinking about going beyond just reducing negative affect and beyond considering one sense at a time. Understanding the sensory experience of the built environment favours a qualia approach. Understanding the full spatial, functional, meaning laden experience favours emotions or wellbeing. Practice theory provides a perspective of how comfort has achieved its status of prime description while human factors give some insight on how novel environments should be implemented. All the approaches shed light on elements of what people want, how they can get it and the personal and societal factors that shape those wants. Table 1 provides a brief overview of the concepts covered in this paper.

Table 1: overview of approaches discussed.

<table>
<thead>
<tr>
<th>Aim</th>
<th>Wellbeing</th>
<th>Emotion</th>
<th>Qualia</th>
<th>Preferences &amp; practice</th>
<th>Inclusive design</th>
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<tbody>
<tr>
<td>Approach</td>
<td></td>
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<tr>
<td>To take human experience of the built environment beyond limited concepts of comfort and negative affect</td>
<td>Identify elements that improve specific aspects of wellbeing</td>
<td>Identify elements that give rise to particular emotional episodes</td>
<td>What are the salient qualia of office experience?</td>
<td>Understand groupings and formation of preferences by practices.</td>
<td>What do people want to do? How do we enable them?</td>
</tr>
<tr>
<td>Understand sensory experience</td>
<td>Provide environments that support wider wellbeing</td>
<td>Design for emotional episodes</td>
<td>Expand the vocabulary of designers</td>
<td>Prevents ongoing standardisation of environment</td>
<td>Participative architecture. Personalisation.</td>
</tr>
<tr>
<td>Possible practical and economical improvements to</td>
<td>As part of a wider whole</td>
<td>As part of a wider whole</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Designing for and measuring</td>
<td>Designing for and measuring</td>
<td>Expand design possibilities</td>
<td>Design of social / strategic</td>
<td>Shift the focus of design from internal</td>
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building design  wellbeing  emotion  interventions to affect people’s preferences  conditions to affordances

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REFERENCES

ASHRAE 2009. ASHRAE handbook: Fundamentals, Atlanta, ASHRAE.
FANGER, P. O. 1970. Thermal comfort : analysis and applications in environmental engineering, Copenhagen, Danish Technical Press.
KEELING, T., CLEMENTS-CROOME, D., LUCK, R. & POINTER, P. How the sensory experience of buildings can contribute to wellbeing and productivity. In: NICOL, F., ed. The changing
context of comfort in an unpredictable world 12-15 April 2012 Windsor, UK. London, UK: NCEUB.


