Thermal Boredom

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INTRODUCTION

In buildings today, people have come to understand, perceive, and expect consistent and stable thermal qualities provided by mechanical systems. This has not always been the case. Prior to the establishment of an air-conditioning standard by the American Society of Heating and Ventilating Engineers (ASHVE) in 1938, the driving force behind the design of the indoor physical environment was proper ventilation for health rather than thermal control of the environment for comfort. In the 1930s through the 1960s, after the widespread acceptance of conditioned buildings, research focused upon creating optimum environments for thermal comfort. Researchers established universal optimums for comfortable temperatures for various climates.

The current definition of comfort within the context of two internationally accepted comfort standards - ASHRAE 55-92 and ISO 7730 (1, 2) - is "the condition of mind that expresses satisfaction with the thermal environment." Alternate definitions, however, reveal that comfort can be a psychological phenomenon (and elusive).

We as human beings may in fact desire variations in our thermal environment. McIntyre (3) discusses the need for sensory and physical stimulation and makes a case for fluctuating interior temperatures to "counteract 'thermal boredom' . . . It can be argued that achieving a steady optimum temperature is akin to finding the most popular meal at the canteen and then serving it every day." Heschong (4), for example, argues for environments with physical variations rather than static conditions, describing comfort as a relationship between thermal contentment and human imagination. We as humans are capable of recognizing, remembering, and adapting ourselves to most thermal experiences.

The objective of this modest paper is to promote discussion of "thermal boredom." This discussion is of importance because of 1) our loss of connection with the temporal and thermal qualities of the outdoor environment (that is, from within sealed buildings), 2) the impact upon our energy resources as we design for climate control, and 3) the primary need to design places for well-being.

Information used in this paper is not based on rigorous research, but can be regarded as "soft" information informally collected from colleagues. It is hoped that from this discussion, we may launch further ideas about how we might quantify and qualify these notions that ultimately shape how we design for environmental control.

Information was collected from two professional list-serv groups on the Internet: Comfortzone (5), a group formed to enhance communication between members of the international thermal comfort community on various topics related to thermal comfort; and the Society of Building Science Educators (6), an association of university educators and practitioners in architecture and related disciplines who support excellence in the teaching of environmental science and building technologies. Responses came from England, Australia, India, Switzerland, Denmark, and the United States.

A BRIEF SUMMARY OF RESPONDENT ANECDOTES

The most useful information gleaned from the Internet survey was anecdotal in nature and, without attempting analysis, some of the responses are summarized below:

- Roasting your backside in front of a fire (dramatic radiant asymmetry);
- Opening a window to get "fresh air" — well it is really just a blast of cold air;
- Having a bedroom cold enough that you really want to cuddle next to your sleeping partner;
- Wading barefoot in the northern Pacific - any season of the year;
- In Japan I find people tend to think that getting cold invigorates the mind;
- Intelligent workplaces will make people lazy;
- In Scandinavia, we pay lots of money to sit in steamy sauna baths at temperatures that actively push our core temperature towards the thresholds of safety and tolerance. When we get to those limits we run outside and roll around in the snow (depending on how much vodka we've been drinking) or immerse ourselves in an ice-cold bath, forcing skin, and ultimately, core temperatures to begin an excursion in the opposite direction. If we emerge from the sauna feeling "neutral" or "comfortable" then we are likely to lodge a formal request for our money to be refunded;
- Occupants of some of the early passive solar houses experienced temperature variations that "were in tune with nature". I remember being in David Wright's passive solar Sea Ranch house in California and it was colder than 50°F (10°C inside) and we had to do jumping jacks to bring up the room temperature (and ours) to something approaching comfort—and he was ecstatic about the variation in temperature;
- If we design for the mean we may well be producing a climate that almost everybody finds uncomfortable (too hot, too cold, too draughty, too stuffy, etc) all the time. In

ergonomic theory such a practice is laughable - who would want a door designed for average height people?

- The canteen user wants not only variety but choice, and the two cannot be entirely separated;
- I live in the Oxford Ecohouse, a thermally massive building, which means that the internal temperature varies only 1-2 degrees over 24 hours. It is a monolithic, hugely stable internal climate and we love it. There's a very safe feel to the house - it is a mass radiant thing - not a machine thing. I also lived in the central Persian desert where we would go out from 28°C every evening from the basement to 38°C in the courtyard and we were very happy then because it was what we expected?
- *"Thermal Beige"* –Professor Scott Wing at the University of Arkansas, Department of Architecture uses this term as the search for a uniform condition intended not to be noticed. Uniformity, whether in color, typeface (remember Helvetica was to be the universal typeface), or environmental conditions, obscures our perceptions of the very conditions which we seek to inform. A fish doesn't know water...etc.
- *"Thermal Empatharium*" - a project designed by John McCreery for environmental technology students at Ball State University in Indiana allows student interpretation and observations about changes in the climate.
- "*Interstitium*" – Professor Ralph Knowles of the University of Southern California examines the dynamic space between the winter and summer solar envelopes that allow a building to expand and contract to accommodate programmatic and environmental responses to seasonal changes.
- *"A Room to Appreciate Sunrise"* – Professor Paul Clark at Virginia Tech University conducts a design competition with students who are to consider variations in light, comfort and energy.

RESOURCES ON THERMAL VARIATION

The following list is a compilation of various works on the topic of thermal variation suggested by several respondents - by no means an exhaustive list, but simply a few places to start looking for information. In addition to the references below, several respondents suggested sifting though the *Psychological Abstracts*.

Knowles, Ralph, "*The Rituals of Place"* (1999) where ritual is taken to be an imaginative recreation of the natural rhythms we experience. Available as a PDF file: http:www-rcf.usc.edu/~rknowles/

Ackerman, Diane, *A Natural History of the Senses*, New York: Random House, 1990.

Wyon, D.P., Asgeirsdottir, B., Kjerulf-Jensen, P., Fanger, P.O., "The effect of ambient temperature swings on comfort, performance and behaviour," *Archives of Science and Physiology*, Vol. 27, No. 4, pp. A441-A458 (1973). In our research from the 1970s we exposed subjects to temperature swings with different amplitudes and frequencies, and to a constant temperature. They preferred the constant level. This applies to persons who are working and do not want to be disturbed. During leisure, people may enjoy variations: saunas, ice baths, etc.

The Adaptive Model Concept outlines a series of adaptive responses which enable building occupants to adapt to indoor and outdoor climates by means of behavioral adjustments (clothing, windows, fans etc), physiological adaptations (acclimatisation), and psychological adjustments (expectations). The relationship of the adaptive model and modification of ASHRAE Standard 55 is the subject of current discussion. (7)

SUMMARY . . . OR, RATHER, FUTURE DIRECTIONS

Several interesting threads of thought appeared in many of the responses. The literature indicates that there have been a few studies on *control* – the desire for thermal variation may be a function of whether the individual has control over the change in the temperature, e.g. user-controlled blinds, fans, thermostats in the space. Expectation also plays a large role on how we experience comfort. In some cases, an expectation for lack of comfort may lead to a greater tolerance for temperature variation.

Michael Humphreys, of Oxford-Brookes University, UK clarified this discussion by posing three more questions: a) Do we prefer our bodies to be in a dynamic rather than a steady state? b) Do we prefer our thermal environment to be changing rather than steady? c) Do we prefer to be able to change our thermal environment?

The key implications of these questions are: 1) how we approach the design of passively cooled and hybrid mode ventilated buildings - perhaps using intentionally-designed thermal gradients and transition zones in buildings; 2) how related topics of "thermal boredom" (e.g. adaptive model approach) may influence changes to the current comfort standards and guidelines; and 3) the potential for increased human well-being, comfort, and environmental satisfaction.

REFERENCES

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2. ISO. Moderate Thermal Environments, ISO 7730. 1994, Geneva: International Organization for Standardization.
3. McIntyre, D.A. *Indoor Climate*, London: Applied Science Publishers Ltd., 1980.
4. Heschong, Lisa, *Thermal Delight in Architecture*, Cambridge, MA: The MIT Press, 1979.
5. Comfortzone: comfortzone@penman.es.mq.edu.au
6. SBSE: sbse@uidaho.edu
7. http://atmos.es.mq.edu.au/~rdedear/ashrae_rp884_home.html

Other references that came in after paper deadline (not published)

8. S.Kuno, H.Ohno, N.Nakahara, A Two-Dimensional Model Expressing Thermal Sensation in Transitional Conditions, *ASHRAE Transactions*, Vol.93, Part2, 1987.

9. H.Ohno, S.Kuno, M.Kida, N.Nakahara, Physiological and psychological responses in thermal transients with ramp change, *ASHRAE Transactions*, Vol.93, Part2, 1987.