

Igor Knez · Sofia Thorsson

Influences of culture and environmental attitude on thermal, emotional and perceptual evaluations of a public square

Received: 30 March 2005 / Revised: 28 November 2005 / Accepted: 20 December 2005 / Published online: 16 March 2006
© ISB 2006

Abstract The main objective of the present quasi-experimental study was to examine the influence of culture (Swedish vs Japanese) and environmental attitude (urban vs open-air person) on participants' thermal, emotional and perceptual assessments of a square, within the PET (physiological equivalent temperature) comfortable interval of 18–23°C. It was predicted that persons living in different cultures with different environmental attitudes would psychologically evaluate a square differently despite similar thermal conditions. Consistent with this prediction, Japanese participants estimated the current weather as warmer than did Swedish participants and, consistent with this, they felt less thermally comfortable on the site, although participants in both countries perceived similar comfortable thermal outdoor conditions according to the PET index. Compared to the Japanese, the Swedes estimated both the current weather and the site as windier and colder, indicating a consistency in weather assessment on calm-windy and warm-cold scales in participants in both cultures. Furthermore, Swedish participants felt more glad and calm on the site and, in line with their character (more glad than gloomy), they estimated the square as more beautiful and pleasant than did Japanese participants. All this indicates that thermal, emotional and perceptual assessments of a physical place may be intertwined with psychological schema-based and socio-cultural processes, rather than fixed by general thermal indices developed in line with physiological heat balance models. In conse-

quence, this implies that thermal comfort indices may not be applicable in different cultural/climate zones without modifications, and that they may not be appropriate if we do not take into account the psychological processes involved in environmental assessment.

Keywords Thermal comfort · Weather · Micro climate · Culture · Environmental assessment

Introduction

Over the years, several thermal climatic indices have been set up to model and predict the thermal interaction between the human body and its surrounding environment (e.g. Thom 1959; Fanger 1970; Steadman 1971, 1979; Gates 1972; Gonzales et al. 1974; Jendritzky et al. 1979; Gagge 1980; Mayer and Höppe 1987; Höppe 1993; VDI 1998). The first models used as indicators for the thermal environment were empirical, based on single or composite meteorological parameters. Later, heat balance modelling of humans was initiated and, in the 1970s, physiologically relevant indices were developed. A review of the progress of modeling the thermal interaction between the human body and its surrounding environment during the twentieth century is given in Höppe (1997). Heat balance models have shown to be useful tools for the assessment of the thermal effect of different urban structures, daily forecasts and warnings, regional and global bioclimatic mapping, epidemiological studies, and climate impact research.

In the absence of empirical thermal comfort studies and models directly relevant to outdoor situations, it has been assumed that a conventional theory of thermal comfort developed for indoor applications can be transferred to outdoor settings without modification (VDI 1998). However, during the last few years the validity of these outdoor thermal comfort indices has been questioned (Nikolopoulou et al. 2001; Höppe 2002; Spagnolo and de Dear 2003; Nikolopoulou and Steemers 2003; Thorsson et al. 2004). Studies on subjective responses to the outdoor environment have shown that actual thermal sensations differ from those

I. Knez (✉) · S. Thorsson
Laboratory of Applied Psychology,
Department of Technology and Built Environment,
University of Gävle,
801 76 Gävle, Sweden
e-mail: igor.knez@hig.se
Tel.: +46-26-648111
Fax: +46-26-648181

S. Thorsson
Physical Geography,
Department of Earth Sciences,
Göteborg University,
Göteborg, Sweden
e-mail: sofia.thorsson@gvc.gu.se

predicted, and that indoor comfort limits are not directly transferable to the outdoor environment. For example, Nikolopoulou and Steemers (2003) showed that only 50% of the variance in subjective comfort evaluation was explained by physical parameters, indicating that psychological processes may be involved in thermal assessment of the outdoor environment. It has also been shown that current outdoor thermal comfort indices may not be applicable across different seasons and geographical/climatic zones without modification (Spagnolo and de Dear 2003).

Recent literature on the evaluation of thermal comfort in relation to outdoor activity in different public spaces such as plazas and squares (Forwood et al. 2001; Nikolopoulou et al. 2001; Zacharias et al. 2001; Thorsson 2003; S. Thorsson et al. MS submitted), streets (Gehl 1968, 1996; Nasar and Yurdakul 1990; Li 1994; Nagara et al. 1996; Nikolopoulou et al. 2001) and parks (Forwood et al. 2001; Nikolopoulou et al. 2001; Thorsson 2003; Thorsson et al. 2004; S. Thorsson et al. MS submitted) shows that perception of the thermal environment strongly influences usage patterns. These findings also show that the usage of some spaces is more influenced by thermal conditions than other spaces, and that the attitude towards the sun and staying outdoors differs between different geographical/climatic zones (S. Thorsson et al. MS submitted).

Different geographical/climatic zones can also be defined as different cultures. According to Reber (1985, p 170), a culture is: "The system of information that codes the manner in which people in an organized group, society or nation interact with their social and physical environment." A member of a culture learns its rules and regulations, which s/he then shares with other members of the "system". These rules provide "standards for perceiving, believing, evaluating, communicating, and acting among those who share a language, a historic period, and/or a geographic location." (Eisler et al. 2003, p 89). As regards the cultural influence on an individual level, psychological research has shown cross-cultural effects on, for example, intelligence (Sternberg 2004), categorisation (Ji et al. 2004), construction of the self (Kitayama et al. 1997; Wang 2004) and self-perception (Cousins 1989). Others have also shown a cultural impact on the perception of human ecology (Eisler et al. 2003) and on the social construction of climate and climate change (Harley 2003; Stehr and von Storch 1995).

A psychological construct that also has some bearing on how people learn about and perceive the world is attitude. For example, Knez (2005) showed that, for persons living in a city, place-related identity processes were more pronounced among persons sharing an environmental attitude of an urban rather than of an open-air person. This held especially for the place-related identity process of distinctiveness, by which we distinguish ourselves from others. In addition, the city "gave" urban compared to open-air persons more positive feelings about themselves and it "facilitated" their everyday life more. How can an environmental attitude of this type influence one's urban behaviour, beliefs and perceptions? A useful perspective in answering this question is to treat attitudes as a type of schemata (e.g. Eagly and Chaiken 1993). Schemata are sets

of knowledge structures and expectations stored in memory that may elicit behavioural, affective and cognitive consequences. A number of schemata theorists have proposed that a person's prior knowledge will influence that person's processes of perception, comprehension and memory of new information (e.g. Bartlett 1932; Minsky 1975; Piaget and Inhelder 1973). In line with this, Brewer and Treyns (1981, p. 208) hypothesised five ways in which schemata might affect cognitive processes of encoding, storing and retrieving new information in memory for places: "... (a) they can determine what objects are looked at and encoded into memory; (b) they can act as framework for new information; (c) they can provide schema-based information which becomes integrated with episodic information; (d) they can the guide retrieval process; and (e) they can determine what information is to be communicated at output".

All this suggests that we may expect different environment-related behavioural, emotional and cognitive consequences related to thermal comfort assessments of outdoor environments for persons living in different cultures with different environment related attitudes/schemata.

Present study

To further our understanding of thermal comfort outdoors and to develop an index that is applicable across the global range of climatic environments, there is a need for research on psychological (individual) and cultural influence on thermal as well as on emotional and cognitive assessments of outdoor places. This paper aims to fill this gap by investigating the influences of an urban vs an open-air attitude to thermal, emotional and perceptual evaluations of a square in two cultures/countries: Sweden and Japan. Both Sweden and Japan are industrial countries, and they have similar economical structures and public spirit. They differ, however, in climate and culture (Eisler et al. 2003).

Given the review and reasoning outlined above, we predict an influence of environmental attitude (urban vs open-air) and culture (Sweden vs Japan) on participants' thermal, emotional and perceptual assessments of a square within the physiological equivalent temperature (PET) comfortable interval of 18–23°C (Mayer and Höppe 1987). Thus, we hypothesise psychological as well as cultural influences on individuals' perceptions of a square despite the comfortable thermal environment, which, according to Mayer and Höppe (1987), should cause an equivalent thermal perception in participants.

Study areas

Two public squares—one located in the Swedish city of Göteborg (57°42'N, 11°58'E) and the other in the Japanese city of Matsudo (35°78'N, 139°90'E), a satellite city of Tokyo—were selected. The designated areas represent

Fig. 1 Photographs showing the Swedish square, Gustav Adolfs torg, Göteborg



typical examples of squares in medium sized Swedish and Japanese cities (population about 500,000).

The Swedish square

The Swedish square is a traditional European square, very busy during daytime with many commuters passing through. Photographs of the designated area are shown in Fig. 1. The square has a spatial extension of approximately 100×60 m and the ground is mostly covered by cobblestones of different sizes and shapes. Buildings define the boundaries of the square on the west, north and east sides. A canal runs along the south side, resulting in little shade and strong wind exposure. The square is laid out with a row of trees; however, these offer little shade during the middle of the day.

The Japanese square

The Japanese square is a modern functional square located in front of Matsudo railway station. It is a gathering point in central Matsudo, with many commuters passing through. The square is lifted one level above ground, providing a vital and pleasant pedestrian link away from the traffic between the station and the surrounding buildings (see Fig. 2). This type of construction around railway stations is seen in many modern Japanese cities. The square is made

of light coloured clinkers and has a spatial extension of approximately 50×40 m, with a 0.4 m wall surrounding the square, where people can sit. The square is laid out without trees, with little shade available during the middle of the day.

Climate

The Göteborg area has a maritime climate, with a mean yearly temperature of 7.6°C. The area has, for the latitude, relatively mild winters and cool summers, with average temperatures of -1.2°C in February and 17.0°C in July. The Tokyo area has a temperate climate, with warm and humid summers and mild and dry winters. The yearly average temperature in Tokyo is 15.6°C, with August being the hottest (27.1°C) and January the coldest (5.2°C) month.

Materials and methods

Methods

Field surveys were performed in Matsudo, Japan, in March 2004, and in Göteborg, Sweden, in April 2004. Field surveys took place between 11.00 a.m. and 3.00 p.m. on weekdays. At this time of the day both air temperature and solar radiation reach their daily maximum and the two squares have most visitors.

Fig. 2 Photographs showing the Japanese square, Matsudo Station Square



Micrometeorological measurements

A meteorological station equipped according to Table 1 was used to measure the micrometeorological factors, i.e. air temperature (T_a), relative humidity (RH), wind speed (W), incoming short-wave radiation (S_{\downarrow}) and incoming long-wave radiation (L_{\downarrow}). The measurement height was 1.1 m, corresponding to the average height of the centre of gravity for adults (Mayer and Höppe 1987), except for the wind measurements. Wind speed was measured at 2 m height, and later recalculated down to 1.1 m using Sverdrup's power law (Stull 2000). Data were sampled once each minute. The meteorological station was placed at the most open point in each space so that the stations would be in the sun during the whole field survey.

Physiological equivalent temperature

The thermal environment was investigated using PET, which is based on the Munich Energy Balance Model for Individuals (MEMI) (Höppe 1984), and is defined as the air temperature at which the energy balance for assumed indoor conditions is balanced with the same mean skin temperature and sweat rate as calculated for the actual outdoor conditions (Mayer and Höppe 1987). The idea behind PET is to transfer the actual thermal conditions into an equivalent indoor environment in which the same thermal sensation is expected (Mayer and Höppe 1987). A PET value of around 20°C is characterised as comfortable, higher values indicate increasing probability of heat stress, and lower values indicate increasing probability of cold stress, as shown in Table 2.

T_{mrt} and PET were calculated using the PC application, RayMan (Matzarakis et al. 2000, Matzarakis 2002). RayMan, developed according to guideline 3787 of the German Engineering Society (VDI 1998), calculates the radiation fluxes within urban structures based on parameters including air temperature, air humidity, degree of cloud cover, air transparency, time of day and year, albedo of the surrounding surfaces, and their solid angle proportions (VDI 1994).

Participants

In total, 106 persons participated in the study, i.e. 43 persons visiting the Swedish square and 63 persons visiting the Japanese square; 55% of the Swedish and 40% of the

Table 1 Measured meteorological factors, instruments and accuracy

Factor	Instrument	Accuracy
T_a	Rotronic YA-100	$\pm 0.2^\circ\text{C}$
RH	Rotronic YA-100	$\pm 1\%$
W	Gill Instruments. Ultrasonic	1.5% RMS
S_{\downarrow}	Kipp & Zonen CM3	
L_{\downarrow}	Kipp & Zonen CG1	

Table 2 Physiological equivalent temperature (PET), thermal sensation and stages of stress; internal heat production: 80W, heat transfer resistance of clothing: 0.9 (Matzarakis and Mayer 1996)

PET (°C)	Thermal sensation	Stage of stress
	Very cold	Extreme stress
4	Cold	Strong stress
8	Cool	Moderate stress
13	Slightly cool	Slightly stress
18	Comfortable	No stress
23	Slightly warm	Slightly stress
29	Warm	Moderate stress
35	Hot	Strong stress
41	Very hot	Extreme stress

Japanese participants were women. Participants were categorised into the age ranges “15–20” (6 Swedish, 7 Japanese participants), “21–35” (4 Swedish, 20 Japanese participants), “36–50” (14 Swedish, 10 Japanese participants), “51–65” (13 Swedish, 19 Japanese participants), and “66–80” (6 Swedish, 8 Japanese participants). These persons were selected because they estimated themselves as urban vs open-air persons (see below) and because they happened to visit the square within the PET thermal comfortable interval of 18–23°C.

Psychological measures

A structured interview, a questionnaire, was handed out to the participants visiting the squares. This instrument comprised questions about demographic variables, clothing, general and specific questions about the current weather and the square, and behaviours and attitudes related to the site. Each interview comprising eight main questions took ca. 5 min to complete. Three main dependent measures based on responses to the questionnaire were analysed in the present study, i.e. estimations of thermal, emotional and perceptual dimensions of the square and of the current weather (see below).

How do you perceive the weather today?

Participants were asked to answer the question “How do you perceive the weather today?”, by responding to three 5-point Likert scales ranging from 1 to 5: (1) calm/windy; (2) cold/warm; and (3) good/bad for outdoor activity (S. Thorsson et al. MS submitted).

How do you feel right now in this place?

Participants were asked to answer the question “How do you feel right now in this place?” by responding to four 5-point Likert adjective scales ranging from 1 to 5: (1) elated/bored; (2) glad/gloomy; (3) calm/nervous; (4) active/passive. These scales were derived from the Knez

and Hygge (2001) measure of current self-reported affect. Participants were also asked to estimate their thermal comfort by responding to a 9-point Likert scale ranging from very cold to very hot, with a score of 5 rating as comfortable (Matzarakis and Mayer 1996).

How do you perceive the place right now?

Participants were asked to answer the question “How do you perceive the place right now?” by responding to four 5-point Likert scales ranging from 1 to 5: (1) ugly/beautiful; (2) unpleasant/pleasant; (3) windy/calm; and (4) cold/warm (S. Thorsson et al. MS submitted).

Urban vs open-air person attitude

The questionnaire also measured the participants’ urban vs open-air person attitude on a 5-point Likert scale ranging from 1 (mostly urban person) to 5 (mostly open-air person) related to the question: “How much of an urban person (find pleasure in street life, shops, the amusements of the city) and open-air person (find pleasure in the sea, the woods, nature) are you?” (see Knez 2005).

Experimental design

A non-equivalent comparison-group quasi-experimental design (McGuigan 1983) was used. This means that the participants were not randomly assigned to the different groups and that the two independent variables may have been confounded with some uncontrolled extraneous variables. Thus, compared with a “true experiment” (Liebert and Liebert 1995), the inferences drawn about the causal relationships between independent and dependent variables are considered to be weaker.

Independent variables

Two independent variables were used. The environmental attitude of urban vs open-air person was the first variable. In line with Knez (2005), participants with scores lower than 3 (1, 2) were considered to be “urban persons” and those higher than 3 (4, 5) were considered to be “open-air persons”. The second independent variable, culture, was defined as two groups of participants visiting the Swedish and the Japanese square, respectively. The two groups were considered as living in two different cultures.

Dependent variables

The three questions: “How do you perceive the weather today?”; “How do you feel right now in this place?”; and “How do you perceive the place right now?” comprising several scales (see above) were used as dependent variables.

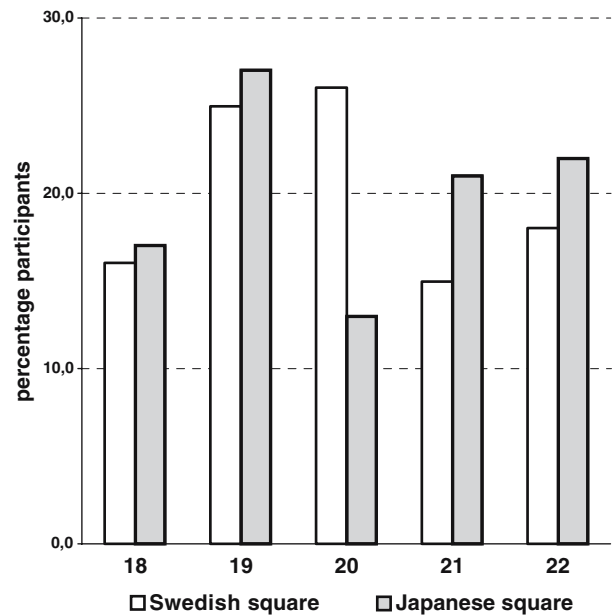


Fig. 3 Percentage participants in Swedish vs Japanese squares as a function of thermal environment [measured as physiological equivalent temperature (PET); 18–23°C]

Results and discussion

Some relevant thermal and descriptive statistics for this study will be reported first, followed by the inferential statistics for the influences of culture and environmental attitude on thermal, emotional and perceptual evaluations of a square. Regarding the inferential statistics, all data were subjected to ANOVA (univariate analyses of variance) with

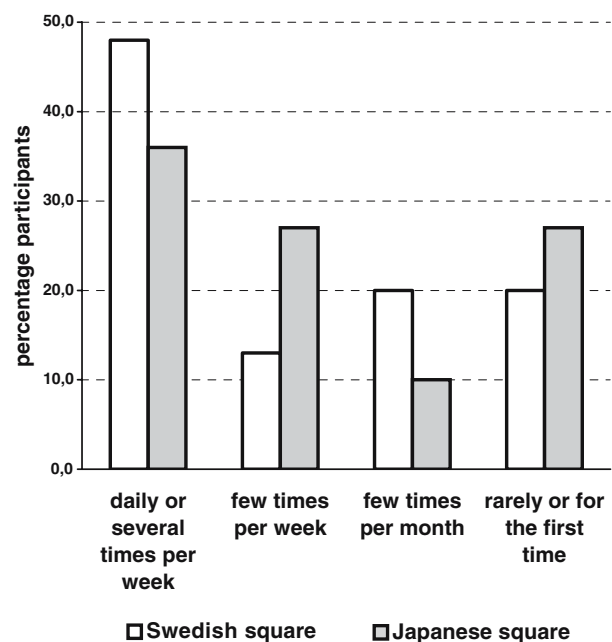


Fig. 4 Percentage participants visiting Swedish vs Japanese squares as a function of the question: “How often do you pass or linger in this place?”

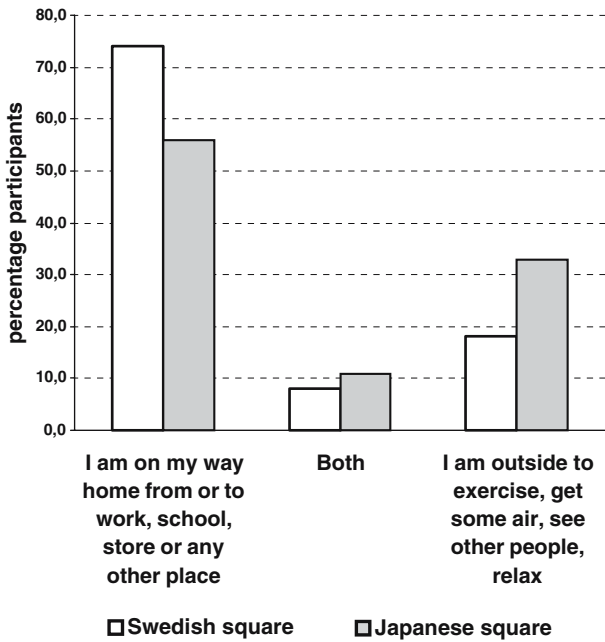


Fig. 5 Percentage participants visiting Swedish vs Japanese square as a function of the question: “What is the most important reason for being in this place?”

the following between-subject independent variables: two cultures (participants visiting Swedish vs Japanese square) × two environmental attitudes (urban vs open-air person). In addition, gender and age were also included in ANOVAs, due to some findings indicating an influence of gender (e.g. Franck 2002) and age (e.g. Lawton et al. 1982) on environmental assessment. No significant impact of these two demographic factors on the dependent variables were shown, however. Therefore, the following discussion of results relates only to the independent variables of “culture” and “environmental attitude”. Furthermore, the SPSS 11.5

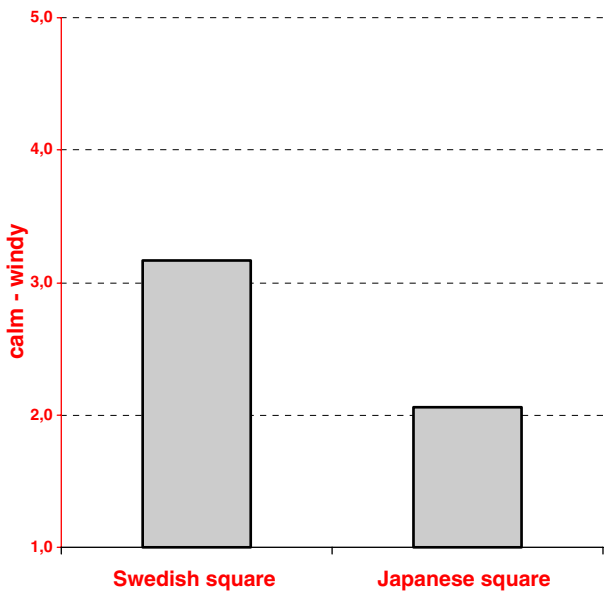


Fig. 6 Mean “calm/windy” evaluation of “the current weather today” in participants visiting a Swedish vs a Japanese square

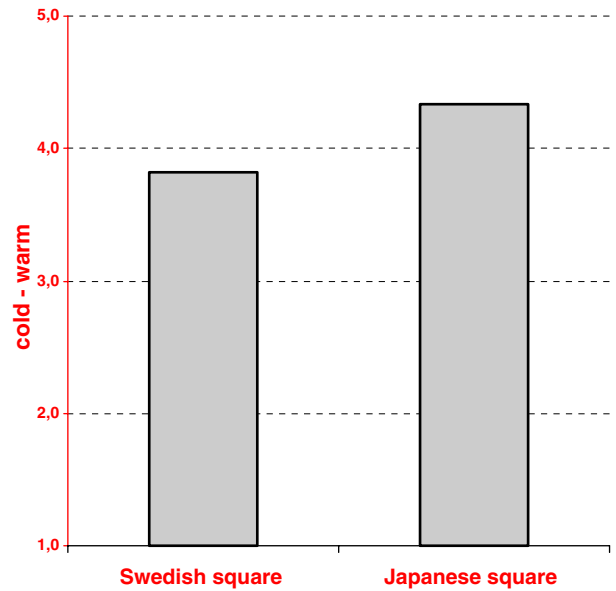


Fig. 7 Mean “cold/warm” evaluation of “the current weather today” in participants visiting a Swedish vs a Japanese square

(a statistical software for Windows) “Type III sums of squares” model was used because it controls for the unbalanced cell frequencies. The number of participants in each 2×2 cell were: Swede/urban person=28; Swede/open-air person=15; Japanese/urban person=23; Japanese/open-air person=40. Total number of participants for each independent variable were: culture=43 Swedes + 63 Japanese; attitude=51 urban persons + 55 open-air persons.

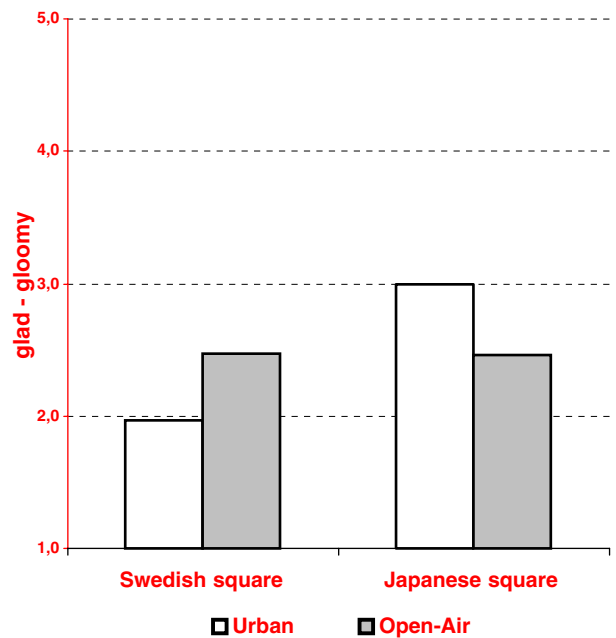


Fig. 8 Mean “glad/gloomy” evaluation of “how do you feel right now in this place” in urban vs open-air persons visiting a Swedish vs a Japanese square

Background conditions

Thermal conditions

Figure 3 shows the percentage of participants in the Swedish vs the Japanese square as a function of thermal environment, measured as PET. As can be seen, a similar frequency of persons participated in the present study during the PET comfortable interval of 18–23°C, but most took part during the PET interval of 19–20°C. During the field surveys the Swedish participants were exposed to a mean PET value of 20.3°C and a mean wind speed of 1.6 ms⁻¹ and the Japanese participants were exposed to a mean PET value of 20.7°C and a mean wind speed of 1.0 ms⁻¹.

Social conditions

In response to the question “How often do you pass or linger in this place?”, almost 50% of the Swedish and 40% of the Japanese participants answered “daily or several times per week” (Fig. 4).

As can be seen in Fig. 5, the most common answer in both countries to the question “What is the most important reason for being in this place?” was, “I am on my way home from or to work, school, store or any other place”.

The foregoing descriptive statistics indicate that similar thermal conditions and numbers of participants in both countries were present in the squares within the comfort PET interval of 18–23°C, and that ca. 50% of participants visited the squares within the PET interval of 19–21°C. Some 40–50% of participants passed the squares daily or several times per week, with most (ca. 60–70%) being on their way home from or to work, school, store or other places.

Inferential statistics

The impact of culture and environmental attitude on participants estimations of “How do you perceive the weather today?”; “How do you feel right now in this place?”; and “How do you perceive the place right now?” will be reported below for each question. Only significant results are reported.

How do you perceive the weather today?

As can be seen in Figs. 6 and 7, the main effects of culture showed that, compared to Japanese participants, Swedes estimated the current weather as significantly more windy, $F(1,106)=15.10$, $P<.01$ and colder, $F(1,103)=5.57$, $P<.05$.

The results imply that although participants in both countries perceived similar comfortable thermal outdoor conditions according to the PET index, compared to Swedish participants the Japanese evaluated the current weather differently. More precisely, the Swedes evaluated

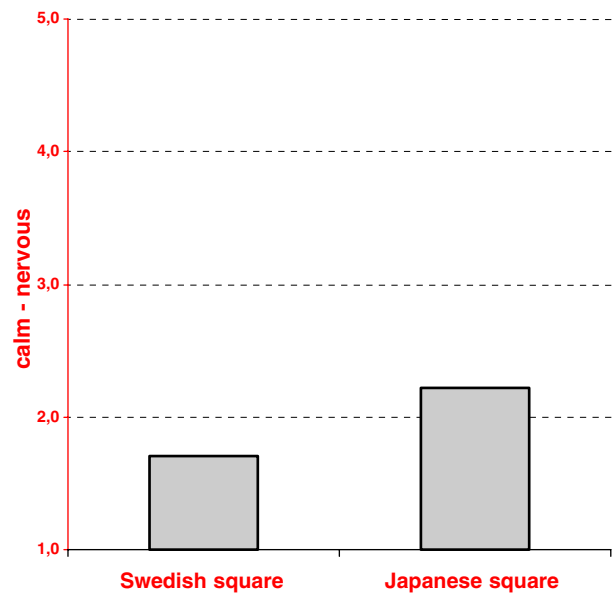


Fig. 9 Mean “calm/nervous” evaluation of “how do you feel right now in this place” in participants visiting a Swedish vs a Japanese square

the given weather as colder and windier than did the Japanese.

How do you feel right now in this place?

A significant interaction between culture and attitude, $F(1,104)=5.37$, $P<.05$, showed that Swedish urban compared to open-air persons felt happier in the square, and that the opposite effect was observed for Japanese urban and open-air persons (see Fig. 8). Furthermore, and as can be

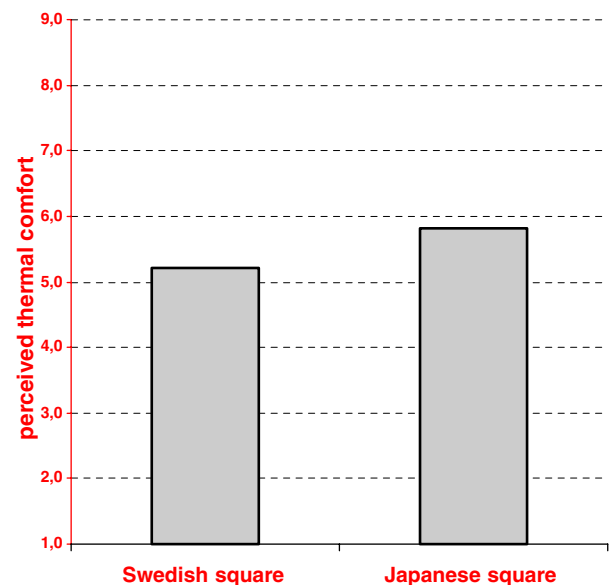


Fig. 10 Mean “thermal comfort” evaluation of “how do you feel right now in this place” in participants visiting a Swedish vs a Japanese square

Table 3 Influence of cold/warm perception of current weather (independent variable)

Dependent variable	R^2	Beta	df	MS	F	Sig
Thermally comfortable	0.27	0.52	1, 75	25.8	27.1	0.00

seen in Fig. 8, there was no difference between Swedish and Japanese open-air persons in how glad they felt, but Swedish urban persons felt more glad in the square compared to Japanese urban persons. Finally, a main effect of culture showed that Swedish participants felt happier than Japanese participants, $F(1,104)=5.26, P<.05$, and this was accounted for by the difference between Swedish and Japanese urban persons (see Fig. 8).

As can be seen in Figs. 9 and 10, two main effects of culture showed that Swedish participants felt significantly more calm being in the square compared to their Japanese counterparts [$F(1,104)=5.07, P<.05$], as well as thermally more comfortable [$F(1,105)=7.77, P<.01$].

The results imply that, compared to the Swedes, the Japanese felt significantly worse in the square, i.e. less glad and calm, and thermally less comfortable. The latter result is in line with the above reported results showing that Japanese participants estimated the current weather as warmer (see Fig. 7) than did Swedish participants. Consistent with this, and as shown in a regression analysis (see Table 3), compared to Swedish participants the Japanese estimated the current weather as warmer and they felt less thermally comfortable (see Table 3) on the site (cf. also Figs. 7 and 10). In addition, there was a difference in how glad urban persons from the two countries felt in their respective square, indicating a cultural difference in urban attitude as regards place-related emotional evaluation.

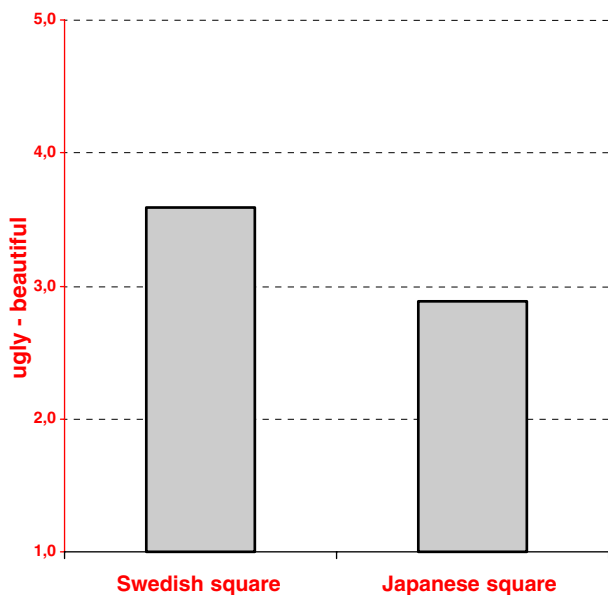


Fig. 11 Mean “ugly/beautiful” evaluation of “the place right now” in participants visiting a Swedish vs a Japanese square

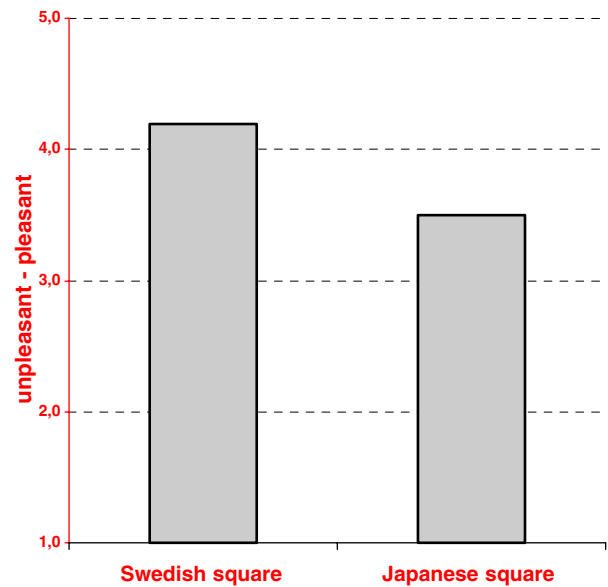


Fig. 12 Mean “unpleasant/pleasant” evaluation of “the place right now” in participants visiting a Swedish vs a Japanese square

How do you perceive the place right now?

As can be seen in Figs. 11 and 12, main effects of culture showed that compared to Japanese participants, Swedish participants estimated the square as significantly more beautiful [$F(1,105)=8.03, P<.01$]; and pleasant [$F(1,105)=9.73, P<.01$].

Furthermore, a two main effects analysis of culture showed that Swedish participants perceived the square as significantly more windy [$F(1,105)=8.40, P<.01$] (see Fig. 13) and colder, [$F(1,105)=8.60, P<.01$] (see Fig. 14) than did Japanese participants.

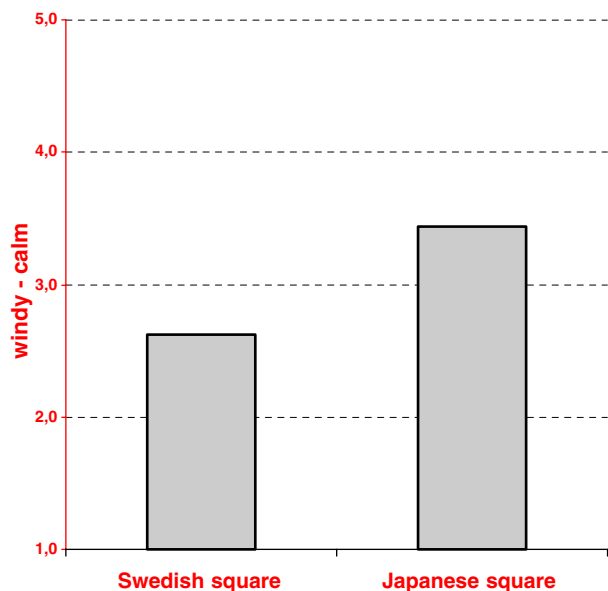


Fig. 13 Mean “windy/calm” evaluation of “the place right now” in participants visiting a Swedish vs a Japanese square

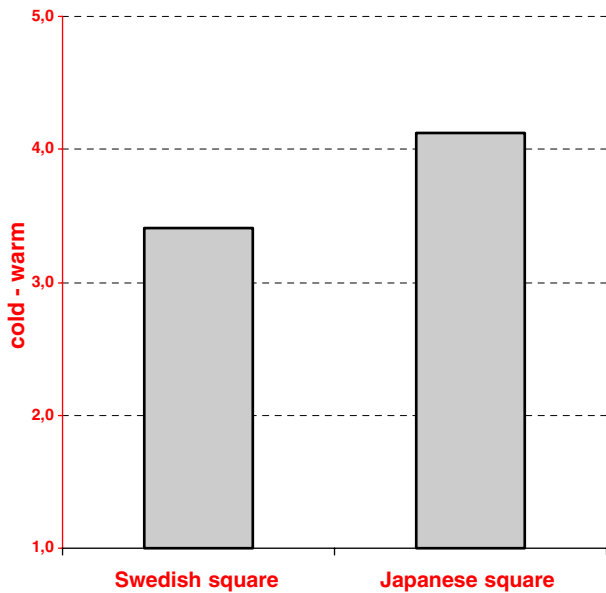


Fig. 14 Mean “cold/warm” evaluation of “the place right now” in participants visiting a Swedish vs a Japanese square

According to these results, Swedish perceptual estimations of the square were more positive, i.e., the square was more beautiful and more pleasant, compared to those of the Japanese participants. Consistent with the above reported estimations of the current weather (cf. Figs. 6 and 7 with Figs. 13 and 14), compared to the Japanese, Swedes perceived the square as windier and colder, meaning that participants from both countries showed a consistency in estimating the weather according to calm/windy and cold/warm dimensions. Finally, Swedes felt more glad than gloomy on the site than did Japanese and, in line with that, as shown in a regression analysis (see Table 4), Swedes evaluated the site as more beautiful and pleasant.

Conclusions

The main objective of the present study was to examine the influence of culture (Swedish vs Japanese) and environmental attitude (urban vs open-air person) on participants’ thermal, emotional and perceptual assessments of a square, within the PET thermal comfortable interval of 18–23°C (Mayer and Höppe 1987). It was predicted that persons living in different cultures with different environmental attitudes may psychologically evaluate a Swedish and a Japanese square differently despite similar thermal conditions. Generally speaking, and consistent with the predic-

tion, it was shown that culture had an especially significant impact on participants’ psychological assessments of a square.

More precisely, although participants in both countries perceived similar comfortable thermal outdoor conditions according to the PET index, Japanese participants estimated the current weather as warmer than did Swedish participants (see Fig. 7). In line with that, and as shown in a regression analysis (see Table 3), they felt less thermally comfortable on the site. Interestingly, compared to the Japanese, the Swedes estimated both the current weather and the site as windier and colder, indicating a consistency in weather assessment on calm/windy and warm/cold scales in participants in both cultures (see Figs. 6, 7, 13 and 14).

Swedes felt happier (explained by the difference between the two countries’ urban persons; see Fig. 8) and calmer (see Fig. 9) on the site, and they perceived the square as more beautiful and pleasant than did the Japanese (see Figs. 11 and 12). Consistent with their mood (more glad than gloomy), they evaluated the site as more beautiful and pleasant (see Table 4). This is in line with Gifford’s (1980) result showing that persons in a positive mood compared to those in a less positive mood rated interiors as more pleasant. This tentatively indicates a link between a person’s mood and her/his evaluation of the aesthetics of a physical place. In addition, if we regard the Swedish square as architecturally more attractive than the Japanese square (see Figs. 1 and 2), then we may speculate that design per se may also have to some extent accounted for the cultural lack of correspondence in perceptual evaluation of the two squares.

Given that different cultures involve different conceptions of the self, others, and the interdependence of the two (Markus and Kitayama 1991), it must be noted that the differences in environmental assessments between Japanese and Swedish participants could in part reflect a “cultural response bias”, meaning that, compared to the Swedish participants, the Japanese might have evaluated the square, and how they felt while in the square, in a more modest way. “Indeed, modesty is a valued personal attribute in many situations in Japan, a cultural bias that leads to a general avoidance of extreme judgments” (Eisler et al. 2003, p. 99). This is, however, difficult to dissect given the data obtained.

In summary, the results obtained suggest that thermal, emotional and perceptual assessments of a physical place may be intertwined with psychological schema-based (Brewer and Treyens 1981) and socio-cultural (e.g., Kitayama et al. 2004; Markus and Kitayama 1991) processes, rather than being fixed by general thermal indices developed in line with physiological heat balance models (Höppe 1997; Mayer and Höppe 1987). This implies that thermal comfort indices may not be applicable in different cultural/climate zones without modification (Spagnola and de Dear 2003; S. Thorsson et al. MS submitted), and that they may not be appropriate if the psychological processes involved in the environmental assessment are not taken into account.

Table 4 Influence of glad/gloomy on the site (independent variable)

Dependent variable	R^2	Beta	df	MS	F	Sig
Beautiful/ugly	0.18	0.42	1, 60	12.65	12.84	.001
Pleasant/unpleasant	0.17	0.41	1, 60	7.42	11.87	.001

Acknowledgements This work was supported by a research grant from FORMAS, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, and from the Japan Society for Promotion of Science (JSPS) Postdoctoral Fellowship for North American and European Researchers. The field surveys in Matsudo, Japan were performed in collaboration with Professor Tsuyoshi Honjo and Dr. En-Mi Lim at the Graduate School of Science and Technology, Chiba University, Japan. We would like to thank the Urban Climate Spaces research group and Terry Hartig for constructive comments.

References

- Bartlett FC (1932) *Remembering*. Cambridge University Press, Cambridge
- Brewer WF, Treyns JC (1981) Role of schemata in memory for places. *Cognit Psychol* 13:207–230
- Cousins SD (1989) Culture and self-perception in Japan and the United States. *J Pers Soc Psychol* 1:124–131
- Eagly AH, Chaiken S (1993) *The psychology of attitudes*. Harcourt Brace College, New York
- Eisler AD, Eisler H, Yoshida M (2003) Perception of human ecology: cross-cultural and gender comparisons. *J Environ Psychol* 23:89–101
- Fanger PO (1970) *Thermal comfort*. Danish Technical Press, Copenhagen
- Forwood B, Hayman S, Tadepalli S (2001) Thermal comfort in urban open spaces. In: de Dear RJ, Potter JC (eds) *Biometeorology and urban climatology at the turn of the millennium*. Proceedings of the International Congress of Biometeorology and International Conference of Urban Climatology, 8–12 November 1999. Wesley Conference Centre, Sydney
- Franck AK (2002) Women and environment. In: Bechtel RB, Churchman A (eds) *Handbook of environmental psychology*. Wiley, New York, pp 347–373
- Gagge AP (1980) The new effective temperature (ET*)—and index of human adaption to warm environments. In: Horvath, Yousef (eds) *Environmental physiology: aging, heat and altitude*. Elsevier, Amsterdam, pp 59–77
- Gates DM (1972) *Man and his environments: climate*. Harper and Row, New York
- Gehl J (1968) *Mennesker til fods* (in Danish). Arkitekten 70 (20):429–446
- Gehl J (1996) Life between buildings, using public spaces. Ariktekt Forlag 173–201
- Gifford R (1980) Environmental dispositions and the evaluation of architectural interiors. *J Res Pers* 14:386–399
- Gonzales RR, Nishi Y, Gagge AP (1974) Experimental evaluation of standard effective temperature a new biometeorological index of man's thermal discomfort. *Int J Biometeorol* 18:1–15
- Harley T (2003) Nice weather for the time of year: the British obsession with the weather. In: Strauss S, Orlove B (eds) *Weather, climate, culture*. Berg, Oxford, pp 103–118
- Höppe (1984) *Die Energiebilanz des Menschen* Dissertation. University of Munich, Munich
- Höppe P (1993) Heat balance modelling. *Experientia* 49:741–746
- Höppe P (1997) Aspects of human biometeorology in past, present and future. *Int J Biometeorol* 40:19–23
- Höppe P (2002) Different aspects of assessing indoor and outdoor thermal comfort. *Energy Build* 34:661–665
- Jendritzky G, Sönning W, Swantes HJ (1979) Ein objectives Bewertungsverfahren zur Beschreibung des hermischen Milieus in der Stadt- und Landschaftsplanung. *Beiträge Akademie für Ramforschung und Landesplanung, Beiträge* 28. Schrödel, Hannover
- Ji L-J, Zhang Z, Nisbett RE (2004) Is it culture or is it language? Examination of language effects in cross-cultural research on categorization. *J Pers Soc Psychol* 1:57–65
- Kitayama S, Markus HR, Matsumoto H, Norasakkunkit V (1997) Individual and collective processes in the construction of the self: self-enhancement in the United States and self-criticism in Japan. *J Pers Soc Psychol* 6:1245–1267
- Kitayama S, Snibbe AC, Markus HR, Suzuki T (2004) Is there any “free” choice? Self and dissonance in two cultures. *Psychol Sci* 8:527–533
- Knez I (2005) Attachment and identity as related to a place and its perceived climate. *J Environ Psychol* 25:207–218
- Knez I, Hygge S (2001) The circumplex structure of affect: a Swedish version. *Scand J Psychol* 42:389–398
- Lawton MP, Windley P, Byerts T (eds) (1982) *Aging and the environment; theoretical approaches*. Springer, New York Berlin Heidelberg
- Li S (1994) Users' behaviour of mall urban spaces in winter and margin seasons. *Archit Comport/Arch Behav* 10:95–109
- Liebert RM, Liebert LL (1995) *Science and behavior: an introduction to methods of psychological research*. Prentice Hall, New York
- Markus HR, Kitayama S (1991) Culture and self: implications for cognition, emotion and motivation. *Psychol Rev* 2:224–253
- Matzarakis A (2002) Validation of modelled mean radiant temperature within urban structures. In: AMS, Fourth Symposium on the Urban Environment, 20–24 May 2002, Norfolk, Virginia Abs 7.3, 72–73
- Matzarakis A, Mayer H (1996) Another kind of environmental stress: thermal stress. *WHO Newslett* 18:7–10
- Matzarakis A, Rutz F, Mayer H (2000) Estimation and calculation of the mean radiant temperature within urban structures. In: de Dear RJ, Kalma JD, Oke TR, Auliciems A (eds) *Biometeorology and urban climatology at the turn of the millennium*. Selected Papers from the Conference ICB-ICUC'99, Sydney, WCASP-50, WMO/TD No 1026, pp 273–278
- Mayer H, Höppe P (1987) Thermal comfort of man in different urban environments. *Theor Appl Climatol* 38:43–49
- McGuigan FJ (1983) *Experimental psychology: methods of research*. Prentice Hall, New Jersey
- Minsky M (1975) A framework for representing knowledge. In: Winston PH (ed) *The psychology of computer vision*. McGraw-Hill, New York
- Nagara K, Shimoda Y, Mizuno M (1996) Evaluation of the thermal environment in an outdoor pedestrian space. *Atmos Environ* 30:497–505
- Nasar JL, Yurdakul AR (1990) Patterns of behaviour in urban public spaces. *J Archit Plann Res* 7:71–85
- Nikolopoulou M, Steemers K (2003) Thermal comfort and psychological adaptation as a guide for design urban spaces. *Energy Build* 35:95–101
- Nikolopoulou M, Baker N, Steemers K (2001) Thermal comfort in outdoor urban spaces: understanding the human parameter. *Sol Energy* 70:227–235
- Piaget J, Inhelder B (1973) *Memory and intelligence*. Basic Books, New York
- Reber AS (1985) *Dictionary of psychology*. Penguin Books, New York
- Spagnolo J, de Dear R (2003) A field study of the thermal comfort in outdoor and semi-outdoor environments in subtropical Sydney Australia. *Build Environ* 38:721–738
- Stehr N, von Storch H (1995) The social construct of climate and climate change. *Clim Res* 5:99–105
- Steadman RG (1971) Indices of windchill of clothed persons. *J Appl Meteorol* 10:674–683
- Steadman RG (1979) The assessment of sultriness. Part I. A temperature-humidity index based on human physiology and clothing science. *J Appl Meteorol* 18:861–873
- Sternberg RJ (2004) Culture and intelligence. *Am Psychol* 5:325–338

- Stull R (2000) *Meteorology for scientists and engineers*. Pacific Grove, Brooks/Cole
- Thom TC (1959) The discomfort index. *Weatherwise* 12:57–60
- Thorsson S (2003) *Climate, air quality and thermal comfort in the urban environment*. Doctoral thesis A87, available from Earth Science Centre, Göteborg University, Box 460, 405 30 Göteborg, Sweden
- Thorsson S, Lindqvist M, Lindqvist S (2004) Thermal bioclimatic conditions and patterns of behaviour in an urban park in Göteborg, Sweden. *Int J Biometeorol* 48:149–156
- VDI (1994) VDI 3787, Part 2: environmental meteorology, interactions between atmosphere and surfaces; calculation of the short- and long wave radiation. VDI/DIN- Handbuch Reinhaltung der Luft, Band 1b, Düsseldorf
- VDI (1998) VDI 3789, Part I: environmental meteorology, methods for the human biometeorological evaluation of climate and air quality for the urban and regional planning at regional level. Part I: climate. VDI/DIN- Handbuch Reinhaltung der Luft, Band 1b, Düsseldorf
- Wang Q (2004) The emergence of cultural self-constructs: autobiographical memory and self-description in European, American and Chinese children. *Dev Psychol* 1:3–15
- Zacharias J, Stathopoulos T, Hanqing W (2001) Microclimate and downtown open space activity. *Environ Behav* 33:296–315