Thermal comfort in Philippine office buildings: the Coolth* preference

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ABSTRACT: This paper examines the role of non-thermal factors in comfort perception and builds on the findings of the thermal comfort field study carried out in air-conditioned offices in Makati City (Manila), Philippines. The analysis of the responses of the Filipino office workers indicated that some conventional thinking about comfort preferences is open to question. The responses of the surveyed office workers contradicted currently accepted thermal comfort theory and drew out questions on the behavioural variables that affect thermal comfort perception, expectations and preferences. The ‘one-dimensional’ classical thermal comfort theory has been to strictly provide and maintain a neutral thermal state. However, it is suggested that responses of subjects in climatically controlled environments have much to do with cultural, social and contextual dimensions, which have been regarded by the prevailing comfort paradigm as secondary factors. Just as thermal comfort research has been extended to include contributions from the disciplines of social psychology, ergonomics and sociology to pay more attention to the interaction between people and their environments, theories of practices, consumption and technology would also point out viable directions to questions on dimensions of behaviour, user characteristics, expectations and preferences of thermal environments. The findings of this study suggest that the associated behaviour towards comfort impact energy consumption and are attributed to practices which are formed as a result of social, cultural and personal conditions.

* Prins (1992) and Stern (1992)

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INTRODUCTION

People have been modifying the thermal environments in their quest for comfort, leading up to the invention of mechanical refrigeration and its use in conditioning the air in buildings. The basis for air-conditioning use is the demand for a higher degree of comfort. Air-conditioning in the tropics, where the outdoor climate is a monotonous fluctuation around a hot humid theme, plays a critical role in providing comfortable environments in modern offices. Although, it has long been recognized that quality of indoor environments should not be improved at the expense of higher energy consumption, climatically controlled environments effect a dependence on the consumption of energy to make the buildings habitable. Particularly, energy consumption in Southeast Asia is growing yet energy efficiency remains far below levels in developed countries (Duffy, 1996). Air-conditioning design and operation closely follow the universally applied criteria of the thermal comfort standards (ASHRAE, 1992; ISO, 1993). The potential for energy conservation through stringent control of indoor temperatures underpin the examination of the applicability of comfort standards particularly in developing countries in the tropics. The ANSI/ASHRAE Standard 55-1992 ‘Thermal Environmental Conditions for Human Occupancy’ is used extensively as a reference for comfort levels in the Philippines (Philippine Society of Mechanical Engineers, 1993; National Building Code of the Philippines, 2000). In this regard, a thermal comfort study was carried out in Manila, Philippines, in June to August 2002 (wet season) and April to May 2003 (dry season) with the main objectives of documenting the indoor conditions of office environments and investigating the comfort responses and preferences of office workers (Andamon, 2003, 2004). The general results show that despite the cool conditions of the surveyed offices, the office workers indicated that lower temperature ranges than the ambient temperatures were acceptable. Building on the findings of the Philippine field study, the objectives of this particular paper are:

1) To characterize the thermal conditions in Philippine office buildings in comparison with the prescriptions of ANSI/ASHRAE Standard 55-1992.

2) To analyse the occupants’ perception and acceptability of the level of thermal comfort in air-conditioned offices and compare with the standard’s criterion.

3) To understand the role of non-thermal factors in influencing thermal comfort perception and acceptability and place in context with ensuing effects on consumption to satisfy comfort preferences.

1. PHILIPPINE THERMAL COMFORT SURVEY

1.1. Indoor Climates of Office Buildings

The indoor thermal environments found in Manila office buildings were compared to the ANSI/ASHRAE Standard 55-1992 comfort standard. For all the offices, air and radiant temperatures averaged 23.7°C and 22.8°C, respectively. Relative humidity had a mean of 47.4%. Average air velocity was 0.14 m/s. The individual frequencies of the temperature and humidity combinations were plotted in comparison in a psychrometric chart format (Figure 1). While these
averages of the indoor measurements were within the standard’s prescriptions, measurements that fell within the winter comfort zone account for 53.1% of all the workstation visits. Two-thirds (75.1%) of the workstation visits fell within the summer comfort zone, a third (30.3%) fell within the overlapping region of the winter and summer comfort zones. Because of the assumption that low clothing levels are prevalent in tropical conditions, the consequent presumption is the application of the standard’s criteria for summer comfort. However, measurements suggest that indoor conditions in Philippine office buildings, although within the standard’s prescriptions, are characterized as being cooler than those set by the summer design requirements.

Figure 1: Distribution of Indoor Climatic Measurements on ANSI/ASHRAE Standard 55-1992

1.2. Occupant Perception: Subjective Thermal Assessment and Acceptability

In response to the immediate conditions of the workstations, understandably, the thermal sensation votes (TSV) centred around the ‘slightly cool’ and ‘cool’ categories with a total vote of 64.9%. (Figure 2) This indicated that the voting pattern was biased towards the cooler categories with a mean response of -1.04, whereas the central categories of ‘slightly cool’, ‘neutral’ and ‘slightly warm’ (ASHRAE/indirect Acceptability) had only 63.5% of the votes, with 17.3% votes for the ‘neutral’ category. However, when directly asked whether the measured thermal environment was acceptable or unacceptable, the subjects’ responses likewise reflected the skewed pattern toward the cooler categories, indicating the same shift in central tendency. A total of 66.42% indicated that in spite of having cooler than ‘neutral’ sensations, the indoor thermal conditions of the offices are acceptable. The ANSI/ASHRAE Standard 55-1992 uses the operative temperature as the indoor environmental index for evaluating thermal comfort. The standard defines a range of operative temperatures and humidities that are acceptable to 80% or more of the occupants. The temperature range is mainly applicable for sedentary activities (≤1.2 met), with normal winter clothing, 0.8-1.2 clo or summer clothing, 0.6-0.8 clo.

In the Philippine study, juxtaposing the thermal assessment and direct acceptability responses of the Filipino office workers to the operative temperature ($T_o$), translated these responses to actual temperature values. For the direct acceptability votes, 90% of the office workers found the temperature range of 21.5°C to 24.0°C $T_o$ acceptable, whereas 80% accepted temperatures from 21.5°C to 24.5°C $T_o$ (Figure 3). However, the reported acceptable on the ASHRAE Acceptability, which were the TSVs on the central three categories (-1.0, +1) as shown in Figure 2, had its maximum at 70% of the office workers with an acceptable temperature range of 23.0°C to 24.5°C $T_o$. Notably, in both direct and indirect measures, the analysis of responses indicated that 88.8% of subjects would feel uncomfortable at temperatures beyond 24.5°C $T_o$.

The summer comfort temperature criterion of the standard at 90% acceptability is 23.0°C to 26.0°C $T_o$. The observed acceptable temperature ranges with over 80% acceptability pushed the lower limit of the summer comfort prescription outward by 1.5K and likewise lowered the upper limit by 2.0K. The implication of this analysis is also indicated in the chart presented in Figure 2. Neutral temperatures do not necessarily equate to acceptable (preferred) temperatures. Values derived using the neutrality-seeking models of the comfort standard do not give an indication of the behaviour or preferences of individuals (Williamson et al., 1995). A striking observation is that the prescription of the standard will not satisfy the lower temperature preferences of the office workers. This prompts the need for more information on people’s cooling behaviour and practices.
1. THE PREFERENCE FOR COOL/COLD CONDITIONS

2.1. Psycho-Social Factors on Subjective Comfort Responses
The science of conducting thermal comfort surveys together with the measurement of fundamental thermal comfort parameters has made significant developments over the last three decades. The compiled databases (Humphreys, 1976; de Dear et al., 1997) provide empirical knowledge from experiments around the world with useful information available from a diversity of climates and various building occupancies. However, studies that focus on the psycho-social factors affecting comfort perceptions and preferences (Haghighat & Donnini, 1999; Erlanson et al., 2003), particularly of air-conditioning use for comfort (de Dear & Auliciems, 1988; Auliciems, 1989) are a minority. It has been argued that responses of subjects in climatically controlled buildings may only be tangentially related to comfort standards and have much more to do with expectations and cultural norms (Kempton & Lutzenhisser, 1992). To understand the physical responses of the Filipino office workers, further questions dealing with psycho-social factors and some user attitudes and beliefs on air-conditioning were asked of the subjects. The responses of the Filipino subjects suggest that other issues, non-thermal factors, could shape thermal perceptions of and satisfaction with the indoor climate.

Thermal comfort research has been extended to include contributions from the disciplines of social psychology, ergonomics and sociology to pay more attention to the interaction between people and their thermal environments. Perhaps theories of technology, practices and consumption would also point out viable directions in providing answers to questions on dimensions of behaviour, user characteristics, perceptions and preferences of thermal environments.

2.2. Co-Evolution of Comfort Cooling
In looking into this notion, Shove’s theories of the co-evolution of comfort (Shove 2003) drawn from sociological and anthropological literature on consumption and studies of innovation in science and technology provide an understanding of comfort preferences. Three dimensions were delineated to allow the interpretation of how conventions and expectations of comfort may have come to be as they are. For this study, these three dimensions are translated to: (1) the relation between technologies and social practices, (2) the relation between technology of air-conditioning and the built environment and (3) the relation between the built environment and the practices associated with air-conditioning use (Figure 4).

Two mechanisms of change operate simultaneously on these three dimensions: the mechanism of difference or why technologies are acquired and that of coherence or how technologies are used. In the theory of difference, Dimension 1 highlights material culture. Based on the preliminary analysis of answers to questions of user attitudes on air-conditioning use, translating this to the Philippine context, it would seem that the acquisition of air-conditioning is driven by the need to distinguish oneself from others. For example, answers to interview questions on the importance of working in an air-conditioned office were ‘for prestige’ and ‘reputation’. As Shove suggested, the meaning of acquiring technologies is not influenced by science and advertising alone. This in turn would account for the social dimensioning of the acquisition and use of air-conditioning, which would relate to Dimension 3, highlighting consumer culture. With the mechanism of difference, the social meaning of mechanical cooling was established and continually evolved. The theory of difference also explains the normalization of a temperature setting. For example, previously extreme cold temperatures than usual become normal and new extremes are set (Wilhite & Lutzenhisser, 1999).

![Figure 4: Co-evolution of Comfort Cooling](Image)

The second mechanism of change is that of coherence or how technologies are used. This would position air-conditioning and the associated ways of life corresponding to the built environment. Change in meaning of air-conditioning use can be explained in terms of lifestyle coherence (the expectation that items or habits and practices should match) (McCracken, 1988). The second mechanism explains how coherence leads to the reinvention and reshaping of technical objects in use. Thus, the practices of cool comfort can be likened to the economic growth process which causes “ever-growing demands that lead it ever onward” (Easterlin, 1974:121).

2.3. Reconfiguring Comfort
Shove further suggests that the societal reconfiguration of comfort develops on three levels (1) evolving socio-technical landscapes, (2) backdrop of regimes (social order or system) and (3) novel ‘configurations’. Constructing this model of socio-technical change for this study, respectively, these levels would be the (1) built environment, (2) local beliefs in place, and (3) local practices (Figure 5). Shove contends that with this hierarchical analysis, it would be possible to intervene deliberately at any level in such a way as to reshape transitions. It is the local beliefs and practices that sustains and reproduce practices relating to the built environment. The interpretation of the Shove model in the Philippine context would explain the diffusion of the technical (largely Western) definition of comfort: from an ideal comfort to be emulated, to the Filipino ‘translation’ of cool comfort as modernity and the adoption of a cooler temperature range equated to progress. “The social load for air conditioning is tied up with ideas of what it is to be... modern”... (Wilhite & Lutzenhisser, 1999:283).

The literature evidence that gives support to this model of reconfiguration of comfort is the concept of ‘localization’ put forward by Mulder (1992) in his study on the Filipino interpretations of everyday life. He suggests that “in the process of localization, foreign elements have
to find a local root, a native stem onto which they can be grafted. If they do not interact in this way, the foreign ideas and influences may remain peripheral to the culture" (Mulder, 1992:4). Working on this notion, the idea of adopting comfort cooling was facilitated by the local tendencies already in place – that of preferring cooler than ambient conditions.

Figure 5: Reconfiguring Comfort

2.4. The (Re)Shaping of Preferences
Looking into historical and literature evidence, supported by the responses on user attitudes and beliefs on air-conditioning use, it would seem that the preference for cool and/or cold conditions can be explained by the hot and cold syndrome (Jocano, 2001), which describes the physical relations with the environment in Philippine society. Cool/cold representations are generally believed to be good for health (Jocano, 2001:34-35). Thus, the reshaping of temperature preferences, engendered by imported themes of modernity and westernisation, was able to take root. The technological advancement in the capacity to change the indoor environment, by cooling, has reconfigured the collective concepts of normal and acceptable conditions, and in turn reconfiguring the meaning of comfort. Everyday life involves conformity to social norms, thus it would seem that the cooling practices, having modified conventional ways of life, have become socially patterned. Studies on thermal comfort, having dealt with the technicalities of specifying the indoor environment, would likewise have to look into how these specifications have influenced the re-interpretation of comfort. Social and technical constructs both contribute to the transformation of the indoor environment and the ways of life associated with it.

The notion of the co-evolution of comfort, its societal re-configuration and (re)shaping of comfort preferences resonate the cultural theory of coolth posited by Prins (1992) and Stern (1992). The social origins of the preference for coolth, defined by Stern (1992:262) as the “subjective experience of feeling cool during hot weather”, was demonstrated by the Filipino office workers’ acceptable temperature ranges which are brought about by social, cultural and contextual reasons.

3. CONCLUDING DISCUSSION

3.1. Indoor Comfort Temperatures and Building Energy Consumption
The reliance on mechanically controlled environments means the dependence on the consumption of energy in order to make buildings habitable. Comfort has become synonymous with the consumption of applied energy (Cooper, 1982). In the 2002 and 2003 Annual Reports of the Manila Electric Company (the Philippines’ foremost distributor of electricity and responsible for the power distribution in the metropolitan Manila area), the commercial sector accounted for 35% of the total energy sales, with 0.7 percent growth rate from 2002. Specifically indicated was that the growth in the energy consumption of office buildings pushed up energy sales (Manila Electric Company, 2002:21; 2003:13).

The results of the analysis on sensation versus preference indicate lower temperature preferences of office workers in Philippine office buildings. These temperature preferences in order to be comfortable have implications on building energy consumption. The present paper suggests that there is a need for extensive research and more information on people’s cooling behaviour and practices. As part of the on-going analysis of the research, building simulations will be made to demonstrate how these thermal preferences impact on the buildings’ energy demand.

3.2. Consumption and the Environmental Debate
The Philippines is important to world energy markets because it is a growing consumer of energy, particularly of electric power, and a potential market for foreign energy firms (United States Energy Information Administration 2003).

However, despite this statement, the country is on the verge of a power crisis (Cabacungan Jr & Ho, 2004; Dumiao, 2004). In this regard, thermal comfort studies should look into the part buildings and the scientifically specified indoor environments play in defining comfort and the package of expectations, practices and conventions which impact energy consumption. The results of the Philippine study indicate that the comfort preferences of the Filipino office workers, which are translated to lower temperatures, raise the issue of how the energy intensive service of cooling by extension impinge on the country’s consumption of energy. This Philippine study of thermal comfort calls for the understanding of the social and technical transformation of what people take to be normal and ordinary conditions of comfort. Following this structure of investigation would mean the inclusion of thermal comfort issues in energy consumption and consequently, environmental debate. It has been put forward that there is a need of changing the ‘philosophy’ that underpins the comfort standards which was the stance of the adaptive approach to thermal comfort (Humphreys, 1995). Adaptive standards, considered to be more energy efficient, however “do not enhance [the] understanding of thermal comfort” (Parsons, 2003:238). Rather than a re-formulation of temperature standards and more than mere adjustment of numbers, the challenge is to change the “contemporary meanings and expectations of comfort” (Shove, 2003:40). Recognizing and understanding how the built environment and social institutions engender comfort cooling preferences would incite debates on how future policies could reshape it. This agenda would re-frame the discussion about the relationship between sustainability and comfort and would consequently introduce a different way of thinking about choice, change and environmental responsibility.

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