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## Thermal memory and transition in lobby spaces

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### Abstract

This paper investigates people's short term thermal history in transitional lobby spaces. It sets out the first stage for exploring the possibility that repeated short term experiences can modify people's long term thermal history and thermal memory towards a better thermal adaptation. Data from 50 lobby spaces in Higher Education Institutions (HEI) in the UK was collected in order to identify lobby typologies. Fieldwork was carried out during the summer of 2013 in three different buildings in Sheffield, UK. Surveys involved 610 questionnaires along with simultaneous environmental monitoring at four specific points and two sequences of spaces from exterior to an interior environment. People's thermal perception was analysed in space sequences with lobby and without lobby. Methodology and initial results are presented in this paper. Outcomes suggest that people's thermal perception can be altered over short periods of time. Temperature differences from one space to another, temperature sequences and direction are the main factors affecting people's thermal memory in the short term. The paper provides valuable insights on the key factors that impact upon people's adaptation and tolerance to changing thermal experiences.

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### 1. Introduction

Nowadays climate change and increasing temperatures are putting people's health at risk. Are current and future generations ready to face this climate variability? Are the different social sectors providing people with the knowledge, tools and opportunities to adapt to changing and extreme temperatures? In order to provide comfortable

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interior environments in terms of temperature, Heating, Ventilation and Air Conditioning (HVAC) systems in buildings can consume up to 50% of the total energy used during operation[1]. In addition, buildings are isolating people from external temperatures and limiting their ability for thermal adaptation due to providing fixed temperatures. Interestingly, some authors claim that people look for temperature variations as a way to reach thermal comfort. Temperature deviations do not always cause discomfort; the contrary, fixed temperatures provoke people's discomfort to some extent [2]. The concept of comfort is dynamic and is related to the way people perceive, interact and adapt with the environment rather than a static condition that should satisfy the majority of the population. Individuals do not always have the same thermal sensations and preferences over a short or long period of time, therefore thermal comfort cannot be considered, studied and provided as a static condition [3]. The built environment sector should offer to people not only adaptive opportunities but also thermal variability on a daily basis to eventually improve people's adaptation and thermal tolerance. Relatively few studies have explored people's thermal perception in variable temperatures and dynamic situations [4-7], or explore new concepts related to thermal variability. Over time people are able to adapt themselves to a wide range of conditions that they habitually experience. Previous studies have demonstrated that the temperature in which people feel comfortable is close to the mean temperature they have experienced over a period of time. The study of people and thermal variability has been strongly linked with people's thermal history [7].

### 1.1 Thermal history

People's thermal history refers to the previous thermal conditions that influence their current thermal perception of the environment. Therefore, people's current thermal state will affect their next thermal experience depending on the time of exposure [8]. Thermal history can be referred to as long-term or short-term; an example of long term effect is the influence of the climate of a place on people's thermal perception, when people have been living there for many years. The effect of the change of climate during the seasons of the year is also a long term effect. An example of a short term effect is people's thermal experiences during their everyday life, which could be grouped under the effects of either weeks, days, hours or seconds. The degree of impact of people's thermal history on their perception depends on different physical and psychological factors [4, 9, 10]. In this paper thermal memory is defined as the thermal storage capacity of human body influencing current people's thermal perception.

The study of thermal history helps to understand people's thermal perception, choices, preferences and expectations. By looking at people's short term thermal history previous studies have detected some patterns and preferences depending on the place and climatic conditions they were in before [11]. It can be suggested that building design could create new short term experiences that might influence people's thermal adaptation in the long term. Interestingly, researchers have claimed that during short-term thermal experiences people tend to tolerate a wider range of temperatures. They suggest outdoor places, semi outdoor and transitional spaces as potential areas to explore people's thermal adaptation; since people are influenced by different factors compared to the indoor environment where they are more tolerant to climatic variations [12]. But, what are the factors that influence people to tolerate different range of temperatures in the outdoors, semi outdoor and transitional spaces?. Table 1 illustrates some of the concepts addressed in previous studies [6, 8, 10, 13, 14] that are related with people's short-term thermal history.

Few researchers have been able to draw valid conclusions from short term and dynamic thermal experiences since the effects of multiple variables create a complex area of study. There is a lack of field research exploring the short term thermal effect on people in real life. Most studies on thermal history have been focused on the long term effect [15, 16] or are situated in outdoor [6, 7], passageways [4], indoor spaces [17] and other pedestrian urban spaces. Transitional spaces connecting the indoor and outdoor environment have not been studied in much detail. Previous experiments carried out in lobby spaces have only involved people's perception from outside to inside or from inside to outside. The limitation of this approach does not take into account the effect of the lobby on people's short term thermal history in following spaces. In order to assess the effect of the lobby space it is necessary to evaluate people's thermal perception before and after passing the lobby and people's thermal perception with and without passing through the lobby. A number of studies tend to overlook the fact that people's thermal perception in the lobby is the result of the influence of the previous thermal conditions plus the conditions of the lobby. On the contrary, people's perception of a space after passing through the lobby is based on the results of the lobby effect plus the current thermal conditions of the space. It is very important to highlight this issue, since the objective of this work is to evaluate the effect of the lobby space on people's perception on the short term thermal experience in a sequence of spaces as they experience it in real life conditions.

Table. 1. Concepts influencing people's thermal perception in shorts periods of time

Concept	Description	Concept	Description
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