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Climate and behaviour in a Nordic city

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Abstract

Four urban public spaces, representing various designs and microclimates, were investigated in Gothenburg, Sweden, in order to estimate how weather and microclimate affect people in urban outdoor environments. The research strategy was both multidisciplinary and interdisciplinary and included scientists from three disciplines: architecture, climatology and psychology. The project is based on common case studies carried out during four seasons, including measurements of meteorological variables, interviews and observations of human activity at each place. Multiple regression analysis of meteorological and behavioural data showed that air temperature, wind speed and clearness index (cloud cover) have a significant influence on people's assessments of the weather, place perceptions and place-related attendance. The results support the arguments in favour of employing climate sensitive planning in future urban design and planning projects, as the physical component of a place can be designed to influence the site-specific microclimate and consequently people's place-related attendance, perceptions and emotions.

Keywords: Public spaces; Urban climate; Climate planning; Environmental psychology; Environmental design

1. Introduction

Scientists from a wide range of different disciplines including architecture, climatology, engineering and psychology have long been interested in how weather and climate affect people in the urban outdoor environment. Several factors have been shown to influence people's perceptions and use of the outdoor environment, among them the design and function of the space, as well as the physiological and psychological parameters involved in human reactions to the physical environment. To date, most of the research has been carried out within the individual disciplines. As a result, the different factors have been identified, but knowledge of their individual and combined influence is still lacking, since an integrated research approach is necessary for such analyses.

1.1. Climate and urban design

Two disciplines, architecture and urban design and urban climatology, dominate the published literature on how buildings and the urban environment affect climate (Mills, 1999). A key objective within architecture and urban design is the creation of a 'comfortable' living environment. Research on this topic often has a bioclimatic focus and an empirical and inferential approach and the results are normally presented as guidelines and real-world examples. In contrast, research in urban climatology, a special field within meteorology and climatology, focuses on measurements and the modelling of physical processes in order to interpret the changes in atmospheric properties that give rise to the "urban effect". With some exceptions, research within urban climatology is not carried out for the purposes of design and the results obtained are often theoretical and not readily interpretable from a design perspective (Mills, 1999, 2006; Eliasson, 2000).

Bioclimatic urban design is pointed out as a potential subject for research in which the combined skills of the climatologist and the designer can be beneficially employed. One of the classical

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lines of research within human biometeorology is the development of comfort indices that model and predict the thermal interaction between the human body and its surrounding environment (e.g. Höppe and Seidl, 1991). Over the years, outdoor thermal indices have been criticised mainly due to their inability to provide realistic assessment under transient exposure and to include psychological factors. As shown by Nikolopoulou and Steemers (2003), only approximately 50% of the variance between objective and subjective comfort evaluations could be explained by the physical and physiological conditions. They suggest other factors that could influence the tolerance interval for thermal comfort, such as experience, expectations, sense of control, the "naturalness" of the environment and the need for stimulation.

1.2. Climate and human psychology

Research on how emotion, cognition and activity influence the tolerance range for climate comfort is comparatively rare. The relation between functional use and microclimatic conditions has been confirmed by several studies (e.g. Gehl, 1971; Westerberg, 1994; Nikolopoulou et al., 2001; Zacharias et al., 2001; Thorsson et al., 2004, 2006) which show that comfortable weather conditions, i.e., high temperature and access to sunlight increases the number of people present in an urban space. Studies also show that both too cold and too warm conditions have a negative influence on the emotional state, which in turn tends to trigger aggressive behaviour (e.g. Cohn, 1993; Simister and Cooper, 2005). Emotional and cognitive research suggests that emotional states can influence cognitive processes (e.g. Blaney, 1986; Kuiken, 1991). If climate is a moderator of emotional state, then it is likely that it also affects other aspects of the environmental experience, such as the visual aesthetics (e.g. Gifford, 1980; Knez and Thorsson, 2006). There also appears to be a link between thermal comfort and some psychological aspects of the environmental experience (see Knez and Thorsson, 2006).

The concept of space, comprising physical and spatial connotations, has traditionally been used in geographical and architectural discourse. It does not include the psychological and social aspects of spatial experiences and has therefore been redefined in environmental psychology by the notion of place (e.g. Graumann, 2002). Several authors have sketched similar accounts of the theory of a place (e.g. Canter, 1977) comprising three key components: physical (form and space), functional (activities) and psychological (meanings people assign to a place) aspects. Canter (1997) has further developed his earlier model into four "facets" of place: functional differentiation, place objectives, scale of interaction and aspects of design. Place objectives extend the previous psychological (individual) aspects by including both social and cultural components, while the scale of interaction addresses the environmental aspects. Yet, as pointed out by Knez (2005), an insufficiency in these theoretical accounts is the omission of climate, which influences individual, social, economic (Parker, 1995), and criminal behaviour (Rotton and Cohn, 2002) and memories of, and meanings we attribute to places (Knez, 2006).

1.3. The purpose of this paper

This paper describes an investigation of urban public places in relation to micrometeorological variations and human perceptions of climate. The study combines meteorological and behavioural data in an analysis of the impact of three weather variables (clearness index (CI), air temperature (T_a) and wind (w)) on participants' perceptions of current weather and on their behavioural, aesthetical and emotional assessments of four urban public spaces. The main goal of the investigation was to test the hypothesis that the three weather variables have a significant influence on peoples' weather assessments and place-related perceptions, emotions and attendance.

2. Methods

2.1. An integrative research approach

The present study is part of the "Urban Climate Spaces" project, involving scientists from the fields of climatology, psychology and architecture. The project has an integrative research approach with a common goal: its aim is to traverse disciplinary boundaries in order to develop integrated knowledge and theory, i.e., to conduct interdisciplinary work (Tress et al., 2004) for the purposes of analysing the complex relational links between climate and human behaviour and its implications for sustainable urban design (Knez, 2005, 2006; Knez and Thorsson, 2006, 2007; Lindberg, 2005; Thorsson et al., 2006).

2.2. Case studies

Case studies were conducted in the city of Gothenburg, which is located at latitude 57°N on the Swedish west coast. Four urban public spaces with different design and varying microclimates ranging from an exposed waterfront plaza and large open square to a park with shading trees and a small sheltered courtyard were included in the study (Fig. 1). Micrometeorological measurements, observations and structured interviews were conducted simultaneously during four case studies (October 2003, January, April and June 2004). Each study period included five days over a period of two weeks. The aim was to find 5 days in each season with different weather, with respect to air temperature, cloud cover and wind speed. Rainy days were excluded. In total, 20 days of measurements, observations and interviews were conducted in Gothenburg. The case studies were performed between 11 a.m. and 3 p.m. Solar radiation and temperature normally reach their daily maxima during this period, and the places under study are frequently used by people.

2.3. Micrometeorological measurements

The air temperature and relative humidity (Rotronic YA-100), globe temperature (AMR Pt100 PK24) as well as incoming short and long wave radiation (Kipp and Zonen CM3 and CG1) were measured at a height of 1.1 m above the ground, corresponding to the average height of the centre of gravity for adults (Mayer and Höppe, 1987). Wind speed and direction (Gill Ultransonic)